

An Assessment of Lithic Extraction Technology at a Metavolcanic Quarry in the Slate Belt of North Carolina

by

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Abstract

The Three Hat Mountain Quarry, 31DV51, is located in Davidson County, North Carolina. Prehistoric groups used this quarry as a rich and variable source of metavolcanic raw materials, which included rhyodacites and tuffs. Excavations at the site revealed stratified deposits of cultural materials. This paper will present a comparative assessment of these materials and will address issues regarding changes in extraction technology, reduction strategies, and modes of distribution over time. Particular attention will be given to how the differences in raw material types across the quarry may have affected the technological aspects of procurement and initial processing strategies.

In North Carolina we are both blessed and cursed at the same time. We are blessed in the fact that a major portion of the Piedmont Region of the state lies within the Carolina Slate Belt. The Slate Belt is a region of numerous metavolcanic outcrops, which supported prehistoric people with an abundance of knappable raw materials. As a result, the area is littered with prehistoric quarry sites. We are cursed in the fact that very little work has been undertaken on any of these quarries. Quarry studies in North Carolina is still in its infancy (Abbott 2003). Few detailed studies have been made at specific quarries. In this paper I will attempt to address several issues related to quarry studies, lithic resource procurement and distribution based on some of the information at hand.

I will focus my discussion on a specific quarry site (31DV51, Three Hat Mountain) located in Davidson County, North Carolina. This quarry lies along the western edge of the Carolina Slate Belt north of the Uwharrie Mountains. Previous work at this site suggests several interesting aspects regarding material acquisition or extraction and distribution to sites located as far as 28 km away from the source (Mountjoy and Abbott 1982; Abbott 1987, 1993, 1996). I will suggest explanations for the patterns observed in the data and will make inference regarding specific economic patterns that may have been responsible for the behavior behind the remains. A model concerning lithic raw material procurement and distribution during the Late Archaic will be presented and suggestions for further work will be outlined. This paper will begin with a discussion of quarry types and quarry-related activities as they relate to the Carolina Slate Belt.

QUARRY TYPES AND QUARRY-RELATED ACTIVITIES

In terms of quarry types and quarry-related activities, I will utilize, with some variation, the three classes of lithic resource acquisition discussed by Tim Church (1994). These include: *quarries*, in a classical sense, where pits or tunnels are used to expose new material; *extraction sites* where natural outcrops of material are exploited; and sites such as *cobble bars* where gravel is utilized for raw material. I will depart from Church's nomenclature regarding a limited definition of a quarry as those areas where raw material is mined. In that case most of the quarry sites in North Carolina would have to be classified as extraction sites. To my knowledge there are only three locations where quarry pits have been documented. These include Morrow

Mountain (31ST18) (Daniel and Butler 1996), Sugarloaf Mountain (31ST66) (Hargrove 1989), and Three Hat Mountain (31DV51) (Mountjoy and Abbott 1982). In my opinion, a quarry denotes repeated use over time. It signifies a place where the quality and/or abundance of a raw material is great enough to draw in individuals and groups over a long period of time. This phenomenon occurs regardless of whether the material is actually mined in the technical sense of the term, or collected from natural outcrops on the ground surface. Some limited digging may occur at these sites but it may be directed toward digging partially exposed nodules out of the ground or following rich veins outward from gullies or stream banks. A quarry also denotes to me an expanded sense of scale in terms of landscape use. A quarry site is spread out over a large area and encompasses an extensive palimpsest of occupations or episodic use.

An extraction site denotes more ephemeral, less intensive use of a source. In this case a single individual might have utilized an outcrop of raw material as an embedded activity (Binford 1979). In addition, a small group might have utilized an outcrop over a short period of time. I would also lump into the concept of an extraction site locations where fortuitous, chance, encounters with useable, even exotic, raw material were exploited (Abbott and Harmon 1998). In many cases a few episodes of use may be noted; however some extraction sites may have sustained only one visit. An extraction site denotes an expedient or fortuitous quarry.

Cobble bars and gravel-related usage is becoming more important to quarry studies in the Carolinas and south central Virginia (Abbott et al. 2000a; Abbott et al., 2001; Abbott et al. 2003). This results from an increased awareness by many of the importance of quartz, quartzite, sandstone, and silicates as a quality source of raw material for prehistoric groups (Cantley 2000; Tippitt 2001; Abbott et al. 2001). Much of this awareness can be credited to the diligent work of Scott Jones in Georgia (Jones n.d., Appendix A; Jones 2000; Abbott et al. 2001).

As noted by the citations listed above, all of these “quarry and quarry-related” types have been noted in North Carolina. In central North Carolina, however, the most important aspects related to quarry activities are directly related to the specific geology which embodies the Carolina Slate Belt. In order to understand and fully appreciate the nature of prehistoric quarry-related activities a brief review of the geology of the Slate Belt is in order.

THE GEOLOGIC NATURE OF THE CAROLINA SLATE BELT

In terms of a geologic consideration of quarry-related activities, the use of the name “Carolina Slate Belt” is a traditional, but somewhat misleading name (Watson and Laney 1906; Stuckey and Conrad 1958; Sundelius 1970; Jones 1977). The rocks within the Carolina Slate Belt are neither confined to North or South Carolina nor composed largely of slate (Wilson et al. 1976). As presently defined, the term refers to a group of metavolcanic and metasedimentary rocks of late Proterozoic to Cambrian age. These rocks extend for the most part southwest from central Virginia approximately 640 km into central Georgia. The Slate Belt reaches its maximum width of 140 km in central North Carolina (Butler and Secor 1991:66). It is generally accepted that the formations that comprise the Slate Belt are comprised mainly of breccias, tuffs, flows, and metasedimentary rocks. The dominant sedimentary rocks include shale, mudstone, argillite, and siltstone. More coarse-grained rocks of this nature include graywacke, conglomerate, and sandstone.

Traditionally, many of the felsic metavolcanic rocks of the Slate Belt have been termed “rhyolites.” Presently, it is accepted that most of the materials are dacites and rhyodacites. According to Edward Stoddard:

Rhyolite is supposed to have alkali feldspar phenocrysts and quartz phenocrysts and almost all of the felsic volcanic rocks in the Slate Belt have plagioclase feldspar phenocrysts and quartz phenocrysts and they really should be dacite (Uwharries Lithics Conference, 1999).

In eastern North Carolina the rocks of the Slate Belt run beneath the Cretaceous and Tertiary sediments of the Coastal Plain (Figure 1). The Charlotte Belt lies to the west of the Slate Belt. The Charlotte Belt is a region of highly metamorphosed gneiss, schist and granite. The Gold Hill Fault runs from Union to Davidson County and marks the boundary between these two geologic zones (Wilson et al. 1976).

THE STRATIGRAPHY OF THE CAROLINA SLATE BELT IN NORTH AND SOUTH CAROLINA

In the central Piedmont of North Carolina, the Slate Belt is divided into a stratigraphic sequence consisting of a series of geological formations (Figure 2). In order of age, these include the Uwharrie, Tillery, Cid, Floyd Church and Yadkin Formations (Milton 1984; Harris and Glover 1988). The Uwharrie Formation is composed mainly of felsic metavolcanic rock (tuff, lapilli-tuff, breccia, and some welded tuff) with secondary amounts of mafic tuffs (Butler and Secor 1991:68). The Tillery Formation consists mainly of laminated to thinly bedded metamudstone and represents a change from high energy to low energy deposition, when compared to the Uwharrie Formation (Butler and Secor 1991:69). The Cid Formation, along with its Flat Swamp Member, is composed of mudflow breccia, lava flows, welded tuffs, and bedded tuffs. The Flat Swamp Member is comprised mainly of felsic volcanics with large components of devitrified glass, mudflows, and andesitic basalt (Butler and Secor 1991:69). The Floyd Church Formation is composed of siltstone and mudstone, while the Yadkin Formation contains volcanic sandstone and siltstone (Butler and Secor 1991:69-70). The rocks of the Uwharrie and Tillery Formations also appear in northern South Carolina as an anticlinorium (Mckee and Butler 1986).

Secor and Wagner (1968) described Slate Belt stratigraphy in central South Carolina. In this area the Slate Belt consists of alternating sequences of metavolcanic and metasedimentary rocks contained within three formations. These include the Persimmon Fork, the Asbill Pond, and Richtex Formations (Secor et al. 1986). The Persimmon Fork Formation is composed mainly of poorly sorted to unsorted, felsic to intermediate crystal-lapilli tuff. Other types of metavolcanic and metasedimentary rocks occur as stratiform lenticular sheets in this formation. These rocks include vitric tuff, amygdaloidal andesite and basalt, sandstone and mudstone (Butler and Secor 1991:72). These rocks were deposited during the Middle Cambrian (ca. 570 to 530 Ma) (Butler and Fullagar 1975). The Asbill Pond Formation is composed primarily of metasedimentary rock (sandstone and mudstone) interbedded with fragmental intermediate to felsic volcanics (mainly tuffs). This formation is younger than the Persimmon Fork Formation, but is also Middle Cambrian in age. The Richtex Formation is a sequence of mudstone, siltstone, wacke and greenstone. These rocks are locally interbedded with intermediate to mafic tuff and flow breccia. The age of this formation is not well established, but may be Late Proterozoic in age (Butler and Secor 1991:72-73).

QUARRY STUDIES WITHIN THE SLATE BELT

Numerous quarry sites have been documented by studies throughout the general area. Most of these studies have addressed single quarry sites (Sellon 1980; Mountjoy and Abbott 1982; Novick 1987; Hargrove 1989; Abbott 1987, 1993, 1996; Abbott and Harmon 1998); or a small set of related sites and/or quarries (Baker 1980, 1983, 1989; Davis 1994; Eastman et al. 1998). Several studies have involved large-scale surveys in the Uwharrie Mountains (Cooper and Hanchette 1977; Cooper and Norville 1978; Benson 1999, 2000). To date only one major study has addressed multiple Slate Belt quarries on a regional level (Daniel and Butler 1991; Daniel 1994, 1998; Daniel and Butler 1996).

Daniel and Butler (1991, 1996) studied an approximate 90 sq km area within the Uwharrie Mountains to look for the sources of raw material present at the Hardaway Site in Montgomery County, North Carolina. Twenty-seven quarry sites were sampled and subjected to petrologic analysis. As a result of this work, Daniel and Butler were able to identify and define the characteristics of Uwharrie Rhyolite.

Uwharrie Rhyolite is divided into four basic types based on: 1) *color*; 2) *grain size* (within the groundmass); and 3) *the presence and/or abundance of special features* (i. e. phenocrysts, flow-banding, and spherulites) (Daniel and Butler 1996:9). The types include, 1) *aphyric* (which includes a flow-banded variety); 2) *plagioclase porphyritic*; 3) *quartz porphyritic*; and 4) *plagioclase-quartz porphyritic*.

Six of the quarries studied by Daniel and Butler (1996) were located within the Uwharrie and Tillery Formations near Asheboro, North Carolina (located approximately 38 km north of the Hardaway Site). The range of variation of raw materials from this area appeared greater when compared to the Uwharrie Rhyolite. Most of the material from the Asheboro area appeared to be rhyolitic tuff. The most distinctive features of these materials include the presence of white calcite within the groundmass of the Uwharrie Formation materials and pyrites within the Tillery Formation specimens (Daniel and Butler 1996:25-30).

Using the typological model developed with Bob Butler, Daniel has been able to document the movement of Uwharrie Rhyolite, particularly the flow-banded variety, over 100 km away from the source across North Carolina, down the Yadkin-Pee Dee, and nearly to the coast of South Carolina. With this information, Daniel (1994, 1998) has developed a settlement pattern model regarding Early Archaic band movements in North and South Carolina. In this model separate macrobands scheduled respective trips to major quarry sites (i.e., Morrow Mountain in North Carolina and the Allendale chert quarries in South Carolina) for the specific goals of stone acquisition (Daniel 1998:202-204). As a result stone acquisition was seen as a specific, contributing, factor in determining group movements, rather than being embedded and incidental to other subsistence activities. While Daniel acknowledges that some embedded activity probably took place, he states:

I would argue that this behavior accounted for only the minor amounts of raw material that supplemented assemblages predominately made of chert and rhyolite. Rather, as I have suggested above, scheduled trips were probably made to the Uwharrie and Allendale quarries specifically to acquire stone. This scheduling did not necessarily involve any extra effort in settlement mobility, since (turning the notion of embeddedness around) subsistence procurement would then have been incidental to stone procurement. Once groups had refurbished their tool kits and left the quarry settlements, the stone that they did obtain was probably acquired incidentally in the region they were exploiting for food (Daniel 1998:203).

The studies discussed briefly above have helped improve our knowledge concerning the archaeology of the Slate Belt. There are still, however, many questions and major gaps in our understanding of the Slate Belt as a primary source of lithic raw material during prehistory. Many questions concerning the economic and logistical importance of this area to prehistoric groups through time remain unanswered. One of the major problems continues to be the inability to positively identify specific sources from specific raw material types, either in hand specimens or in artifact form (particularly when weathered). This problem is directly related to the complexity of Slate Belt geology. Due to this complexity, there is a real identification problem related to specific Slate Belt material (Benson 1999, 2000; Ingram et al. 1999). Recent work experimenting with trace and rare earth elements to fingerprint lithic sources within the Slate Belt and beyond is underway and shows great promise for the future (Irwin and Moore 2003).

In addition to the studies listed above, Lewarch et al. (1985:95) noted that some sites within the proposed Randleman Reservoir survey area (in Randolph County, NC) contained a "medium to high percentage of primary and secondary reduction artifacts." These sites were thought to be small, expedient quarries. In these locations local material was extracted and used on the spot. Other expedient quarry sites have been documented in or near the Slate Belt (Lautzenheiser, et al. 1996; Abbott and Harmon 1998). These sites contain locally available "exotic" materials such as chert, jasper and chalcedony.

In spite of all the work listed above, few of these studies have addressed any specific quarry in detail in terms of technology, site structure, and periods of use and/or occupation. One site, 31DV51, has received more intensive study than most within the region. The results of this work will be summarized in the text below.

LITHIC STUDIES AT 31DV51, THREE HAT MOUNTAIN

Three Hat Mountain lies within the Flat Swamp Member of the Cid Formation (Stromquist and Sundelius 1969). The area gets its name from the three major peaks that form the mountain. A geologic map of the area shows the mountain within a complex zone of metasedimentary and metavolcanic rock. Lithic raw material suitable for stone tool manufacture outcrops on the ground surface as small veins, boulders and nodules of varying sizes. The prehistoric quarry and subsequent workshops cover an area of approximately 625 acres. This area contains several locations where quarry and reduction debris is heavily concentrated on the ground surface (Figure 3). Three Hat Mountain has been addressed by three separate studies (Jones 1979; Mountjoy and Abbott 1982; and Abbott 1987). Each of these studies will be briefly discussed below.

Geologic Survey of Three Hat Mountain (Jones 1979)

Jones (1979) conducted a preliminary geologic survey of the mountain. The rocks examined consisted of crystal and lithic tuffs (cryptocrystalline rhyodacites and argillites). These rocks are light gray to grayish black in color and exhibit great variation from outcrop to outcrop. Some green and very light gray tuffs were noted, but were rare when taken as a percentage of the whole. The rocks weather to form a white to light cream cortex.

The lithic tuffs (vitric, felsic, felsic crystal and breccia) are similar in composition to the crystal tuffs. Feldspar fragments tend to be slightly larger in the former. Grain size of the tuffs range from fine-grained (< 0.75 mm in size) to medium fine-grained (0.75 mm to 1.0 mm in size).

Quartz is the most abundant mineral identified among the crystal tuffs. Orthoclase feldspar with small amounts of albite occurs in many of the rocks and phenocrysts. The crystals are white to light pink in color and are euhedral in shape, measuring up to 1.5 mm in length. Chalcopyrite and arsenopyrites occur as small grains and cubic crystals within many of the specimens collected from the mountain. Much of this material was highly suitable for the production of stone tools.

Archaeological Excavation at 31DV51 (Mountjoy and Abbott 1982)

Beginning in 1975, Mountjoy and Abbott documented the Three Hat Mountain quarry site in Davidson County, North Carolina (Figure 3). The previous geologic study by Jones (1979) provided strong evidence for local faulting. The rocks bordering the faults were apparently infiltrated with additional silica producing fine-grained rock with homogeneous texture. Numerous quartz veins cutting through the metavolcanics on Three Hat Mountain supplied the necessary silica for this process. These veins ranged in thickness from less than one centimeter to ten meters. The largest vein was located on the westernmost peak striking eastward toward the highest peak (Figure 3). This type of stone provided excellent raw material for tool production. Prehistoric groups appear to have been able to distinguish these geological features and exploit them for high quality raw materials. Stone mining and knapping activities occurred near the upper heads of gullies where veins and nodules of materials were exposed (Mountjoy and Abbott 1982). Nodules of raw material protruding from the ground surface were collected and converted into primary and secondary cores and quarry blades to be transported from the mountain. Additional, more wide-ranging activities appear to have been carried out at workshop areas at the base of the mountain. The ground surface over much these areas is littered with prehistoric lithic reduction debris. This debris occurs mainly as refuse resulting from primary, secondary and tertiary lithic reduction activities (Mountjoy and Abbott 1982). The debris is interspersed with primary and secondary core fragments (Bradley 1975), aborted quarry blades and projectile points (Coe 1964).

The University of North Carolina at Greensboro undertook limited excavations at Three Hat Mountain under the direction of Joseph B. Mountjoy. A single excavation unit measuring four square meters was dug on the west slope of the southernmost and largest peak of the mountain group. This excavation was undertaken within an area very high artifact frequency (Figure 4). Five distinct strata were observed and over 16 thousand artifacts were recovered to a depth of 1.3 meters below the ground surface (Figure 5). Most of the artifacts were cortical and noncortical waste flakes and angular debris (Table 1). Many of the waste flakes were complete flakes (Sullivan and Rozen 1985). Other artifacts included cores and quarry blades, with smaller frequencies of formal and expedient tools.

Temporal diagnostics dating to the Late Archaic (Savannah River projectile points) were identified in Level 2. Type I and II quarry blades were associated in high proportions with Middle Archaic (Stanly and Morrow Mountain) components at the Doershuk Site (Coe 1964:50-51). These types of quarry blades were identified in Level 4.

Table 1: 31DV51, Artifact Types Within Excavation Unit on Southern Peak

<u>Artifact Type</u>	<u>Lv1/%</u>	<u>Lv2/%</u>	<u>Lv3/%</u>	<u>Lv4/%</u>	<u>Lv5/%</u>	<u>Total/%</u>
Cortical Flakes	438/28.5	1982/18.8	205/14.6	587/24.2	76/11.7	3288/19.9

Noncortical Flakes	368/23.9	5458/51.8	283/20.2	702/28.9	118/18.1	6929/41.9
Angular Waste	712/46.3	3015/28.6	893/63.7	1113/45.9	435/66.7	6168/37.3
Cores	6/0.4	30/0.3	11/0.8	7/0.3	9/1.3	63/0.3
Quarry Blades	12/0.8	38/0.4	9/0.6	16/0.7	11/1.9	86/0.5
Utilized Flakes	0/0.0	2/<0.1	1/<0.1	2/<0.1	2/0.2	7/<.01
Unifacial Tools	0/0.0	3/<0.1	0/0.0	0/0.0	0/0.0	3/<.01
Hammerstones	1/<0.01	1/<0.1	0/0.0	0/0.0	0/0.0	2/<.01
Projectile Points	0/0.0	5/<0.1	0/0.0	0/0.0	0/0.0	5/<.01
Other Tools	0/0.0	0/0.0	0/0.0	0/0.0	1/0.1	1/<.01
Totals	1537/9.3	10534/63.6	1402/8.5	2427/14.7	652/3.9	16552/100

Surface collections were made across the slope and around the base of the mountain within areas designated as workshops. The holdings of local collectors were also catalogued and used to supplement the information gained from the surface collections (Mountjoy and Abbott 1982; Abbott 1987). The range of projectile point types collected spanned most of the Archaic Stage in the Piedmont of North Carolina as described by Coe (1964) (Table 2). The greatest frequency of these temporal diagnostics are related to the Middle Archaic (Guilford and Morrow Mountain) and Late Archaic (Savannah River and Type III quarry blades) (Coe 1964). An ephemeral presence associated with Terminal Paleoindian (Hardaway) and Early Woodland (Badin) are noted in private collections (Coe 1964).

Table 2: 31DV51, Diagnostic Projectile Points

<u>Temporal Designation</u>	<u>Frequency</u>	<u>Percent</u>
Late Paleoindian	1	0.2
Early Archaic	72	16.3
Middle Archaic	140	31.7
Late Archaic	228	51.6
Early Woodland	1	0.2
Totals	442	100.0

Additional work was undertaken on the northern peak in 1984 (see Figure 3). This work consisted of controlled and general surface collections within an area, which contained a dense concentration of debris and appeared to contain a quarry pit. The culturally derived artifacts collected from this area were similar to the assemblage recovered in the area where the excavation unit was dug in 1975 (Table 3). Most of the quarry blades were Types II and III (Coe 1964). This information suggested that the use of this portion of the site occurred during the Late Archaic.

Table 3: 31DV51, Artifact Types on Northern Peak

<u>Artifact Type</u>	<u>Frequency</u>	<u>Percent</u>
Cortical Flakes	95	21.1
Noncortical Flakes	165	36.7
Angular Waste	125	27.8
Cores	23	5.1
Quarry Blades	41	9.1
Utilized Flakes	1	0.2

One major difference in the assemblage from the northern peak lay in the type of raw material quarried and/or selected. All of the material on the northern peak consisted of a porphyritic rhyodacite (Abbott 1987). This material appeared to be the object of quarry activities in the area surrounding the quarry pit.

Across the site as a whole most of the formal quarry blades and projectile points exhibited lateral snaps and strongly suggest that these specimens were broken during manufacture and discarded on the site. Most of the diagnostic projectile points, along with other tool types and tertiary debris were located around the base of the mountain in workshop areas. Most of the quarry blades, primary and secondary debris was located on the three peaks in areas where the raw material was procured. Based on the observations across the site as a whole 31DV51 functioned primarily as a quarry and associated workshop where a wide range of naturally occurring raw material was collected and processed. The site contains a high percentage of complete waste flakes and production failures, which strongly suggest that the focus at the site was material collection, reduction, and biface production (Sullivan and Rozen 1985). This activity appears to have begun in the late Paleoindian times and gradually increased in intensity through the Early and Middle Archaic. The heaviest use of the site appears to have occurred during the Late Archaic. While an ephemeral Early Woodland (Badin) and Middle Woodland (Yadkin ceramics) presence has been observed on the site, the quarry appears to have been largely abandoned after the Late Archaic.

Documentation of the Range of Raw Material Variability and Distribution (Abbott 1987)

Further research was undertaken at the Three Hat Mountain quarry to document the range of raw material variation using a set of macroscopic variables. Beginning in 1982 baseline research was conducted to address this problem (Abbott 1987, 1993, 1996). The primary research questions were very simple and centered on whether it was possible to document the range of variation of raw materials available at a known quarry (31DV51) and see if that range could be identified on other archaeological sites outside of the Slate Belt. The research involved the use of a set of macroscopic and textural variables to document the range of variation of the naturally occurring lithic materials present at Three Hat Mountain. The range of variation, once established, was compared to the variation of lithic assemblages from five separate sites located up to 28 kilometers away from Three Hat Mountain to determine the extent of similarity (Figure 6). Initially four sites (31DV126, 31DV133, 31DV141, and 31DV27) were considered for comparative purposes. Later a fifth site, 31DV267, was added to the group (Figure 7). 31DV267 is a site located at the base of Three Hat Mountain and was included to compare the materials present at a site in the immediate vicinity of 31DV51. In essence, the naturally occurring range of raw material variation at a single quarry was compared to the culturally derived range of materials present on individual sites. It was initially assumed that most of the raw material from the outlying sites should fall within the range of variation documented at 31DV51. This was assumed because 31DV51 was the closest quarry, greater than 50 square meters in size, known at that time to exist in relation to the sites used for comparison (see Sellon 1980).

The field phase of this research centered on the collection of representative samples from Three Hat Mountain and the sites used for comparison. The data collection phase at Three Hat Mountain utilized a set of two-meter dogleash collection units. The placement of these units was randomly selected along a transect using a table of random numbers to generate azimuth and distance measures. The placement of this transect was located centrally across the three-peaked

mountain group and extending from the southernmost peak northwest across the two smaller northern peaks. Each dogleash unit was measured from a separate point along this transect at a constant interval until the total number of sample units were completed. Eighty-five dogleash units were collected (Figure 8). Lithic materials outcropping on the ground surface were collected within the units; however, no culturally altered specimens were collected. The presence or absence of cultural materials within each unit was, however, noted. Specimens were extracted using a geologic hammer in areas where large boulders were encountered within a given sample unit. Sample units devoid of any lithic materials on the ground surface were designated as sterile units. Six of the units (7.06%) fell into this category.

The same data collection methods were employed at the five sites used for comparison with the exception that only culturally derived materials, instead of naturally occurring material, were collected. The general area surrounding each site was inspected prior to the collection of samples units to insure that no outcrops of knappable material was located nearby. These areas included the surrounding ridges, streams, and gullies. This activity was undertaken to help support the assumption that all cultural materials present at the sites used for comparison were transported from elsewhere and were not collected from expedient sources in the general vicinity (with the obvious exception of 31DV267). In addition, each site selected for comparison contained temporal diagnostics within the general range documented at Three Hat Mountain.

The classification and analysis was carried out by visual inspection, supplemented with a hand-held comparator and a 10X to 20X stereoscopic microscope. Specimens from all sample units were classified according to a set of macroscopic variables, which included: groundmass, texture, luster, fracture quality, presence or absence of inclusions, weathering, and anomalous features (Figure 9). The only quantitative measure was for density. For this variable the specific gravity of each specimen was recorded using a Jolly Scale. Using dBaseII software the information was compiled and sorted into lithic groups based on the similarity of macroscopic variables. As a result, the range of variation of the representative lithic groups at 31DV51 and on each site was established.

Twenty-four lithic groups were identified for Three Hat Mountain (Abbott 1987, 1993). This variation was established in consultation with the late Dr. J. Robert Butler of the University of North Carolina at that time. The variation in the naturally occurring materials ranged widely from heterolithological breccia (Group B), difficult to knap, to a very fine-grained rhyodacite (Group X) with excellent conchoidal fracture qualities. Others in this range include flow-banded rhyodacite (Group F), coarse-grained dacite (Group J), andesite (Group K), and porphyritic rhyodacite (Group O). All groups contain pyrite (iron pyrite, chalcopyrite, or arcenopyrite) inclusions within their respective groundmass.

Four lithic groups (B, F, N, and O) were identified in nearly two-thirds of the sample units. Group B is a heterolithological breccia with dark differentially devitrified minerals (Figure 10). Group F is a flow-banded rhyodacite with groundmass inclusions of chalcopyrite (Figure 11). Group N is a breccia with undifferentiated pyrite groundmass inclusions (Figure 12). Group O is porphyritic rhyodacite with plagioclase inclusions (Figure 13). A distinct pattern emerged in terms of the distribution of lithic groups across the mountain. The distribution of the groups mentioned above are divided between the two smaller northern peaks where Group O is almost exclusively located, and the large southern peak where the majority of other lithic groups occur, including the very fine-grained rhyodacite (Group X) (Figure 14).

All of the sites chosen for comparison, to include 31DV267, share similarities in terms of temporal span, site type, function, and activity sets (Abbott 1987). Analysis of the separate assemblages from each site suggests that they correspond to Wood's definition of multiple

activity site types (1978:263-265). These sites most probably functioned as locations where the length of occupation and the range of activities, manifest in the respective assemblages, extended beyond what would be expected for expedient extraction of resources (Tainter 1979).

Eighteen lithic groups were identified at 31DV267. Of these sixteen were within the range of variation documented at Three Hat Mountain. These included Groups B, D, E, F, I, J, M, N, O, P, Q, T, U, V, W, and X. These are described as follows:

- Group B** - Heterolithological volcanic breccia with dark differentially devitrified minerals, probably iron pyrites (J. Robert Butler, personal communication, 1984)
- Group D** - Flow-banded rhyodacite with iron pyrite in the groundmass
- Group E** - Rhyodacite with dark patches of differentially devitrified minerals (probably chlorites) present in the groundmass (J. Robert Butler personal communication, 1984)
- Group F** - Flow-banded rhyodacite with chalcopyrite within the groundmass
- Group I** - Microcrystalline rhyodacite with numerous pockets of oxidized iron pyrite which appear to have filled gas bubbles within the matrix (contains chalcopyrite in the groundmass)
- Group J** - Coarse-grained dacite with flecks of chlorite and chalcopyrite
- Group M** - Rhyodacite with iron pyrite eroding in the groundmass as pitted areas of rust
- Group N** - Crystal lithic breccia with pyrites within the groundmass (J. Robert Butler, personal communication, 1984)
- Group O** - Microcrystalline porphyritic rhyodacite with plagioclase inclusions
- Group P** - Rhyodacite with sulfides and/or pyrites in the groundmass (J. Robert Butler, personal communication, 1984)
- Group Q** - Heterolithological rhyolitic breccia with chalcopyrite in the groundmass
- Group T** - Fine-grained rhyodacite with pyrite and/or sulfides in the groundmass
- Group U** - Microcrystalline rhyodacite with undifferentiated inclusions of phyrte in the groundmass
- Group V** - Cryptocrystalline rhyodacite
- Group W** - Rhyodacite with dark pitted areas of differentially crystallized minerals and chalcopyrite in the groundmass
- Group X** - Cryptocrystalline rhyodacite with undifferentiated pyrites in the groundmass

At the other sites, seventeen lithic groups were identified at 31DV126. Of these five groups were within the range of variation documented at Three Hat Mountain (Groups M, O, U, W, and X). Twenty-three lithic groups were identified at 31DV133. Of these four groups were within the range of variation identified at Three Hat Mountain (Groups I, K, V, and X). Group K is a heterolithological breccia with dark, differentially crystallized minerals (probably andesite) present in contrast to the groundmass (J. Robert Butler, personal communication, 1984). Twenty-two lithic groups were identified at 31DV141. Of these three groups were within the range of variation documented at Three Hat Mountain (Groups I, O, and X). Fourteen lithic groups were identified at 31DV27. Of these three groups were within the range of variation documented at Three Hat Mountain (Groups O, Q, and U).

The analysis discussed above did provide a means for some pattern recognition. It was observed that 66.00 percent of the artifacts collected at 31DV267, the site closest to Three Hat Mountain, were within the range of variation established for the quarry. The percentage of overlap decreased with distance for the remaining sites. Approximately 46.25 percent of the artifacts from 31DV126, located 10.8 km away from the quarry and only 8.46 percent of the

artifacts from 31DV27, the most distant site, were within the range of variation of 31DV51 (Table 4).

Table 4: A Comparison of the Selected Sites

Site	f*	%**	Distance (km)
31DV267	16 (88.88%, N=18)	66.00 (n=526)	<1.0
31DV126	5 (29.41%, N=17)	46.25 (n=247)	10.8
31DV133	4 (17.39%, N=23)	22.44 (n=130)	13.9
31DV141	3 (13.64%, N=22)	8.58 (n=206)	16.9
31DV27	3 (21.43%, N=14)	8.46 (n=27)	28.5

*f = the frequency of lithic groups within the range of variation of raw materials from 31DV51

** % = percent of artifacts within the range of variation of raw materials from 31DV51

The data suggests that as sites occur further away from the source at 31DV51 the percentage of materials within the range of variation documented at the quarry follow a rapid distance decay curve (Figure 15). In this situation there appears to be a rather abrupt decrease in the raw material frequency within a relatively short distance from the quarry (for a broader comparison see Sassaman et al. 1988 and Daniel 1994). The fall-off curve appears to truncate between 10 to 12 km from 31DV51. After approximately 17 km the percentage of artifacts within the range of variation documented at 31DV51 does not change much between 31DV141 and 31DV27, even though the distance from the quarry nearly doubles (Table 4). This study was of particular value in demonstrating the wide range of variation within a single quarry site within the Slate Belt. The study also demonstrated that a fairly high percentage of the naturally occurring material was actually selected for use by prehistoric groups. In addition, a relatively rapid (Gaussian) distance-decay curve was demonstrated for the material from this quarry (Figure 15).

DISCUSSION

A comparison of the artifacts from general surface collections, controlled surface collections and excavated contexts suggest that the function of the site remained constant over time. The site functioned as a prehistoric quarry where groups from Paleoindian times through the Archaic and into the Woodland came to collect knappable raw materials. Additional analysis of the artifacts from excavated contexts strongly suggests that the reduction technology, while focused on specific style through time, did not change in terms of the primary objectives. The technologies through time were fixed on the extraction and reduction of a range of raw materials at the site. The high quantities of complete flake debris and production failures suggest that biface production was the primary goal of the individuals working at the site, particularly during the Middle and Late Archaic. Part of this activity included inspection and selection of suitable materials for use and inspection and discard of unsuitable or rejected materials. All of these activities produce a vast amount of waste. The work at 31DV51 does allow the development of a model for raw material acquisition and distribution that is applicable to 31DV51 and the Slate Belt in general during the Middle and Late Archaic. This model will be presented in the text below.

Information collected at 31DV267 suggests that at least 16 different raw material types were selected for use or at least reduction from a wider range of naturally occurring materials at Three Hat Mountain. These constitute a relatively large number of raw materials present at 31DV267 from 31DV51. Some of these materials (such as Group B) do not appear to be particularly good for reduction and tool production. One explanation for the presence of this

material at 31DV267 may be that at sites adjacent to a source, with a diverse range of raw material variation at hand, one would expect some degree of experimentation or prospecting to be undertaken by those extracting the resources. If a particular material was not suitable for use, based on initial reduction or attempted use, then it would be likely that the material would be discarded and not transported any further. It should be noted that those lithic groups documented on the sites at a greater distance were all relatively high in inferred quality for the purpose of lithic reduction (Table 4). If raw material experimentation to determine raw material quality is undertaken; then, one might expect those materials that are qualitatively better to be manifest at further distances from the source (Renfrew 1977).

The percentage of materials within the range of variation documented at 31DV51 falls rapidly between 10-17 km away from the source. These materials exhibit a gaussian fall-off curve regarding interaction (or presence in the archaeological record) and distance from the source (Renfrew 1977). At 28 km from the site only three of the materials remain in the system. According to Renfrew (1977:76-77) high-value goods will travel farther than other less valuable ones. The data from the Three Hat Mountains studies support this notion. The fall-off curve seen in Figure 15 suggests that porphyritic rhyodacite (Group O), heterolithological rhyolitic breccia (Group Q), and microcrystalline rhyodacite (Group U) were the preferred raw materials from Three Hat Mountain. These materials appear to stay within the distribution system. Cryptocrystalline rhyodacite (Group X) and microcrystalline rhyodacite also appear to be selected as preferred raw materials.

The distribution patterns suggested by the fall-off curve appear to change over time from the Early Archaic to the Late Archaic. The curve may remain the same, but the cultural and behavioral factors creating the curve may change. During the Early Archaic the area between 31DV126 and 31DV51 probably represents the foraging radius which included the quarry. Within this radius a wider range of raw materials would have been used due to close proximity to the quarry and an effort to conserve the preferred, higher quality material for use in the outer reaches of the settlement range away from the quarry. Lower quality materials may have been used for expedient activities in the foraging area around the quarry while the higher quality materials would have been converted into formal tools or “geared-up” for the time spent away from raw material sources. In this pattern the distribution of raw materials represents the movement of people at the band-level of organization across the landscape outward across their range. According to Daniel (1998) this range may have extended as much as 250 km away from specific sources. Other researchers suggest ranges between 50-130 km (Gardner 1983). In both of these models the proximity to lithic resources influence settlement patterns. Of interest to the study of Three Hat Mountain are the changes in the range of settlement over time, which may have had a dramatic impact on the acquisition and distribution of raw materials.

According to many scholars settlement patterns become very localized within the Southeast by the mid-Holocene (Goodyear et al. 1979; Sassaman et al. 1988). As a result of reductions in the size of settlement ranges we must assume that group mobility becomes increasingly constricted and access to raw materials may have become equally restricted (Anderson and Schulderein 1985; Blanton 1983; Goodyear et al. 1979; Sassaman et al. 1988; Klein and Klatka 1991). Many researchers indeed have suggested that raw material procurement patterns become increasingly localized through time (Chapman 1977; Gardner 1974; Sassaman et al. 1988). This suggests that the proximity to lithic sources becomes increasingly more limited to certain groups and increasingly more important to others during the Middle and Late Archaic. In this situation access to quarries like Three Hat Mountain may be more an economic issue rather than a settlement or band schedule issue.

In this pattern the curve seen in Figure 15 represents the movement of commodity (raw material) rather than individuals. The area within 10 km of the quarry would represent a supply zone of the raw material for a particular group or lineage. The distance beyond 10 km would represent “down the line” exchange of the preferred materials. As with earlier groups the higher quality materials remain in the system as trade items. Given the overwhelming frequency of Middle and Late Archaic temporal diagnostics present at 31DV51 and the outlying sites used for comparison, it is probable that this mode of procurement and exchange begins at some point during the Middle Archaic and intensifies, reaching a peak, during the Late Archaic.

It is of interest to note that the most preferred material is Lithic Type O (the porphyritic rhyodacite) that dominates the northern peaks at the quarry (see Figure 13). Coe (1964:35-44) notes that porphyritic rhyodacite was the primary raw material used for the manufacture of Middle and Late Archaic points from the Doerschuk Site. Other studies support this observation in numerous collections from across the Piedmont Region of North Carolina (Daniel and Butler 1996:32). Daniel and Butler suggest that the preference for this material was the result of over-exploitation of higher-quality materials from Morrow Mountain (1996:32-33). It seems more likely that the porphyritic raw material was selected for its functional qualities rather than as a default choice. Late Archaic stone tools are large and would have required a strong, durable material to facilitate a reasonable use/wear life. The porphyritic rhyodacite embodied in the Type O material from Three Hat Mountain would have provided appropriate strength needed to support the size and function of Late Archaic points.

During the Late Archaic exploitation of resources at 31DV51 probably intensified to facilitate the increased need for raw materials. This occurred as the probable result of several factors. First, population density most likely increased during the Late Archaic. Second, Late Archaic technology was geared toward the production and use of large, broad projectile points/knives (notably the Savannah River point within the Piedmont of North Carolina) (Coe 1964). This technology requires a large amount of material and inherently produces a large amount of waste. Third, the constriction of group range and the subsequent establishment/or intensification of trade networks that develop during the Late Archaic facilitated the increased exploitation of lithic resources. These materials would have been of great importance as trade goods to the groups, which included the quarries within their territories or reduced ranges. The materials would have been incorporated into a system, which involve a “down the line” trading network or system and in time probably involved the transportation of materials, such the Type O material, to gateway communities for wider (regional) distribution (Hirth 1978). The Donnaha Site (31YD9) in Yadkin County (Woodall 1984; Woodall 1990) possibly served as a gateway community for the distribution of lithic raw materials into the northwestern Piedmont and beyond (Woodall and Abbott 1983). This site is located approximately 60 km northwest of Three Hat Mountain in the Yadkin River floodplain (see Figure 6). It is of most interest that this site develops during the Late Archaic (Woodall 1984).

These trade networks would not have been as extensive as some of the other cultural areas (such as Poverty Point), which developed in other locations within the Southeast during this period of time. The networks within the Piedmont were probably local in extent and fostered the development of wealth and prestige at the local or individual level. This wealth may have fostered the prestige of certain lineages, but did not create the conspicuous wealth noted elsewhere in the Southeast and Ohio Valley. The process that fostered the growth of local wealth and prestige during the Late Archaic probably also sowed the seeds of destruction for the functional use of Three Hat Mountain as a source of lithic material. The near glaring absence of observable components related to the Woodland Stage at 31DV51 strongly suggests that the resources were over exploited during the Late Archaic. The nature of Late Archaic technological needs, which require a large amount of raw material and creates a vast amount of waste coupled

with an increased demand for certain raw material types exhausted the accessible supply at 31DV51. The presence of the quarry pit on the northern peak probably represents some of the final efforts to extract raw material from the site. At some point the return on the labor investment failed to justify the effort and the site was abandoned as a quarry. It is probable that exploitation was extended to other sites within the Slate Belt with similar results and impacts on the resource. This process likely continued throughout the Late Archaic.

The advent of the bow and arrow fostered a dramatic change in lithic technology. In the Piedmont of North Carolina projectile point sizes gradually diminish over time. As a result the needs and demands for raw materials change. Evidence exists within the Uwharrie Mountains that Woodland groups scavenge or recycled Late Archaic debris for usable raw materials (Abbott 1996). This process of recycling probably occurred during the Woodland Stage at Three Hat Mountain. This type of raw material acquisition would not leave a great deal of evidence that is presently distinguishable within many quarry sites. To date very little work has been done to address this issue or to verify that this sort of activity was widely spread in the Slate Belt.

The work at Three Hat Mountain has demonstrated that prehistoric groups quarried knappable metavolcanic material during most of the Archaic Stage. Most of these materials were converted into either quarry blades or finished tools and transported away from the source. A model for the acquisition and distribution of raw materials from 31DV51 and the Slate Belt at large has been presented in the discussion above. This model remains to be tested at other sites across the Slate Belt and Piedmont Region. Suggestions for further research are presented below.

SUGGESTIONS FOR THE FUTURE

As stated earlier, there has been very little work regarding intensive studies of specific quarry sites within the Slate Belt of North Carolina. At present we know enough only to realize where the major gaps in our understanding happen to be and where we need to improve our data collection and analytical methods. Certainly we need to study more quarry sites. These sites need to be excavated and described in order to produce comparative data. Temporal data needs to be collected and quarry sites in the area need to be placed within chronological framework. At the same time the evolution of use needs to be established on specific quarry sites throughout the Slate Belt. An understanding regarding the changes within quarry technology over time needs to be established for sites within the Slate Belt. Lastly, the range of variation in raw material use needs to be fully understood for the area in general.

The model presented above also merits testing. Evidence of similar distance decay curves surrounding other quarries needs to be sought and the issues regarding the possibilities of Late Archaic over-exploitation of quarry sites need to be addressed. We need to understand the cultural and behavioral dynamics within complex areas such as the Slate Belt. We also need to know how raw materials were transported across the landscape between regional geologic zones. In other words, we need to understand just what is meant by the term "local distribution". This model does provide a baseline by which to study quarry sites and should be addressed and tested by future studies.

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