APPENDIX F:

THERMALLY ALTERED STONE REFIT STUDY

THERMALLY ALTERED STONE REFIT STUDY

Introduction

The re-assembly of material remains, including fauna, ceramics, chipped stone, and thermally altered stone, has led to a more refined understanding of prehistoric technology and site formation (e.g., Cziesla et al. 1990; Hofman and Enloe 1992). Archaeologists working in the Middle Atlantic region have used the refitting technique at various sites to assess site and feature formation processes (e.g., Custer and Watson 1985; Carr 1986; Petraglia 1994; Petraglia and Knepper 2001; Petraglia et al. 2002). Refitting has also proven to be valuable for interpreting the integrity of stratigraphic deposits and for determining the degree to which archaeological patterns are the result of natural or cultural processes. The mending of stone artifacts, in this specific case thermally altered stone, may highlight spatial clustering within features that would not otherwise be obvious in the raw data and more fully characterize stone attributes than found analyzing individual fragments. Refitting across both horizontal and vertical proveniences can be used to address questions about single or multiple use features, relations between features, and feature functions. The refit results in conjunction with other data, such as the spatial arrangement of the stones, the nature of burning and heating evidence, and other artifact associations will allow for an assessment of the wider site function.

Thermally altered stone is increasingly being recognized as an important source of information and new ways have been developed to quantify and systematically characterize this stone and provide distinctions between its use in various activities (Cavallo 1987; Pagoulatas 1992; Latas 1992; Petraglia et al. 1998; 2002). The term “thermally altered stone”, used in this report, is more inclusive than the more commonly used term “fire-cracked rock (FCR)” as it includes all stone that appears to be altered due to heating, such as pieces that are fractured and broken (FCR), discolored pebbles and cobbles (reddened or blackened), crazed (fissured but not fully cracked), or pot-lidded.

Field observations of feature patterning at the Sandom Branch sites presented an avenue to elucidate certain cultural activities that occurred at the site. In the unplowed portions of 7NC-J-227, a spatial pattern was observed between tightly clustered (Features 5 and 35) and less dense, dispersed (Features 17 and 30) concentrations of thermally altered stones. There appeared to be a relationship between the concentrations with the dispersed features located 2-3 meters southwest of the more clustered features.

Comprehensive refitting was employed for two of the thermally altered stone features (Features 30 and 35) that represented the morphologically different types and spatial pattern of interest. Both features contained high numbers of stone fragments and were considered to have the greatest potential for containing conjoinable pieces. Refitting the thermally altered stone within and between the two features could indicate a relationship. Such a pattern would show specific behaviors; for example, cleaning out the more dense concentrations of stone for maintenance, reusing the heated stones for other purposes, or selection and caching of certain stones. In the case of Feature 30, which covered a larger area (as delineated in the field) than Feature 35, the spatial relationship of internal refit groups may help to redefine feature boundaries and suggest implications of inconsistent stone density within the feature.

Another goal of the refitting study was to determine the size and number of cobbles recovered from each feature type, which may indicate that the numbers and sizes of stones selected had an intended function for a specific feature type.

Methods

Spatial proximity is of primary importance in finding refitted pieces. Thermally altered stones (n=1,278) recovered from feature and non-feature contexts from 19 one-meter square excavation units were examined during this study. The units examined consisted of all units in which the features were identified and up to 1 meter away. Initially, the study's design called for the examination of all thermally altered stone in units within 2 m of the feature boundaries to provide a wide area in which to assess horizontal distribution of any refitted stones. The sample area would have included 45 units and 1,502 thermally altered stones. However, given the early success of refitting a large number of fragments within the feature proveniences, budgetary constraints prompted a reduction in the scope of the study, as the refitting process is time consuming. The examined units included portions of N65-N70, E468-E472 (Figure F-1).

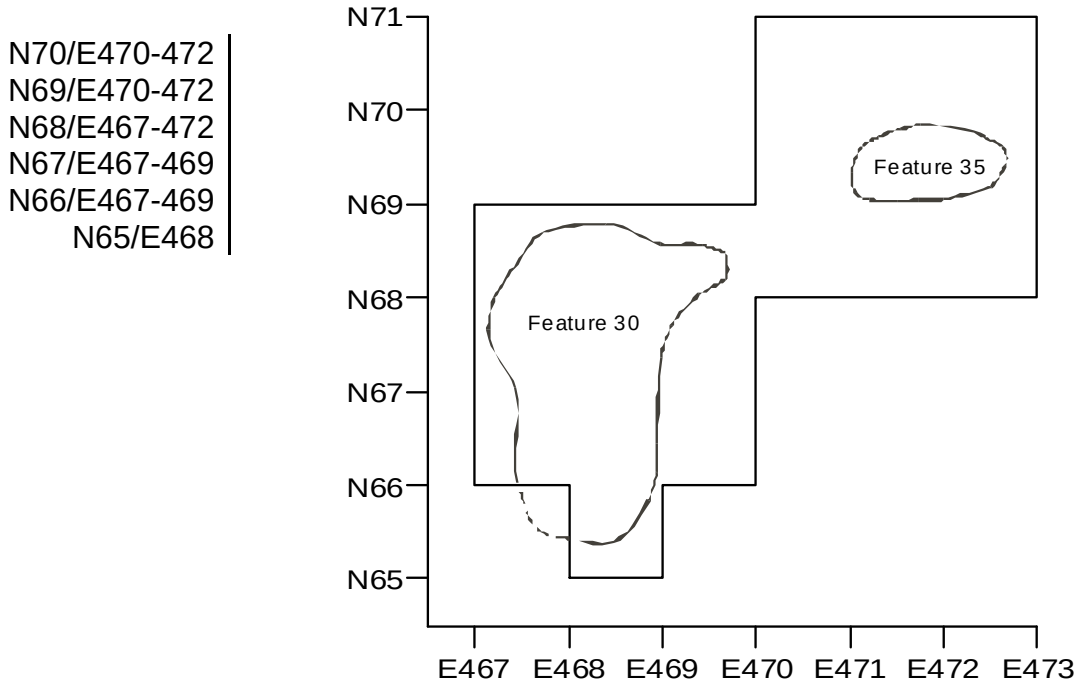

Figure F-1. Unit Locations of Features 30 and 35

Due to the resulting irregular horizontal arrangement, the sample was divided into two subsets of stones from the units contiguous to each feature. This allowed efforts to be focused in a prioritized manner; 1) refitting within feature proveniences, 2) refitting between feature proveniences and surrounding sediments, and finally 3) refitting between the features and their respective sediment proveniences.

Prior to the formal study, the selected artifacts were labeled with their bag numbers, in order to maintain their provenience information. During this labeling process, a number of refits were found, generally from the same vertical and horizontal provenience (i.e., bag number),

although a few refits were found outside of a single provenience. These initial refits were marked along the mended edge and in instances where refits were found in different proveniences, notes were made indicating the bag number of the conjoinable artifacts. Artifact bags were then laid out in respective provenience order so that spatial juxtapositions of potentially conjoinable pieces could be viewed. The artifacts were sorted by unit, stratum, level, and lithic material. The grouping of thermally altered stone by material type proved successful in locating refitted groups. All of the stone fragments within the sample area were examined and refitted by the same person to provide consistency.

It became evident that the many of these groups were likely portions of the same cobble, but that key pieces that would allow the smaller groups to mend to each other were not located in the proveniences selected. As a result, several terms were needed to differentiate and organize the refit data. The first term was primary refit, which was defined as directly conjoining stone fragments and primary refit groups, could consist of multiple primary refit fragments. Secondary refits consisted of stone fragments likely from the same stone, based on visible attributes such as color, shape, and inclusions, which could not be directly conjoined. In the current study, secondary refits were only determined if there was a corresponding primary refit group that was likely a portion of the same original stone. Together, corresponding primary and secondary refit groups were referred to as a stone lot, which represented the most inclusive term and could include multiple primary and/or secondary refit groups. Stone lots were the closest approximation of individual stones, with which to assess the actual number of stones (as opposed to fragments) used within a feature and the approximate size of these stones.

The artifacts that were observed in the field, delineated the feature boundaries, and were provenienced as such, are referred to in this study as "within the feature." The stone fragments within proveniences outside of the feature (both horizontally and/or vertically) were designated "outside the feature." Additionally, the provenience of the constituent fragments of each primary refit group determined whether the refit was wholly "internal", wholly "external", or was comprised of fragments from both inside and outside the feature boundaries. The distinction was important for several assessments of feature integrity.

As the artifacts were not piece plotted in the field, the finest level of precision for discussion of the refit data is within a one-by-one meter unit and a 10-cm level. As such, refits between two contiguous horizontal proveniences could in reality be less than one meter, but no greater than two meters in distance. Similarly, for refits between two consecutive vertical proveniences, refits could be less than 10 cm, but not greater than 20 cm apart. In discussing the vertical separation of artifacts, it is important to recognize that some of the differences may be the result of the excavation strategy and feature recognition. Unit and level designations illustrate the artifact proveniences, but should not be considered exact positions.

After the refitting session was completed, the stone lots were examined in more detail. The material type for the stone was determined based on visual inspection and mineralogical comparisons. Measurements were recorded for the maximum dimension, denoted as length, and its perpendicular, denoted as width. The thickness of the assembled refit group was also recorded as a third dimension of size. All measurements were recorded in centimeters. For a

further indication of size, or mass, the refit groups were weighed with an electronic scale, in grams, to the nearest tenth of a gram.

The stone lots were then examined for variations in visible heat alteration. The heat alteration variables considered were cracking, reddening, pot-lidding, and crazing, which were recorded solely for presence or absence based on the visual inspection.

- *cracking* – referred to fragmented thermally altered stone (i.e., FCR); these pieces were not whole and therefore cracked.
- *reddening* – covered minor pinkish hue changes to very deep red (almost purple) alterations.
- *pot-lidding* – referred to the presence of small voids when small round fragments of stone (mainly from the cortex) spalled off due to changes in temperature.
- *crazing* – referred to fine cracks and fissures on the stone surfaces that had not yet broken off from the stone; this variable was noted only for stone lots and not for individual fragments.

In addition to the stone lots identified in this study, there were two other categories of stone recovered from the feature that had implications for heat intensity and as additional indicators of stone size: "whole thermally altered stone" and "unmodified pebbles/cobbles." The term "whole thermally altered stone" referred to a small subset of stones within and around the feature that were reddened, crazed, or slightly spalled but had not cracked and were therefore nearly complete. Unaltered or "unmodified pebbles/cobbles" referred to those pebbles and cobbles that were collected from within the delineated spatial boundaries of the features, but did not exhibit visible indications of heat alteration. These stones were included as part of the total fragment count used in a variety of the calculations undertaken in the analyses. Their presence was used to indicate relative heat intensity or could elucidate other behaviors such as reuse, caching, or site maintenance.

As another indicator of stone size and feature integrity, the percent complete of the stone lot was estimated. Percent complete referred to the amount of the refit stone that was present. Estimation of percent complete was made by the nearest 10 percent and only on stone lots greater than 50 percent complete. When the stone lots were less than 50 percent complete, not enough remained of the stone dimensions for a reasonably confident estimation. This attribute was used as an indication of the size of the stones used in the feature, a finer assessment of spatial proximity of fragments, and the possible reuse of fragments.

After the data was recorded and descriptions were written for each of the stone lots, the results were entered into a comprehensive database for more detailed analyses. Several calculations were performed for each of the features to illustrate a variety of processes and assess patterning. These calculations included:

- *fracture percentage* – was the number of fragmented thermally altered stone collected from within the feature, divided by the sum of fragmented thermally altered stone, whole

thermally altered stone, and unmodified pebbles/cobbles. This figure was used as a relative indicator of heat and/or use intensity.

- *heat alteration percentage* – were based on the total number of fragments showing signs of the different heat alteration variables recorded, divided by the total number of artifacts. The total could include pieces from inside or outside the feature, or both, depending on the relevance, and is stated in the text. However, in the case of crazing, the variable was not systematically noted on individual fragments, but only described on the refit group level.
- *refit percentages* – only included fragments from within the delineated feature boundaries, and was used to assess the spatial integrity of the feature boundaries.
    - *total refit* – was the sum of all refit pieces, primary and secondary, divided by the total number of thermally altered stone and cobbles/pebbles within the feature.
    - *primary refit* – was the total number of fragments in all primary refit groups, divided by the total number of thermally altered stone and cobbles/pebbles within the feature.
    - *secondary refit* – was the total number of fragments considered secondary to any group, divided by the total number of thermally altered stone and cobbles/pebbles within the feature (there was no way to distinguish multiple primary refit groups within the same stone lot that were secondary to each other, so these were not included in the calculation of secondary refit percent).
- *mean weight* – was the sum of the weights of the fragments, divided by the sum of the fragments considered. Mean weights were calculated for inside versus outside the feature, non-lot versus refit stone lot fragments, and for the total feature to illustrate a variety of different implications.

The analyses conducted on these features were used to more fully describe their differences and similarities and to assess their possible behavioral or functional interpretations. The various attributes and their possible implications are summarized in Figure F-2, which illustrates how the different calculations and variables may relate to feature interpretations.

Feature 30

Feature 30 was a large concentration of thermally altered stones located in the southwest portion of Block H. The evident feature covered an area of 300 x 200 cm and was found in a total of eight 1-m^2 units. There was no associated basin or soil stain to delimit the feature, which was defined by the presence of concentrated stone. Within the feature, 464 thermally altered stones, two flakes, one hammerstone, and 13 unaltered cobbles were recovered. The feature was located in an unplowed portion of the block and occurred 20 cm below the ground surface. The feature was partially disturbed by a decomposing tree stump on the eastern edge of the stone cluster, and several stones attributed to Feature 30 were recovered from this disturbance. However, it was confined to the eastern edge of the feature and the greatest concentration of stone did not appear to have been disturbed by this stump. There was a decrease in density of the stones in the southern half of Feature 30, which was slightly lower in elevation than the northern portion and followed the slope of the landform. The soil within the feature was generally dark to mottled in color and comprised of loamy sand.

Thermally Altered Stone Feature Matrix

General Implications

	high % complete	low % complete
many refits	• primary context, little disturbance • high temperatures —or— • possible reuse of feature w/o removal of cobbles	• primary context, little disturbance • recycled stone • high temperatures —or— • heavily scavenged
few refits	• single use • low temperatures —or— • mixed primary context, little disturbance, w/ whole and recycled cobble fragments	• discard area—secondary context —or— • recycled stone • low temperatures —or— • heavily scavenged

Functional Hypotheses

	high % complete	low % complete
many refits	• cooking—steaming • sweat lodge • repeated use	• use of recycled stone • scavenging
few refits	• cooking—roasting • general heating	• discard area—secondary context • primary context using recycled stone/low temperatures • scavenging

Figure F-2. Chart of Variables, Expectations, and Possible Feature Interpretations.

A total of 338 primary and 73 secondary refit fragments were found during the examination of the thermally altered stones from in and around Feature 30 (Table F-1).

Table F-1. Thermally Altered Stone Summary, Feature 30

Units N65-68/E467-469*	Feature 30	External	Total
primary refit fragments	261	77	338
secondary refit fragments	30	43	73
not refitted	173	213	386
total	464	333	797

*Does not include N65/E467 or E469

Only one unit (N66/E469) of the 10 units containing or adjacent to Feature 30 did not contain primary or secondary refits. Of the 333 fragments considered outside of the feature within the 10 units, 36 percent were either primary or secondary refits to Feature 30.

The refitted fragments formed a total of 56 primary refit groups representing 49 stone lots. The primary refit groups ranged in the number of conjoined fragments from two to 71 (Table F-2). Additionally, several refit groups could not be directly conjoined, but were considered to represent secondary refits. A total of 73 fragments were considered secondary refits to a primary refit group, and four stone lots (e.g., 30-A, 30-C) contained multiple primary refit groups that were secondary to each other. The number of fragments that were refit was relatively high and resulted in a total refit percentage of 61 percent for the fragments within the delineated feature boundaries (i.e., does not include refits to non-Feature 30 proveniences): 55 percent primary refit and 6 percent secondary refit.

Table F-2. Summary of Primary Refit Groups, Feature 30

Lot/ Refit Group	***Material***	***Count***	***Total Weight*** *(grams)*	***% Complete***	***Relative to Feature Boundary***
30-A 1	Quartzite	23	753.9	<50%	Internal/External
30-A 2	Quartzite	9	281.4	<50%	Internal/External
30-A 3	Quartzite	2	69.0	<50%	Internal
30-B 1	Quartzite	71	4,365.5	<50%	Internal/External
30-B 2	Quartzite	2	1,045.4	<50%	Internal
30-C 1	Jasper	2	108.9	<50%	Internal/External
30-C 2	Jasper	2	48.0	<50%	External
30-C 3	Jasper	2	60.4	<50%	Internal
30-C 4	Jasper	5	99.6	<50%	Internal/External
30-D 1	Hornblende Gneiss	8	667.0	<50%	Internal/External
30-D 2	Hornblende Gneiss	3	306.0	<50%	Internal/External
30-E 1	Quartz	3	470.0	<50%	Internal/External
30-F 1	Quartzite	10	865.2	<50%	Internal/External
30-G 1	Quartzite	9	1,045.0	<50%	Internal/External
30-H 1	Quartzite	11	900.2	<50%	Internal/External
30-I 1	Quartzite	7	1,037.4	70%	Internal
30-J 1	Quartzite	12	925.7	<50%	Internal
30-K 1	Quartzite	9	815.7	<50%	Internal
30-L 1	Quartzite	5	839.0	80%	Internal
30-M 1	Quartzite	10	620.8	<50%	Internal/External
30-N 1	Quartzite	7	806.4	60%	Internal/External
30-0 1	Quartzite	5	603.5	<50%	Internal
30-P 1	Quartzite	9	628.3	<50%	Internal
30-Q 1	Quartzite	2	452.5	<50%	Internal
30-R 1	Quartzite	2	264.2	<50%	Internal/External
30-S 1	Quartzite	2	168.4	<50%	Internal
30-T 1	Quartzite	2	156.0	<50%	Internal
30-U 1	Quartzite	2	93.9	<50%	Internal

Table F-2. Summary of Primary Refit Groups, Feature 30

Lot/ Refit Group	***Material***	***Count***	***Total Weight*** *(grams)*	***% Complete***	***Relative to Feature Boundary***
30-V 1	Quartzite	2	59.8	<50%	External
30-W 1	Quartzite	2	115.9	<50%	Internal
30-X 1	Quartzite	3	518.3	<50%	Internal
30-Y 1	Quartzite	2	270.4	<50%	Internal
30-Z 1	Quartzite	5	97.1	<50%	External
30-2A 1	Quartzite	2	39.6	<50%	External
30-2B 1	Quartzite	3	43.9	<50%	Internal
30-2C 1	Quartzite	2	28.2	<50%	Internal
30-2D 1	Quartzite	2	65.1	<50%	External
30-2E 1	Quartzite	2	420.3	90%	Internal
30-2F 1	Quartz	7	925.9	<50%	Internal
30-2G 1	Quartz	9	454.8	60%	Internal/External
30-2H 1	Quartz	8	653.1	<50%	Internal
30-2I 1	Quartz	2	123.7	<50%	Internal/External
30-2J 1	Jasper	2	50.6	<50%	Internal
30-2K 1	Jasper	7	467.9	<50%	Internal/External
30-2L 1	Siltstone	2	343.3	<50%	Internal
30-2M 1	Quartz	2	280.7	<50%	Internal
30-2N 1	Siltstone	13	298.6	<50%	Internal/External
30-2O 1	Jasper	2	432.1	90%	Internal
30-2P 1	Quartz	2	272.0	<50%	Internal
30-2Q 1	Quartz	3	223.1	<50%	Internal
30-2R 1	Quartzite	3	948.5	80%	Internal
30-2S 1	Quartzite	2	1,058.8	90%	Internal
30-2T 1	Quartz	4	1,081.7	60%	Internal
30-2U 1	Quartzite	3	1,048.7	90%	Internal
30-2V 1	Quartzite	4	219.5	90%	Internal
30-2W 1	Quartz	2	258.4	90%	Internal/External

The calculated refit percentage for Feature 30 was relatively high, especially when considering the high number of total fragments it contained. The higher refit percentage suggested that the feature was highly fragmented, but the pieces remained in close spatial proximity, suggesting high heat intensity or prolonged duration and a primary context.

Examination of the proveniences of the refit fragments of Feature 30 strengthened the concept that the stones had remained in close spatial proximity. As shown above in Table F-2, 57 percent of the primary refit groups were from within the feature boundaries, 34 percent contained fragments from inside and outside the feature boundaries, and nine percent were from outside the feature boundaries. Although a total of 120 refit (primary and secondary) fragments were found “outside” the delineated feature boundaries, they primarily were found within the same units that contained the feature, either in the Ao/E-horizons above, or the B-horizon adjacent and below. Primary refit groups 30A-1 and 30B-1 had the greatest spatial separation and highest frequencies of conjoined fragments (Figure F-3). It should be noted that the locations of the refit fragments illustrated within the graphic are not exact locations

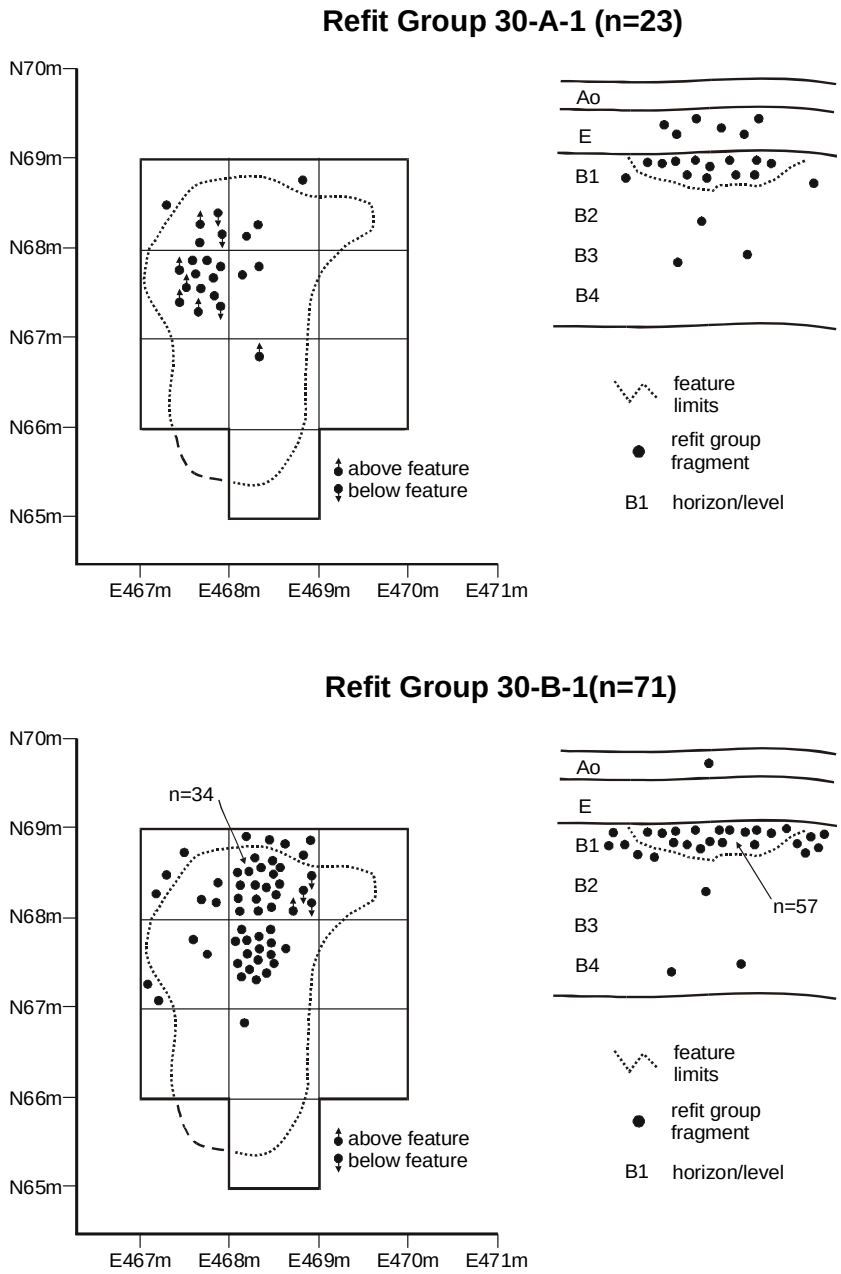

Figure F-3. Spatial Distribution of Primary Refit Groups 30-A-1 and 30-B-1, Feature 30

due to the limits of field provenience methods. The constituent fragments of refit group 30-A-1 were from five horizontal and four vertical proveniences. The greatest spatial separation was vertical, ranging from the E horizon to the third level of the B horizon spanning a maximum of 50 cm. Similarly, fragments of 30B-1 were from five horizontal and four vertical proveniences. The group's vertical separation was the greatest ranging from the Ao horizon to the fourth level of the B horizon spanning a maximum of 60 cm. The deepest fragment (#809-1, N68/E468) from 30-B-1 was the fifth largest by weight at 178.9 g, indicating movement of relatively large pieces throughout the profile. Other fragments from above and below the feature boundaries within these two groups ranged in weight from 1.7-37.1 g.

The fact that many refits came from within the same units suggested that much of the dispersion was vertical in nature likely from biotic activity or differential soil development. A degree of biotic disturbance had already been noted in the eastern portion of the feature, which contained 108 total fragments and 60 of these were part of a stone lot. At the time of excavation, several hardwood trees ranging from saplings to mature trees over 50 cm in diameter, where growing within and adjacent to the excavation block. Large taproots observed throughout the excavations were a likely agent for the vertical movement of artifacts.

Given the seemingly high degree of spatial integrity, the results determined for the percent complete of the stone lots was somewhat less concise than anticipated. Of the 49 stone lots identified in the refit study, only 12 (24 percent) were greater than 50 percent complete and able to be estimated for size. Six of these lots were 90 percent complete, two were 80 percent complete, one 70 percent complete, and the remaining three 60 percent complete. In addition, Feature 30 contained 24 thermally altered stones that were not fragmented and considered "whole" and 13 unaltered whole cobbles. The overall low percent complete within the examined sample suggested that stone had been removed from the feature area. Although this could have been natural, the high refit percentages seem to undermine such an interpretation, and would suggest that people were removing fragments of stone perhaps for reuse in other thermal features or from discard behaviors. The estimation of percent complete coupled with the data from the "whole" thermally altered stones and cobbles allowed for some size comparisons with the local gravel samples collected as part of the investigations.

The size of complete or nearly complete stones from the groups ranged from approximately small pea gravel (less than 3 cm along the longest axis), to large cobble, to boulder-sized pieces (in excess of 24 cm in length and in excess of four kg in weight). More precisely, the stones ranged from a minimum of 3.3 cm for artifacts #794-11 and #794-12, to a maximum of 16.7 cm for artifact #785-56 with a mean maximum length for all 24 stones of 8.1 cm. The largest dimension for any of the stones or stone lots within Feature 30 was for stone lot 30-B-1. Its length was recorded at 24 cm, and at the same time, estimated at less than 50 percent complete, which suggested that it must have been a particularly large boulder-sized stone originally. In fact, many of the stone lot refit groups estimated at less than 50 percent complete had greater maximum dimensions than many of the "whole" thermally altered stones contained within the feature, for example, 30-F (15 cm), 30-H (16.4 cm), and 30-2H (17.3 cm). It could be that the larger sized stones having greater external surface area were more prone to heat fracturing, or had an increased chance for inclusions and flaws that would have been susceptible to heat fracturing, or were particularly attractive for reuse in other features.

The mean weight of the Feature 30 fragments also indicated relatively large fragments. The total mean weight for the pieces within the delineated feature boundaries was 107.1 g, with the refit fragments at 93.8 g and the non-lot fragments with a mean weight of 128.0 g. Comparison of the mean weight of the fragments within the boundaries, to the refit fragments from outside proveniences, showed variability. The refit fragments from outside the feature had a mean weight of only 20.1 g, compared to the 93.8 g found inside; a 79 percent change.

This difference in fragment size quantifies the intuitive sense that larger fragments tend to disperse less, while smaller pieces are more susceptible to both vertical and horizontal dispersion. Feature 30 had an overall fracture percentage of 92 percent, which could be indicative of prolonged use or intense heat.

In terms of heat alteration, 96 percent of the stone fragments of Feature 30 displayed one or more types; reddened, cracked, or pot-lidded. Cracking was the most common heat alteration observed, with 94 percent of the fragments displaying this trait. Reddening also was well represented, with 82 percent of the fragments displaying reddening related to heat. A total of 17 stone lots showed differential reddening of their surfaces, suggestive of varying exposure to heat perhaps due to placement relative to the heat source, or reuse of fragments after initial breakage. In particular, stone lot 30-A displayed a wide range of reddening between the primary refit groups, as well as between the fragments within the primary refit groups. Pot-lidding was the least frequent type of heat alteration within Feature 30, recorded on just one percent of the fragments. This result is consistent with previous studies (e.g., Hickory Bluff) that showed pot-lidding as an infrequent occurrence, and somewhat related to material type or quality. In addition, crazing was noted on the surfaces of nine refit groups: 30-C-1, 30-E-1, 30-G-1, 30-X-1, 30-2H-1, 30-2I-1, 30-2M-1, 30-2Q-1, and 30-2S-1. Overall, the stones that comprised Feature 30 displayed a range of heat alteration with some pieces highly reddened almost purple in color (30-2A), and others showing an array of crazing of surfaces on the verge of fully fracturing. The affect suggested that the stones had been exposed to an intense fire, or multiple episodes of heating.

The refitted fragments of Feature 30 indicated that a range of material types was used (Table F-3). The majority of the stone lots were quartzite, with lesser numbers of quartz, jasper, siltstone, and hornblende gneiss. When considering total fragments within the feature boundaries, an additional four materials were included: sandstone, chert, conglomerate, and ironstone. The predominant use of quartzite (67 percent) within Feature 30 is indicative of specific selection for this material type, especially when compared to the frequency of quartzite within the local gravel sample (19 percent). This selection preference was likely related to the durability of quartzite and its heat retention properties, demonstrated in previous experimental replication studies (e.g., Custer and Silber 1995; Guernsey 1984). The implications of material selection will be discussed further in comparison with Feature 35 and the gravel sample collected locally.

Table F-3. Summary of Feature 30 Material Types

Material	Stone Lots	Percent of Total	Fragments	Percent of Total
quartzite	33	67%	345	72%
quartz	9	18%	70	15%
jasper	4	8%	26	5%
siltstone	2	4%	6	1%
hornblende/gneiss	1	2%	6	1%
sandstone	--	--	19	4%
chert	--	--	2	<1%
conglomerate	--	--	2	<1%
ironstone	--	--	1	<1%
Total	**49**		**477**	

Feature 35

Feature 35 was a small dense cluster of thermally altered stones located in the eastern portion of Block H. The feature covered an area of 135 x 65 cm and was found in two one-by-one meter units. No soil discoloration or increase in charcoal flecking was observed in association with the feature stones, which was delimited by the presence of concentrated thermally altered stone. Within Feature 35, a total of 311 thermally altered stones and three pieces of lithic debitage were recovered. The feature was identified in an unplowed portion of the site at the top of the B horizon.

A total of 262 primary and 35 secondary refit fragments were found during the examination of the thermally altered stones from in and around Feature 35 (Table F-4).

Table F-4. Thermally Altered Stone Summary, Feature 35

Units N68-70/E469-472*	Feature 35	External	Total
primary refit fragments	207	55	262
secondary refit fragments	23	12	35
not refitted	81	141	238
total	311	208	519

*Does not include N69-70/E469

The fragments were contained in all nine of the units within the Feature 35 subset. Of the 208 fragments considered outside of the feature within the ten units, 32 percent were either primary or secondary refits to Feature 35.

The refitted fragments formed a total of 38 primary refit groups representing 30 stone lots. The primary refit groups ranged in the number of conjoined fragments from two to 31 (Table F-5). Additionally, three stone lots (e.g., 35-A, 35-B, 35-C) contained multiple primary refit groups, which were secondary to each other. The result was 74 percent total refit for the fragments within Feature 35, 67 percent primary refit and seven percent secondary refit. The refit fragments from proveniences outside the Feature 35 boundaries were not included, as the calculated refit percentages were used to assess the relatedness of the pieces that were found in the delineated feature boundaries.

Table F-5. Summary of Primary Refit Groups, Feature 35

Lot/Refit Group	Material	Count	Total Weight (grams)	%Complete	Relation to Feature Boundaries
35-A 1	Quartzite	31	2,315.9	<50%	Internal/External
35-A 2	Quartzite	20	1,349.4	<50%	Internal/External
35-A 3	Quartzite	4	285.7	<50%	Internal/External
35-A 4	Quartzite	2	115.5	<50%	Internal
35-A 5	Quartzite	5	146.2	<50%	External
35-B 1	Quartz	10	137.6	<50%	Internal/External
35-B 2	Quartz	2	50.6	<50%	Internal
35-B 3	Quartz	2	11.5	<50%	Internal
35-C 1	Quartzite	7	730.3	<50%	Internal/External
35-C 2	Quartzite	2	83.7	<50%	Internal

Table F-5. Summary of Primary Refit Groups, Feature 35

Lot/Refit Group	Material	Count	Total Weight (grams)	%Complete	Relation to Feature Boundaries
35-C 3	Quartzite	2	110.9	<50%	Internal
35-D 1	Quartzite	27	1,091.2	60%	Internal/External
35-E 1	Quartzite	21	667.7	<50%	Internal/External
35-F 1	Schist	9	274.3	70%	Internal/External
35-G 1	Quartzite	22	1,158.2	<50%	Internal/External
35-H 1	Quartzite	4	358.8	90%	Internal
35-I 1	Quartz	6	362.2	60%	Internal/External
35-J 1	Quartzite	3	262.5	<50%	External
35-K 1	Quartzite	7	541.9	50%	Internal
35-L 1	Quartz	5	319.1	60%	Internal
35-M 1	Quartzite	3	1,660.6	<50%	External
35-N 1	Quartzite	3	101.0	<50%	Internal/External
35-O 1	Quartzite	2	123.2	<50%	Internal
35-P 1	Quartz	2	548.7	<50%	External
35-Q 1	Quartz	2	202.9	<50%	Internal
35-R 1	Quartz	2	118.7	<50%	Internal
35-S 1	Quartzite	3	312.7	50%	Internal
35-T 1	Quartzite	6	359.7	<50%	Internal
35-U 1	Quartzite	7	316.1	<50%	Internal
35-V 1	Quartzite	6	344.8	80%	Internal
35-W 1	Quartzite	3	164.1	<50%	Internal
35-X 1	Quartzite	2	107.1	<50%	Internal
35-Y 1	Quartzite	10	610.4	<50%	Internal
35-Z 1	Quartzite	2	174.6	<50%	Internal/External
35-2A 1	Quartzite	2	50.7	<50%	External
35-2B 1	Quartzite	9	847.2	70%	Internal/External
35-2C 1	Quartz	4	209.0	90%	Internal
35-2D 1	Quartzite	3	110.7	<50%	Internal/External

The calculated total refit percentage was relatively high at 74 percent, with the majority (n=207) consisting of primary refit pieces. Considering the high number of total fragments contained within the feature, this result was significant, especially given that more secondary refit fragments may have been present and indicated that fewer whole cobbles/pebbles may have been used in the original feature. The results suggested that although the pieces were highly fragmented, a large number were still in relatively close spatial proximity.

Of the 38 primary refit groups, 50 percent were internal refits, 37 percent were a combination of fragments found inside and outside of the feature, and 13 percent were from outside the feature. At least one fragment from each of the five external refit groups was recovered from a horizontal provenience containing Feature 35 and was within a contiguous vertical provenience. One external primary refit group (35-A-5) was included in a stone lot that was part of Feature 35. External primary refit group 35-J-1 was found in the B horizon of two non-contiguous units (N68/E470 and N70/E470) outside of the units containing Feature 35 and cannot be considered a refit to Feature 35. Thirty-seven additional refit fragments were

found in the surrounding units found in both the surface and sub-surface horizons, demonstrating both vertical and horizontal dispersion.

The visually delineated boundaries for Feature 35 were contained solely within two one-meter square units, which contained 82 percent (n=245) of all the refit fragments identified for the feature. This high percentage coinciding with the visual boundaries suggested a high degree of spatial integrity for the feature. Figure F-4 illustrates the horizontal and vertical distribution of three primary refit groups that had the greatest spatial separation of constituent fragments. One fragment (#911-2) of refit group 35-A-2 was from a non-contiguous unit outside the Feature 35 subset within Test Unit N68/E469. This fragment showed the greatest spatial separation of all of the fragments within the study, as it was at least 1 m away from and 20 cm below the depositional surface of the feature. The fragment weighed 1.3 g.

Despite the relative spatial integrity and high refit percentage of Feature 35, of the 38 stone lots identified, only eight (21 percent) were greater than 50 percent complete. Of these, three were 60 percent complete, two each were 70 and 90 percent complete, and one was 80 percent complete. Feature 35 also contained seven "whole" thermally altered stone artifacts that showed signs of reddening but had not cracked. However, the feature did not contain any unaltered pebbles or cobbles within its boundaries, which suggested relatively high heat intensity or a more primary location for the artifacts, without secondary inclusions. The overall incomplete nature of the stone lots, given the examination of all proveniences within one meter of the feature boundaries for primary and secondary refits, suggested that a good percentage of the stone initially contained within Feature 35 had either been removed, or the stones were fragmentary to begin with. In either case, the low numbers of stone lots greater than 50 percent complete, suggested a degree of reuse of stone, as the high refit percentages and relative spatial integrity of the feature would be counter to the notion of natural dispersion factors removing that much stone beyond the 2 m in the study. The result is significant and points to intensive and cyclical use of raw materials by the site inhabitants.

The size of the "whole" stones from the feature had a small range of variation as compared to the fragmented thermally altered stone artifacts. The maximum lengths for the complete stones ranged from 6.1 cm on artifact #628-68 to 9.9 cm on artifact #628-70, with a mean of 8.1 cm for the group of seven artifacts. The measurements taken for the different refit groups displayed more variation, although due to their fragmentary nature, not much could be said about the minimum dimensions. However, the greatest dimension recorded was 18.9 cm for 35-M-1, which was estimated to be less than 50 percent complete. Several other large dimensions were recorded on refit groups less than 50 percent complete, for example, 35-A-1 (17.9 cm), 35-G-1 (18.8 cm), and 35-Y-1 (16.8 cm), with the implication that many of the stones were initially large cobble to boulder-sized pieces (in excess of 24 cm in length and in excess of four kg in weight), before undergoing thermal alteration. Therefore, the larger fragments that were not found during this study may have been more attractive for potential reuse and were subsequently removed from the feature boundaries. Additionally, the fact that that the "whole" thermally altered stone artifacts were generally uniform in size, and likely smaller than the fragmented artifacts, suggests that the larger sized cobbles and boulders may have been more prone to fracturing due to larger surface areas or greater degree of inclusions and flaws susceptible to heat fracturing.

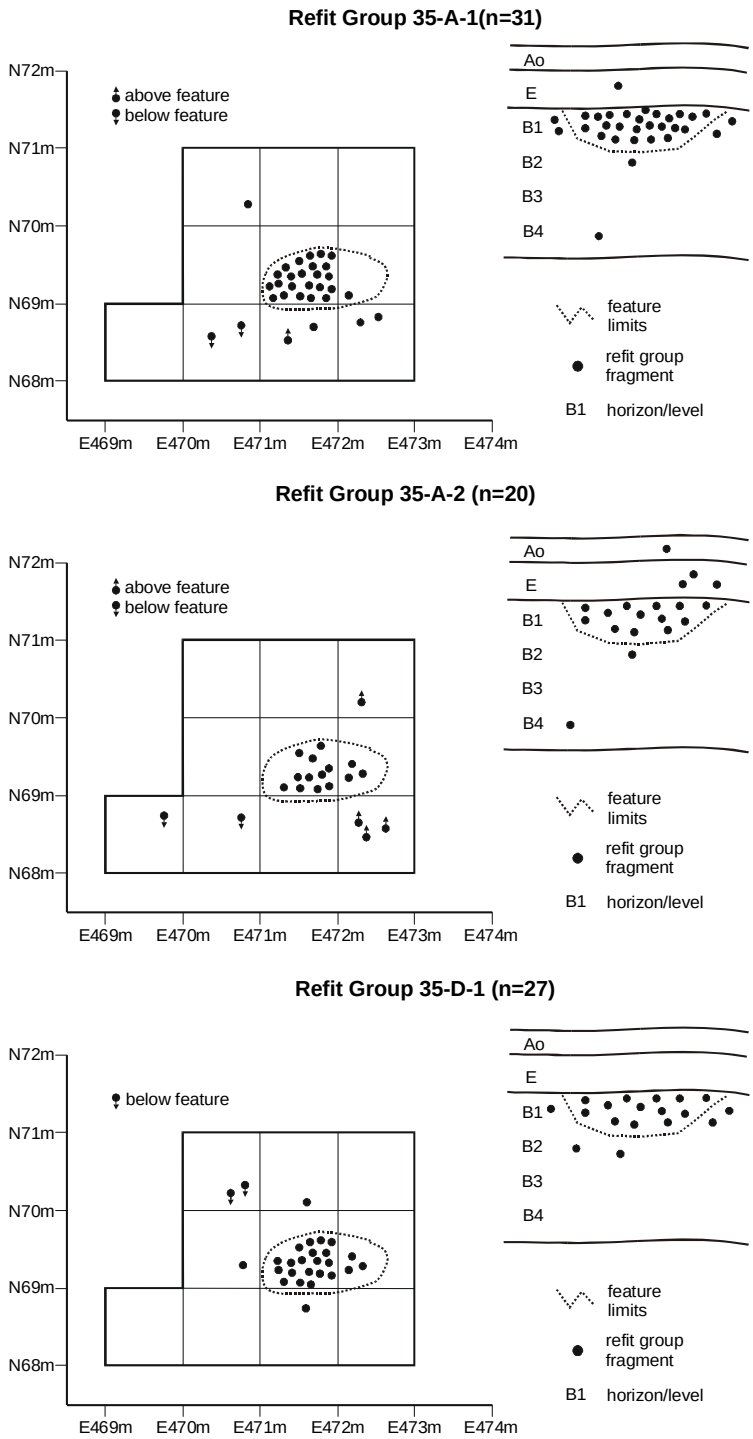

Figure F-4. Spatial Distribution of Primary Refit Groups 35-A-1, 35-A-2, and 35-D-1, Feature 35

Mean weights for the feature provided another relative indicator of fragment size. Within Feature 35, the total mean weight for the feature was 62.2 g, with the refit pieces having a mean weight of 58.3 g and the non-lot pieces having a mean weight of 73.3 g. Contrary to the results observed in Feature 30, when the mean weights of the refit fragments for Feature 35 within the delineated boundaries were compared to those outside, there was negligible

difference. Within the feature, the mean weight of the refit fragments was 58.3 g, while those refit fragments from outside had a mean weight of 56.9 g; a difference of only 2 percent. This result suggested that fragment size was relatively uniform both inside and outside the feature boundaries, which would indicate cultural movement as opposed to natural dispersal forces that tend to work more readily on smaller fragments (Stevenson 1991). The cultural interpretation is also strengthened when considering the horizontal differences covered by the fragments from outside the feature: being relatively the same size, as indicated by mean weight, a more uniform spread of the fragments across the ten units would be expected. Instead, the majority of the refit pieces remained close to the delineated feature boundaries. The overall fracture percentage of 98 percent suggested intense heat or prolonged use for Feature 35.

Examination of the heat alteration variables displayed by Feature 35 further indicated intense heat or long term use. Every fragment recovered from within the boundaries of the feature displayed signs of thermal altering. Cracking was the most prevalent heat alteration at 98 percent of the fragments within the feature, followed by reddening at 84 percent. Pot-lidding was not observed on any of the fragments recovered from within Feature 35. However, one refit fragment from outside the feature boundaries was pot-lidded. Of the 67 external refit fragments (primary and secondary), 65 (97 percent) were reddened and all were cracked. Significant differential reddening of surfaces was noted on nine stone lots. Specifically, stone lots 35-C, 35-D, and 35-F tended to show more reddening along one side, presumed to be the bottom, than was evident on the opposite side, or top. These cases were likely the result of relative placement within the feature, such that sides were not evenly exposed to the heat source. Other signs of differential reddening within a stone lot could be indicative of reuse or change in relative position after initial breakage. Despite the relative high degree of heat alteration, crazing of the surfaces was not common, and was noted on only four stone lots: 35-C, 35-S, 35-2B, and 35-2D. Overall the majority of stone lots displayed high degrees of heat alteration and suggested a high degree of heat intensity, perhaps over prolonged use.

The refitted materials in Feature 35 were comprised of only three material types: quartzite, quartz, and schist (Table F-6). Conglomerate was the only additional material found within the feature boundaries when considering total fragments. The material type frequencies clearly demonstrated selection preferences for the feature, with approximately 74 percent of the fragments being quartzite. Having only trace numbers of other materials might also indicate more integrity for the feature, with less secondary material having been incorporated into the feature. The high percentage of quartzite is similar to Feature 30.

Table F-6. Summary of Feature 35 Material Types

Material	Stone Lots	Percent of Total	Fragments	Percent of Total
quartzite	28	74%	254	82%
quartz	9	24%	43	14%
schist	1	3%	5	2%
conglomerate	--	--	9	3%
Total	**38**		**311**	

Discussion

The data derived during the course of the refit study provided several avenues for both site-wide generalizations and feature comparisons. Both Features 30 and 35 contained portions of large cobble and boulder-sized fragments that were larger than anticipated before refitting commenced: boulders of this size were not recovered during the controlled gravel collection from the gravel bars located in the tributaries of and in Sandom Branch. The results suggested that the landform might have changed since the site was abandoned. In excavation units located at the eastern extent of the site, an infilled stream channel was found and those units contained large cobbles of quartzite, closer in size to the cobbles found in Features 30 and 35 than to those collected in the gravel study. This channel was likely related to the gully located just north of the site.

Activities related to material economy were clearly suggested by the results gathered in detailed analysis of the stone lots. During the refit study, most of the materials examined from both of the thermal features were not of stone tool manufacturing quality, implying intentional selection. The stone lots displayed a range of natural inclusions and flaws that would have been disadvantageous for lithic reduction, even within the cryptocrystalline jasper and chert stones. Of the combined 79 stone lots from both features, only three were noted as being of sufficient quality for lithic reduction and tool manufacture: stone lot 30-E (quartz); 30-2I (quartz); and 35-A (quartzite). Two additional stone lots, 30-2G (quartz) and 35-H (quartzite), displayed some indications of battering and possible reduction. However, the friable nature of the specimens made such a determination unclear. The rarity of good quality lithic material in these features (6 percent) suggested careful selection preference against such materials, care having been taken to not include cryptocrystalline and other high quality materials into the thermal features. It is possible that the stones selected for use in thermal features may have been examined for specific attributes not related to stone tool manufacture prior to their inclusion into these fire-related activities. The pieces found in the features may have been selected based on heat retention, shape, or other utilitarian or non-utilitarian properties. In terms of the latter, Clark and Custer (2003:46-57) have suggested that oral traditions among the Nanticoke and other Native American populations in the Middle Atlantic region hold that rocks were subjected to long periods of heating as part of mortuary rituals.

Within the study, quartzite accounted for the majority of the stone used in both features: a combined 77 percent of all fragments (Figure F-5). In contrast, the local gravel sample contained only 19 percent quartzite, demonstrating a clear selection preference for quartzite in thermal features. The use of quartzite in the Sandom Branch features was consistent with the results observed at the Hickory Bluff site, where quartz and quartzite (combined) accounted for 79 percent of the thermally altered stone assemblage subjected to detailed examination (Petraglia et al. 2002). The trend suggested that quartzite and quartz were specifically selected for and may have displayed characteristics desirable for thermal features. Previous experimental replication studies (Custer and Silber 1995; Guernsey 1984) have suggested that those materials may be more resistant to thermal stresses or may be heated for longer periods or more often before cracking, although more rigorous experiments and verification is still required. The small percentage of other materials contained within

Features 30 and 35 at 7NC-J-227 may represent secondary inclusions or pieces selected for other characteristics, such as size.

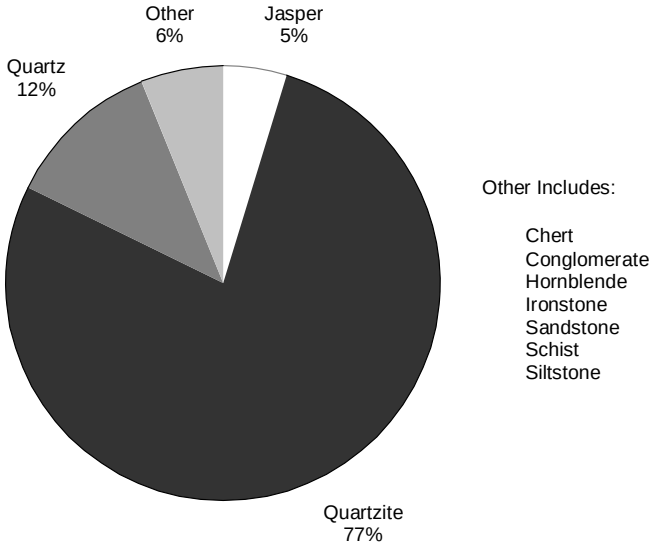

Figure F-5. Lithic Material Frequency within the Sampled Features

The percent complete data for both features was similar, with the majority of stone lots identified less than 50 percent complete. The result suggested a general pattern of reuse of lithic material, or at least its purposeful transport around the site away from its original position. No refits occurred between Features 30 and 35 which would imply a more direct relationship between the features, such as reuse of stone between the features. However, refit group 35-A-2 contained artifact #911-2, which was from outside the feature boundaries of both Feature 30 and 35. The unit that contained this refit fragment, N68/E469, also contained 19 thermally altered stones from Feature 30. Yet, given the lack of primary as well as secondary refits between the features, the overlap in provenience was likely related to the spatial proximity of the features rather than a functional or temporal relationship.

The mean weight for fragments within the two features was calculated in several ways in an attempt to assess fragment size and spatial implications. The first mean weight comparison was made between refit fragments and the non-lot fragments within each of the features (Figure F-6). Mean weights were greater for both categories within Feature 30 and showed a tendency for the non-lot stone to have greater weights. Feature 35 had lesser mean weights than Feature 30 and also displayed a similar tendency for greater weights within the non-lot fragments, although there was less variation than Feature 30. This result suggested slightly more uniformity in size within Feature 35, perhaps indicating selection for specific sizes. However, the similar tendency for non-lot fragments to have greater weights, in both features, might be indicative of the refit pieces being more fragmented and smaller than the non-lot stones.

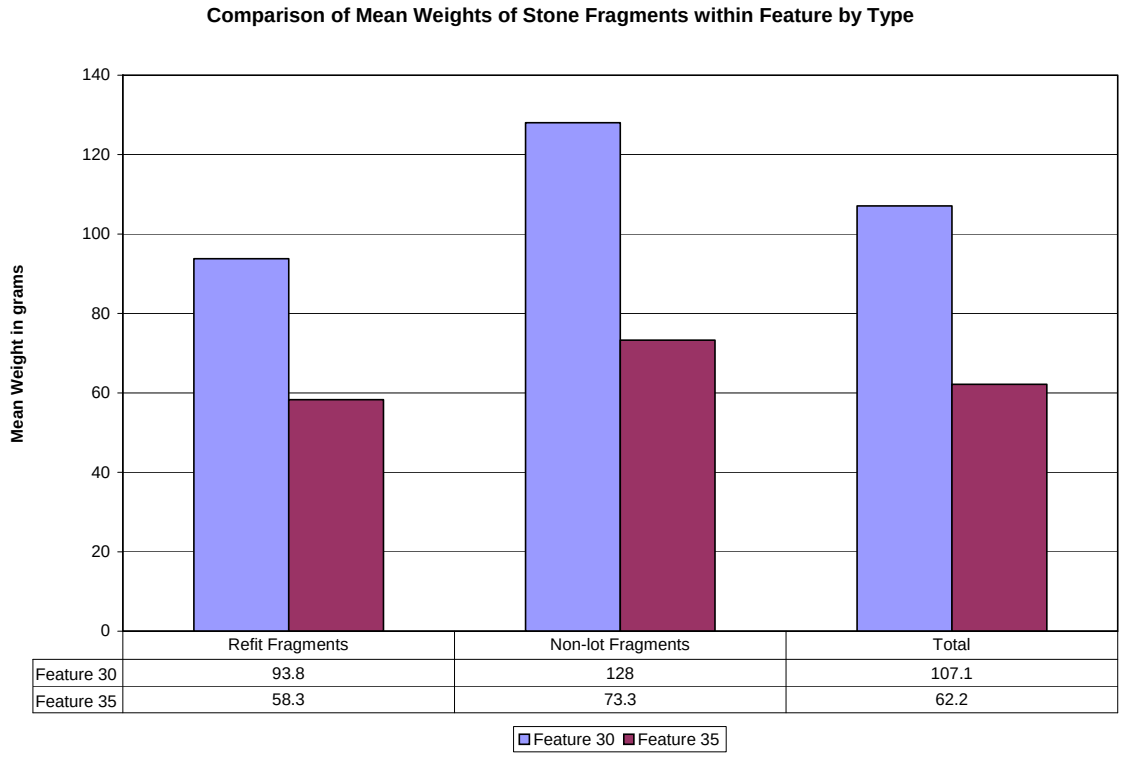

Figure F-6. Comparison of Mean Weights of Stone Fragments within Features 30 and 35

The mean weights of the refit fragments were then compared for those pieces inside versus outside the feature boundaries. This comparison indicated variation between Features 30 and 35 (Figure F-7). For Feature 30, there was a significant difference in the mean weights of the fragments within and outside the feature boundaries, with the former being larger than the latter. The result suggested that smaller fragments are more likely to be dispersed outside the feature boundaries. Conversely, the mean weights of the fragments associated with Feature 35 showed only slight variation. Despite being found in an additional eight test units, the refit fragments found outside the boundaries of Feature 35 had only a slight difference in mean weight (1.4 g) from those refit fragments found within the boundaries. The results for Feature 35 again indicated more uniformity in fragment size for the feature. The differences between Features 30 and 35 may be indicative of varying postdepositional histories and relative ages of the features. Feature 30 may have been deposited earlier, allowing more time for smaller fragments to disperse over greater distances than Feature 35. If that interpretation were correct, it would indicate non-contemporaneous use of the features. Alternatively, the differing morphologies and dispersion of fragments could be related to the initial cobble size and the type and/or degree of fragmentation that occurred.

Heat alteration variables did not display much variation between the features or the fragments found outside the features (Figure F-8). Cracking was the most common heat alteration characteristic noted within the study. Reddening was the next most common alteration and again with only slight variation between features. The frequency of pot-lidding and stones with no observable alteration was low for the assemblage (maximum 2 percent and 4 percent respectively). Feature 35 contained no fragments of either type, but the result may be more related to material type than functional differences between the features.

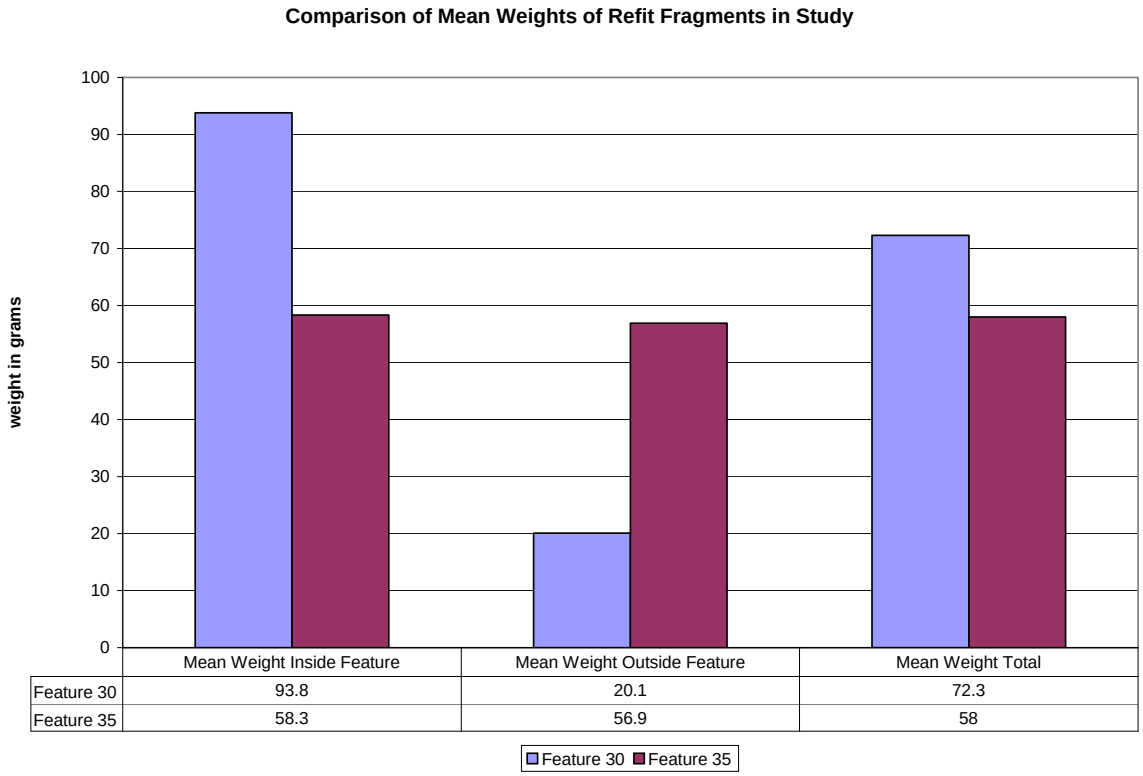

Figure F-7. Comparison of Mean Weight of Refit Fragments Inside and Outside of the Feature Boundaries

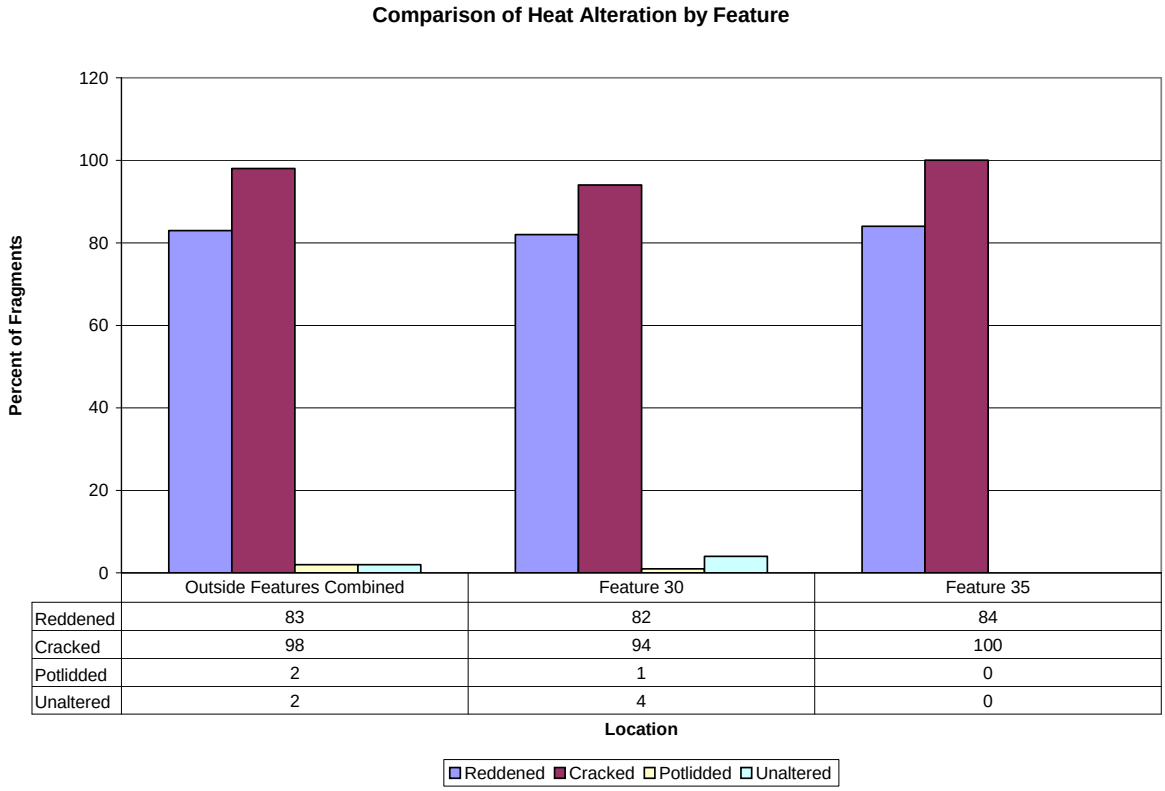

Figure F-8. Comparison of Heat Alteration Variables by Feature

Feature 30 contained a greater frequency of materials other than quartzite than Feature 35, and was therefore more likely to show slight variations in heat alteration variables. The relative uniformity of heat alteration variables between Features 30 and 35, and the fragments outside the feature boundaries, suggested a consistent degree of heat intensity or use between the features and indicated no discernable functional differences. The low percentage of fragments with no visible thermal alteration implied that the features were subjected to intense, extended, or repeated heating.

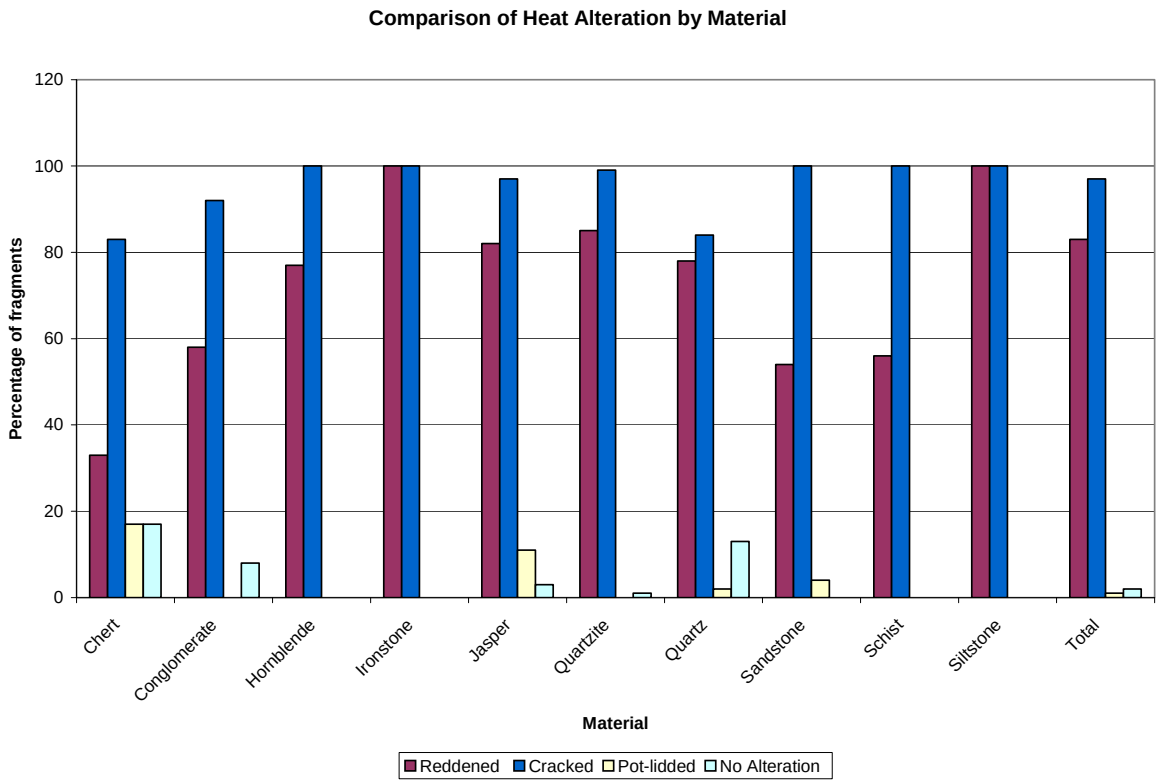

Figure F-9. Comparison of Heat Alteration Variables by Material Type

Comparison of heat alteration variables by material type indicated some degree of variation (Figure F-9). The cryptocrystalline examples of chert and jasper showed greater tendency to be both pot-lidded or to contain no visible alteration. The tendency for these materials to exhibit pot-lidding may be a function of their better conchoidal fracture patterns, which also makes them desirable for tool manufacture. These same materials also exhibited a slightly higher frequency for no visible heat alteration, which may suggest that they were incidental inclusions within the features or were associated with nearby activities (i.e., hearth associated assemblage). Quartz also displayed a similar tendency towards either pot-lidding or no visible heat-related characteristics. The remaining material types in the assemblage all displayed consistently high frequencies of cracking. Likewise, reddening was consistent, except for chert, sandstone, and schist, which displayed the lowest incidences within the study. However, given the generally low frequencies of materials other than quartzite, the results may be misleading and further testing with larger sample sizes of these materials would be instructive. The observed differences suggested that material types are

differentially susceptible to varying heat alterations, or were subjected to different amounts of heating.

The refit study conducted for two thermally altered stone features at 7NC-J-227 produced data with site-wide implications. While refits between the two features was initially an expectation of the study, the lack of such refits suggested that despite their close spatial proximity, the two features were likely non-contemporaneous in use. In fact, the differences in their visual morphology may have indicated a relative age difference between the features, with fragments from Feature 30 having been more widely dispersed suggesting that the feature was the older of the two. The pattern of a high degree of fragmentation and low percent complete of the stone lots in both features suggested a recurrent pattern of reuse at the site, in addition to the possibility of stone fragments having been scavenged for other uses. An expansion of the refit study to include more thermally altered stone features from the site may have produced evidence of contemporaneity of features or indicated where stones may have been reused. However, the pattern of cyclical reuse of stone from both features was clearly demonstrated. Indications of selection preference, material economy, and site patterning also were obtained from the study illustrating further the value and type of information to be obtained from detailed analysis of thermally altered stone assemblages.

Selected Photographs of Primary Refit Groups, Feature 30.

30-A-1

30-D-1

30-B-1

30-B-1 (apart)

30-G-1

30-F-1

30-M-1

30-J-1

30-2G-1

30-N-1

Selected Photographs of Primary Refit Groups, Feature 35.

35-A-1

35-A-1 (apart)

35-E-1

35-C-1

35-I-1

35-G-1

35-Y-1

35-U-1

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