

# POSSIBLE SOURCES OF MYLONITE AND HORNFELS DEBITAGE FROM THE COOPER SITE, LYME, CONNECTICUT

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## ABSTRACT

Debitage of three metamorphic rock types, a mylonite and two types of hornfels, have been identified from the Cooper Site (75-60), a Middle to Late Woodland occupation on a Connecticut River terrace in Lyme, Connecticut. The mylonite, a fine-grained rock from a fault zone, may have come from the nearby Honey Hill Fault (8 km upriver), in which case this would be the first documented use of material from this source. The two hornfels, which are composed of cordierite-chiastolite-biotite-spinel (spotted) and magnetite-orthorhombic pyroxene-cordierite, have no known source in Connecticut. Van Houten (1971), however, described similar hornfels from New Jersey, where the Lockatong shales have been baked by igneous intrusions. Such metamorphic rocks, which frequently are overlooked in prehistoric trade studies, have great potential in sourcing material because of their diagnostic but variable mineralogy, which can be determined easily in thin section.

## INTRODUCTION

The Cooper Site (75-60) was initially reported by McBride (1984) but largely excavated by David R. George and the University of Connecticut Archaeological Field School during the 1994 field season. The site has yielded artifacts from Middle and Late Woodland occupations. We will discuss three metamorphic materials from the site's lithic assemblage: a mylonite and two types of hornfels. All three rock types have been identified in thin section. These identifications add to the list of diverse lithic materials utilized by the prehistoric occupants of Connecticut (e.g. Calogero and Philpotts 1995). The mylonite is likely from a previously unrecognized locally available source. In contrast, the hornfels, which is unlike any found in Connecticut, indicates possible long-distance trade in a material frequently considered locally distributed.

The Cooper Site overlooks the Connecticut River on a terrace 10 meters above the high tide mark. The site is 300 meters south of Hamburg Cove, and 11 km north of Long Island Sound. Only a portion of the total site area has been excavated, as determined by transect sampling. A 113-square-meter excavation block has been exposed, revealing 23 features and over 10,000 lithic artifacts (Figure 1). Although the site lacks natural stratigraphy, analysis of the feature and artifact concentration patterns suggest two discernable temporal components.

The Middle Woodland component of the Cooper Site appears limited to the northern portion of the excavated area. It is interpreted as a series of small, briefly-occupied camps. Relatively small amounts ofdebitage and tools from this component were found near rock-lined hearths, two of which have been dated to 1875±70 B.P. and 1358±100 B.P. or 75 AD and 592 AD, respectively (Table 1).

The Late Woodland component we interpret as the remains of at least one wigwam structure and a series of associated pits and hearths. Thirty-three post molds near the center of the excavation block form an ovoid ring with dimensions equal to those of wigwams from historical accounts (Gookin 1970; Stiles 1761: cited in Sturtevant 1975; Williams 1970; Wroth 1970). One hearth was radiocarbon-dated to 858±50 B.P. or 1092 AD, and two ceramic sherds were thermoluminescence dated to 908±20% B.P. and

880±20% B.P. 942 AD and 1070 AD, respectively (Table 1). These dates fall within the early portion of the Late Woodland Selden Creek Phase of the Lower Connecticut River Valley sequence (McBride 1984).

TABLE 1: RADIOMETRIC DATES FROM THE COOPER SITE

Radiocarbon Dates

<u>Date</u>	<u>Context</u>	<u>Laboratory Identification</u>
(Uncalibrated) 1930±70 B.P. (Calibrated) 1875±70 B.P.	Feature 9 Charcoal	Beta #80913
(Uncalibrated) 1490±100 B.P. (Calibrated) 1875±70 B.P.	Feature 1 Charcoal	Beta #5318 McBride (1984)
(Uncalibrated) 970±50 B.P. (Calibrated) 858±50 B.P.	Feature 13 Charcoal	Beta #80914

Dates calibrated according to Stuiver *et al.* (1973).

Thermoluminescence Dates

<u>Date</u>	<u>Context</u>	<u>Laboratory Identification</u>
908±20%	ceramic sherd*	Alpha #496
880±20%	ceramic sherd*	Alpha #497

Provenience unrecorded, dates reported in McBride (1985).

Dense concentrations of debitage and tool fragments were found within several of the pit features, with well over half of the site's total lithic assemblage from the largest of these pits (Figure 1: Feature 3). Over 5,000 fragments of lithic debris concentrated in a group of non-overlapping pits suggests a period of very intensive use. Floral and faunal analysis of the Late Woodland component indicates at least a spring, summer, and fall occupation (George 1995; George and Bendremer 1995).

Within each component, there appears to have been episodic depositions of lithic debris. Debitage occurs in spatially discrete concentrations of visually distinct material types. However, because the material type of each concentration was often unidentifiable on macroscopic visual characteristics alone, representative flakes from the concentration were chosen for petrographic analysis.

For the making of a standard polished petrographic thin section, the selected flake is epoxyed to a glass slide, ground and finally polished to a thickness of 30  $\mu$  (1 micron = 1/1000 mm). At this thickness, most rocks are translucent, allowing their crystalline fabric and mineral composition to be observed under a microscope and the material identified according to this information (Philpotts 1989; Williams *et al.* 1982).

The present study focuses only upon the metamorphic rocks from the Cooper Site because of such material's variable but diagnostic mineralogy. Petrographic analysis can determine the parent material and means of subsequent metamorphism. An understanding of a metamorphosed rock's formational history is critical to locating an artifact's geologic source. Further, contact zones have a geographically limited

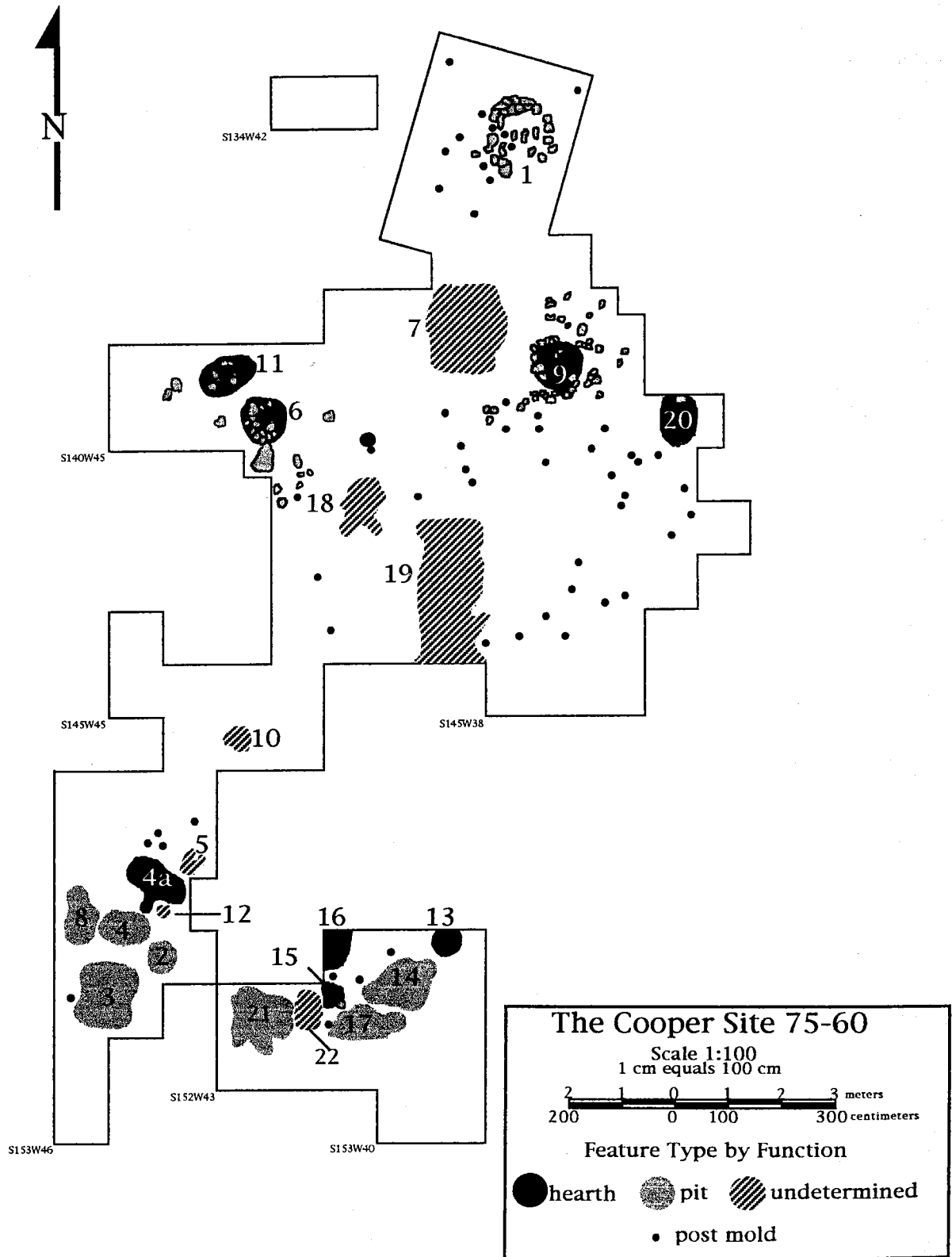


Figure 1. Plan view of the Cooper Site.

distribution. These combined factors make metamorphic rocks amenable to sourcing. By identifying material type and potential sources, the geographic extent of lithic procurement areas can be estimated.

### MYLONITE

The mylonite debitage is associated with the Middle Woodland component. Mylonite is an extremely fine-grained rock formed in a fault zone. The intense shear stresses near some faults recrystallize the surrounding rock into a fine-grained material (Philpotts 1989). Macroscopically, the material from the site resembles a dark grey, translucent hybrid of chert and quartzite with streaked inclusions. Without the aid of a microscope, this material is difficult to differentiate from chert. The 15 flakes from the Cooper Site are a mylonitized granite, as evidenced by the streaks visible in hand specimen. Under the microscope, it is evident that the streaks are actually undestroyed parent rock within the recrystallized matrix.

The Honey Hill and Lake Char faults, both of which could produce mylonite, cross south-eastern Connecticut. The Honey Hill Fault crops out 8 km upriver from the site, at Gillette Castle State Park (Figure 2). This outcrop, and a second in Preston, Connecticut, were sampled for mylonite. While both

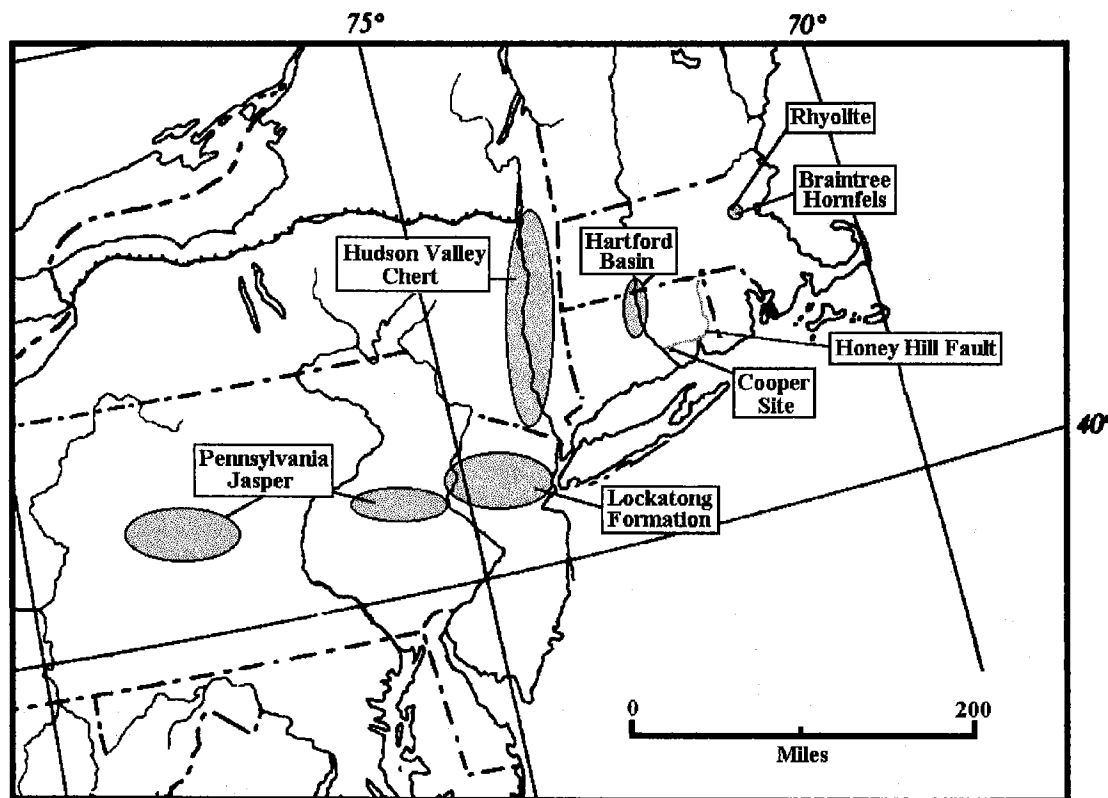


Figure 2. General locations of sources referenced in text, in relation to the Cooper Site.

outcrops contain mylonitic material suitable for the production of stone tools, these materials differ from that found at the site. The rock from Gillette Castle State Park is a pseudotachylite, which is an intrusive mylonitic glass formed by frictional fusion, and the outcrop in Preston contained mylonitized gabbro. Thus, we are presented with the interesting scenario of having located two sources of material which could

have been utilized for the production of stone tools, but to our knowledge has not yet been documented in the archaeological record. The source of the mylonitized granite from the Cooper Site has yet to be determined. Given the site's proximity to a major fault zone and the variety of rocks through which this fault cuts, the source likely lies undiscovered along the margins of the Honey Hill Fault.

### HORNFELS FROM THE COOPER SITE

Two types of hornfels were identified from the lithic assemblage of the Cooper Site. Hornfels is any contact metamorphic rock that has been recrystallized by high temperatures into a hard, fine-grained, homogenous material (Calogero and Philpotts 1995). Its presence in the archaeological record is frequently misidentified or unrecognized (Calogero 1991, 1992), with petrographic analysis of the unweathered interior often the only method of identification.

The first of the two hornfels is a "spotted" hornfels, so-called because subsoil artifacts are yellow-grey (Munsell 2.5Y 6/3), with numerous small, dark spots of less than 1 mm in diameter irregularly distributed across the surface, roughly 2 mm apart. When ultrasonically cleaned, samples appear purplish-grey (Munsell 2.5Y 6.5/1). The material exhibits conchoidal fracture, and fresh breaks reveal a black, fine-grained interior. Five thin sections were made.

Hornfels is classified according to its constituent mineral assemblage. The "spotted" hornfels is thus a cordierite-chiastolite-biotite-spinel hornfels. It exhibits absolutely no bedding, schistosity, or foliation. This hornfels was formed from an aluminous shale. The fine-grained (~1  $\mu\text{m}$ ) granoblastic matrix is composed predominately of red biotite, and quartz or feldspar. The "spots," visible in hand-specimen, are chiastolite crystals ( $d = 47 \mu\text{m}$ ) which have been altered to a clay mineral and are ringed by green spinel ( $d = 3 \mu\text{m}$ ). Some spinel also occurs throughout the matrix. Also present are porphyroblasts of cordierite similar in size to the chiastolite crystals but lacking the rims of spinel crystals. Veins of chlorite ( $w = 3 \mu\text{m}$ ) and tourmaline ( $w = 3 \mu\text{m}$ ) are visible.

Fifty-seven pieces of cordierite-chiastolite-biotite-spinel "spotted" hornfels debitage and an assortment of tools are found within the Middle Woodland component, concentrated near Feature 7 (Figure 1). These tools include a utilized blade, several biface fragments, and utilized flakes. No cortical flakes were recovered, suggesting that this material was transported to the site as a prepared core or biface.

A second hornfels, also a metamorphosed aluminous shale but visually distinct from the "spotted" hornfels, was recovered from the Cooper Site. The weathered exterior of the artifacts is blue-grey (Munsell 7.5YR N6/0), with some white, tan, or brown layering. Several pieces display a rough cortical surface, which follows the relict bedding planes of the parent shale. Samples emit a clay odor when moistened. The material exhibits conchoidal fracture, and fresh breaks reveal a black, extremely fine-grained interior. Six thin sections were made.

This hornfels is a magnetite-orthorhombic pyroxene-cordierite hornfels. The matrix is composed of ~1  $\mu\text{m}$  grains of magnetite and orthorhombic pyroxene, with porphyroblasts of cordierite ( $d = 12 \mu\text{m}$ ) throughout. The layers visible in hand-specimen are marked by the presence of an unidentified amphibole, possibly anthophyllite. Veins filled with red biotite ( $w = 9 \mu\text{m}$ ) and limonite ( $w = 6 \mu\text{m}$ ) are also present.

This hornfels is associated with the Late Woodland component, and 861 pieces of hornfels debitage and tools were found near Features 13-17 and 21-22 (Figure 1). These tools include scrapers, utilized flakes, and core fragments. Unlike the hypothesized prepared core of the spotted hornfels, this material appears to have been brought to the site as very roughly shaped "tablets." Several core fragments display planar cortical surfaces which are apparently the natural bedding of the parent rock. These tablets were little modified before being transported to the site.

### POSSIBLE SOURCES OF HORNFELS

At present, neither of the hornfels are attributed to an exact geologic source. Hornfels in Connecticut occur only in the Hartford Basin, where three extrusive basalt flows have metamorphosed micaceous siltstone and arkosic sandstone (Figure 2). No basalt dikes are known to have intruded through shales (Calogero 1991; Philpotts and Martello 1986). In addition, the shales that are present in the Hartford Basin are coarser-grained than that which produced the artifacts from the Cooper Site and typically contain detrital mica grains.

Rocks similar to those in Connecticut occur in central Massachusetts. The one basalt flow there contacts only coarse sandstone. Farther east, hornfels does occur in the Massachusetts Quarry outside of Boston (Figure 2). This material is referred to as Braintree Hornfels (Bowman and Zeoli 1977; Ritchie and Gould 1985). No thin sections of this material were available for comparison, but published mineralogical descriptions (Chute 1969) indicate a different composition than either hornfels from the Cooper Site. Braintree Hornfels is common in the archaeological assemblages of sites in southeastern Massachusetts and northern Rhode Island, but appears to be limited to a 30 km radius from the quarries (Ritchie and Gould 1985; D. Ritchie, personal communication; Strauss 1992).

Hornfels similar to that from the Cooper Site is also not known to occur geologically in Rhode Island. All formations in which hornfels might be formed have been subjected to the large-scale regional metamorphism characteristic of the area (Murray 1988). The shales which produced the Cooper Site artifacts have not been regionally metamorphosed, for foliation in the rock fabric would be visible in thin section.

Thus, the apparent source of the Cooper Site hornfels does not lie to the north or east. This is perhaps not surprising given what is currently understood about Middle and Late Woodland exchange systems. Rhyolite is the only identified material occurring abundantly in archaeological sites in Connecticut from sources generally north and east (Figure 2). Calogero has noted that this material appears almost exclusively in Archaic contexts, and reports no Woodland Period sites with rhyolite artifacts from central Connecticut (Calogero 1991; Calogero and Philpotts 1988, 1989).

In marked contrast, the Middle and Late Woodland sites in Connecticut do show increasing amounts of trade in material originating generally from the south and west (Calogero 1991; Feder 1984; McBride 1984). Chert and jasper are the two non-local lithic materials that most frequently appear in these artifact assemblages. Both chert and jasper have sources in the Delaware Watershed and Hudson Valley (Figure 2) (Hammer 1976; Hatch 1994; Lavin 1983, 1987; LaPorta 1994; Wray 1948). Particularly for cultures in the Delaware Watershed, trade volume seems to have peaked during the transitional Middle and Late Woodland periods (Hatch and Maxham 1995; Luedtke 1987; Stewart 1989).

Sources of hornfels have been identified in the Mid-Atlantic from the Lockatong shales (Figure 2). These shale beds extend from southeastern New York, across north-central New Jersey, and terminate in northeast Pennsylvania (Van Houten 1969). Argillite and hornfels from these shales are often indistinguishable macroscopically. Both are well documented in the archaeological record of New Jersey and surrounding areas (Didier 1975; L.E. Williams *et al.* 1981). Geological descriptions of these materials based on over 150 thin sections and 750 X-ray diffraction analyses have been published by Van Houten (1960, 1962, 1965, 1969, 1971), and he describes (1971:4) a "spotted" hornfels identical to that from the Cooper Site. Similar descriptions also exist for the hornfels found within the Late Woodland component. Inspection of the thin sections from the Cooper Site by Van Houten confirms the similarity of this material to that from the Lockatong Formation (Van Houten, personal communication).

While matching written descriptions are not sufficient for absolutely attributing the Cooper Site artifacts to this source, archaeological evidence of similar exchange patterns supports the possibility. Based solely on visual identification, argillite, and possibly hornfels artifacts attributed to the Lockatong Formation have been described from sites in coastal New York (Ritchie 1965, 1971), Long Island (Rutsh 1970), and as far north as Massachusetts (Carty 1983; Massachusetts Historical Commission 1980: cited in Strauss 1989). Further, Calogero has identified hornfels containing corundum from three sites in central

Connecticut. The nearest source of this material is in the Hudson Valley, south of Peekskill, New York (Calogero 1991; Calogero and Philpotts 1995).

Therefore, raw material sources of chert, jasper, and hornfels all occur in relatively close geographic proximity. Within the Late Woodland component of the Cooper Site, concentrations of all three of these materials are found in adjacent deposits. This suggests that these materials may have been part of a common trade connection (George and Tryon 1996), and show not only the range of materials imported from the south and west, but also hint at the extent of social ties and exchange systems with cultures in these areas.

### CONCLUSION

That hornfels may have been included in systems of exchange in chert and jasper is an important consideration when studying Middle and Late Woodland sites in Connecticut. Hornfels is often assumed to be of local origin, and such an untested assumption could drastically alter interpretations of lithic procurement patterns. Similarly, misidentification of locally available mylonite as non-local chert might overplay the role of long distance trade. Petrographic analysis of metamorphic rocks will hopefully continue to serve a pivotal role in lithic sourcing studies. Only by such methods can the full range of available lithic resources and cultural contacts of the Woodland Period Connecticut inhabitants be determined.

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