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RESEARCH REPORT

Red Chert Quarries in the Munsungun Lake Formation: Moving beyond Norway Bluff

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ABSTRACT

Red chert attributed to the Munsungun Lake geologic formation located in northern Maine is common in terminal-Pleistocene, fluted-point-period lithic assemblages throughout New England. A visually identical material also appears in some later-period sites in coastal Maine. Until recently no bedrock source for this red chert showing convincing evidence of precontact use was known. Here we present the NKP site complex, a series of quarry-related stone-tool-manufacturing workshop sites associated with outcrops of high-quality red/green chert. These outcrops represent the only known source of this material with evidence of precontact human use within the Munsungun Lake formation. Although unequivocal fluted-point-period artifacts, such as fluted bifaces, are not yet documented at the NKP complex, the recurrent appearance of red Munsungun chert in fluted-point-period lithic assemblages in New England suggests the manufacture of fluted points took place in the vicinity of these outcrops.

KEYWORDS

Paleoindian; quarries; toolstone acquisition; New England; Pleistocene

1. Introduction

Few large toolstone quarries are known in northeastern North America, with fewer still located in northern New England and the Canadian Maritime provinces (see Bradley et al. 2008, 120–121). Over 40 years ago Robson Bonnichsen (Bonnichsen et al. 1980) identified extensive chert outcrops and associated stone-tool-manufacturing workshops adjacent to Norway Bluff within the Munsungun[1] Lake geologic formation in northern Maine (Figure 1). Bonnichsen's investigations revealed the long-term use of Munsungun chert for the production of chipped-stone tools. The recovery of fluted bifaces as well as other later materials at these workshop areas demonstrated the intermittent use of chert from the Munsungun Lake formation beginning during the terminal Pleistocene and spanning ~12,800 years (Bonnichsen et al. 1980). These discoveries cemented the Munsungan Lake region as an important center of precontact lithic procurement, particularly during the terminal-Pleistocene fluted-point period.

For the purposes of this discussion we define the fluted-point period of New England and the Canadian Maritime provinces following Bradley and colleagues (Bradley et al. 2008). This period in New England begins at approximately 12,900 cal yr BP with the appearance of the Kings Road-Whipple, Vale-Debert, and Bull Brook fluted-point forms. These early points are followed by the later Michaud-Neponset, Crowfield, and Cormier-Nicholas fluted-point forms at approximately 12,200 cal yr BP. The production of fluted points in New England ceases at approximately 11,600 cal yr BP (Bradley et al. 2008, 120). Fluted-point forms found outside of New England and the Canadian Maritime provinces, such Clovis, Folsom, or Cumberland, are not considered in this discussion.

Despite the archaeological potential of this region, little fieldwork took place following the termination of Bonnichsen's investigations. Here we describe a recently discovered lithic quarry area and associated stone-tool-manufacturing workshops/camps within the Munsungun Lake formation. This location was dubbed the NKP quarry complex by Maine State Archaeologist Arthur Spiess, and this name now appears in the site files for the State of Maine. The acronym NKP consists of the initials of the discoverer of the site (Nathaniel Kitchel) and the first letter of a toponym near the site complex. The NKP complex lies roughly 20 km to the southwest of Bonnichsen's original research area, expanding the geographic extent of documented chert procurement areas within the Munsungun Lake formation (Figure 1). The NKP outcrops are also the only currently known source of red Munsungun chert visually identical to the material found in archaeological sites in New England from the terminal Pleistocene forward

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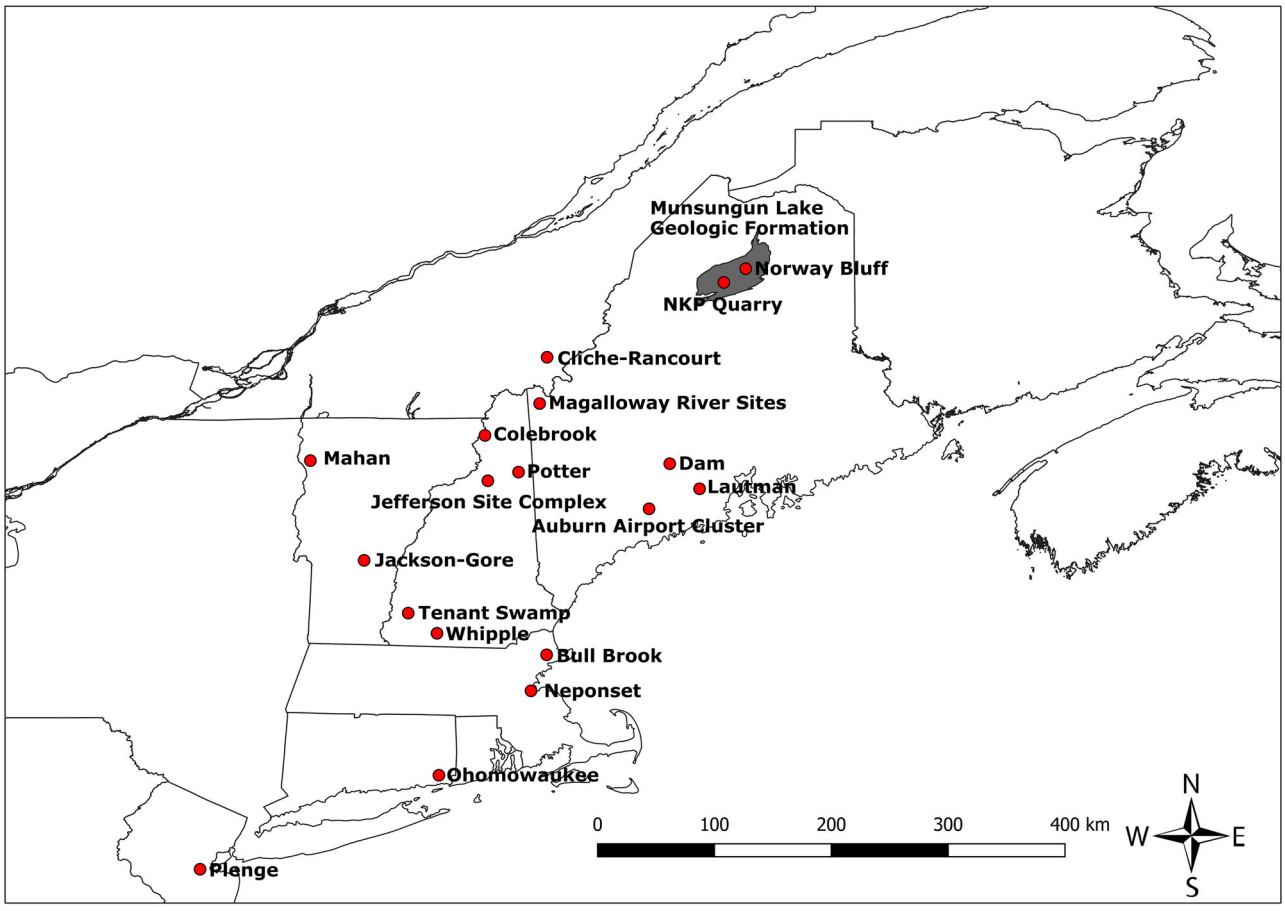

Figure 1 Approximate location of the NKP quarry complex in relation to the Munsungun Lake geologic formation and the previously identified quarry/workshop areas at Norway Bluff, northern Maine. Fluted-point-period sites in the region with raw-material assemblages containing red Munsungun chert are also indicated.

(Burke 2006; Kitchel 2018). At the request of the Maine State Archaeologist, the precise location of the NKP quarry complex is left intentionally vague in both the text and figures of this article.

Visually distinctive red (and green) chert appears frequently in terminal-Pleistocene fluted-point-period archaeological sites throughout New England (Figure 1; Burke 2006; Kitchel 2018; Pollock, Hamilton, and Bonnichsen 1999). The recurrent pattern of this material in fluted-point sites is so strong that many archaeologists in the region consider the presence of red Munsungun chert as nearly diagnostic of a fluted-point-period occupation. Hudgell and colleagues (Hudgell, Bartone, and Cowie 2017, 60) note: "Munsungun chert is so well evidenced in regional Paleoindian sites, especially in Maine, that large percentage proportions of this material in the debitage sample of a site is itself a hallmark of Paleoindian activity […]". A visually identical red chert is also noted with some frequency in Late Prehistoric contexts on the coast of Maine (Doyle 1995, table A6.4; Shaw 2016).

Previous petrographic and macroscopic inspection indicated this red chert arose from the Munsungun Lake geologic formation (Pollock, Hamilton, and Bonnichsen 1999), although no convincing bedrock source location for this material was identified. The lack of a convincing source area for red Munsungun chert left a substantial gap in understandings of lithic raw-material-procurement practices in the region. The red-chert outcrops described herein represent the only currently known sources for this important material and may be the only such source(s) in the region.

Recent disturbance of the archaeological materials at the NKP complex appears limited. No evidence of agricultural activities exists at the site complex, nor were permanent Euroamerican settlements or homesteads established in this area of northern Maine. Intact spodsols (podsols) at the site also indicate minimal recent subsurface disturbance. No evidence of artifact-collecting activities exists in this area, nor are artifacts readily visible on the surface. The site is also remote and difficult to access without firsthand knowledge of its location, which serves to protect the site from collecting. Minimal subsurface disturbance and a lack of evidence of artifact collecting indicate the stone-tool-manufacturing

assemblages and spatial patterns of the artifacts at the NKP complex remain largely intact.

Future investigations at these quarry and workshop areas present a unique opportunity to explore stone-tool-manufacturing techniques and lithic raw-material acquisition practices across the last ~12,800 years in the Northeast. We point out that while other red-chert outcrops are documented within the broader Munsungun Lake formation, these sources exhibit significant visual differences from artifacts recovered in archaeological contexts (e.g., Round Mountain) or lack evidence of prehistoric use altogether (see Kitchel and Barker 2016).

2. Background

The Munsungun Lake formation dates to the Ordovician period (485–444 million years ago) and consists primarily of dolerites and tuffs interspersed with volcanic breccias, with lesser components of slates, cherts, rhyolites, and other rocks. The formation is related to undersea volcanism resulting in the interbedding of sedimentary and igneous rocks. The formation trends from the northeast to the southwest, beginning in the vicinity of Round Mountain in the northeast, and extending to Haymock Lake in the southwest (Figure 1; Osberg, Hussey, and Boone 1985; Pollock, Hamilton, and Bonnichsen 1999). For a more detailed geologic description of the formation see Hall (1970), and Pollock (1987; 1999). Of the various rock types present within the Munsungun Lake formation, those of archaeological interest consist of very fine-grained micro- to cryptocrystalline silicates exhibiting conchoidal fracture, making them suitable for the production of chipped-stone tools. Cryptocrystalline silicates form minor components of the Munsungun Lake formation and consist primarily of volcano-sedimentary cherts and cherty tuffs along with various fine-grained volcanic materials.

Compared to other parts of New England, formal archaeological reconnaissance in the Munsungan Lake region began relatively recently with survey efforts starting in the 1950s. The waterways of northern Maine quickly demonstrated significant archaeological potential, with dozens of sites identified along the margins of the many lakes and streams in the area (Butler and Hadlock 1962). Survey and excavation in the vicinity of Norway Bluff during the 1980s documented many stone-tool-manufacturing workshops with the earliest dating to the terminal-Pleistocene fluted-point period, although these sites did not produce radiometric dates (Bonnichsen et al. 1980; Ellis and Payne 1995; Payne 1987). The recovery of fluted bifaces near the shores of Munsungan Lake cemented the area as a key location for lithic raw-material procurement during the fluted-point period among archaeologists working in the region. This association was reinforced by the repeated recovery of red/green Munsungun chert in fluted-point sites throughout New England (Burke 2006; Kitchel 2018; Pollock, Hamilton, and Bonnichsen 1999).

The association between Norway Bluff and fluted-point production (Bonnichsen et al. 1980; Ellis and Payne 1995; Payne 1987), combined with analyses linking artifacts from fluted-point sites in southern New England to the Munsungun Lake formation (Pollock, Hamilton, and Bonnichsen 1999), caused Norway Bluff to be considered the *de facto* source for the red/green chert recovered from fluted-point-period archaeological sites in New England. Despite the willingness of archaeologists to associate red cherts in fluted-point sites with the Munsungun Lake formation, outcrops of this material with evidence of precontact knapping activities were not yet documented within the formation. Additional pedestrian surveys by Kitchel also failed to locate any sources of red chert of knappable quality on the flanks of Norway Bluff or immediately adjacent areas (Kitchel and Barker 2016, 2–3).

The lack of a source area for red chert in the vicinity of Norway Bluff is supported by archaeological materials recovered during excavations near the landform. Bonnichsen and colleagues note (Bonnichsen et al. 1980, 31):

> The two raw materials favored for artifact production at locality 1 are a zebra-striped bluish-gray and white chert, and a solid red metasiltstone. Both materials are typical facies of the Munsungun Lake formation. Whereas the red material has a low frequency of occurrence, the zebra-striped chert dominates the lithic assemblage.

More recent work at a series of stone-tool-manufacturing workshops on the summit of Norway Bluff also failed to document significant quantities of red chert in debitage assemblages (Hudgell, Bartone, and Cowie 2016), further indicating red chert was not regularly procured at Norway Bluff. The lack of an identified primary or secondary source for the red chert found in fluted-point-period sites to the south within the Munsungun Lake formation, substantially limited our understanding of the lithic raw-material resource procurement in the region.

To address this significant gap in knowledge relating to one of the most distinctive and widely transported lithic raw materials in New England, Kitchel and Barker initiated a survey program within the Munsugnun Lake formation to document lithic-procurement locations and attempt to identify potential sources of red chert. This process was expedited by Barker's significant firsthand knowledge of the region gleaned from many years working as a forest ranger for the State of Maine

in the region. During these survey efforts, Kitchel identified a primary outcrop of red/green chert associated with copious quarrying and flaking debris (Outcrop A) (Kitchel 2018; Kitchel and Barker 2016). Subsequent survey identified a second, less-intensively-used outcrop of homogeneous red chert some 3 km from the initially identified outcrop (Outcrop B). Together these closely associated outcrops represent the only known source for red/green chert within the broader Munsungun Lake formation exhibiting evidence of past human use.

3. The outcrops

Outcrop A consists of red as well as red and green chert (or cherty tuff (Chunzeng Wang, personal communication 2019)) layered between volcanoclastic rock. Limited deposits of black and gray chert also exist at Outcrop A. The chert deposit consists of a 1-m to 3-m-high cliff dipping near vertically. The outcrop extends with intermittent visibility for over 400 m, with the strike running generally southwest/northeast. The chert found in this deposit ranges from very fine-grained material with a waxy to glassy luster to less fine-grained material grading towards subconchoidal mudstone. While some portions of this outcrop are highly fractured with very small joint sets, other areas contain visible chert blocks nearly 20 cm in maximum dimension (Figure 2).

Quarrying and flaking debris at Outcrop A is extensive. Test excavations revealed a surface deposit of anthropogenic blocks and quarry debris that thickens towards the outcrop face, reaching a maximum observed thickness of approximately 15 cm (Figure 3). These test units also show that all stages of reduction occurred at this location. Angular debris is the most common reduction product; however, obvious flakes are also present. While many flakes are large and consistent with primary-reduction activities, smaller flakes are present with some displaying characteristics such as high dorsal scar count and prepared (e.g., faceted or ground), lipped platforms indicative of biface manufacture. Most flakes recovered adjacent to the outcrop consist of red or red and green material, with small quantities of black and gray chert.

The face of Outcrop A exhibits evidence of precontact raw-material extraction including negative bulbs of percussion and areas of battering and crushing likely associated with the removal of larger blocks of material (Figure 4). Several hammerstones have also been recovered during subsurface testing efforts adjacent to the outcrop face. No organic quarrying tools such as antler picks have yet been recovered, and if present in the past they likely deteriorated in the acidic New England soils. Current cover by lichen, moss, and other vegetation indicates that the percussion marks found on the face are not the product of modern geologic prospecting or rockhounding. There is also a small depression at the base of the outcrop in some areas which may indicate the removal of soil and sediment by precontact populations to access buried areas of the outcrop, although treethrow activity provides and alternative explanation for this feature. No circular or semicircular quarry features exist adjacent to Outcrop A.

The presence of large quantities of angular quarry debris and flakes in the vicinity of Outcrop A makes this location unique within the Munsugnun Lake formation, as other red-chert outcrops show no evidence of precontact use. Additionally, evidence of active precontact extraction on the outcrop face itself is also unknown elsewhere within the Munsungun Lake formation and is rare in other areas of the Northeast. Further, this site shows no signs of contemporary collecting or looting activities, nor has the rockface been impacted by modern stone collection or sampling. The long period of intensive use and undisturbed nature of this location makes this area unique in New England, and among only a handful of similar sites elsewhere in North America.

Pedestrian survey in summer 2019 of a recently logged area approximately 3 km from Outcrop A revealed a second red-chert outcrop, Outcrop B, associated with less dense deposits of stone-tool-manufacturing debris. Chert at Outcrop B consists exclusively of red chert and lacks the gray or green mottling found at Outcrop A. The material at Outcrop B also displays a coarser texture than that of Outcrop A. Whether any adjacent stone-tool-manufacturing loci exist near this outcrop remains unevaluated. Given that previous geochemical analyses indicated the possibility of two related but discrete acquisition areas for the red chert present in fluted-point-period sites (Kitchel 2018, 874), the detection of this second nearby outcrop is intriguing. While Outcrop B warrants further investigation, because only cursory reconnaissance has been undertaken at this location, Outcrop B is not discussed in more detail here.

4. Associated workshop areas

Given settlement patterns observed at Munsungun Lake (Bonnichsen et al. 1980, 15), as well as at the analogous Flint Run Complex (Carr et al. 2013; Gardner 1972, 1974, 1977, 1983), we posited stone-tool-workshop areas and perhaps campsites existed on gentle slopes in the vicinity of Outcrop A. Hoping to detect potential workshops or campsites, we initiated subsurface testing on well-drained, gently sloping landforms adjacent to

Figure 2 Large chert block between joint sets at Outcrop A.

Outcrop A. Surface visibility is virtually zero in areas surrounding Outcrop A, so survey consisted of 50 × 50-cm shovel test pits placed on a 4-m grid oriented to magnetic north. Shovel-testing efforts located areas of high artifact density on a gently sloping landform located approximately 30 m from the shores of a small lake. Additional shovel testing revealed that artifact density varies widely across this landform over short distances (Figure 5). We believe these artifact concentrations represent discrete activity areas or knapping episodes. Distinct changes in artifact density demonstrate that spatial patterns remain intact across this landform and that a continuous homogeneous scatter of flakes is not present across the entirety of the landform.

Figure 3 Test pit located approximately 10 m from the quarry face of Outcrop A. Note the layer of quarry blocks and debris near the surface, and the illuviated portion of the spodic horizon below the leaf litter.

Following the discovery of these high-density areas, we opened two block excavations (Block A and Block B) in areas of particularly high artifact density. Block A now covers 6 m^2, while Block B covers 16 m^2. Debitage density at both locations is high, with some $50 \times 50 \times 10$-cm quads producing more than 2000 flakes, although these areas of particularly high artifact density are limited in spatial extent (Figure 6). Currently we have recovered over 40,000 individual flakes as well as hundreds of formal and informal tools. Block A has produced no temporally diagnostic artifacts but did yield a single formal end scraper made of a grayish green material (Figure 7) visually similar to a material present in the Michaud fluted-point site, Auburn, Maine (Spiess 1985; Spiess and Wilson 1987).

Block B produced a single side-notched point (Figure 8), tentatively identified as an unusual Middle/Late Archaic point form. This point resembles "eared-stem points," points described by Bourque at the Turner Farm and Mugford sites where he regarded them as a variant of the narrow-stemmed point style (Bourque, Cox, and Lewis 2006, 338; Bourque 1995, 178). Five formal end scrapers (Figure 8) were also recovered within 1 m of the point. All scrapers are manufactured from exotic materials, a pattern found in Terminal Archaic and Early Woodland components at the Turner Farm site on the coast of Maine (Bourque 1995, 180), and among other Terminal Archaic sites in the state (e.g., Bourque 1995).

An area of charcoal staining that may be a hearth feature is also present within Block B and yielded two radiocarbon dates on white pine (*Pinus strobus*) charcoal, of 7747 ± 42 (D-AMS 034812) and 7741 ± 34 (D-AMS 034813) ^{14}C yr BP. This age is inconsistent with the Late/Terminal Archaic "eared-stem" point described above, indicating the typological identification of the point is incorrect or the charcoal stain significantly predates the point. Despite the incongruity between the typological affiliation of the point recovered from Block B and the associated radiocarbon dates, the dated charcoal stain in this locus physically contains flakes and corresponds with a concentration of burned artifacts making it unlikely that this stain predates the deposition of *all* artifacts at this location. Given these observations, Block B most likely represents a palimpsest of occupations. Additional excavations are needed to understand the relationship between the radiocarbon dates and point recovered at Block B.

Block B has also yielded what may be a single medial fragment of a channel flake (Figure 9). Whether this item indicates a sparse fluted-point-period assemblage mixed with later materials, or merely a flake produced incidentally by bifacial flaking during later periods, remains ambiguous. Although we have not currently recovered additional diagnostic fluted-point-period materials at these workshop areas, given the prevalence of red Munsungun chert in fluted-point sites throughout New England we believe it likely that the manufacture of fluted points took place in this area, although further testing is needed to demonstrate the presence of fluted-point materials at this location. To date, our survey and testing

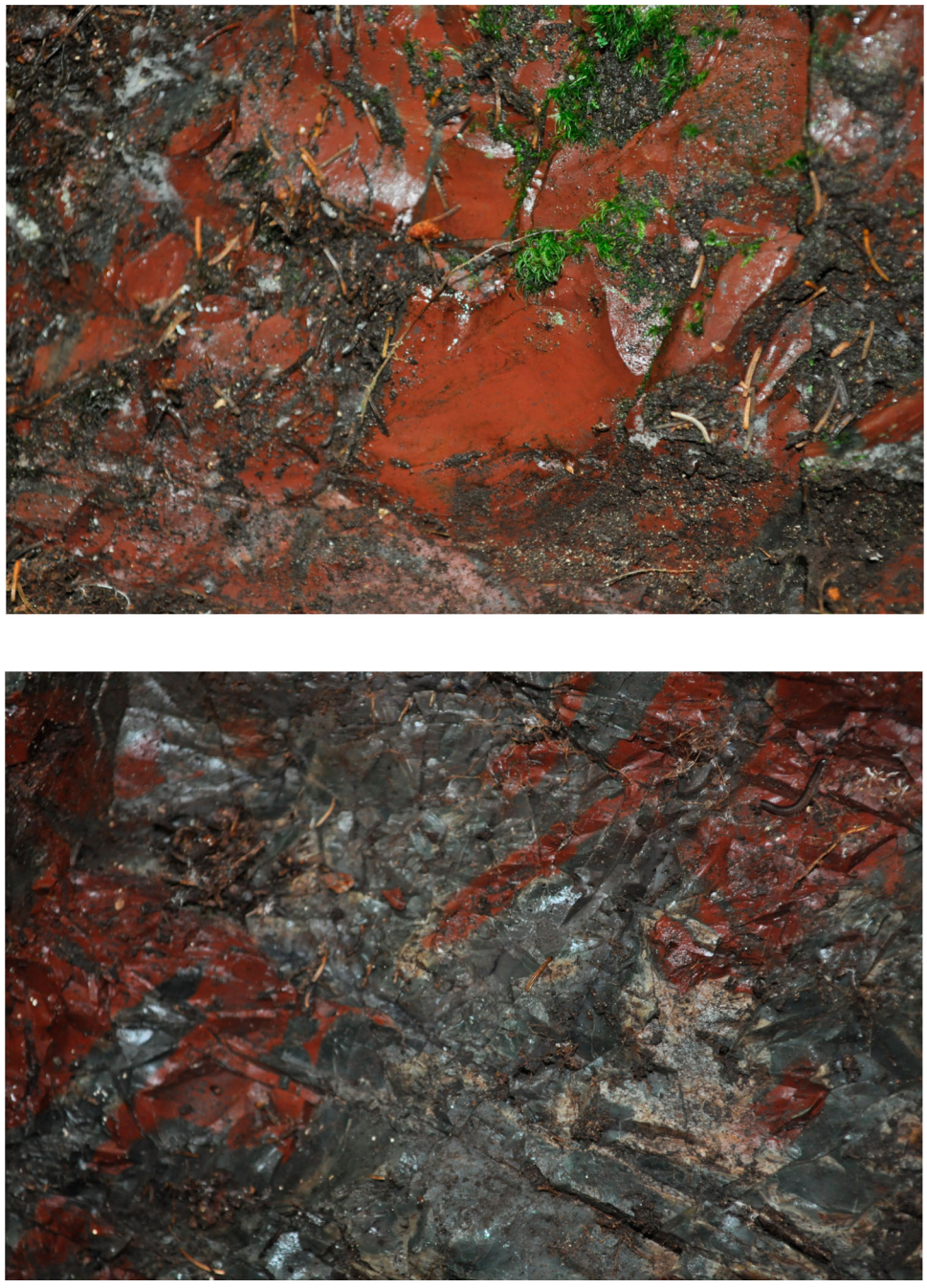

Figure 4 Anthropogenic modifications to the quarry face of Outcrop A. Top pane shows a negative bulb of percussion. Bottom pane shows battering and crushing.

efforts have covered only a small portion of the well-drained, gently sloping areas adjacent to Outcrop A. We believe it likely that additional shovel-test survey will reveal other extensive stone-tool-manufacturing loci in this area. Testing is required to refine both the period (s) of use of this location and the boundaries of these workshop areas.

The integrity of the workshop areas appears excellent as no evidence of looting or collecting exists within any of the documented workshop areas. Soil surface visibility approaches zero, making incidental collection of surface artifacts impossible. Intact spodic soils show soil disturbance from agricultural activities never took place at this location. Some subsurface disturbance may have occurred during previous logging activities on and around these sites, but these impacts appear minimal. Tree-throw activity following logging did cause some shallow subsurface disturbance in these workshop areas, but these impacts are localized rather than universal. Overall, subsurface disturbances at the workshops

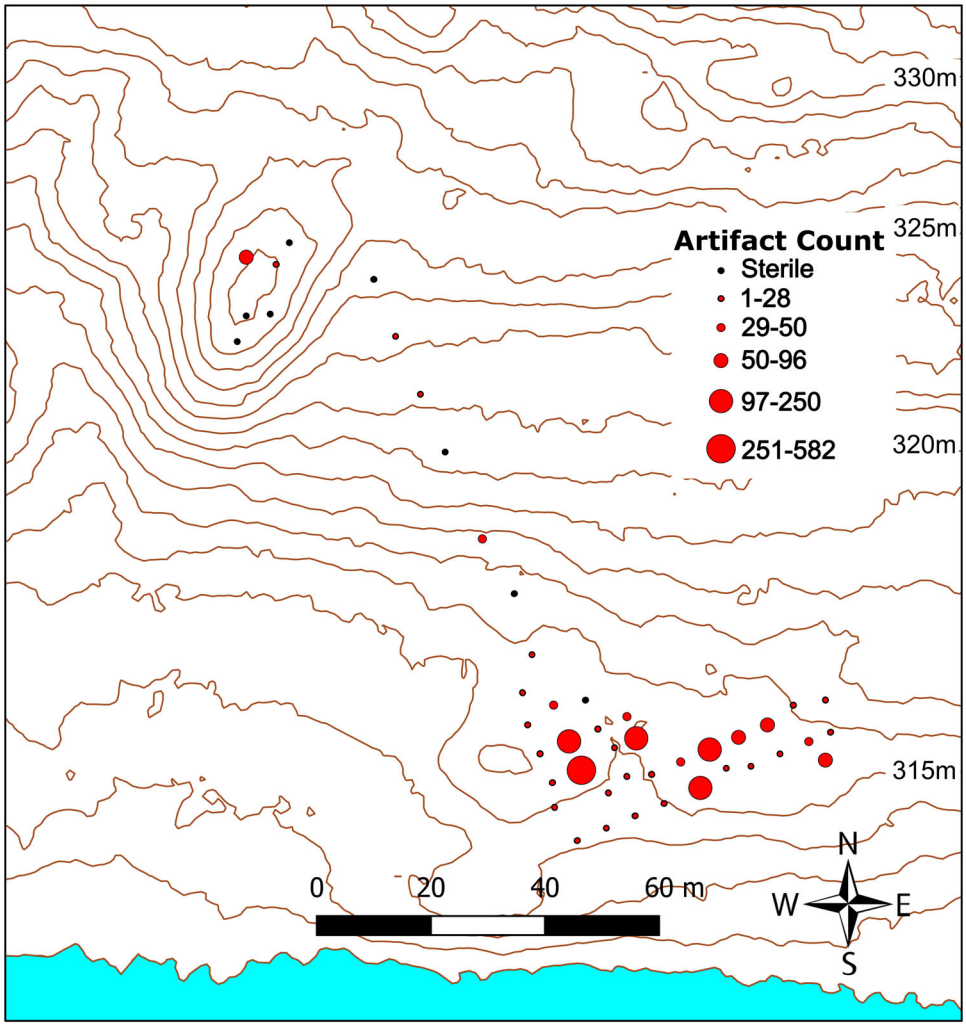

Figure 5 Map of shovel-test-pit locations and corresponding artifact counts per 50 × 50-cm shovel test pit. The approximate shoreline of the lake appears at the bottom of the map.

appear minimal, while evidence for artifact collecting is nonexistent. To our knowledge these circumstances are unique among quarry sites in the region, where decades of agricultural disturbance and artifact collecting have substantially impacted artifact assemblages surrounding quarry areas located in more densely populated areas.

5. Conclusions

The outcrops and workshops described above represent the only known source locations for red Munsungun chert. Although this distinctive material was long attributed to the Munsungun Lake formation, the lack of known outcrops of this material associated with stone-tool-manufacturing debris left doubts about this association. Although additional geochemical analyses are necessary to confirm visual identifications, previous studies indicate red Munsungun chert is easily identified by macroscopic visual inspection alone (Kitchel 2018). Furthermore, the absence of visually similar materials elsewhere in the Munsugnun Lake formation supports this supposition.

Chert visually identical to the material found at the NKP complex is virtually ubiquitous in fluted-point-period sites throughout New England, appearing in 100 per cent (19 out of 19) of fluted-point-period sites (and loci) throughout New England previously analyzed by Kitchel (Kitchel 2018, tables 1 and 2). Beyond this sample, the material is visually identified in many other fluted-point-period sites as well (Burke 2006; see also Figure 1). The frequency of red Munsungun chert in fluted-point-period lithic assemblages is all but opposite the availability of the material on the landscape, with outcrops of red/green chert uncommon throughout the Munsungun Lake formation. Gray and black cherts along with other fine-grained materials are far more widespread within the formation, indicating precontact populations,

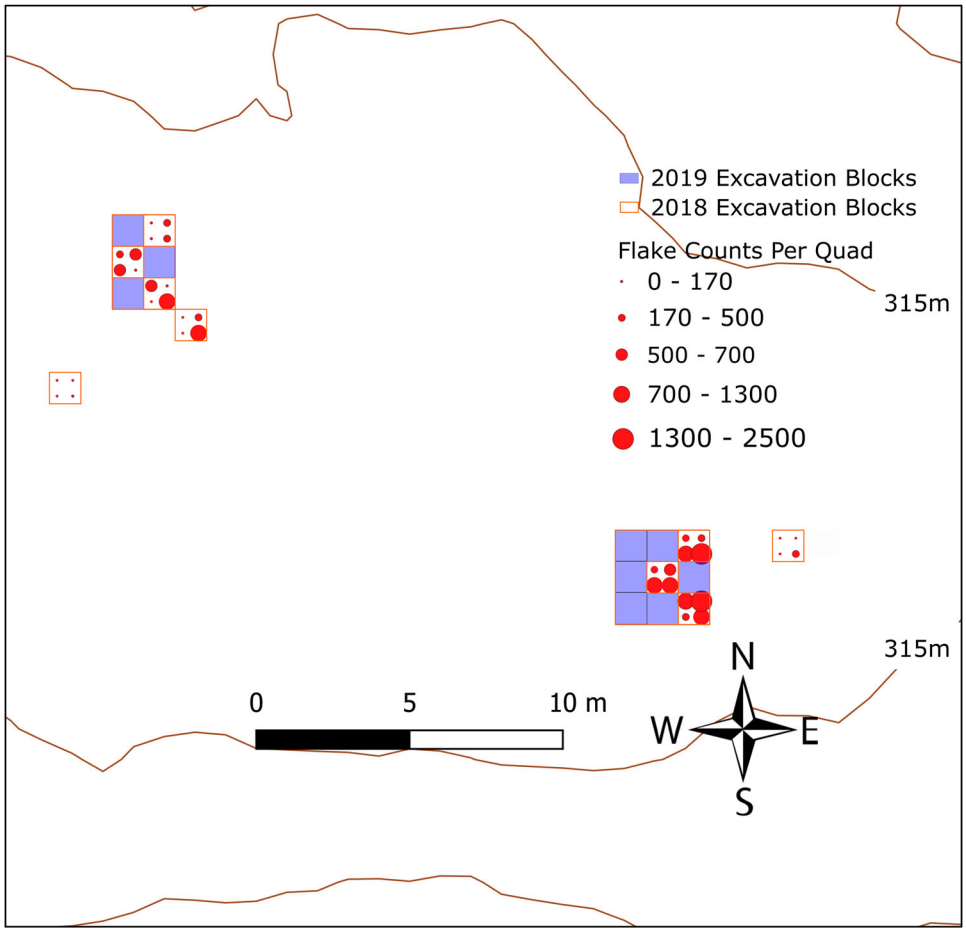

Figure 6 Currently excavated areas and artifact counts per 50 × 50-cm quad for Blocks A (left) and B (right). Shaded blocks indicate 2019 excavations for which complete artifact counts are not yet tabulated.

particularly during the fluted-point period, intentionally selected this material based upon either technological or visual characteristics.

Figure 7 End scraper from Block A.

Although raw-material quality can be evaluated across many variables such as package size (e.g., joint set spacing) or texture, knappability remains largely subjective. Regardless, no obvious technological differences exist between the red chert at the NKP quarries and the more widely distributed gray and black cherts. Both materials are very fine grained, easily flaked, and available in relatively large package sizes. Technological factors alone do not readily explain the preference for red chert during the fluted-point period. Ultimately visual characteristics seem to be the most parsimonious explanation for the selection of red chert over other available materials.

While red Munsungun chert is clearly favored during the fluted-point period (Kitchel 2018), the use and transport of this material during later periods remains poorly understood. Although red Munsungun chert does reappear in Woodland-period sites on the coast of Maine (Doyle 1995, table A6.4; Shaw 2016), the presence of this material is not well documented in other time periods, leaving a nearly 10,000-year gap in the documented use of this toolstone. Even with our currently

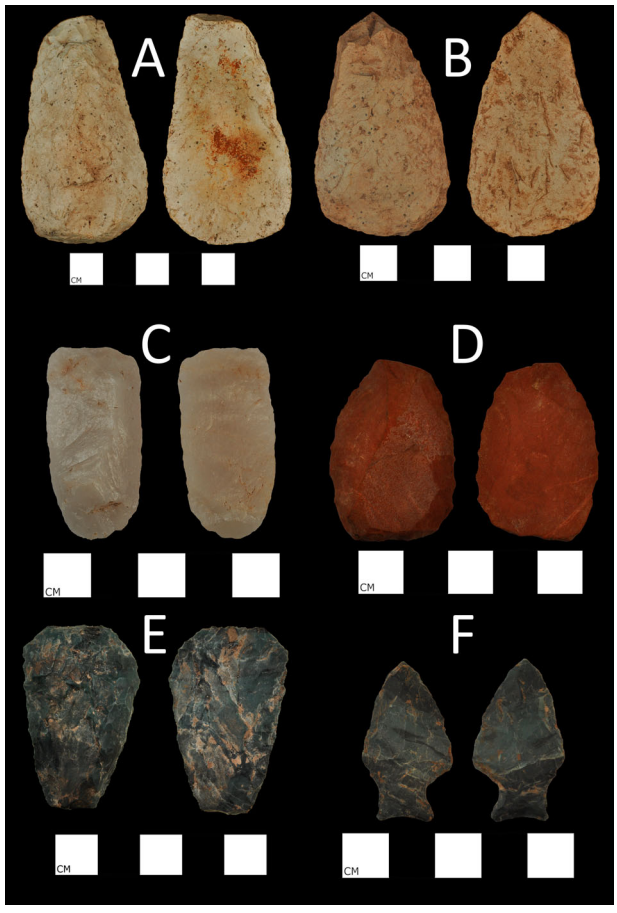

Figure 8 Selected tools from Block B. A and B, scrapers made of Kineo/Traveler rhyolite; C, a milky quartz scraper; D, a scraper made on unidentified coarse-grained red material visually dissimilar from those within the Munsungun Lake formation; E, end scraper; F, point made from a visually identical material. Although this material is superficially similar to greenish varieties of Munsungun chert, color patterns and joint-face mineral deposition are dissimilar to known varieties of Munsungun chert. Both items display significant rounding of dorsal and ventral flake scars potentially indicating long-distance transport.

Figure 9 Possible channel flake fragment from Block B.

limited testing program, we have significantly expanded the period(s) of use of this material and this source area into the Archaic. Additional survey and excavation in this area is needed to further explore the use of this material across time.

The discovery of these chert outcrops also shifts the center of lithic procurement (for red chert) away from Norway Bluff, particularly during the fluted-point period. Although Norway Bluff was undoubtedly an important source of toolstone among precontact populations during the fluted-point period and beyond, we find no evidence to support the idea that red Munsungun chert was procured at this location. Although substantially more work is needed to understand other potential source areas for this material within the formation, it is possible that the two red chert outcrops described above are the only source locations for red/green Munsungun chert employed by past populations to manufacture stone tools.

Because large-scale chert quarries are rare in New England and the Canadian Maritime provinces, this recently discovered site complex presents an opportunity to explore precontact lithic technology through time in the region. This research potential is expanded by the lack of site disturbance arising from agricultural tillage and artifact collecting. To our knowledge a quarry site with this level of preservation does not exist elsewhere in the region. While additional investigations are needed to define the location and extent of surrounding workshop areas, our preliminary survey has demonstrated the archaeological potential of this quarry location and has begun to fill previous gaps in our knowledge of lithic raw-material procurement in the far Northeast from the terminal Pleistocene forward.

Note

1. Munsungun is not consistently spelled and sometimes appears as “Munsungun” or “Munsungan”. Conventionally “Munsungun” refers to the geologic formation and chert (e.g., Munsungun chert), while “Munsungan” refers to toponyms (e.g., Munsungan Lake). We employ these spellings here.

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Disclosure statement

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Heather M. Rockwell holds a PhD in Anthropology from the University of Wyoming. Her research focus includes archaeology of the fluted-point period, computational methods in archaeology, and microware analysis. She is the deputy Wyoming State Historic Preservation Officer and an adjunct professor at the University of Wyoming.

Amanda Barker worked for many years for the Maine Forest Service. She is an expert in the human and natural history of the woods or northern Maine. She teaches science at the Maine School Advisory District 32 in Ashland, Maine.

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