The Greensville Creek Clovis Activity Area

Nottoway River Survey Research Report #6

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Clovis Point

End Scraper Flake Knife

Chisel-Wedges

Side Scraper/Knife/Saw

Choppers

Cores

Hammerstones

[These artifacts are from the Greensville Creek Clovis site portion of the activity area; the scales are in cm.]

The Greensville Creek Clovis Activity Area

Background

Tool-Stone Deposits (Quarry) Near Greensville Creek

The Greensville Creek Clovis activity area, Figure 1, in southeastern Virginia is composed of three archaeological sites and four separate small chert flake clusters all separated by no more than one mile and within an area of about one square mile. The three primary sites are: 1) the Brunswick County tool-stone deposits or quarry, several adjacent lithic material collection and initial testing locations; 2) the Terrace site, a near-quarry manufacturing site; and 3) the Greensville Creek Clovis site, a small near-quarry manufacturing site with a possible associated Clovis kill site or Clovis kill processing area. The Greensville Creek Clovis site was the last of the three sites found, and it was discovered by us, Nottoway River Survey (NRS), in 2015 during an archaeological survey in eastern Brunswick County, Virginia.

The presence of deposits of chert-like tool stone seems to be the primary reason for the Clovis interest in this area. These deposits were observed by us earlier in 2004 on recently cleared land adjacent to Greensville Creek near the Brunswick County-Greensville County line. In our 2015 publication (1), we identified these closely connected tool-stone deposits as the Brunswick County chert quarry.

The quarry was found north of route 605, Lewis Drive, in extreme eastern Brunswick County and about four miles west of the City of Emporia, Virginia. Tool stone was seen as float in the form of flat platelets and small, rounded nodules located over a distance of about 1000 feet among outcrops of granite on hills and on higher ground adjacent to the flood plain of Greensville Creek about 1.3 miles north of the Meherrin River, Figure 1.

We saw no direct evidence that collection of this material by Native Americans involved any form of excavation, but any such evidence likely would have been erased by surface erosion. Some of the nodules and platelets we found at the quarry showed evidence of having been recovered there by Native Americans and tested for quality by removal of a few flakes.

Weathered flake surfaces of Native American-quarried fragments of the chert-like stone found by NRS at the deposits appeared to have a somewhat fibrous structure, often to be layered, to vary from grainy to waxy in texture, and to be somewhat sparkly/reflective when observed in direct sunlight. Similar material has been described as “Brunswick County chert” (2) by the author, local artifact collectors, and some Virginia archaeologists for over 30 years although the exact location of the quarry outcrops or deposits of this stone had not been reported prior to our 2015 publication. An abbreviated copy of the laboratory analysis (8) of this tool stone is contained as the Attachment.

Given the fairly modest quantity of the best of the tool stone we recovered remaining on the surface at the Brunswick County quarry deposits, there may be more, similar sources in the general area we have not yet discovered. This conclusion is based upon the number of counties in southeastern Virginia that reportedly have produced artifacts of the material. Most of these artifacts were recovered in the adjacent counties of Greensville, Sussex, and Brunswick, but some are known as well from Dinwiddie, Mecklenburg, Prince George, and Southampton counties.

In one extreme case, artifacts of this distinctive material were found by a local collector and reported by NRS from the Quail Springs Clovis site (3, 4) located in the City of Virginia Beach. This site is approximately 85 miles to the east of the Brunswick County tool-stone source.

It has been observed by NRS that several traditions of early Native Americans in southeastern Virginia used this type of unusual stone for the manufacture of projectile points and many types of unifacial tools (2, 3). These traditions include Clovis of the Paleoindian period and Palmer/Kirk of the Early Archaic.

Two Clovis-Related Archaeological Sites Near the Brunswick County Tool-Stone Deposits on Greensville Creek

The Greensville Creek Clovis site and the Terrace site are very near the Brunswick County-Greensville County line, and they are approximately 4000 feet and 1500 feet, respectively, from the central area of the tool-stone deposits (quarry) on Greensville Creek. Both sites were investigated by NRS through surface surveys, and both were found to contained tools and debitage of material identical to that found at the nearby tool-stone deposits.

Location A in Figure 1, the Greensville Creek Clovis site in Brunswick County, was not known to NRS previously, but it was discovered by us during our archaeological survey in 2015 as it was being destroyed by construction activity. This site is frequently designated the GCrCS throughout this report.

The other site, B in Figure 1, the Terrace site, has been known to local artifact collectors for many years. It is north of the GCrCS but in Greensville County. The NRS investigation of the Terrace site, along with our review of the artifacts in local collections, revealed that it was used by the Clovis people as a location for the manufacture of cores and bifaces. It was also determined by NRS that prior surface collecting had removed many artifacts from the plow zone.

Collectively, locations A and B have produced in-process, completed, and use-damaged artifacts of the local tool stone including one finished, complete Clovis point. Other artifacts recovered by NRS from the two sites include a fragment of finished Clovis point, early stage Clovis biface and preform fragments, unifacial tools, various types of cores, chisel-wedges, and on one of the sites (the GCrCS) some large, heavy tools such as choppers and hammerstones. Most of these artifacts are of the local chert-like stone, but there were artifacts found at both sites of several other locally available materials such as argillite, quartzite, and quartz.

The Greensville Creek Clovis site, the GCrCS, figures 1 (inset 5) and 2, is the more important to us of these two sites as related to our study of the Clovis occupation of southeastern Virginia. The reason the site is thought by NRS to be important is that it is single component. In contrast, all of the numerous Clovis sites that we have studied or investigated in Virginia for over 40 years contained concentrations of somewhat similar Early Archaic-age material. The more general, culturally non-diagnostic artifact types such as some unifacial tools, chisel-wedges, hammerstones, choppers, cores, and the majority of flakes we found over the years on the multicomponent sites were often indistinguishable by time-period or tradition, i.e., as either Clovis or Palmer/kirk. This has presented something of a problem when trying to accurately define the extent of Clovis activities from surface collections and even from some excavated collections. But with the GCrCS collection it appears that we can draw more accurate conclusions concerning the specific activities there of the Clovis people given the single component nature of the site along with the fairly small number of different artifact categories recovered.

By mid-year 2016, the GCrCS had been largely destroyed by construction of a Dominion Energy 500-kv electrical transmission line interconnection associated with the construction of a new power plant. However, as it was discovered by us in early 2015 after the initial land clearing activity but before it had been totally destroyed, we were able to obtain a reasonable idea of the site's size and function. This site, on the Brunswick County side of Greensville Creek, was located about 4000 feet southeast of most of the tool-stone deposits and 3500 feet north of the Meherrin River. At the closest, it was approximately 750 feet southwest of Greensville Creek, but as observed by NRS in 2015 it was near a small spring.

Some professional CRM work was done in the general area of the GCrCS before the massive land clearing related to the construction project, but for whatever reason the site was not reported. This may possibly have been because the Clovis site at the time was not listed in the state (DHR) inventory of archaeological sites. It is also possible that the transmission line interconnection

construction area, which was separate from the power plant construction area, may not have been included within the scope of CRM work (5). Even with CRM work, the Clovis artifacts may not have been recognized before the land was cleared of most of the vegetation. As is typical of most small Clovis sites in Virginia, the artifact concentration here was relatively light.

The other nearby Clovis location, the Terrace site, figures 1 (inset 4) and 56, is multi-component. This site is on the other side of the creek in Greensville County on a high terrace in cultivated farmland about 4000 feet north of location A, the GCrCS, but it is only 1500 feet east of most of the tool-stone deposits. As previously noted, it was discovered many years ago, and artifact collectors are known to have surface collected diagnostic projectile points representing several time periods and traditions as well as much of the chert-like debitage from the plow zone.

The Terrace site was shown to us in the 1980s by one of the collectors living in nearby Emporia, Virginia, and the site was initially described by him to us as several closely connected artifact concentrations. A small collection of flakes and cores of the local chert-like stone (Brunswick County chert) from the site was given to us by this collector, and we recovered similar artifacts there, mostly flakes, cores, and biface fragments, on several occasions. In addition, we recovered a few Middle Archaic and Late Archaic projectile points and point fragments of argillite, rhyolite, quartzite, and quartz from two of the Terrace site concentrations. Only one of the later period points that we collected, a Woodland-period small stemmed point, is of a material somewhat similar to the local chert-like stone, and we saw no other Archaic or Woodland period points of this stone from the site. We consider some of the artifacts that we collected from two of the concentrations on the Terrace site to be of Clovis age, and these are listed in Table 2 and briefly described in this report. A few of these artifacts are shown in figures 57, 58 and 59.

Four Other Local Concentrations of Artifacts of the Brunswick County Tool Stone

Also discovered during our survey within a mile of the tool-stone deposits and Clovis locations A and B, and in both counties, were four much smaller artifact concentrations consisting of scatters of flakes and core fragments of the local chert-like stone. These locations are shown in Figure 1 as adjacent activity areas C, D, E, and F, and all four had been exposed prior to the land clearing activity. None of these sites produced a Clovis point or a fluted preform, but location D produced a small chert hammerstone and location E produced a chert chisel-wedge. All four sites produced a few edge-worked or edge-used flakes of the local tool stone. Based upon the weathering of these artifacts, they are likely of significant age and may be related to the two larger sites, locations A and B. In addition to the chert-like debitage and tools, these other four locations produced a few Middle Archaic and Late Archaic projectile points and flakes of local argillite and quartz.

Clovis Finds in the General Area More than One Mile from the Tool-Stone Deposits on Greensville Creek

Clovis Isolates

Two isolated finds of finished, complete Clovis points of chert were recorded from the general area of the tool-stone deposits on Greensville Creek many years ago in B. C. McCary's surveys of Virginia fluted points. These survey reports appeared periodically in the *Quarterly Bulletin* of the Archaeological Society of Virginia. The two artifacts are shown in Figure 3 as points numbered 330 and 669 (McCary's survey numbers). Specifically, the two points (330 and 669) were recovered about 1.5 miles north and 1.5 miles east, respectively, of the tool-stone deposits.

One of the two points in Figure 3, survey #330, is of the Williamson or Cattail Creek variety of chert, which is found in Dinwiddie County, Virginia on the Williamson and Ampy farms, the Williamson Clovis site (1, 3, 6), about 25 miles to the north. The other point, survey #669, is shown by drawings of both faces in Figure 3, but it has not yet been studied by NRS. From

McCary's description of it as a "gray chert," it may well be the very common grayish-white variety of the local Brunswick County chert-like stone.

There is a significant difference in the texture of the local chert-like stone (Brunswick County chert) compared to that of more common regional Virginia cherts such as the Williamson variety. This is evident by comparing the Williamson chert point in Figure 3, #330, with a Clovis point of somewhat similar size and color but of much different structure and texture identified as the Brunswick County chert (chert-like stone) variety; this point is also shown in Figure 3 but as survey point #538. The point was found in Brunswick County, Virginia in the 1960s or early 1970s about 11 miles to the west of the Brunswick County chert quarry, and it is in the J. H. Boney collection in Emporia, Virginia. Two other Clovis points of Williamson chert and one of Brunswick County-like chert are shown together for comparison in Figure 3, and several other Clovis points of the Brunswick County chert-like stone are shown in Figure 9.

The Greensville County Clovis Site

In the general region, but removed from the immediate area of the tool-stone deposits on Greensville Creek, is the large Greensville County Clovis site (3) (a.k.a. the J. H. Boney Clovis site). About seven miles downriver from the quarry, this is a well-known hunting-related site on a large swamp adjacent to the Meherrin River. The Greensville County Clovis site is of significant interest because some of the artifacts, Figure 4 and Table 3, are of material identical to the local Brunswick County quarry chert-like tool stone, but most of the artifacts recovered there are of other types of Virginia chert such as the above referenced Williamson chert from Dinwiddie County. A few of the artifacts from the Greensville County Clovis site are of non-chert lithics, including quartz and tuff, which are materials known from the general area and from the south in North Carolina. The Greensville County Clovis site is discussed in more detail below under the section on nearby sites within the local Clovis landscape with an apparent connection to the Greensville Creek Clovis site and/or the Brunswick County tool-stone deposits.

Petrological Analysis of the Brunswick County Quarry Tool-Stone

Given our interest in the Brunswick County quarry tool-stone, NRS sponsored a petrological analysis of Native American-collected lithic samples from the Brunswick County deposits by a commercial laboratory, Spectrum Petrographics, Inc. Included in the study were samples from the quarry and samples from the two significant archaeological sites along Greensville creek. The Spectrum Petrographics' analysis (8), which is contained here in an abbreviated summary form as the Attachment, has provided a new, more accurate identification of this rather odd chert-like material. The new petrological identification is metamorphosed silicified fault breccia, and it has been described simply as quartz schist by the petrographers. In general composition, this material is made up of mixtures of variously metamorphosed quartz and silicified calcite evaporite.

Much of this material averages about 99-percent micro-grain quartz and chalcedony. With the excellent conchoidal fracture characteristics of the stone and the presence of a large chalcedony fraction in the structure, it looks and weathers like chert, and, as noted above, it has been known locally as chert (2) for over 30 years. However, this material is clearly nothing like the typical bedded cherts, such as Ohio Flint Ridge chert, known from further west.

In this report, the stone is described by NRS as Brunswick County quarry chert or just Brunswick County chert, and it is frequently abbreviated BCC in figure captions. This name or designation replaces the old, rather general and purely descriptive terminology, fibrous chert, which has been used for some years in archaeological publications (1, 3, 9, and 10).

Depending on the degree of metamorphism, the Brunswick County chert when reduced to flakes, cores, and tools often has the surface appearance of a fabric of multidirectional to parallel,

thin, white lines or "fibers" present in a contrasting cherty ground mass. The ground mass may be white, grayish-white, cream, tan, pink, yellow, blue, or brown, and there is a small amount of green. Much of this chert has a reflective, glittery, or somewhat sparkly appearance, which from Spectrum Petrographics' analysis seems to be related to the micro-grain quartz fraction of the structure. The micro-grain quartz fraction is quite different in reflective character than that observed with the chalcedony fraction.

According to the analysis by Spectrum Petrographics (8), this material started as a combination of: 1) euhedral quartz that was deposited directly in bedrock fractures from hydrothermal fluids, and 2) calcite crystals or blades from fluid evaporation through vents from the bedrock fractures in areas with the quartz. This was followed by cooling of the fluid in the fractures and silicification of the calcite crystals and filling of the voids. After that, and over a very long geological period, the material experienced varying degrees of metamorphism. The resulting combination of variably metamorphosed materials results in chert-like stone of somewhat differing structure as shown in figures 6 through 17.

In terms of formation, according to Virginia State Geologist David Spears (11), the bedrock fractures or faults containing this type of chert are considered to be related to extensional faulting in the Triassic and Jurassic periods. These faults originated as compressional or transpressional crustal breaks, which occurred in the middle to late Paleozoic era. After that, they were reactivated as normal faults during the breakup of Pangea and the creation of Mesozoic basins.

Small pieces of this local Brunswick County chert had been observed on cultivated farmland above Greensville Creek by artifact collectors over the years, but a chert deposit had not been found here until the NRS work in 2004 (1) described above. The first of several small deposits was discovered as a result of our field surveys in areas of ongoing logging and land clearing operations at the time in both Brunswick County and Greensville County along Greensville Creek.

As previously noted, the outcrops produced the chert as float on the surface in the form of platelets and nodules, many quite small, on low-elevation hills and terraces on and adjacent to the flood plain of the creek north of location A, the GCrCS. A typical outcrop location, overgrown as seen in 2022, is shown in Figure 1 (inset #3). The Geologic Map of Virginia (12) shows that the local bedrock here is composed of mafic and felsic volcanic rock plus granite, but there is no fault breccia or quartz schist identified in the area.

The Geologic Map of Virginia also shows zones of Pliocene sand and gravel in the immediate area. Some of this material in the form of quartzite and quartz gravel and cobbles was routinely used at the Terrace site, mostly by Middle Archaic and Late Archaic people, but it was used to a much more limited extent there by the Clovis people. It is noted that artifacts of this material were absent from the GCrCS except for a few flakes and one large split-cobble chopper of quartzite.

Chert or chert-like stone very similar to the Brunswick County variety found along Greensville Creek has been known from two other quarry locations in Virginia for over 50 years. However, the cherts from each of the three quarry locations are a little different as shown in figures 6 through 8. One location, the Bourne chert quarry, is in Hanover County in central Virginia some 70 miles to the north. The other location, the old Mitchell Plantation chert quarry, is also in eastern Virginia but in adjacent Sussex County about 13 miles north of the Brunswick County chert deposits. Figure 5 shows the relative location of all three of these quarries.

An interesting sample of this material with relatively little metamorphism was collected by NRS from one of the Brunswick County deposits on Greensville Creek, and it is shown for comparison to the more typical material as Figure 12 before and after sectioning for petrographic study. This unusual sample is shown and described in more detail in the attached abbreviated petrological report as NRS sample #2, with section 2/S2 (27 x 46 mm) macrographs. Another similar example of this type of stone with relatively little metamorphism is shown in Figure 6, which is an NRS-

collected sample recovered on the Bourne Paleoindian chert quarry (9), Figure 5, in Hanover County, Virginia near the Community of Rockville. The silicified calcite crystals are clearly shown to be parallel in individual clusters but intersecting other similar clusters at various angles.

In the past, it was recognized by NRS that this type of stone was found and employed by Native Americans in Virginia. We have found Paleoindian, Early Archaic, and a few early Middle Archaic points, figures 9 through 11. Also, this material seems to have been employed rarely in Virginia for the production of Middle Archaic and Late Archaic points. Some artifacts, mostly Clovis points, of this type of chert-like stone are known to have been recovered in northeastern North Carolina (16) (for example see Figure 9 point #3) as far south as 50 miles below the Brunswick County quarry, and these points may have been made from material quarried or collected in Virginia. No North Carolina source of this particular stone is known to us.

Analysis of Location A, the Greensville Creek Clovis Site (GCrCS)

Topography

Location A, the Greensville Creek Clovis site (GCrCS), a primary subject of this report, was situated just inside Brunswick County, Virginia very near the Greensville County line as shown in Figure 1. The topography of the immediate site area was relatively flat, but the site was positioned at the eastern edge of a 200-foot-above-mean-sea-level (AMSL) terrace, Figure 2, which before recontouring in 2016 was seen to abruptly drop approximately 10-feet in elevation to the east. The concentration of cultural material was on this terrace but at the very edge near the elevation drop.

At one location, the abrupt elevation drop was associated with a seepage spring at the eastern end of the site that contained aquatic plants including cattails when first observed by NRS in 2015. Later bulldozing in 2016 associated with surface recontouring adjacent to the industrial facility filled the low spot and covered the small spring.

To the east of the archaeological site at the 170-foot AMSL contour, the local topography resembled a bowl with a narrow, necked-down drainage channel to the northeast toward Greensville Creek. This topography, Figure 2, with the bowl-shaped depression associated with the spring to the west, is typical of both seasonal wetlands and locations in southeastern Virginia where beavers often place dams to form shallow lakes. A beaver lake at this location seems likely during times in the past with possibly higher flow from the spring. Such a lake would have been at the approximate location shown by the blue oval in Figure 2.

Collecting Artifacts on the Greensville Creek Clovis Site

Given the small size of the GCrCS and the small number of formal tools recovered there, had this site been multicomponent with the Clovis material intermixed with Early Archaic-age material it would have been of little archaeological interest. The true significance of this site is that it was single component. As such, the archaeological materials found there, i.e. the hammerstones, choppers, in-process biface fragments, chisel-wedges, edged-flakes, and cores, that are not formal, diagnostically Clovis artifacts still can without doubt be attributed to a Clovis occupation.

To judge how much of the cultural material originally on-site may have remained for us to recover, we considered two different manners in which the artifact content on the site could have been reduced over time. The first is previous collecting of artifacts from the surface.

This entire area of Virginia is known to have been under cultivation for a considerable period before the Revolutionary War, and it remained so well throughout the twentieth-century. In earlier times, as the ground was disturbed through planting crops, farm workers likely noticed the odd, brightly colored stone cores, flakes, and tools, and they possibly collected some of them. There are heavy rust marks on some of the artifacts collected by NRS from this site indicating that these

items were in a plow zone long before the land was completely cleared and recontoured in the 2015-2016 time period.

In more recent times, it is evident from aerial and satellite photographs that the land has been disturbed often through logging, which would have provided some opportunity for local collectors to recover artifacts from the surface. Figures 18 through 20 show the appearance of the site and general site area over a period of 25 years from 1994 to 2019.

As shown in Figure 18, the site area in 1994 was completely wooded, but by 2002, Figure 19, most of the site area had been logged with some open-ground exposure allowing some level of visibility possibly suitable for artifact collecting. By 2008, Figure 20, most of the more productive parts of the site had grown back in trees, but part of the northern edge of the site not visible in 2002 had been recently logged likely providing some surface visibility in this area.

After the discovery of the Williamson Clovis site and chert quarry in 1949 in adjacent Dinwiddie County, local artifact collectors became aware that chert flakes on an archaeological site in this area of Virginia often meant the presence of highly-sought-after Clovis points. However, none of local artifact collectors with whom we have spoken over the past few years has revealed a prior knowledge of this site, and only a few of the artifacts from this site that we found would have had any special appeal to most of the local collectors.

It is likely that the total collection from this site had it been discovered by artifact collectors would have been a Clovis point and possibly a few flakes and cores of similar material. Any Clovis points found here by local collectors probably would have been recorded in one of McCary's fluted point survey reports as were the two points described above that were found about 1.5 miles from the site, but our review of all Virginia fluted point survey reports showed no other Clovis points recorded near the GCrCS. Still, it is possible that other points may have been found locally in just the last few years after the fluted point survey was discontinued.

The second and by far most destructive manner of artifacts loss was through the massive land clearing and surface recontouring activity for the 500-kv electrical transmission line interconnection, figures 22 through 28, that took place here from 2015 through 2016. This activity ultimately resulted in most of the site and areas around it being down-cut through bulldozing. The remaining artifacts were probably buried with surface-soil fill in lower ground to the east.

Over a period of about 18 months from early January 2015 to middle July 2016 prior to recontouring, NRS made 16 trips to the site on weekends after rain storms to surface collect. We estimate that we may have recovered perhaps thirty-percent of the artifacts that were on the surface during an average trip to the site as the overall surface visibility early-on was no more than 20 to at most 50 percent. This was due in large part to the substantial amount of residual forest debris on the ground in the areas of the artifact concentrations up to about early June 2016 as shown in figures 23, 24, and 27.

On most of our trips to the site we were able to search at least a few hours, and we often interfaced with construction site security personnel. We were allowed on site only because the location of interest was at the far western perimeter of the general construction area, and as such it was well away from most of the day-to-day work activity.

Throughout the period in which we had at least some access to the site, our method of investigation was simply surface collecting. We accomplished this by walking over all of the accessible, exposed surface from at least two directions on each trip. In late July 2016 due to the later stage construction-related recontouring and grading activity directly on the archaeological site, we were informed by construction management that it was no longer safe for us to be there, and we no longer had access.

Nothing has been recovered from the site by NRS since late July 2016, and we have not revisited the site. However, from our observations made in mid-year 2016, it would appeared that

the general area was down-cut and flattened and the site completely bulldozed away as seen in figures 25 and 26.

Number and Size of Artifact Clusters Comprising the Greensville Creek Clovis Site (GCrCS)

There were three clusters or areas of concentration of the Brunswick County chert Clovis artifacts within what we have defined as the site. The site, shown in figures 28 and 29, is considered to have been fairly small, and it is represented in this report by an oval, Figure 29, of about 290 feet southwest-to-northeast by about 190 feet northwest-to-southeast. Based upon these dimensions, the site represented an area of approximately 48,500 square feet, therefore, the general site area was about 1.1 acres.

As shown in Figure 29, the cluster or area of the heaviest concentration of all types of artifacts, location X, is about 0.4 acres. Within area X, the smaller area representing the greatest concentration of artifacts is defined within the red rectangle, and this is shown in more detail in Figure 30 with a description of the artifacts found there by specific location. Most of the formal tools including the complete projectile point, a complete end scraper, edge-worked flakes, biface fragments, wedges, and choppers were found here as were most of the cores, core fragments, and biface reduction flakes.

Another smaller concentration of artifacts at the site, Y, shown in Figure 29, produced mostly small trim flakes, and it represented approximately 0.1 acres. The smallest artifact concentration, Z, shown in Figure 29, was an area of only 0.04 acres or about 1,600 square feet as best we could determine. Concentration Z produced a few flakes, several core fragments, and a single chisel-wedge but no other artifacts.

Artifact Assemblage

All artifacts recovered at the GCrCS are stone; nothing of bone, wood, or fabric remained in the acidic sandy loam soil of this open site. The specific artifact types from the GCrCS are listed in Table 1 and shown in figures 31 through 33, and 37 through 55.

We were able to resolve the artifacts into only 10 major categories for this site, and the artifact total for the site from Table 1 is 1,481 items. The total inventory of all of these artifacts classified as tools represents only 71 items or about five percent. This classification includes some rather minimally worked or used items such as the hammerstones, chisel-wedges, and edge-snapped-flake tools.

The artifact assemblage at this site is very interesting. As noted above, all of the artifacts that were on the site certainly were not recovered before it was destroyed. However, given the large differences in artifact numbers by type or class that we did recover, we believe that our sample is adequate for us to infer activities carried out there by the Clovis people. The artifact categories from Table 1 are given below by descending number of items recovered, and they are discussed by category:

<u>Flakes</u>

There are 1,357 various types of flakes that are otherwise unworked and apparently unused. Most of these flakes, 1,295, are of the local Brunswick County chert. There are 49 flakes of a dark black argillite, which is eroded and deeply weathered to a gray-green color, but no materials other than the Brunswick County chert and the argillite individually account for more than four flakes. The total of all of the flakes of materials other than the local chert and argillite is only 13.

The flakes can be broken down into five general categories: 1) decortication flakes with some original weathered cortex surface of the stone, 366 items; 2) non-decortication flakes that cannot be further categorized but are all thought to be related to core platform preparation, biface reduction, or tool edging, 857 items; 3) biface reduction flakes with ground platforms, Figure 37, 67 items; 4)

biface end-thinning flakes with ground platforms, Figure 37, 17 items; and 5) blocky core-blade-like flakes and flake fragments often with ground platforms, figures 43 and 51, 43 items. There are also seven chisel-wedge spalls (flakes) that appear to be otherwise unworked and unused, and they are listed separately in Table 1 as a sub-item within the category of chisel-wedges.

Most flakes from this site are small, and maximum dimensions rarely exceed 40 mm. This finding is consistent with the small size of cores and core fragments as discussed below.

Cores and Core Fragments

From Table 1, there are 53 various small cores, core fragments, and core-like flaked "chunks." This breaks down into seven identifiable (typeable) cores and 46 fairly small core fragments and chunks. In the core-fragment/chunk category, 38 are the local Brunswick County chert, but eight are the weathered argillite, which also appears to be a local material.

The core types are categorized as follows: bifacial cores, four items; circular-flat or truncated-conical cores, two items; irregular or block core, one item. The 46 fairly small core fragments and chunks cannot reliably be broken down into other categories, but most appear to have been blocky or irregular in shape.

Only two cores exceed 100 mm in maximum dimension. The largest 10 of the core fragments or chunks are between 50 and 78 mm in maximum dimension. Overall, the average size of cores and core fragments in the NRS Greensville Creek Clovis site collection is small, but, similarly, chert platelets and nodules of only small to medium size, generally in the range of 50 mm to 150 mm, make up most of the Brunswick County chert material in the nearby quarry deposits.

Unifacial Edge-Worked Tools and Small Tool Fragments

There are 20 unifacial edge-worked tools, figures 38, 39, and 40, of which four are small tool fragments. All of these items are of the local Brunswick County chert except for one end scraper of an exotic (non-local) gray chert. The 16 most complete objects are: 1) side scrapers, knives or saws, four items; 2) end scrapers, one complete item and one use-damaged item; 3) edge-worked pointed flakes (awls?), three items; and 4) flake knives, seven items. The complete items in this tool category range in maximum dimension from 22 to 67 mm with the average size being in the 30-40 mm range. Overall, these are fairly small by comparisons with similar tools from quarry-related Clovis sites in Virginia such as the Williamson site (3).

Bipolar Tools

These items, categorized as chisel-wedges, are all bipolar-battered thick flakes of the local Brunswick County chert. There are 12 such tools, six complete chisel-wedges and six large fragments of chisel-wedges, figures 44 and 45. As noted under flakes, there are also seven smaller chisel-wedge spalls that can be identified but do not represent enough of a chisel-wedge to be classified as a large fragment. The complete chisel-wedges range in maximum dimension from 26 to 62 mm, while the fragments range in maximum dimension from 22 to 47 mm. The spalls range from 25 to 38 mm, with most about 35 mm. Compared to the chisel-wedges known from the Williamson Clovis site in Dinwiddie County, most of the Greensville Creek chisel-wedges would be considered of medium to small size. These items are not thought to be bipolar cores as flakes from such items tend to be thin and irregular, and not suitable for the manufacture of edged tools.

Edge-Used Flakes

Another 12 items are flakes that show obvious edge-wear and edge-damage from use, and they are categorized as tools, figures 40 and 41. The average length of these tools is in the 35-40 mm range with width often about equal to length. The tools are fairly sturdy and often show signs of significant edge damage. All 12 of the tools are of the local Brunswick County chert.

Clovis Point Preform Fragments

The finding of 11 biface fragments that probably represent early-stage Clovis point preforms, figures 32, 33, and 51, indicates that at least some biface reduction was taking place on the Greensville Creek Clovis site. This is understandable given the close proximity of the site to the tool-stone deposits.

Nine of the 11 fragments are of the local Brunswick County chert, one fragment is of a banded argillite, and one fragment is of a green tuff-like stone. Except for one small, unfluted biface, Figure 32, only fragments of large, thick, early-stage preforms were found. Most of these biface fragments are very short pieces with maximum lengths of about 20-30 mm. No typical, bifacially flaked late stage Clovis point preforms with flute scars were recovered, and no large fragments of in-process bifaces remain in the assemblage. It appears that any usable, large piece of chert such as a large biface or biface fragment generated on site was further reduced on site or retained for other use at another location.

Five of the biface fragments are best described as snapped preform bases, possibly relating to the preparation of platforms for early stage longitudinal thinning flake (flute) removal. Such a procedure was suggested by Floyd Painter in 1965 (13) based upon his analysis of unfinished, in-process Clovis bifaces recovered upon the very large Williamson Clovis site in nearby Dinwiddie County, Virginia, which he studied for many years.

Based upon his analysis of unfinished Clovis points from the Williamson site, Painter suggested that large, classic Clovis points were longitudinally reduced in thickness or fluted after first removing or snapping off a short segment of the starting biface to form a single-flake striking platform, Figure 34 C. Painter went on to suggest that this method of preparing a striking platform for fluting was carried on as needed throughout the flaking process as the Clovis point neared completion.

Our own analysis of the biface fragments, figures 34, and 36, associated with Clovis point manufacture on the Williamson site, compared to the Greensville Creek site artifacts in figures 32 and 33, supports some of Painter's suggested process, the "Cattail Creek Fluting Tradition," but only as one of several early stage process options in the manufacture of Clovis points.

About one-third of the complete in-process early stage bifaces from Williamson in the NRS collection do show striking platforms for longitudinal flake removal formed by production of a single break on an angle from vertical that carried away a portion of the end of the base, Figure 35. However, only three of the later-stage broken basal ends or failures from point manufacture show that they had, and failed, with this type of platform preparation as shown by examples in figures 34 and 36. This would seem to indicate that either the snapped-base technique was rarely used in later stages of point manufacture or that bifaces with snapped bases rarely subsequently failed by bend break. Indeed, the three examples noted above with snapped-base platforms in the NRS collection from the Williamson site show later-stage biface failure by the tip simply breaking or snapping off apparently due to shock or bending stress.

Snapped-Flake Tools

There are nine edge-snapped-flake tools, Figure 42. These tools resemble bruins, but they were created by snapping the edges of flakes rather than striking off bruin spalls. These tools from the Greensville Creek Clovis site are identical to some snapped-flake tools recovered by NRS from both the Williamson Clovis site and from the Clovis levels of the Cactus Hill site (3, 6, 10). Wear on such tools recovered from all sites is usually confined to the one, or more, points created by intersections at snapped flakes, but an occasional example will show edge wear between points. The examples from the Greensville Creek site range in maximum dimension from 20 to 64 mm. All nine of these tools are of the local Brunswick County chert.

Choppers

There are four choppers. One was also tabulated as a block core but counted in the artifact total only once. These tools are very different in size, shape, and thickness. One example was made upon a chert block core, one upon a chert cobble with minimal flake removal, one upon a large, wide, flat, chert decortication flake, and one upon a split quartzite cobble. All three of the chert choppers are of the typical Brunswick County chert variety. The maximum dimensions of these four items range from 67 to 133 mm.

Hammerstones

There are two hammerstones, figures 54 and 55, and they are both of the local Brunswick County chert. It is quite surprising that no hammerstones of tougher materials such as quartzite or compact sandstone were recovered. The two chert hammerstones are heavily battered, and they appear to have been recycled from large chert cores. One of the hammerstones, Figure 54, is the largest, heaviest hammer we have recorded on any of the Clovis sites we have examined in Virginia including those from the very large Williamson quarry. Given the small size of the chert cores and core fragments found on the GCrCS, a hammerstone of this size and weight, about 3.5 kg, seems completely out of place for any quarry-related activity that might have been carried out here. It is interesting that this hammerstone was found very near the complete Clovis point and the chisel-wedges.

Clovis Points and Clovis Point Fragments

There is one finished, complete Clovis point and one small fragment of a finished, possibly use-damaged Clovis point, Figure 31, in the Greensville Creek site tool assemblage. Both of these items were found in the same general area of the site. Both are of the local Brunswick County chert. The one complete Clovis point found on the site, which is small and very sharp, seems out of place given the general lack of finished tools. This point appears to have been used and then underwent at least one cycle of resharpening. This point's basal area was slightly damaged when it was dislodged, and from the lack of rust stains in the damaged area this likely happened during the most recent episode of land clearing with a bulldozer in 2016.

The midsection-fragment representing a second small Clovis point is similar in width and thickness to the complete example. There is no flute scar remnant on either face of this small fragment, but there is a small zone of edge grinding on one side, which apparently indicates that this was toward the basal end of the point. The fragment appears to have been recycled as a scraping, cutting, or planing tool along a broken edge. Both the complete and the fragmentary Clovis point appear to have been parallel sided as are most of the Clovis points, Figure 4, found on the much larger Greensville County Clovis site just seven miles to the east.

Greensville Creek Clovis Site Artifact Assemblage Summary

First, it should be reemphasized that based upon shape, most of the artifacts found on the GCrCS could not have been positively identified as of Clovis origin had they been mixed with artifacts of Early Archaic age. Many Early Archaic Palmer sites produce a somewhat similar assemblage of tools, cores, and flakes.

The most common tools that were found at the GCrCS are the quickly made "expedient" items including chisel-wedges, choppers, edge-snapped flakes (likely inscribers), crudely edge-worked small flakes, and edge-used flakes. Very few delicate tools for fine work such as end scrapers, small side scrapers, carefully edged flake knives, or awls were recovered, and some types of Clovis tools such as gravers and drills were totally absent. Many of these small, delicate tool types that are in low numbers or absent at the GCrCS are common in the assemblages from other local sites

including the Williamson Clovis site, the Greensville County Clovis site, and even in the small collection of tools known from the excavated Clovis levels on the Cactus Hill site.

The chisel-wedges, chisel-wedge fragments, and chisel-wedge spalls are of some interest because a relatively large number were recovered compared to other tools. This category of tool was apparently used to split or cut wood, bone, or tusk. It also seems likely that these tools could have been used to cut-apart or disarticulate a large kill. However, as the Greensville Creek site does not appear to have been a primary location for manufacturing, the number of chisel-wedges recovered seems unusual.

Except for one small, complete but unfluted chert Clovis biface or preform, only fragments of early-stage, thick bifaces that are presumably Clovis point preforms were found at the GCrCS. The finding of 11 of these fragments indicates that at least some early stage biface reduction was taking place. Most of these biface fragments are snapped bases possibly relating to the preparation of platforms for early stage longitudinal thinning flake (flute) removal.

Only one finished Clovis point and a Clovis point mid-section (fragment) were found at the GCrCS. The one complete, small, and very sharp Clovis point that was found on the site seems out of place given the general lack of finished tools. Still, this point is of the local Brunswick County chert, as is the fragment, and both seem likely to have been made on site or nearby. The complete point also shows traits of undergoing resharpening before it was discarded or lost. Therefore, it seems probable that other Clovis points could have been made to completion on site, used there, and resharpened after such use before finally being discarded or lost.

There are two heavily used chert hammerstones in the assemblage, and one of the hammers is very large. However, there is no indication that big pieces of chert were quarried here necessitating the presence of such a large tool. It seems quite likely that the large, heavy hammerstone was on this site for a purpose not related to quarry activity.

There are indications that as a primary activity small, natural chert cobbles or fragments collected nearby at the tool-stone deposits were being reduced to cores and used here. The ratio of unused or otherwise uncategorized chert non-decortication flakes to unused or otherwise uncategorized chert decortication flakes is not particularly large at 2.19:1, and this suggests that some primary core reduction was taking place here and not all flake work was later-stage tool production. The cores and core fragments discarded as a result of this activity are small and of a variety of shapes. No single core shape predominates in the GCrCS assemblage, and many flakes seem to have been removed from small, blocky chert cores or nodules in a random fashion.

The majority, 991, of the 1,357 flakes surface collected on this site appear to be a combination of small chisel-wedge spalls, core blades, core preparation flakes, biface reduction and end-thinning flakes, and trim flakes. Most of these flakes would be classified as non-decortication. There are very few flakes of stone foreign to the site area in the artifact assemblage, and even the 59 weathered gray-green argillite core fragments and flakes in the assemblage seem to have been made from larger fragments of this material found locally, adjacent to Greensville Creek.

Inferred Clovis Activities at the Greensville Creek Site

From the tool assemblage, we can infer activities of the Clovis people at the GCrCS. The site was not located on a tool-stone deposit, but there were close-by deposits. It is certain that some early stage lithic reduction work was undertaken here, and in support of this there are small fragments of cores and a thousand or so decortication and non-decortication flakes. However, there are no large early-stage cores or large core rejects, and given the overall core and flake assemblage, the site is not interpreted as a primary quarry reduction site.

The 11 biface fragments found here are early stage, and none of the biface fragments recovered here seems to be a late-stage manufacturing failure. Therefore, large-scale, full-cycle biface

manufacturing does not seem to have been a primary activity, but there was early-stage biface reduction.

There are very few small, delicate tools such as end scrapers, drills, and gravers. Most of the tools are edged flakes, which appear to be knives or saws. No significant amount of later stage manufacturing seems to have occurred on this site, and, from the tool assemblage, there is nothing to identify this location as a domestic residence of any duration or significance.

There are 12 bipolar tools and fragments, all likely chisel-wedges used for cutting or splitting, and their presence seems to be consistent with the presence of several artifacts identified as roughly-edged expediently made choppers. There is one exceptionally large hammerstone, but this would seem to have been of no use as related to lithic procurement or reduction at this location. It was likely used to batter a substance such as bone or tusk.

There is one finished Clovis point and there is a mid-section fragment of a second, so it appears that projectile points were used on site or close by. All things considered, this combination of tools suggests that the location was a short duration camp site, a limited manufacturing locality, and that it was possibly associated with a nearby kill location where the animal(s) was initially processed for meat and bone/tusk using large, heavy tools. In fact, the entire assemblage of artifacts minus the cores and a few early stage biface fragments is similar to that found at the LaPrele mammoth kill site in Wyoming (15). However, no bone survived at the Greensville Creek site due to the acidic soils, so we can only speculate as to a kill-site association.

Analysis of Location B, the Terrace Site

Background

As noted previously, the Terrace site, location B, was discovered years ago by local artifact collectors who surface collected artifacts, mostly of Archaic age, from the plow zone. NRS recovered artifacts there, primarily flakes, cores, and bifaces, on a few occasions by surface collecting, and we consider some of the artifacts, mostly those of chert, to be of likely Clovis age. The site is a multi-component Paleoindian and Archaic period site on the east side of Greensville Creek and about 4000 feet north of location A, the GCrCS. This site is located on a high terrace, which is now cultivated farmland as shown in Figure 56, and while the Terrace site is located approximately 1200 feet east of Greensville Creek, there are springs originating from the edge of the terrace located both to the east and west of the primary concentrations of archaeological materials. A spring-fed impoundment forming a small lake is just south of one of the agricultural fields.

The Terrace site is 1500 feet east of the primary tool-stone deposits placing it less than one-half the distance from these deposits as is the GCrCS. As discussed below, it appears from the artifact assemblage we recovered at the Terrace site that more decortication reduction of chert nodules and platelets from the nearby deposits occurred there than at the GCrCS. Also, it seems that more early-stage manufacturing of bifacial cores occurred there and that some early-stage Clovis preform reduction occurred.

Recovered Artifacts Presumed to be of Clovis age

Some of the artifacts that we collected on the Terrace site, other than common flakes, are identified as of likely Clovis age, and they are shown in figures 57, 58, and 59 and listed in Table 2. The problem, of course, is that we cannot be certain that all of these artifacts are Clovis-related given the amount of Middle Archaic and Late Archaic material known from this site.

The total number of possible Clovis-age artifacts we recovered on the terrace site is 774, or about one-half the number we collected from the GCrCS. We did collect some projectile points, primarily of Middle Archaic and Late Archaic age, Figure 63, of argillite, rhyolite, quartz, and

quartzite from the Terrace site, but only one of the later-period projectile points, a small stemmed point likely of Woodland age, is of chert somewhat similar to the local Brunswick County variety. Also, it is significant that no later-period diagnostic artifacts made of the Brunswick County chert were observed by us in local collections from the area.

We recovered no finished Clovis points or finished Clovis point fragments on the Terrace site although we did recover 14 fragments of broken-in-process preforms, some shown in Figure 58. Twelve of the preform fragments found by NRS are of the local Brunswick County chert, one is of quartzite, and one is white quartz. Three of the fragmentary preforms can be characterized as thin and late stage. We found only two small channel (flute) flakes at the Terrace site compared to 17 recovered on the GCrCS.

On the trips made to the Terrace site, we found a few crudely made, apparently ad hoc or "expedient-use," scrapers and edged-flakes. But, only two tools from the site appear to be the typical carefully made, curated tools of the type commonly recovered on the large residential sites such as the Williamson Clovis site and the Greensville County Clovis site. Overall, the number of small, edge-worked tools recovered, 16, is similar to the number, 20, we recovered on the GCrCS, but there is a poorer quality to most of the Terrace site tools. Snapped-flake tools, thought to have been used for scoring wood or bone during manufacture, were more common on the GCrCS than on the Terrace site, 15 compared to 9 respectively. The Terraces site assemblage of flakes compared to that from the GCrCS contains fewer (48 compared to 110) with ground striking platforms, and there are only 15 parallel sided blade-like flakes and blade-like flake fragments in the collection compared to 43 from the GCrCS.

Considering the entire artifact assemblage from each site, there are more chert cores, core fragments, and core-like chunks on the Terrace site than on the GCrCS, 100 compared to 53, which is a ratio of about 2:1. The ratio on the Terrace site of unused and otherwise uncategorized chert non-decortication flakes to unused and otherwise uncategorized chert decortication flakes is just 1.26:1 while it is 2.19:1 on the GCrCS. Based upon these factors, we have defined the Terrace site as more related to the initial reduction of local quarry stone than was the GCrCS.

In summary, just a few small, delicate "curated" tools were recovered on the Terrace site, and based upon the tool assemblage this site may not have functioned as a residential camp. In this regard, it is similar to the GCrCS, but unlike the GCrCS we found no choppers, large chert hammerstones, finished fluted points, or any quantity of chisel-wedges on the Terrace site. The total inventory of artifacts recovered on the Terrace site reveals little about specific activities that occurred there other than the initial reduction of quarry-stone nodules and platelets and some, mostly early-stage, manufacturing of bifaces and preforms.

The Local Clovis Landscape as Related to the Brunswick County Chert Deposits on Greensville Creek

Other Significant Clovis Sites Within 30 Miles Found to Contain at Least Some Artifacts of Brunswick County-Like Chert

The Greensville County Clovis Site (a.k.a. the J. H. Boney Clovis site)

Seven miles downriver to the east of the Brunswick County chert outcrops is the Greensville County Clovis site, a recognized Clovis hunting/residential camp (3), Figure 5 location 6. The artifact total for this site as could be determined in 1988 by NRS from reviewing the Boney Family collection was 1,460 artifacts of all lithic materials.

According to the site's discoverer, Mr. J. H. Boney, the Greensville County Clovis site has produced 14 finished Clovis points and fragments, nearly 200 scrapers, and a number of Clovis preforms as well as other Clovis artifacts that were recovered in several individual artifact clusters

along a sand ridge near the Meherrin River (7). However, this site produced very few cores or core fragments in any of the artifact clusters, and the site is not considered in any way quarry related.

In the Boney Family collection, the Brunswick County-like chert artifacts totaled only 62, Table 3, with some shown in Figure 4. Here the overall ratio of flakes and the few cores to formal tools for all lithic materials is only about 4:1. But, for the 62 Brunswick County chert artifacts at this site that we evaluated, the flake-and-core to tool ratio is even smaller at 1.95:1, Table 3.

The number of artifact categories observed by NRS at the Greensville County Clovis site is 16 (3) as compared to only 10 at the GCrCS. However, one category of artifact, the chisel-wedge, recovered at the GCrCS was not recovered at the Greensville County Clovis site. This seems to indicate that one or more of the activities taking place at the GCrCS was not taking place at the much larger Clovis hunting/residential camp seven miles downriver.

This ratio of tools to flakes and cores of the Brunswick County chert at the Greensville County Clovis site indicates that most of what was transported, possibly just seven miles downriver, from the area of the Brunswick County chert quarry or from the nearby GCrCS to this site was finished tools. It does not appear that many unfinished items were brought to the Greensville County Clovis site from the Brunswick County chert quarry area to be finished at a later time. However, late-stage unfinished Clovis points (preforms), quarried of apparently superior Williamson chert in Dinwiddie County about 25 miles to the north, were transported to the Greensville County Clovis site for later completion.

This seems to indicate that raw chert pieces, cores, and unfinished artifacts of the Brunswick County quarry material were not carried too far from that quarry. This chert may have been considered inferior to other local cherts due to the small size of available pieces and the layered structure of some of the pieces. NRS has observed that in the collection of artifacts from the Greensville County Clovis site, there are several examples of breakage of Brunswick County chert tools through apparently weaker layers in the stone at the location of silicified calcite crystals.

The Baskerville Site

A likely Clovis kill site was discovered by NRS in 1980 on the Baskerville Farm along the Nottoway River in Sussex County, Virginia (3), Figure 5 location 5, about 16 miles north of the area of Brunswick County chert quarry. In a circular area some 50 feet in diameter in a low, poorly drained area at the edge of a swamp, two large Clovis points (Figure 60) and twelve large river cobbles were discovered. No other apparent Clovis artifacts, except one edge-worked flake (flake knife), or any other large cobbles were found within 500 feet.

A small, possibly related Clovis site was identified on the same side of the river on a sandy ridge about 1500 feet directly to the west. Our (NRS) interpretation of this location with the two Clovis points, a single worked flake, and the large river cobbles was a kill site where the cobbles were used for some purpose in the hunt or subsequent processing of the kill. The acidic soil did not allow for preservation of any bone or tusk, but we could imagine no other reason for such an unusual combination of items at this spot.

As related to the GCrCS, the significance of this find is the odd combination of stone materials of the two Clovis points, Figure 60. One point is of Brunswick County chert as found at the GCrCS, and the other point is of an unusual, banded argillite identical to that of a Clovis preform snapped-base found on the GCrCS, which is shown in Figure 33 and for comparison in Figure 60.

The GCrCS and the Baskerville Farm are the only Clovis locations known to NRS in southeastern Virginia where the combination of these two lithic materials, Brunswick County chert as found at the GCrCS and banded argillite as found at the GCrCS, has been found. It seems likely

that the same people who were at the GCrCS were at the Baskerville Farm. It is also interesting that both of these sites have been identified by NRS as likely Clovis kill sites.

The Cactus Hill Site

The Cactus Hill site, 44SX202, in Sussex County, Virginia, Figure 5 location 4, is located approximately 26 miles to the northeast of the Brunswick County chert outcrops. Within the levels containing Clovis artifacts in excavation areas A, A-B, and B of this stratified site, typical Clovis tools of the Brunswick County-like chert have been found (1, 10) mixed with tools of other lithic materials including Williamson chert.

Specifically, the Brunswick County-like chert artifact total at Cactus Hill includes a greatly resharpened Clovis point, 10 unifacial tools, edge-used flakes and core fragments, a few unutilized flakes, and one snapped base of a biface or Clovis point preform. Many of these artifacts are shown in Figure 61.

While other sites were excavated by NRS along the Nottoway River that produced the Brunswick County-like chert in the lower, older site levels, only Cactus Hill produced a dated hearth with an associated Clovis tool of this material (1, 10), Figure 60, item number 8. The dated hearth was the first Clovis hearth found by NRS in excavation area B at the site, and it produced a standard radiometric date of 10,920+/-250 radiocarbon years BP on pine charcoal. A later-processed AMS date on a hearth with similar contents at the Clovis level in excavation area A of the site produced an AMS date of 10,910+/-40 radiocarbon years BP.

The date of 10,920+/-250 radiocarbon years BP is the only Clovis date we have from any site with a hearth associated with a typical, representative piece of Brunswick County-like chert. At Cactus Hill, dates for a slightly later fluted point tradition represented by thinner and more narrow points with deeper concave bases, but not employing the Brunswick County-like chert, are 10,840+/-40 and 10,810+/-40 radiocarbon years BP.

The Williamson Site

The very large Williamson Clovis site is in Dinwiddie County, Virginia on the Williamson and Ampy farms about 25 miles to the north of the Brunswick County chert quarry, Figure 5 location 7. Some locations on and adjacent to the Williamson and Ampy farms are known to have produced a good quality chert widely distributed in southeastern Virginia and generally known in the literature as Williamson chert, Cattail Creek Chalcedony, or Little Cattail Creek Chalcedony. The problem with the Williamson chert artifacts from the Williamson site is that not all of these are of Clovis age. The Williamson site also produces Early Archaic, Middle Archaic, and Transitional Late Archaic points and tools of Williamson chert.

NRS has observed one Clovis point, three end scrapers, approximately 10 flakes, one core, and one Early Archaic point of the typical Brunswick County-like chert on the Williamson site in an area of predominantly Clovis use. Given that this site has produced well over 150 Clovis points of all types of lithic materials but most of the local Cattail Creek Chalcedony, the amount of the Brunswick County-like chert recovered on the site is fairly insignificant. Still, the Greensville County Clovis site contained a significant number of artifacts of Cattail Creek Chalcedony, and the site is just seven miles downriver from the area of the Brunswick County chert deposits. This may explain the presence of the Brunswick County-like chert at Williamson given the known movement by this group of Clovis people between general locations.

Summary of the Local Clovis Landscape as Related to the Distribution of Brunswick County-Like Chert

Southeastern Virginia is one of the areas in the eastern United States with an above average number of finds of Clovis sites and finds of single (isolated) Clovis points across the local landscape (14). Here, in just the area of 875 square miles represented by the brown dashed-line oval in Figure 64, more than 225 fluted points have been recovered. Most of these fluted points are classified by NRS as the Clovis type. The Clovis points are of a variety of lithic materials, mostly chert, and they are known from every part of this area along the major rivers, along the creeks, and adjacent to springs and in swampland (3). A small number of the points from all environments are of the local Brunswick County-like chert.

In this area, three large sites have produced multiple finds of Clovis points and associated tools. While two of these large sites, Conover site and Greensville County Clovis site, are defined as hunting camps removed seven to eight miles from the closest quarry, the third site, Williamson, is a large quarry with an associated very large residential site or base camp. Most of the Clovis artifacts from these three large sites are of the Williamson chert variety found up on the Williamson site on Little Cattail Creek in Dinwiddie County, but chert similar to the Brunswick County variety from the quarry on Greensville Creek is represented at each site. The Brunswick County chert quarry is located from approximately seven to 25 miles from these three sites.

Of the four large and small chert quarries known in this area, Williamson, Bolsters Store, Mitchell, and Brunswick County (1), two of these sites, the Brunswick County chert deposit (quarry) on Greensville Creek and the Mitchell chert quarry along the Nottoway River 13 miles to the north, produce similar types of the odd silicified fault breccia generally referred to as Brunswick County chert. In total quantity, this type of chert is fairly rare across the landscape when compared to the Williamson quarry chert variety. While the Greensville Creek site and the Terrace site produce the largest number of artifacts of the Brunswick County quarry chert, this is expected as they are located within a mile of the quarry.

In addition to the three large Clovis sites and the four quarry sites described above, there are at least 20 small Clovis sites of three different types in this area. For these locations, site function can be inferred based upon the specific types of associated tools and debitage. These sites are found in every environment within the local landscape and generally within a distance of no more than 20 miles from a chert quarry. They include: 1) small hunting camps with no quarry association, about 16 in number; 2) small hunting camps with significant associated quartzite cobble collection and reduction activity, two; and 3) likely kill sites, two.

Typically, the type 1 sites, for example the Slade site (1, 3) (44SX7), produce from 1 to 4 finished fluted points and from 9 to 50 scrapers and other tools. Of this number of tools, almost all of these sites generally produce from one to three formal tools or edge-used flakes of the Brunswick County chert although a few sites, such as the Slade site noted above, have produced more as shown in Figure 62.

The two type 2 sites, Fannin and Cactus Hill (1, 3), which are located at quartzite cobble outcrops along the Nottoway River, have produced 3 and 10+ finished fluted points and 9 and 22+ end scrapers plus side scrapers, respectively. The Fannin site produced a biface, four tools, and a few flakes of the Brunswick County chert; the Cactus Hill site has produced 14+ tools, several core fragments, and a few flakes of this material.

The two probable kill sites, Baskerville site on a small swamp near the Nottoway River, and Greensville Creek Clovis site removed about a mile from the Meherrin River at what may have

been a spring-fed lake, each produced two Clovis points or point fragments. The Greensville Creek site, has also produced a small number of tools such as end scrapers and worked flakes. The Baskerville presumed kill site produced only a single flake knife and a small collection of unworked, large river cobbles in addition to the two large Clovis points. These two sites have been discussed previously in this work as producing a similar mix of lithic material types including the Brunswick County chert.

Within this 875-square-mile area of southeastern Virginia, the Brunswick County-like chert represents only a small fraction of the chert used by the Clovis people for tools, but it is found at each site type and within every environment on the landscape. This suggests that the Clovis people in this area were very familiar with the local terrain, had some use for each of the local water-related environments, and moved in a fashion to frequently visit many of the sites while efficiently exploiting both the large and small lithic resources across the landscape.

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The assistance provided by Mr. J. H. Boney of Emporia, Virginia in our work along Greensville Creek is acknowledged. Mr. Boney brought the Terrace site to our attention, and he was very helpful in allowing us to analyze and photograph the Greensville County Clovis site material that he and his family members found in the 1980s and 1990s. He also provided photographs and collector information used in this report. Permission was granted to us some years ago to surface collect upon the Terrace site by the family that once owned the entire site. The site, now posted, is owned by one group, leased for farming by a second group, and leased for hunting by a third group.

Mr. Bruce Deem of Chesterfield County, Virginia in early 2015 brought to our attention the ongoing land clearing activity along Greensville Creek associated with construction of the Dominion Energy power plant 500-kv electrical transmission line interconnection. Without his information, we would not have been aware that this area near the tool-stone deposits was being cleared of vegetation.

The Dominion Energy contractor's management and security personnel allowed us limited, occasional weekend access to certain peripheral work locations on their construction site to conduct surface collections when this could be done safely. This access was allowed up to the time that the Greensville Creek archaeological site was destroyed. No CRM work was known to be done in this area of the general construction site during the period of our surface collecting, and without the contractor's indulgence and help nothing of the Greensville Creek Clovis site would now be known.

The careful and very professional laboratory work conducted for NRS by Spectrum Petrographics, Inc. provided detailed information concerning the nature and formation mechanism of the local tool stone used by the Clovis people. A shortened version of their independent report is presented as the attachment to this document.

And finally, we would like to thank Virginia State Geologist Dr. David Spears for his assistance. He provided much needed information concerning the nature and geological periods of the crustal faulting that eventually resulted in formation of the tool stone found along Greensville Creek.

Table 1. Clovis Artifact Types, Numbers, and Dimensions by Lithic Material Type from the Greensville Creek Clovis Site (GCrCS) in Brunswick County, Virginia.

Artifact Type/Figure Number(s) (see notes)	Local Brunswick County Quarry Chert	Other Materials as Stated:	Dimensions are Length x Width x Thickness Unless Otherwise Indicated (all measurements are mm) (see notes)	Total by Artifact Type
Clovis Point: Figure 31	1		43.5 x 19.5 x 6.5 mm	1
Clovis Point Midsection Fragment: Figures 31, 38	1		15 x 21 x 6.5 mm	1
Clovis Biface Preform (?): Figure 32	1 (tip recently broken)		#1: 54+ x 29 x 10 mm	1
Clovis Preform Snapped-Bases, and fluting failures: Figures 32, 33	6	1-argillite	#2: 21 x 34 x 17 mm #4: 32 x 52 x 20 mm #5 (Argillite): 26 x 42 x 8 mm #6: 22 x 38 x 10 mm NS: 24 x 34 x 17 mm A: 42 x 36 x 16 mm (failure) B: 22 x 29 x 9 mm (failure)	7
Clovis Preform Mid-Section: Figure 32	1		#3: 36 x 49 x 13 mm	1
Clovis Preform Tips: Figures 32, 51	1	1-green tuff	#7 (Chert): 60 x 44 x 17 mm Fig. 51: (Tuff): 37 x 44 x 15 mm	2
Bifacial Cores: Figure 46	4		#1: 85 x 68 x 29 mm #2: 74 x 46 x 38 mm #3: 66 x 47 x 26 mm #4: 59 x 50 x 22 mm	4
Flat-Circular or Truncated-Conical Cores: Figures 47, 48	2		Fig. 47: 103 x 83 x 55 mm Fig. 48: 77 x 63 x 43 mm	2
Irregular Core or Block Core: Figure 49 (Also tabulated as a chopper but not counted twice)	1		133 x 76 x 54 mm	1
Core Fragments or larger, broken "chunks"	38	8-argillite	Largest dimension of the ten largest samples only: 50, 58, 60, 61, 62, 64, 66, 67, 75, and 78 mm	46

(only one example shown – argillite): Figure 51			The argillite example shown: Fig. 51: 69 mm	
End Scraper: Figure 38		1-gray chert (non-local)	27 x 22 x 10.5 mm	1
End Scraper Fragment: Figures 38, 39	1		24 x 19+ x 6 mm	1
Side Scrapers, Knives, or Saws: Figure 40	4		#1: 51 x 31 x 19 mm #2: 48 x 35 x 9 mm #3: 74 x 37 x 29 mm #4: 57 x 54 x 25 mm	4
Awl-Like Pointed-Edged Flakes: Figures 38, 40	3		Fig. 38, #5: 38 x 17 x 12 mm Fig. 40, #4: 55 x 34 x 23 mm NS: 35 x 16 x 8 mm	3
Edge-Worked Flakes or Flake Knives: Figures 38, 39, 40	6	1-green chert	Fig. 40, #3: 36 x 24 x 6 mm Fig. 40, #6: 56 x 40 x 12 mm Fig. 40, #9: 61 x 25 x 9 mm Fig. 40, #10: 67 x 49 x 18 mm Fig. 38, #4: 33 x 29 x 9 mm Fig. 38, #6: 29 x 19 x 7 mm NS: 22 x 34 x 10 mm	7
Edge-Used Flakes: Figures 40, 41	12		Length only: 24, 29, 32, 48, 42, 40, 48, 37, 35, 44, 42, and 47 mm	12
Snapped-Flake Tools: Figure 42	9		#1: 31 x 35 x 12 mm #2: 36 x 23 x 8 mm #3: 26 x 20 x 5 mm #4: 29 x 29 x 7 mm NS: 64 x 21 x 11 mm NS: 30 x 19 x 5 mm NS: 22 x 23 x 3 mm NS: 15 x 20 x 5 mm NS: 64 x 21 x 11 mm	9
Small Fragments of Edged Tools: Not Shown	4		Lengths only: 23, 23, 21, and 15 mm	4
Chisel-Wedges: Figures 44, 45	6		#1: 62 x 27 x 22 mm #2: 43 x 16 x 17 mm #5: 26 x 19 x 13 mm #7: 37 x 26 x 14 mm #8: 45 x 40 x 27 mm #10: 50 x 27 x 19 mm	6

Chisel-Wedge Fragments: Figure 44	6		#4: 47 x 20 x 15 mm #9: 41 x 21 x 11 mm NS: 47 x 16 x 16 mm NS: 42 x 27 x 14 mm NS: 26 x 17 x 10 mm NS: 22 x 17 x 8 mm	6
Chisel-Wedge Spalls: Figure 44	7		#3: 35 x 19 x 7 mm #6: 32 x 16 x 8 mm #11: 36 x 16 x 6 mm NS: 35 x 17 x 6 mm NS: 38 x 13 x 8 mm NS: 25 x 16 x 5 mm NS: 29 x 9 x 4 mm	7
End-Thinning Channel or flute Flakes, (most with ground platforms): Figure 37	15	1-quartzite 1-brown jasper	Smallest: 13 x 18 x 4 mm Average: ~24 x 21 x 4 mm Largest: 32 x 27 x 5 mm	17
Core Blade-Like Blocky Flakes (most with ground platforms): Figures 43 and 51	41	2-argillite	Chert: Largest lengths: 33-39 mm Average lengths: 25-30 mm Smallest lengths: 16-21 mm Argillite: 64, 67 mm (only two, both large compared to chert blades)	43
Biface Reduction Flakes (most with ground platforms): Figure 37	67		Largest: 39 x 42 x 9 mm Average: ~27 x 24 x 7 mm Smallest: 13 x 14 x 3 mm	67
Decortication Flakes (those flakes previously categorized are not included here): Not Shown	365	1-argillite	Chert flake dimensions in this category: 10 to 17 mm: 15.9%, mostly about 15 mm. 18 to 30 mm: 59.8%, mostly about 27 mm. 31 to 70 mm: 24.3%, mostly about 40 mm.	366
Flakes, Non-Decortication (those flakes previously categorized are	798	46-argillite; 1-clear chalcedony; 2-white quartz; 1-yellow quartz;	Chert flake dimensions in this category: 7 to 17 mm: 35.2%, mostly about 14 mm. 18 to 30 mm: 56.4%, mostly about 23 mm.	857

not included here): Not Shown		1-crystal quartz; 2-quartzite; 4-green chert; 1-green tuff; 1-gray chert	31 to 53 mm: 8.4%, mostly about 34 mm	
Choppers: Figures 49, 50, 52, 53	3	1-quartzite (split stream cobble)	Fig. 49 (previously tabulated as a block core): 133 x 76 x 54 mm Fig. 53: 81 x 69 x 28 mm Fig. 50, #5: 67 x 59 x 42 mm Fig. 52 (quartzite): 113 x 82 x 43 mm	4
Hammerstones: Figures 54, 55	2		Fig. 54: 156 x 124 x 121 mm Fig. 55: 128 x 94 x 68 mm	2
Artifact Totals by Material Type	Brunswick County quarry chert **<u>Total 1,404</u>**	All other materials: 58-argillite; 1-clear chalcedony; 1-jasper; 2-white quartz; 1-yellow quartz; 1-crystal quartz; 4-quartzite; 5-green chert; 2-green tuff; 2-gray non-local chert **<u>Total: 77</u>**	----------	All Artifacts **Total <u>1,481</u>**

Notes:
#'s is a reference to the artifact number within the figure number;
NS means that the artifact(s) are Not Shown in the figures.

Table 2. Clovis and Presumed Clovis Artifacts from the Terrace Quarry-Reduction Site in Greensville County, Virginia Approximately 0.8 Miles North of the GCrCS.

Artifact Type	BC Chert	Green BC Chert	Argillite (Weathered	Quartzite	White Quartz	Other Materials	Total
Clovis Preform Overshot Failure: Figure 58				1			1
Preform Tips: Figure 58	2						2
Preform Snapped Bases: Figure 58	3	1					4
Other Preform Fragments: Figure 58	5	1			1		7
Over-Shot Flakes with Edge of Biface: Figure 58	2						2
Channel (Flute) Flakes: Figure 58				1		1-jasper	2
Block, Irregular, and Bifacial Cores and Large Fragments: Figure 57	29	7	1	1	2*		40
Bipolar Cores: Figure 58	1						1
Early Stage Complete Bifaces: Figure 58	4						4
Small Cores and Fragments: Not Shown	52	3			4*		59
End Scrapers (Most Expedient Tools): Figure 59	1	1				1-green rhyolite	3
Side Scrapers, knives, or saws (Expedient	3			1			4

Tools): Figure 58 and 59							
Denticulate: Figure 59	1						1
Awl, Piercer, or Perforator: Figure 59	1						1
Edged-Flakes (Flake Knives): Figure 59	6	1					7
Edge-Used Flakes: Figure 59	2			1			3
Snapped-Flake Tools: Figure 59	2						2
Chisel-Wedges(?): Figure 59	1	1					2
Biface Reduction Flakes with Ground Platforms: Not Shown	27	1		3	1	1-flow banded rhyolite	33
Blade-Like Flakes with Ground Platforms, and Blade Mid-Sections: Not Shown	15						15
Core Preparation Flakes (irregular shape) with Ground Platforms: Not Shown	25						25
Decortication Flakes (those previously categorized not included): Not Shown	195	16	6	3*	4*		224

Non-Decortication Flakes (those previously categorized not included): Not Shown	247	17	29	12*	19*	1-orthoquartzite; 6-rhyolite	331
Hammerstones: Not Shown				1			1
Total by Material	624	49	36	24	31*	10	774

*Under Collected

Table 3. Artifacts of Brunswick County Quarry-Like Chert Recovered on the Greensville County Clovis Site (a.k.a. the J. H. Boney Clovis Site) Greensville County, Virginia Seven Miles West of the Brunswick County Quarry and the GCrCS.

Core Designation	Cores and "Chunks"	Flakes	Number of Tools and Points	Comments	Totals
NRS Analysis: Core Material Type #13	None	3, all large	1 Clovis Point basal fragment; 1 side scraper; 1 flake knife; 1 biface; 1 bifacial side scraper	Deeply colored yellowish-tan, some almost opaque	8
NRS Analysis: Core Material Type #19	1, cortex piece	36	6 end scrapers; 1 graver (S.F. type*); 1 awl; 1 side scraper; 1 edge-worked piece	Mostly white to grayish-white, some with orange cortex; some pale yellow, pale tan, and pale purple	47
NRS Analysis: Core Material Type #20	None	1, large	1 Clovis point; 1 graver; 2 side scrapers; 2 end scrapers	White, weathered	7
Totals	1	40	21	----	62

*Snapped flake graver or general snapped-flake tool.

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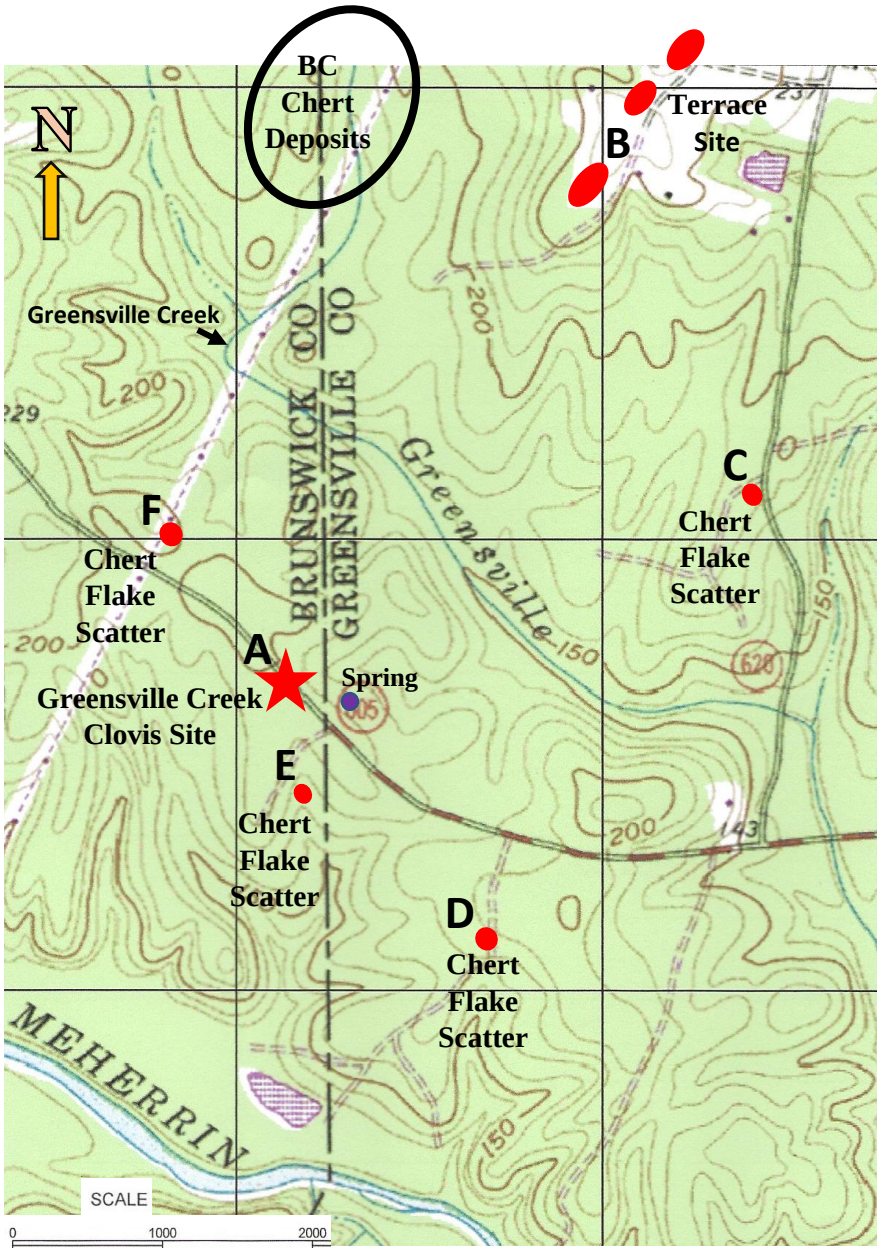

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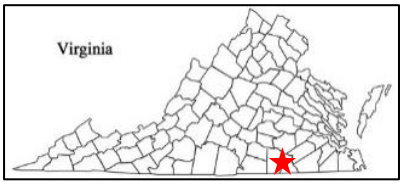

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Figure 1. **Left** (Map, scale is in feet.), the location of the Greensville Creek Clovis site, A, as shown by the red star, an adjacent spring shown by a purple dot, and minor chert flake scatters, C, D, E, and F, in the general area as shown by small, round red dots. The Terrace quarry-reduction site presumed Clovis artifact concentrations, B, are shown at the top right by the small red ovals, and they extend slightly to the north beyond the map border. The area of the Brunswick County chert (BCC) quarry deposits, about 1.3 miles north of the Meherrin River, is shown at the top center-left by the large black-line oval, and the chert is known to extend from Brunswick County to Greensville County to the north slightly beyond the map border. **Right** (insets): **1**) the location of the Greensville Creek Clovis activity area in Virginia shown by the red star; **2**) the appearance of the Meherrin River in the area; **3**) the Brunswick County chert deposit area near Greensville Creek where the stone was seen to outcrop, shown overgrown in 2022; **4**) a view of the local landscape from the Terrace site to the west along utility towers down toward Greensville Creek in the low ground; **5**) the location of the Greensville Creek Clovis site on the local landscape as seen looking to the west from route 605, the site is shown during construction-related land clearing in winter 2015-2016 by the red arrow placed in front of the tree line.

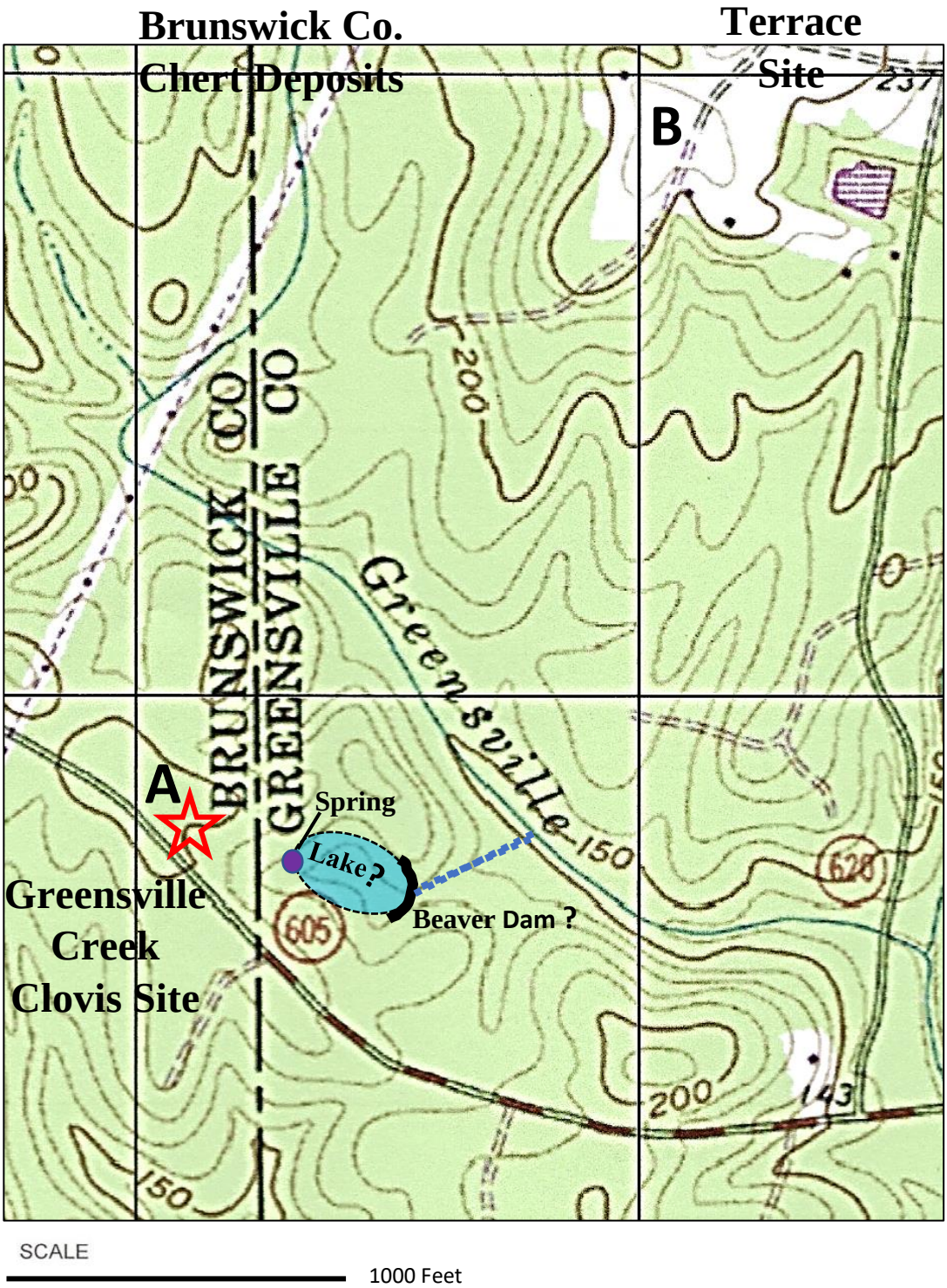
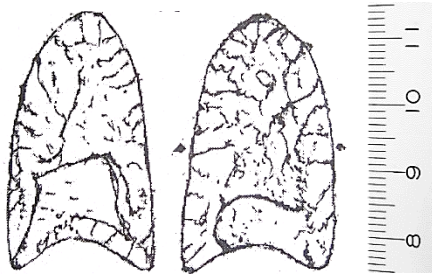


Figure 2. A close-up of site areas A and B shown in Figure 1. The location of the Greensville Creek Clovis Site, A, is marked by the red star at the edge of a 200-foot AMSL contour. The Terrace site, B, is located on a 260-foot AMSL contour. The Brunswick County chert quarry deposits are shown approximately 1500 feet west of the Terrace site. The location of a postulated late Pleistocene lake, about 250-300 feet east of the Greensville Creek Clovis site, and the associated drainage channel to Greensville Creek are shown by the light blue oval and the blue dashed line, respectively. The spring seen by NRS in 2015 is marked by the small, purple circle; the likely location of a possible late Pleistocene beaver dam forming the lake near the spring is shown by the black arc segment.

VFPS #330



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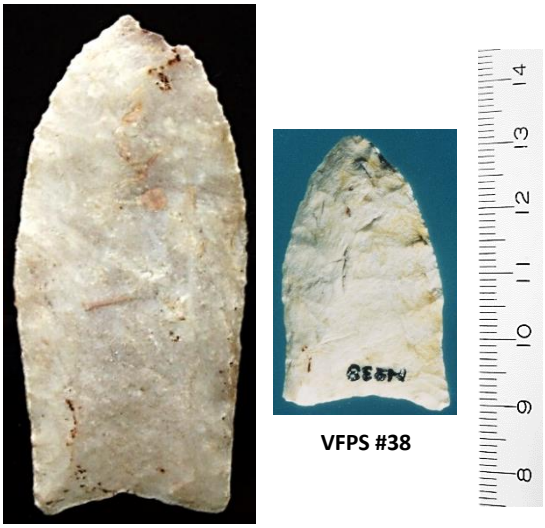

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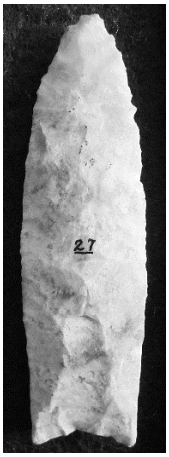

VFPS #424

Figure 3. **Top left**, images of both faces of a cream-yellow-blue Williamson chert Clovis point, VFPS #330, found about 2 miles due north of the Greensville Creek Clovis site (GCrCS) and about 1.5 miles north of the tool stone deposits (NRS collection). **Top right**, Ben C. McCary's drawings of both faces of a "gray chert" Clovis point, VFPS #669, found in 1975 along state route 605 (as is the GCrCS) in Brunswick County approximately 1.5 miles east of the GCrCS; this point has not been examined by NRS to identify the particular chert type (Guy Callaway collection, Emporia, Virginia). **From Bottom left**, images of two Clovis points of BCC: left, a BCC Clovis point, VFPS #538 (J. H. Boney collection, Emporia, Virginia, image from Mr. Boney), found in Brunswick County, Virginia about 11 miles due west of the GCrCS; and right, a BCC Clovis point, VFPS #38, found in Mecklenburg County, Virginia near Skipwith about 40 miles west of the GCrCS (old Arthur Robertson collection; image from the VDHR slide collection). **From Bottom right**, images of two Clovis points of Williamson chert for comparison: left, a Williamson chert (translucent chalcedony) Clovis point, VFPS #523, found in the 1950s in Dinwiddie County, Virginia about 1.5 miles north of the Williamson site (NRS collection); and right, a Williamson chert Clovis point, VFPS #424, found in 1967 in Dinwiddie County, Virginia on the old Roy Ampy Farm part of the Williamson site (NRS collection). Scales in cm.

Figure 4. Artifacts from the Greensville County hunting-related Clovis site on the Meherrin River east of Emporia, Virginia, seven miles east of the Terrace site and the Greensville Creek Clovis site: **1**, Clovis points, the two in red rectangles are identical to Brunswick County chert (BCC) types #13 and #19 (Table 3); **2**, BCC chert type #20 artifacts, end scrapers, a graver, tool fragments, and side scrapers; **3**, BCC chert type #13 artifacts, two bifaces and two flake knives; **4**, BCC chert type #19 artifacts, end scrapers, side scrapers, a snapped-flake graver, an awl, edge-used flakes, a scraping plane, and a core fragment; **5**, enlargement of the structure of the far right BCC chert type #13 artifact in 3, a flake-knife. (All artifacts were recovered in the 1980s and 1990s, old Boney Family collection.)

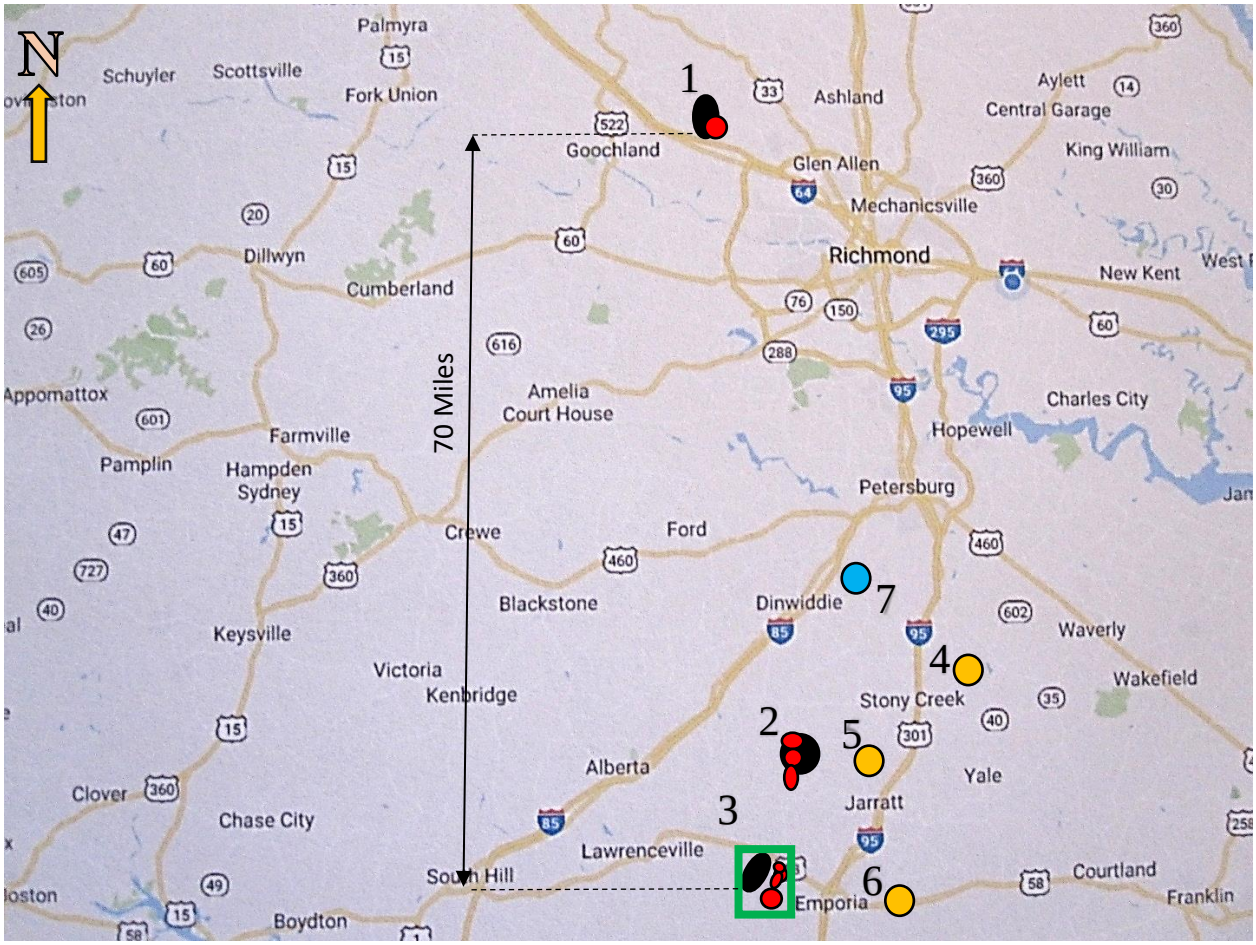

Figure 5. Eastern Virginia chert collection locations (quarry sites), and camp sites with significant amounts of chert similar to the Brunswick County quarry chert. The three small black ovals (1, 2, and 3) denote the approximate locations in eastern Virginia of the three quarries with either the Brunswick County chert or Brunswick County-like chert, the associated red ovals denote the approximate locations of the adjacent Clovis quarry-related sites. Orange ovals (4, 5, and 6) denote the locations of non-quarry Clovis camp sites of significance some distance from any quarry producing the Brunswick County-like chert, and the blue oval (7) denotes a major chert quarry and Clovis base camp producing a different type of chert but with some connection back to other sites containing the Brunswick County-like chert. The numbered locations are defined as follows: **1**, the Bourne Clovis chert quarry and camp site, Hanover County, VA south of South Anna River near Rockville; **2**, the Mitchell Clovis chert quarry and camp sites and Early Archaic chert quarry and camp sites, one mile north of the Nottoway River in Sussex County, VA and about two miles south of the community of Bolsters Store; **3**, in the green rectangle, the Brunswick County, VA chert quarry (chert deposits) along the Brunswick-Greensville County line, and the adjacent Greensville Creek Clovis Site (lower red oval) and the Terrace Clovis site (upper red ovals), all located from 0.65 miles to 1.3 miles north of the Meherrin River and about four miles east of Emporia, VA; **4**, the Cactus Hill Site with excavated Clovis and Early Archaic working surfaces with significant numbers of Brunswick County-like chert flakes and tools thought to be from the Brunswick County quarry but with a few possibly from the Mitchell quarry, this site is located in Sussex County, VA about four miles northeast of the Town of Stony Creek along the Nottoway River; **5**, the old Baskerville Farm Clovis and Early Archaic camp sites with Brunswick County-like chert flakes and tools thought to be mostly from the Brunswick County quarry and the Mitchell quarry, and with a possible kill location with a large Brunswick County-like chert Clovis point, this site is located in Sussex County, VA about five miles north of the Town of Jarratt along the Nottoway River; **6**, the Greensville County Clovis Site (a.k.a. the J. H. Boney Clovis Site), with a total of 62 known Brunswick County-like chert flakes and tools, most of them likely from the local Brunswick County chert quarry but with some possibly from the Mitchell chert quarry, this site is located about two miles east of Emporia, VA along the Meherrin River; and **7**, the well-known Williamson chert quarry and Clovis base camp in Dinwiddie County, Virginia about 25 miles to the north of the major outcrops of Brunswick County chert, a site that has produced some discard-stage artifacts of the Brunswick County-like chert. (Symbols represent general areas but are not to scale on the map.)

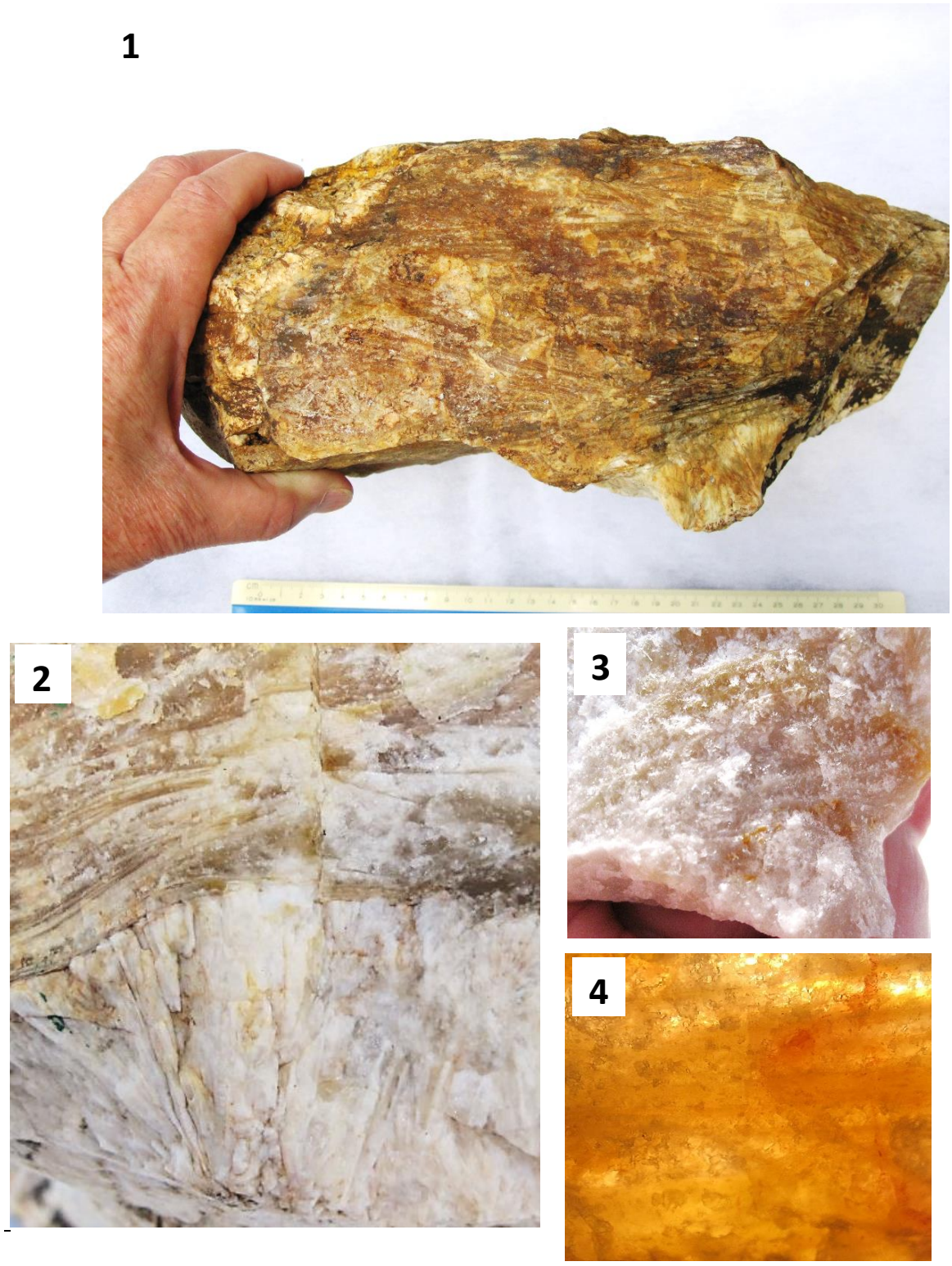

Figure 6. Bourne quarry site chert: **1**) weathered natural surface of a chert-like-stone sample from the D. I. Bourne quarry site in Hanover County, Virginia; **2**) Clovis-age weathered test flake surface on the sample shown in 1, and showing alternate growth directions, probably in different time periods, of metamorphosed silicified calcite crystals in a micro-grain quartz and chalcedony matrix; **3**) a modern test flake from the sample shown in 1, with no weathering; **4**) light transmission through the modern test flake shown in 3, which shows the material structure to be mostly micro-grain quartz. (NRS collection; scale is cm.)

Figure 7. Mitchell quarry site chert: **top image**, weathered surface of a chert-like-stone sample from the Mitchell Plantation quarry site in Sussex County, Virginia; **bottom image**, magnified view of an old fracture surface from the sample shown in image 1, which shows silicified calcite crystals in a chalcedony and micro-grain quartz structure. (NRS collection; scale is cm.)

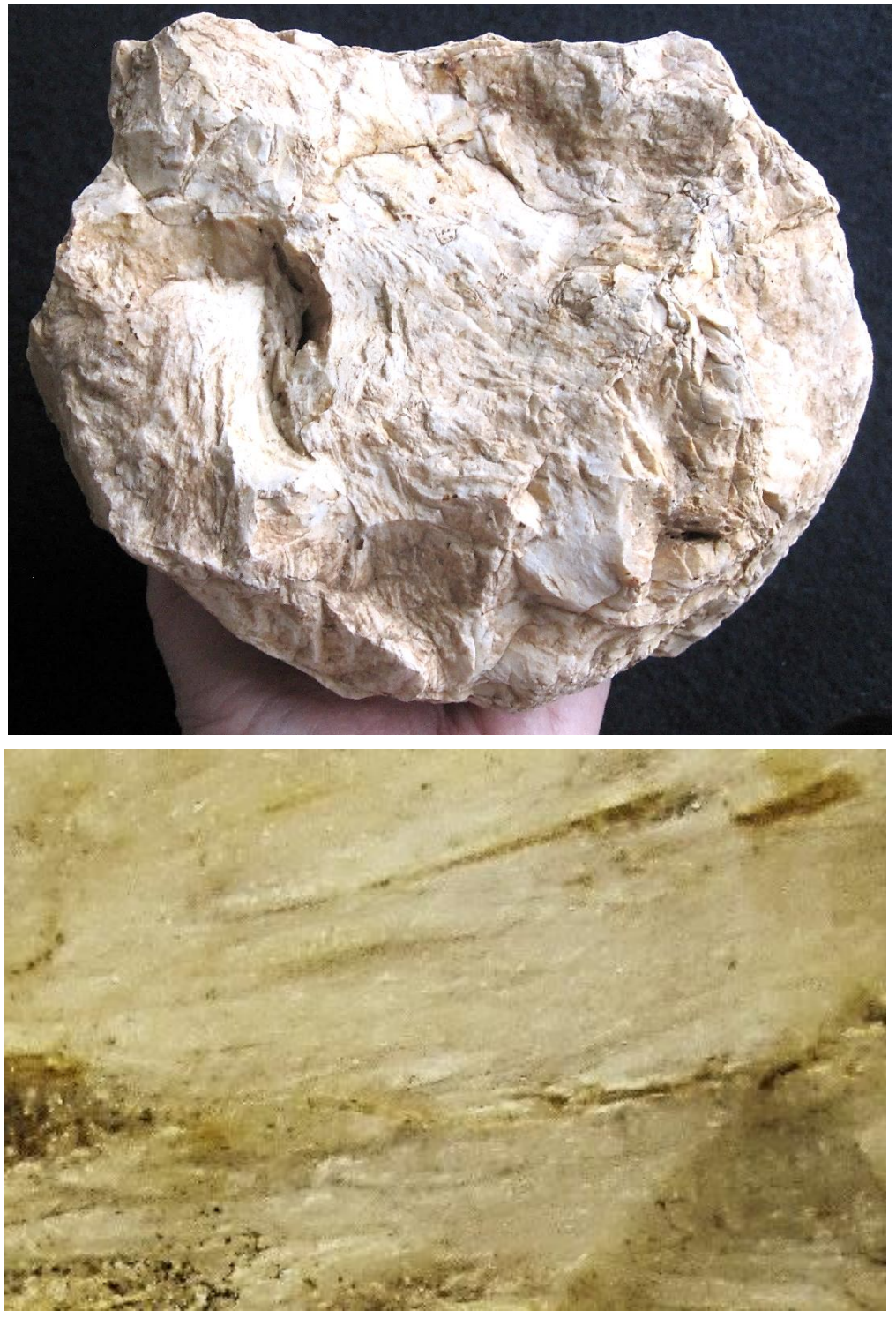

Figure 8. Brunswick County chert quarry sample: **top image,** weathered fracture surface of a Brunswick County chert (quarry) artifact, a hammerstone, from the nearby Greensville Creek Clovis site in Brunswick County, Virginia; **bottom image,** magnified view of a weathered fracture surface of the artifact in the top image showing metamorphosed silicified calcite crystals in a matrix of micro-grain quartz and chalcedony. (NRS collection)

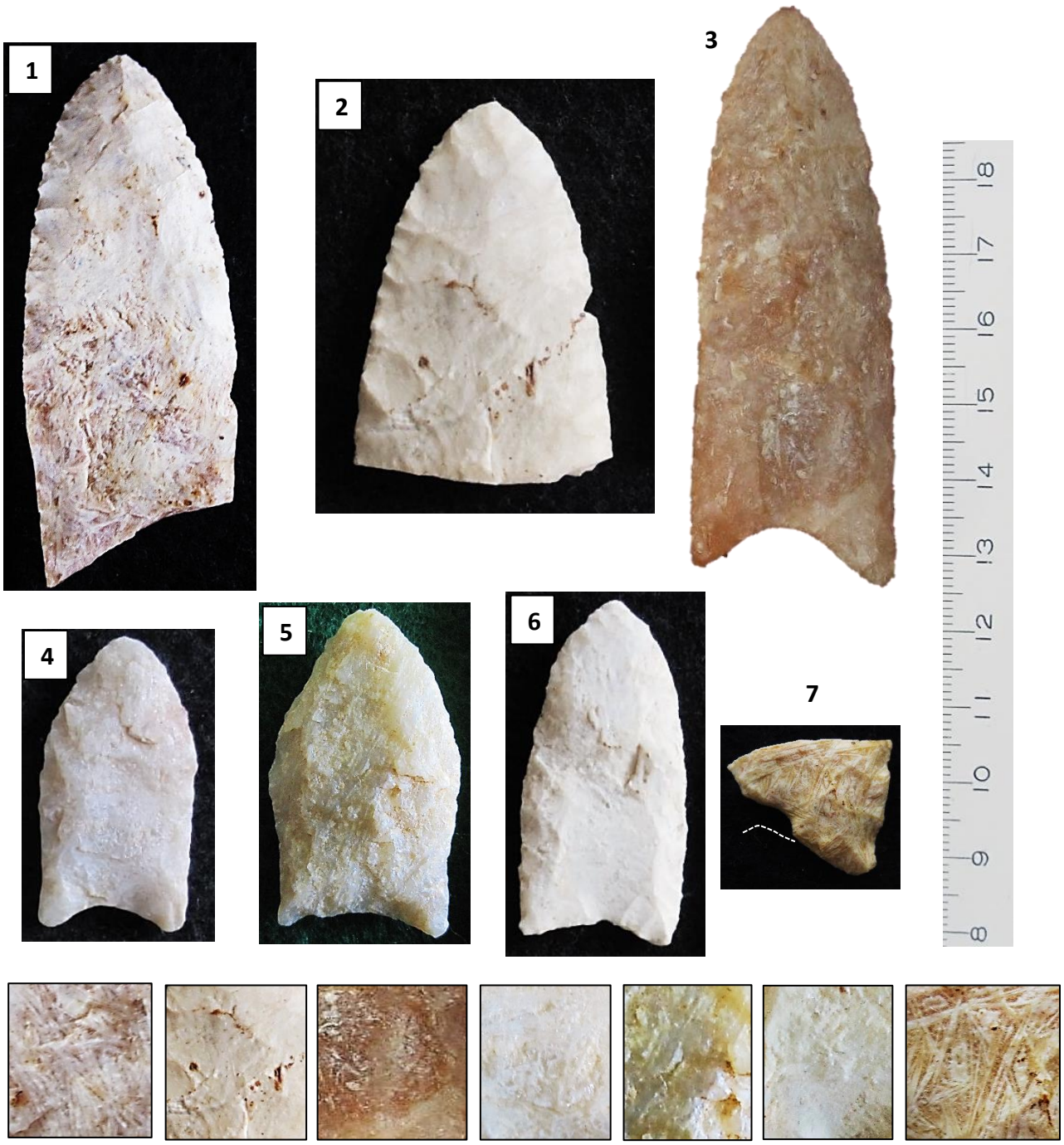

Figure 9. **Top** (images marked 1to 7), Clovis points and point fragments of Brunswick County-like chert from Virginia and North Carolina: **1**) the Baskerville Farm site, Sussex County, VA (McCary's VFPS point #629); **2**) the Quail Springs Clovis site, City of Virginia Beach (Ref. 4); **3**) a coarse Brunswick County-like chert, an isolated find in Nash County, N. C. near Red Oak (Ref. 16, N.C. FPS #4); **4**) the Bourne Clovis quarry site, Hanover County, VA (Ref. 9); **5**) an isolated find from a location near Rockville, VA close to the Bourne quarry site, Hanover County, VA (Ref. 9); **6**) the Greensville County Clovis site, Greensville County, VA (McCary's VFPS point #779); **7**) the Greensville County Clovis site, Greensville County, VA (a Clovis point basal ear fragment) (Ref. 3, Fig. 80, #6). **Bottom** (Photomicrographs, left to right), magnified surfaces of points 1, 2, 3, 4, 5, 6, and 7 showing the structure of silicified calcite crystals in a matrix of chalcedony and micro-grain quartz. (NRS collection except #3, which is in the J. H. Boney collection, Emporia, VA) (Same scale for all; scale is cm.)

Figure 10. Early Archaic Palmer/Kirk and Decatur corner-notched points and a drill of gray-white, yellow-white, and pinkish-white Brunswick County-like chert from different sites in southeastern Virginia. (NRS collection; scale is cm.)

Figure 11. Early Archaic and early Middle Archaic LeCroy, Kirk Stemmed, Kirk Serrated, and Stanly points of Brunswick County-like chert from different sites in southeastern Virginia. Some are heat treated. (NRS collection; scale is cm.)

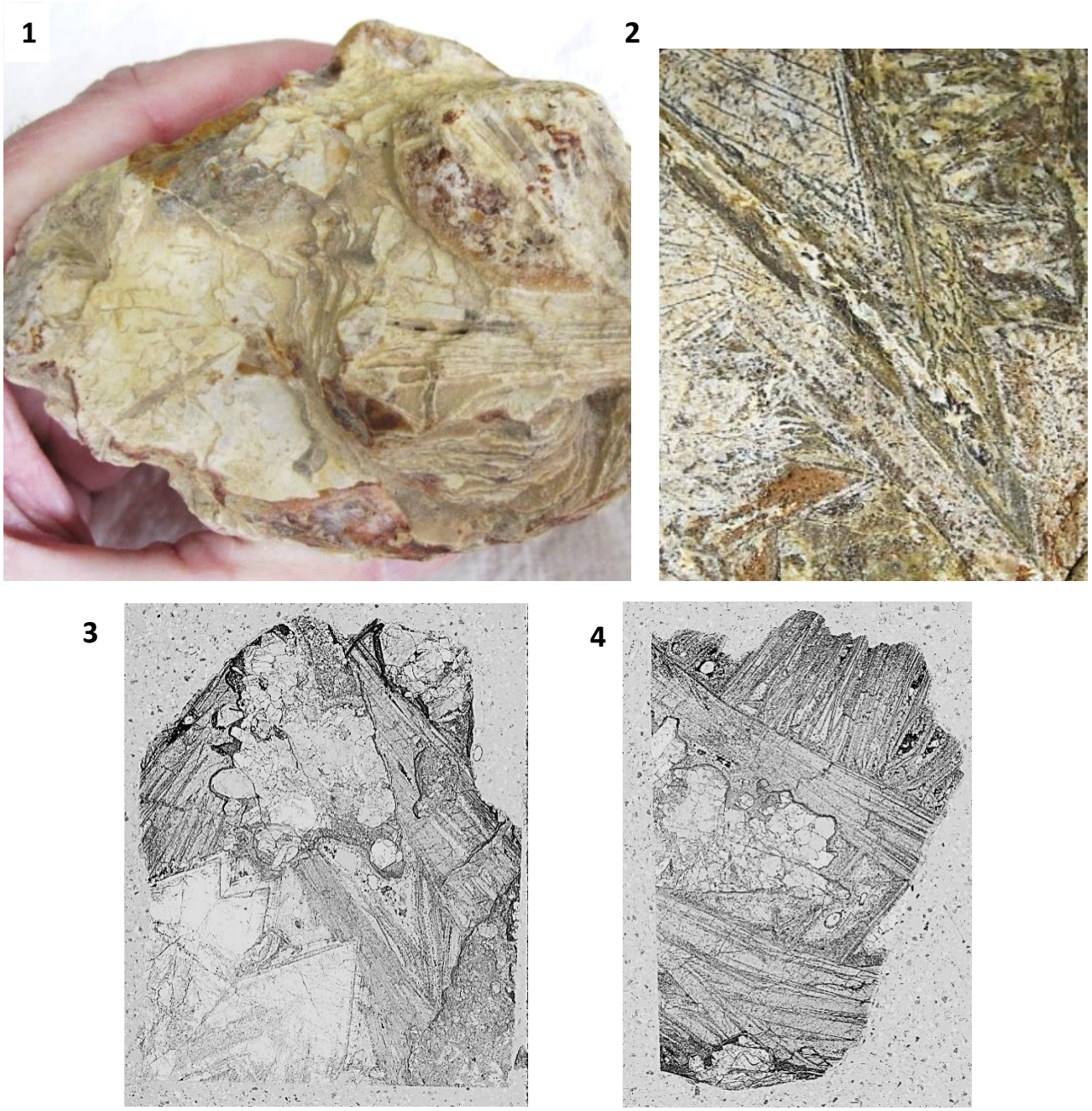

Figure 12. NRS lithic sample from the Greensville Creek area: **1**) NRS sample #2 (see Attachment), Brunswick County quarry, slightly metamorphosed sample composed of euhedral quartz, micro-grain quartz, and silicified calcite crystals; **2**) weathered surface of an artifact of similar slightly metamorphosed chert with silicified calcite crystals from the Mitchell Plantation quarry in Sussex County, Virginia; **3** and **4**) two thin sections through NRS sample #2 in 1 above showing the silicified calcite crystals at different angles and the euhedral quartz as clearly seen in 3; **5**) calcite crystals or blades (not silicified), a hand sample stock image from the internet. (1 through 4, NRS collection)

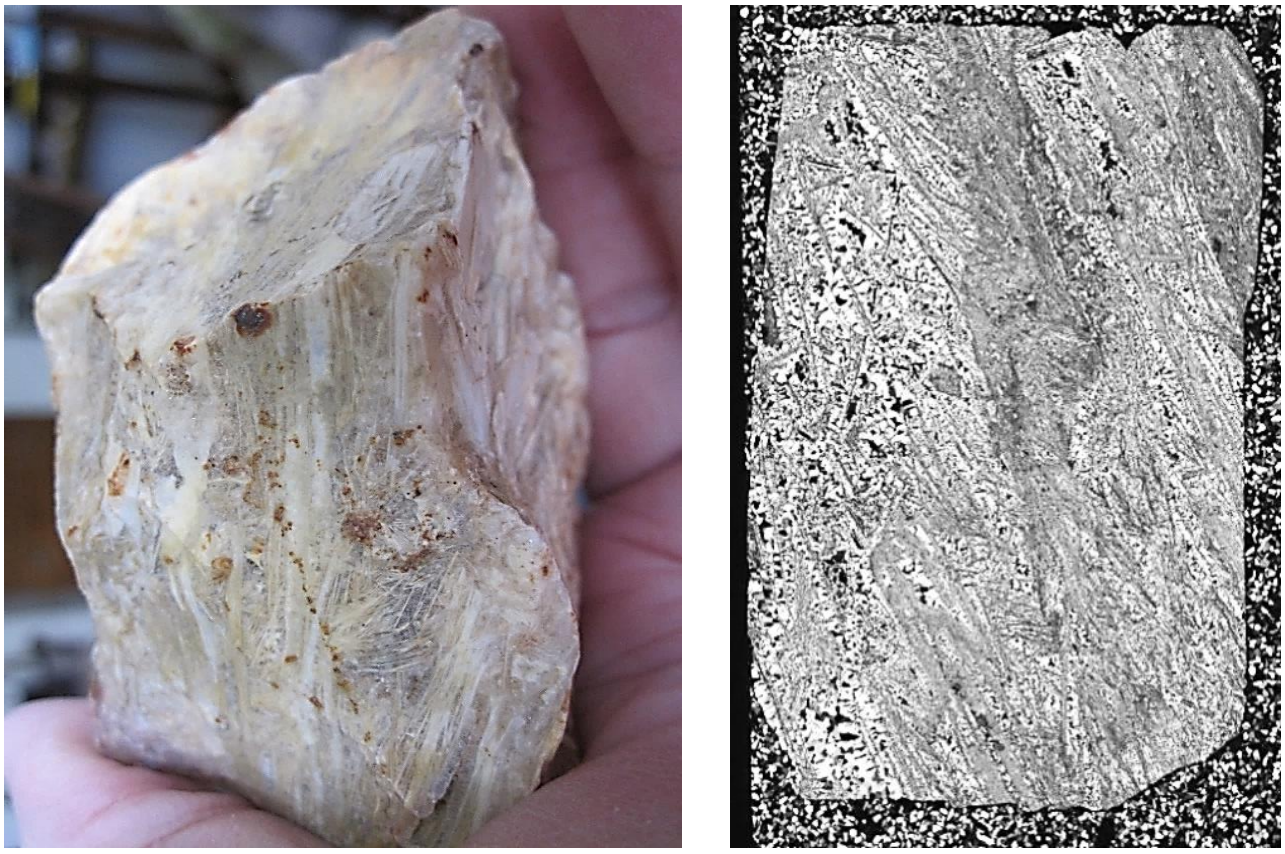

Figure 13. NRS BCC sample from the area of Greensville Creek: **top left**: Native American quarried core of typical metamorphosed Brunswick County chert recovered at a quarry reduction location, the Terrace site, near the Brunswick County, Virginia chert quarry adjacent to Greensville Creek; **top right**, sawed thin section through the same core (27 x 46 mm); **bottom left**, micrograph of the sample structure showing silicified calcite crystals and coarser micro-grain quartz; **bottom right**, the sample structure showing inter-grown microspherulites of chalcedony. (See Attachment, NRS Sample #4) (NRS collection)

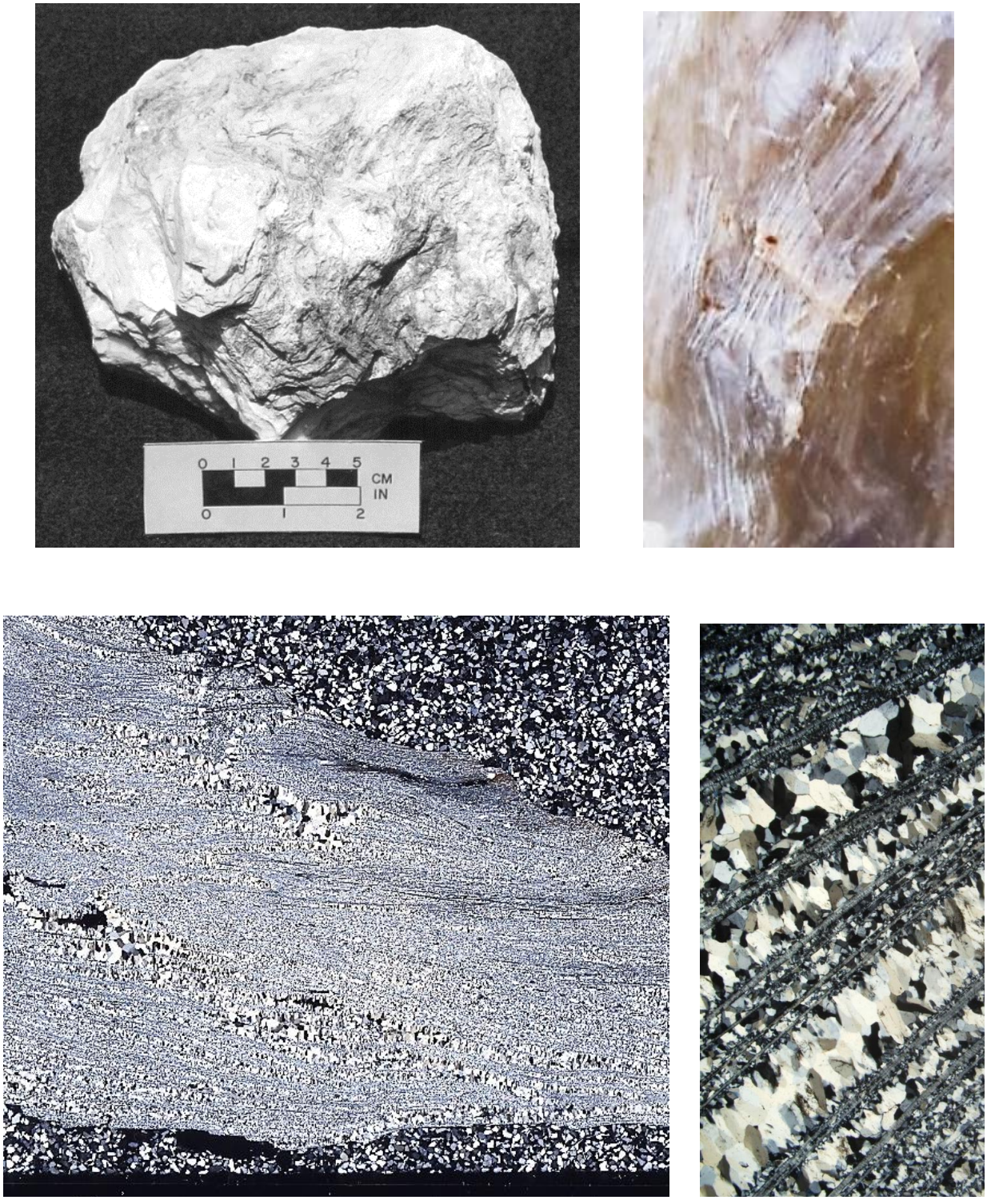

Figure 14. NRS BCC sample from the Greensville Creek area: **top left,** a flat, natural platelet of grayish-white highly metamorphosed Brunswick County chert recovered on a chert outcrop at the Brunswick County, Virginia chert quarry adjacent to Greensville Creek; **top right**, a weathered surface of an Early Archaic artifact of similar highly metamorphosed Brunswick County chert; **bottom left,** portion of a sawed thin section (27 x 46 mm) through the Brunswick County chert platelet, the micrograph of the sample structure shows elongated, parallel silicified calcite crystals and coarser micro-grain quartz; **bottom right**, magnified view in the thin section of the micro-grain quartz structure between the silicified calcite crystals. (See Attachment, NRS Sample #1.)

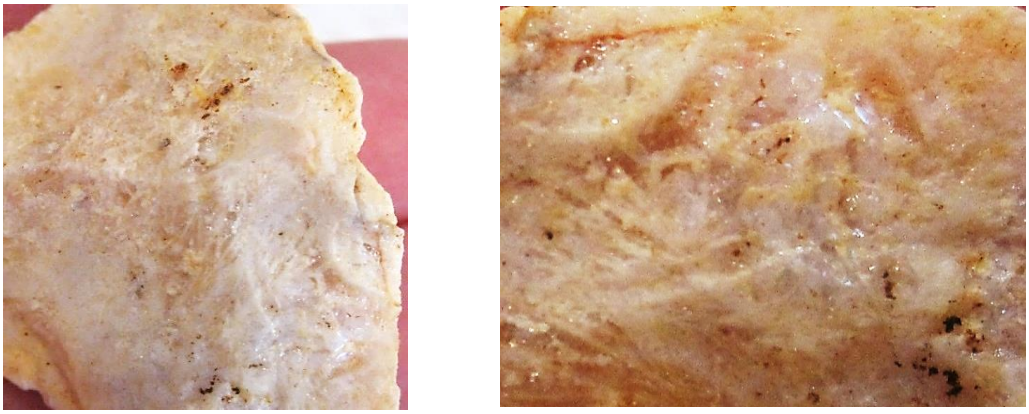

Figure 15. A typical pinkish-white Brunswick County chert flake from the Greensville Creek Clovis site with magnified view at right showing metamorphosed silicified calcite blades in a micro-grain quartz and chalcedony matrix. (NRS collection)

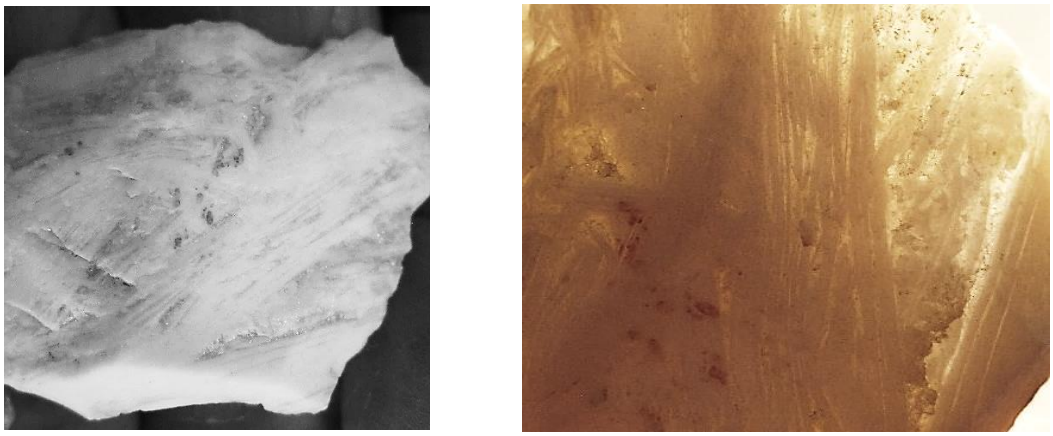

Figure 16. **Left**, the surface appearance of a typical grayish-white Brunswick County chert flake from the Greensville Creek Clovis site showing moderately or partly metamorphosed silicified calcite blades in a micro-grain quartz and chalcedony matrix. **Right**, the through-thickness structure as seen with light transmission through the flake. (NRS collection)

Figure 17. **Left**, the surface appearance of a typical yellowish-tan Brunswick County chert flake from the Greensville Creek Clovis site showing a heavily metamorphosed structure composed of micro-grain quartz and chalcedony. **Right**, the through-thickness structure as seen with light transmission through the flake. (NRS collection)

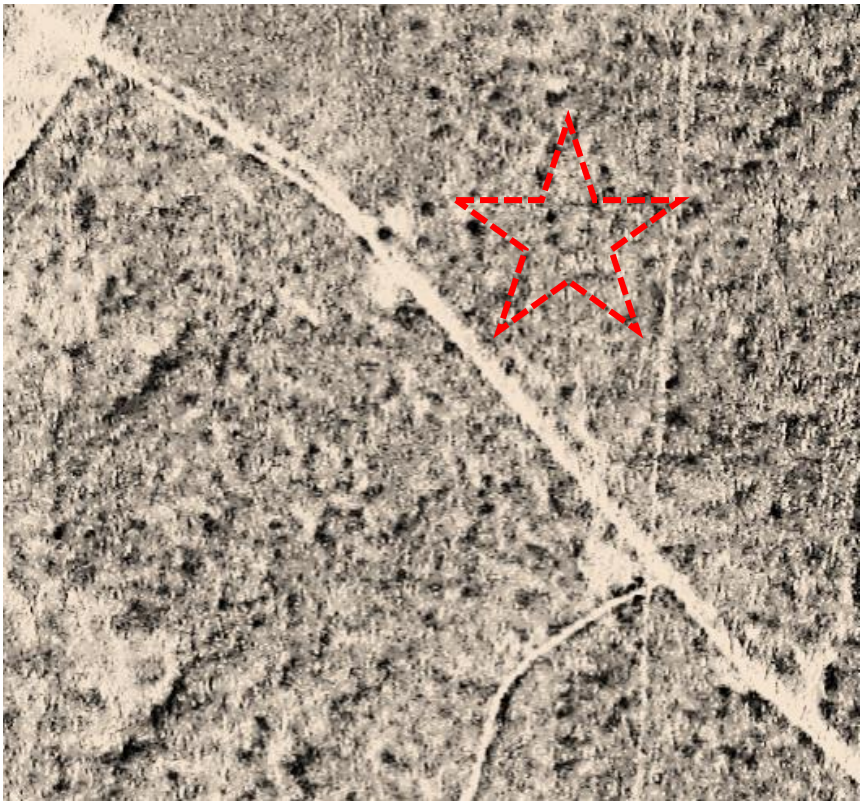

Figure 18. **Top**, aerial view of the general area of the Greensville Creek Clovis site in 1994; the red star indicates the approximate site location. **Bottom**, magnified view of the above image in the area of the Greensville Creek Clovis site, which is indicated by the red star, showing the area completely wooded.

Figure 19. **Top**: aerial view of the general area of the Greensville Creek Clovis site in 2002; the red star indicates the approximate site location. **Bottom**, magnified view of the above image in the area of the Greensville Creek Clovis site, which is indicated by the red star, showing most of the site clear of trees after logging.

Figure 20. **Top**, aerial view of the general area of the Greensville Creek Clovis site in 2008; the red star indicates the approximate site location. **Bottom**, magnified view of the above image in the area of the Greensville Creek Clovis site, which is indicated by the red star, showing most of the site replanted in trees; only a small portion of the north end of the site is now clear of trees.

Figure 21. **Top**, aerial view in 2019 of the general area that contained the Greensville Creek Clovis site; the red star indicates the approximate location that was the site until it was destroyed in 2016 during the construction of a 500-kv electrical transmission line interconnection. **Bottom**, magnified view of the above image. The area that was the Greensville Creek Clovis site as shown by the red star west of the switchyard.

Figure 22. The location of the Greensville Creek Clovis site in Brunswick County, Virginia near the Greensville County line shown by the arrow just in front of the background tree line as seen in December 2015. The photograph was taken looking west along route 605 shortly after removal of vegetation by the owner; Greensville Creek is to the far right in the background beyond that tree line.

Figure 23. The surface condition of the Greensville Creek Clovis site in Brunswick County, Virginia as seen in December 2015 looking north. The top soil containing most of the Clovis artifacts is a light yellowish-brown sandy loam.

Figure 24. The surface condition of the general area of the Greensville Creek Clovis site, Brunswick County, Virginia as seen looking east to the west in December 2015 after logging.

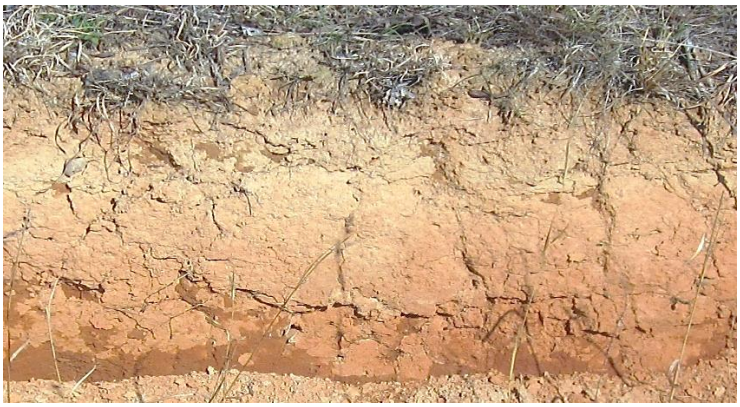

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Figure 25. **Top image**, the general area of the Greensville Creek Clovis site in Brunswick County, Virginia near the Greensville County line as seen in June 2016 looking northeast after removal by bulldozing of remaining logging debris; the primary artifact concentration was in the center-right foreground; Greensville Creek is just beyond the tree line in the background. **Bottom image**, soil profile from the surface 18-inches down into a trench cut during construction work into the edge of the archaeological site in undisturbed soil near the primary artifact concentration; most of the Clovis artifacts were collected in the light yellowish-brown sandy loam shown as the upper level in the soil profile.

Figure 26. The area that was the Greensville Creek Clovis site at the location of the red arrow near the large earth-moving equipment at center background as seen looking west from route 605 in late June 2016. The site was located on a flat terrace above the wet low-ground at a spring. The spring was near the light green vegetation at far center-right (gray arrow), which is shown surrounded by bulldozed soil.

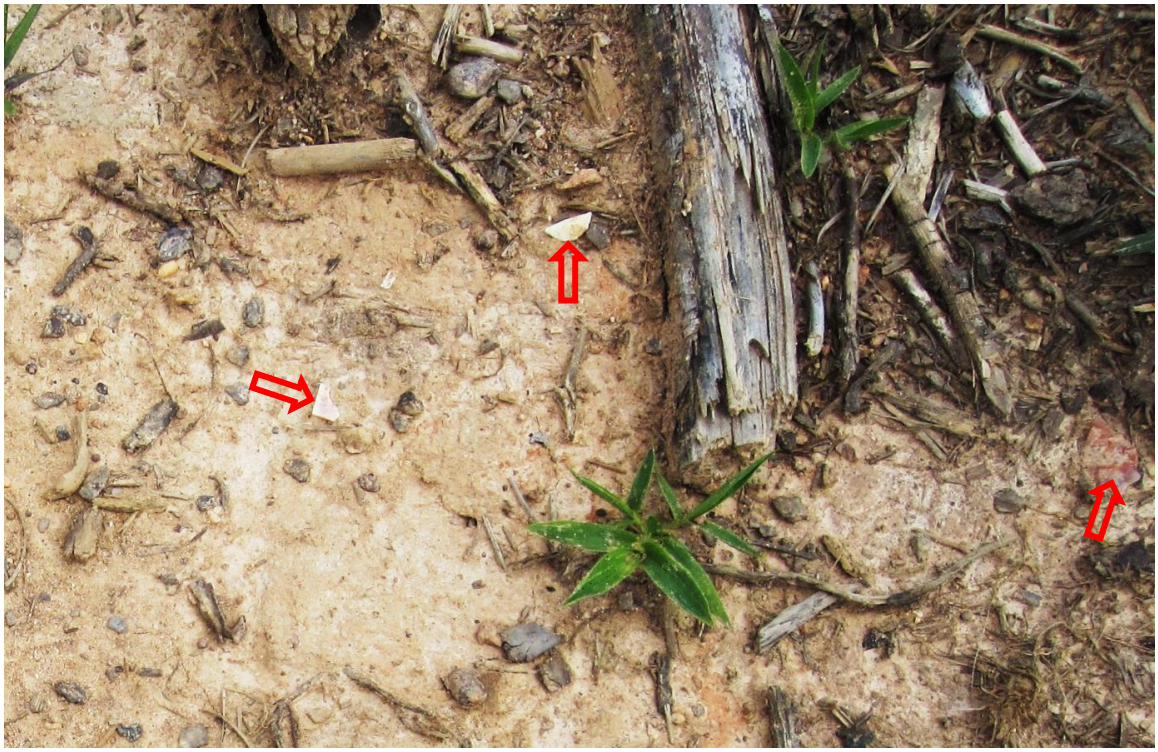


Figure 27. Typical residual forest debris and the typical low density of Brunswick County chert (BCC) artifacts (three flakes noted by red arrows) shown together on a recently washed surface on the Greensville Creek Clovis site as observed by NRS in late 2015.

Figure 28. The general area of the Greensville Creek Clovis site as seen from above during initial land clearing work in late 2015 with construction and forest debris over much of the surface. The area was being used for temporary storage of a few motor vehicles and some construction equipment and materials as seen in the image.

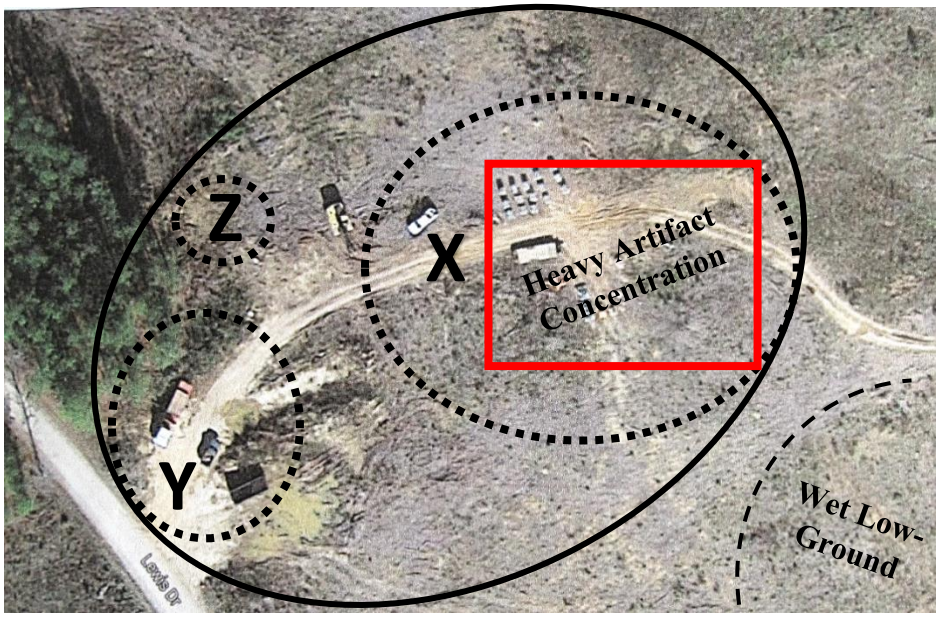


Figure 29. The Greensville Creek Clovis site area shown in Figure 28 with the archaeological site encompassed within the black solid-line oval 290-feet by 190-feet. The high artifact concentration location X, dotted-line oval, is shown with a red rectangle (see Figure 30) representing the area of the highest concentration of artifacts. Lower artifact concentration locations Y and Z are shown on the western side of the site.

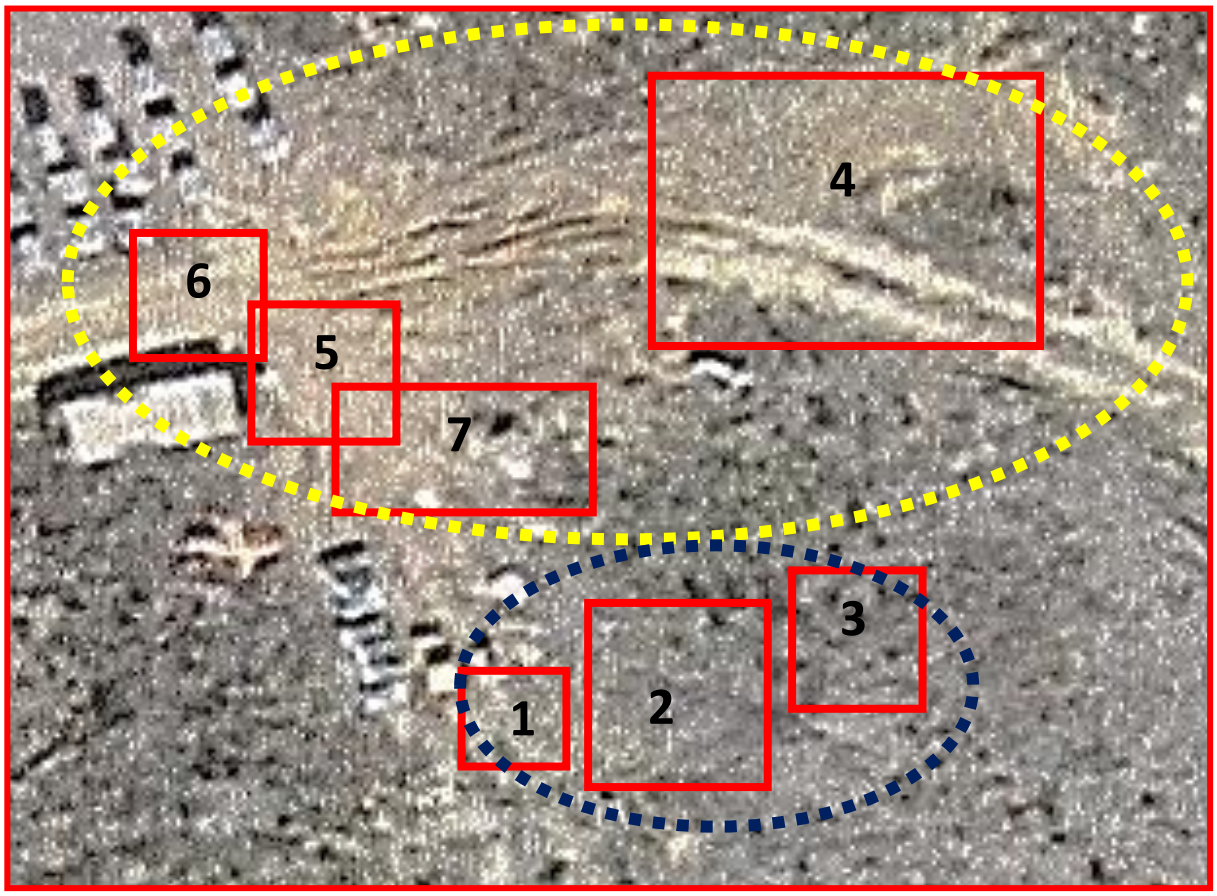


Figure 30. The location of the sub-areas containing the heaviest concentrations of chert flakes and other artifacts on the Greensville Creek Clovis site as seen in the red rectangle within the dotted-line oval designated X in the Figure 29. Sub-areas 1 through 7, produced numerous Brunswick County quarry chert flakes in addition to formal tools in the artifact classes indicated below. In this figure, the large yellow dashed-line oval denotes the apparent primary locations of stone tool manufacturing activity based on the class of stone artifacts found there. The smaller dark blue dashed-line oval denotes an apparent area of likely processing of animal products based on the artifacts found there, and this area is somewhat closer to the location of the spring observed by NRS in 2015.

Sub-Area 1, end scraper and flake of non-local gray chert (end scraper shown in Figure 38). **Sub-Area 2**, a few flakes, a core, choppers, chisel-wedges and a large chert hammerstone (chisel-wedges seen in Figure 44, some other items are seen in figures 48, 49, 50, 53, and 54). **Sub-Area 3**, Clovis point, and a later-stage biface or bifacial knife (Clovis point seen in Figure 31 top, biface seen in Figure 32 as artifact #1). **Sub-Area 4**, snapped-biface basal ends, biface tip fragment, flakes with ground platforms, and cores and core fragments (snapped-biface basal ends seen in Figure 32 top, and Figure 33; biface tip fragment seen in Figure 32 as artifact #7; some of the flakes with ground platforms from area 4 are seen in figures 37 and 43). **Sub-Area 5**, edge-worked flakes (some of the edge-worked flakes from sub-area 5 are seen in Figure 40). **Sub-Area 6**, two bifacial cores (seen in Figure 46). **Sub-Area 7**, worked flake, snapped-biface basal end, small Clovis point mid-section used as a planning tool(?) (these artifacts are seen in figures 40, 32, and 31, respectively). Most of the artifacts in the red-lined sub-area boxes likely originated at or very near these locations, and they did not appear to have been dislodged and relocated from other areas to these spots during site-area vegetation removal.

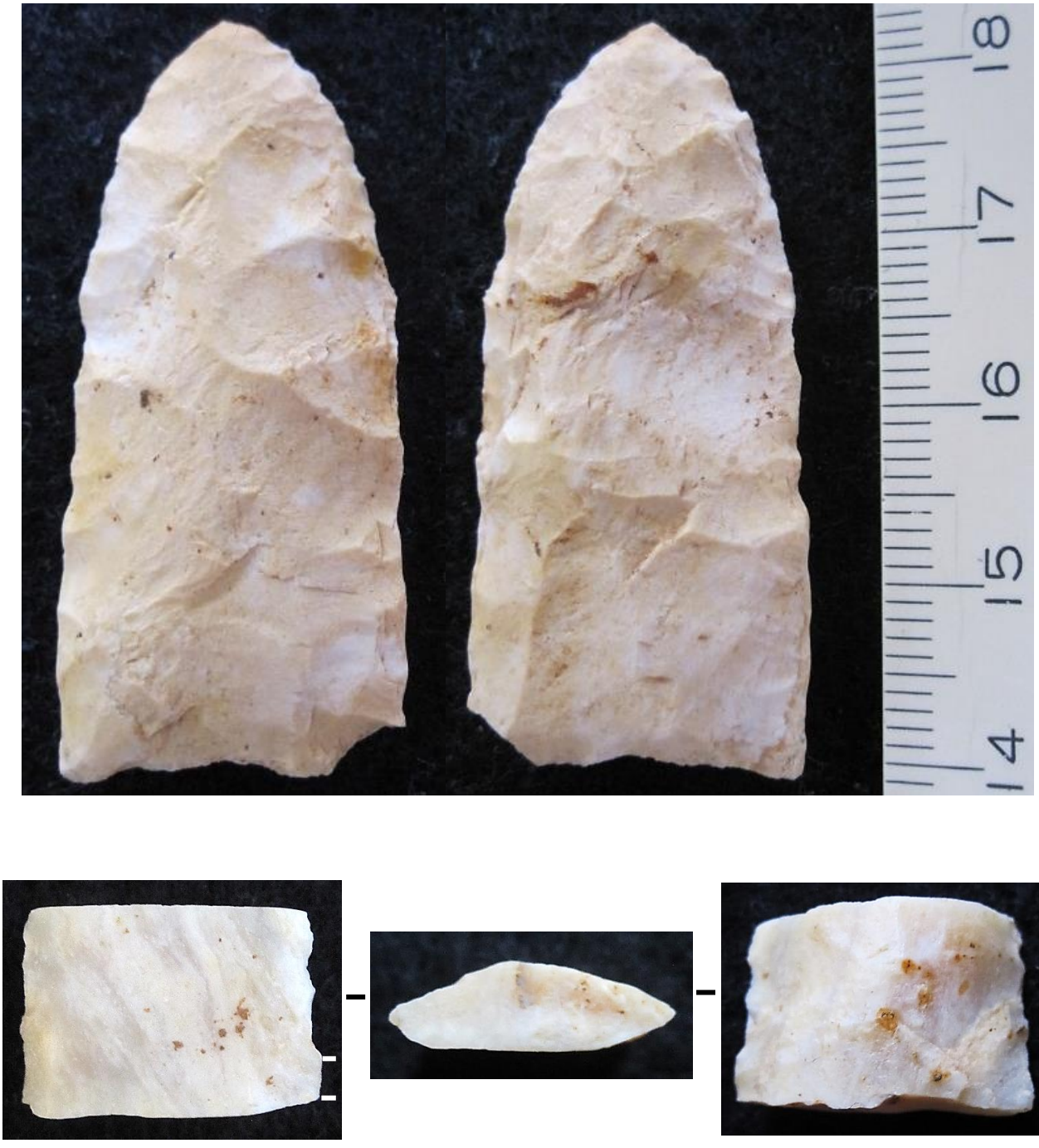


Figure 31. **Top images**, both faces of the only complete Clovis point from the Greensville Creek Clovis site in Brunswick County, Virginia. The recently broken ear resulted from the artifact being dislodged by a bulldozer. The edges of the distal end of the point are very sharp, and the two side edges of the basal area are heavily ground although there is no grinding in the slight basal concavity. **Bottom image**, three views of a midsection fragment of a Clovis point with old breaks. The two, white dash-marks on the image at left indicate the remaining edge grinding likely near the basal end. One broken edge shows use-wear as a planing or scraping tool. Both artifacts are of the local Brunswick County chert although they show different material textural details. The complete point and the point fragment are shown to the same scale, which is in cm. (NRS collection)

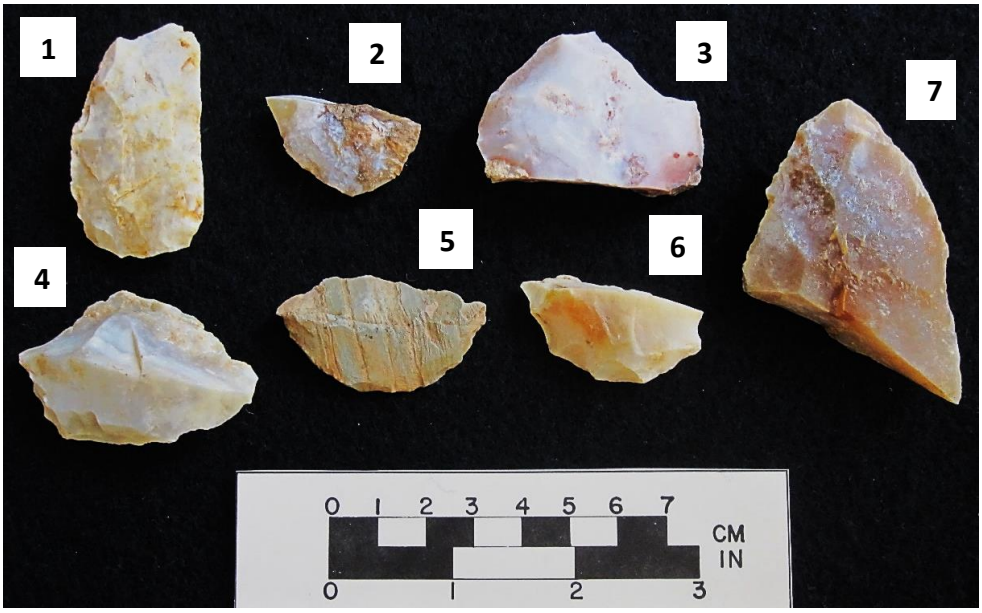
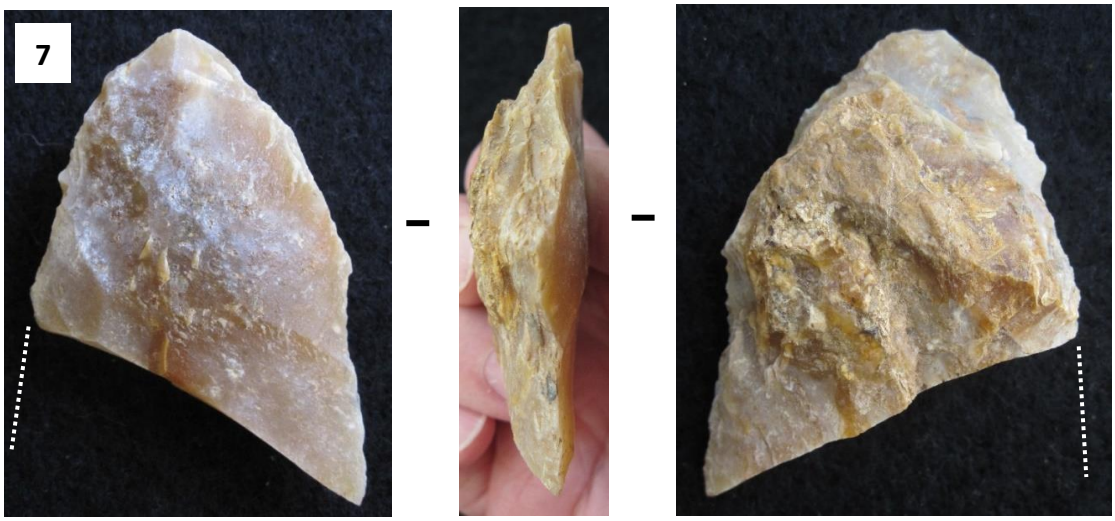


Figure 32. Biface fragments from the GCrCS of Brunswick County chert (BCC), except #5 of argillite. **Top image**, **1**, small Clovis knife or point preform; **2**, **4**, **5**, and **6**, snapped bases of early-stage Clovis preforms; **3**, mid-section fragment of an early stage Clovis preform; **7**, tip portion of an early stage Clovis preform. **Middle images**, both faces of the #1 recently damaged small Clovis knife or point preform showing the longitudinal flake facets on one face. **Lower images**, the layered chert preform tip showing stacked flake scars (center image) which led to failure during transverse flaking. (NRS collection)



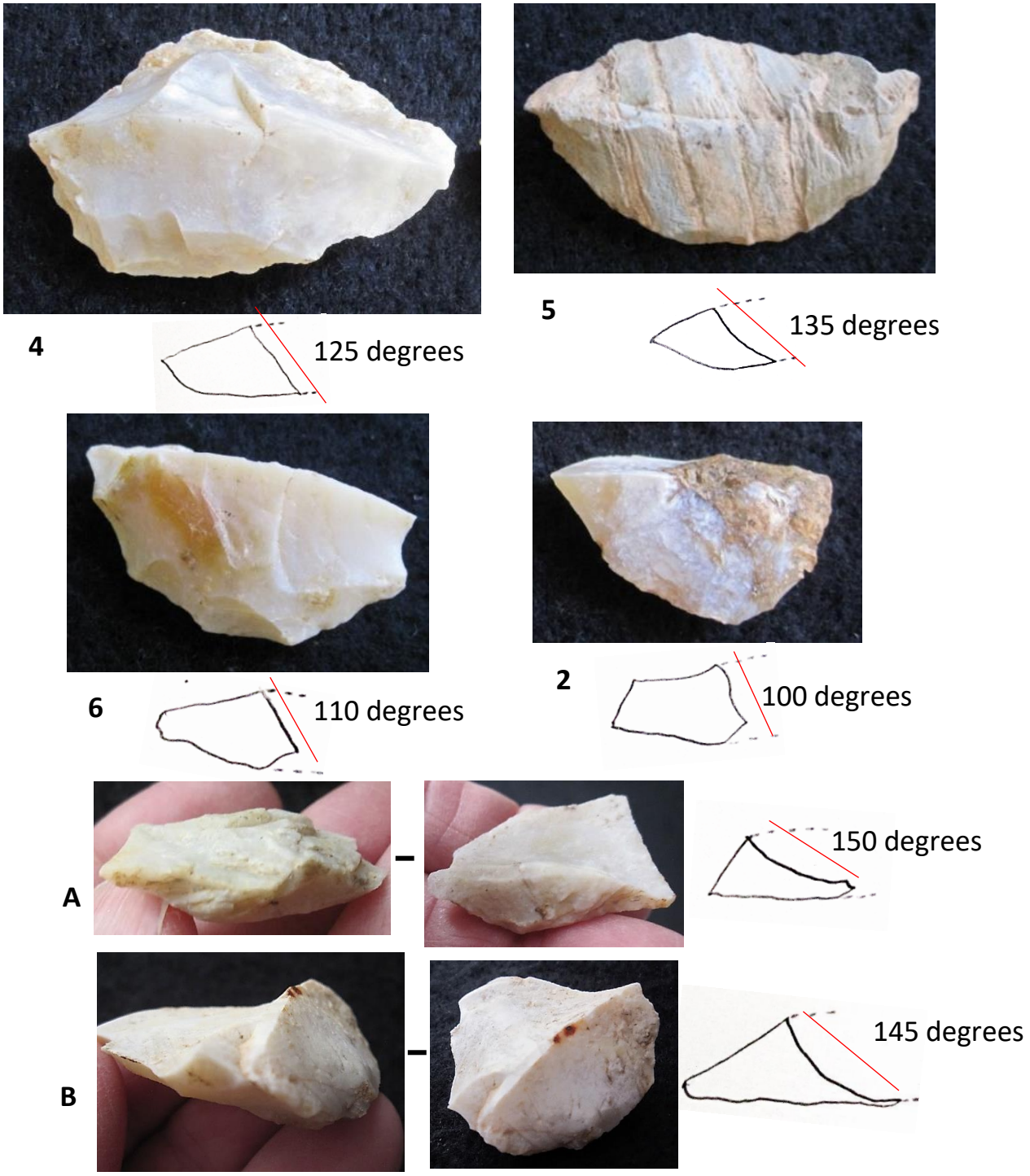


Figure 33. Snapped bases and fluting failures from the Greensville Creek Clovis site: artifacts **2**, **4**, **5**, and **6** are enlarged views of Clovis preform snapped-bases shown by the same numbers in Figure 32; **A**, is a collapsed base fluting failure, in contrast to the snapped bases 2, 4, 5, and 6, but is not shown in Figure 32; **B**, also not shown in Figure 32, is a collapsed base fluting failure from a snapped-base platform resulting in the fragment carrying away a portion of the basal end of the biface. Drawings show the cross-section of each snapped base, and of the fluting failures A and B, revealing the approximate resulting shape and angle of the surface remaining on the larger or primary portion of the Clovis preform. All are Brunswick County chert except #5, which is of a banded Argillite similar to flakes recovered on the site. (NRS collection)

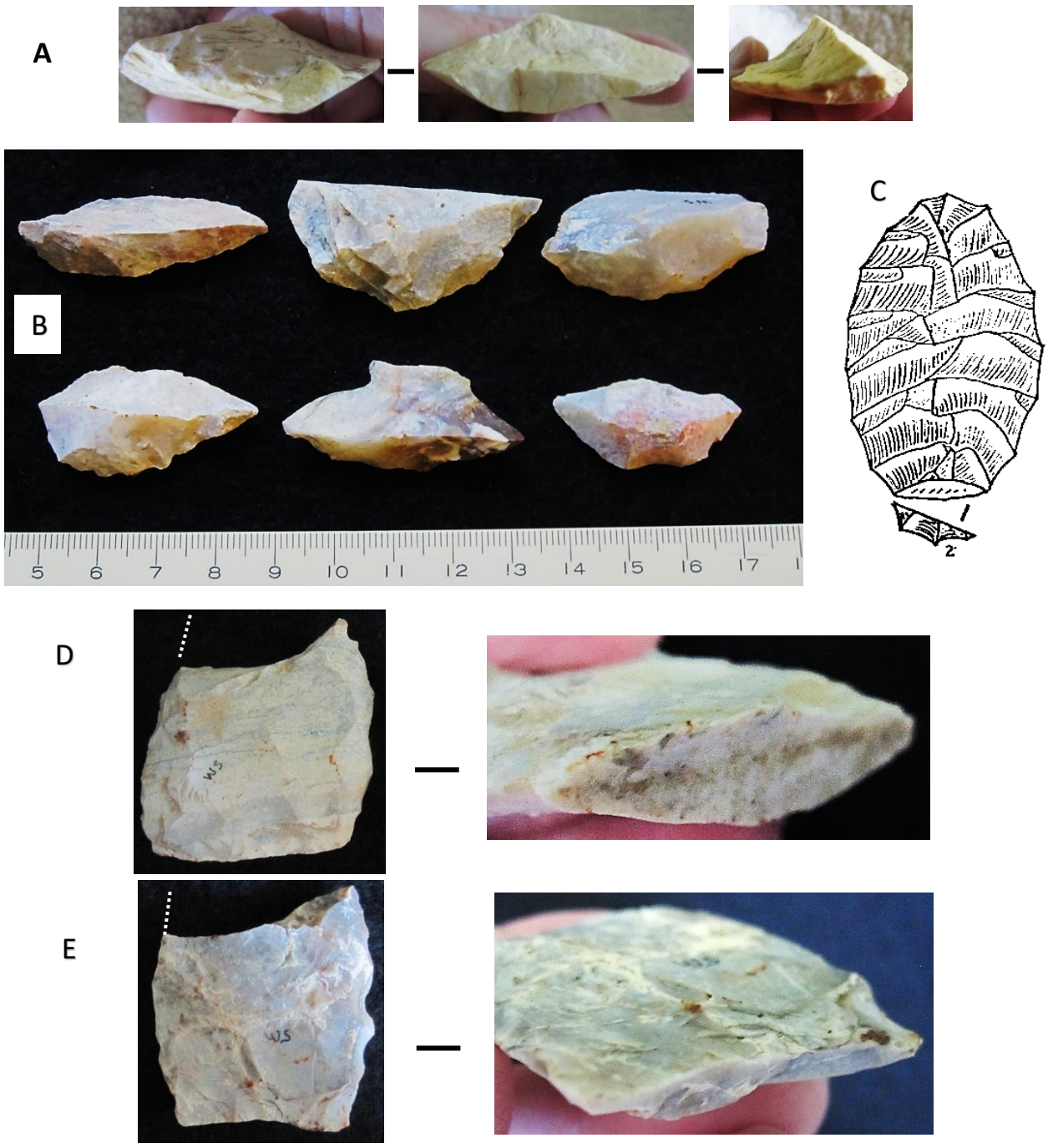


Figure 34. **A**, **top row images**, Figure 61 item #16 snapped base of a Clovis preform of Brunswick County chert from the Sussex County, Virginia Cactus Hill site excavations showing back, front, and side images. **B**, **left image**, six snapped bases from Clovis preforms from NRS surface collections from the Williamson Clovis site and chert quarry in Dinwiddie County, Virginia (also see Figure 36). **C** (drawing), a Clovis biface preform showing a snapped-base striking platform for flute removal suggested by Painter in his 1965 article The Cattail Creek Fluting Tradition (13). **D** and **E**, **left**, two Clovis point preforms from the Williamson site collections with fluting attempted from snapped-base platforms; **right**, the snapped-base platforms enlarged. The bifaces D and E failed when fluting was attempted representing rare examples of fluting-related failures on preforms with snapped-base striking platforms. (NRS collection, scale shown in B is cm)

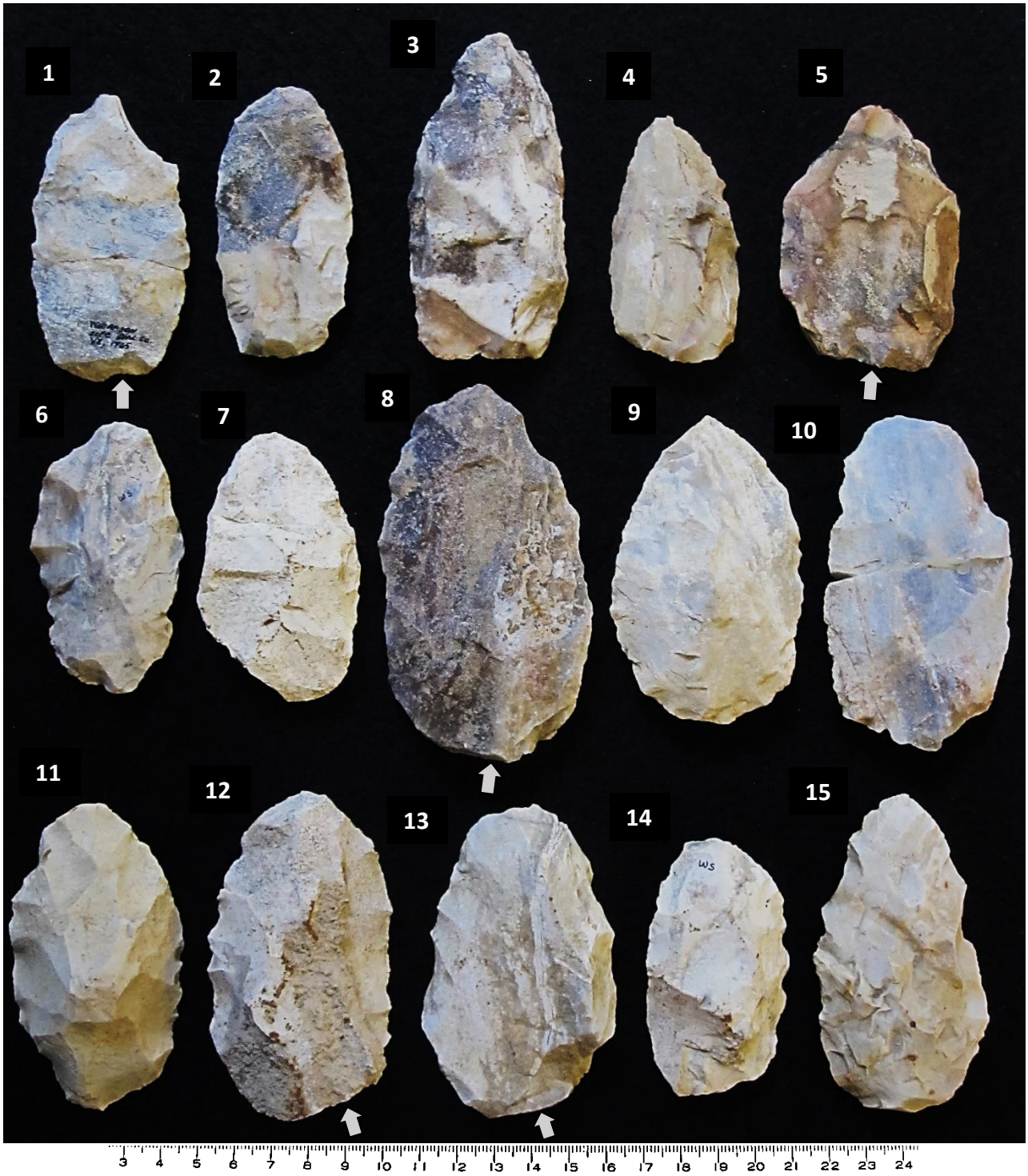


Figure 35. Early and mid-stage Clovis bifaces, all likely Clovis point preforms, from the NRS collection of artifacts from the Williamson Clovis site and chert quarry in Dinwiddie County, Virginia: **1**, **5**, **8**, **12**, and **13** show snapped-bases or single-flake-scar platforms (at arrows) for striking longitudinal thinning flakes, and artifacts numbered **1** and **5** of this group have had longitudinal thinning scars drawn from such platforms; the remaining artifacts show no sign of this technique although some, artifacts numbered **6**, **9**, **10**, and **15**, may have been discarded or lost before the basal portions were intentionally removed to form platforms for longitudinal thinning. Artifacts numbered **2**, **3**, **4**, **11**, and **14** had platforms prepared differently, by multiple-flake removal, before fluting was attempted. (Scale is cm)

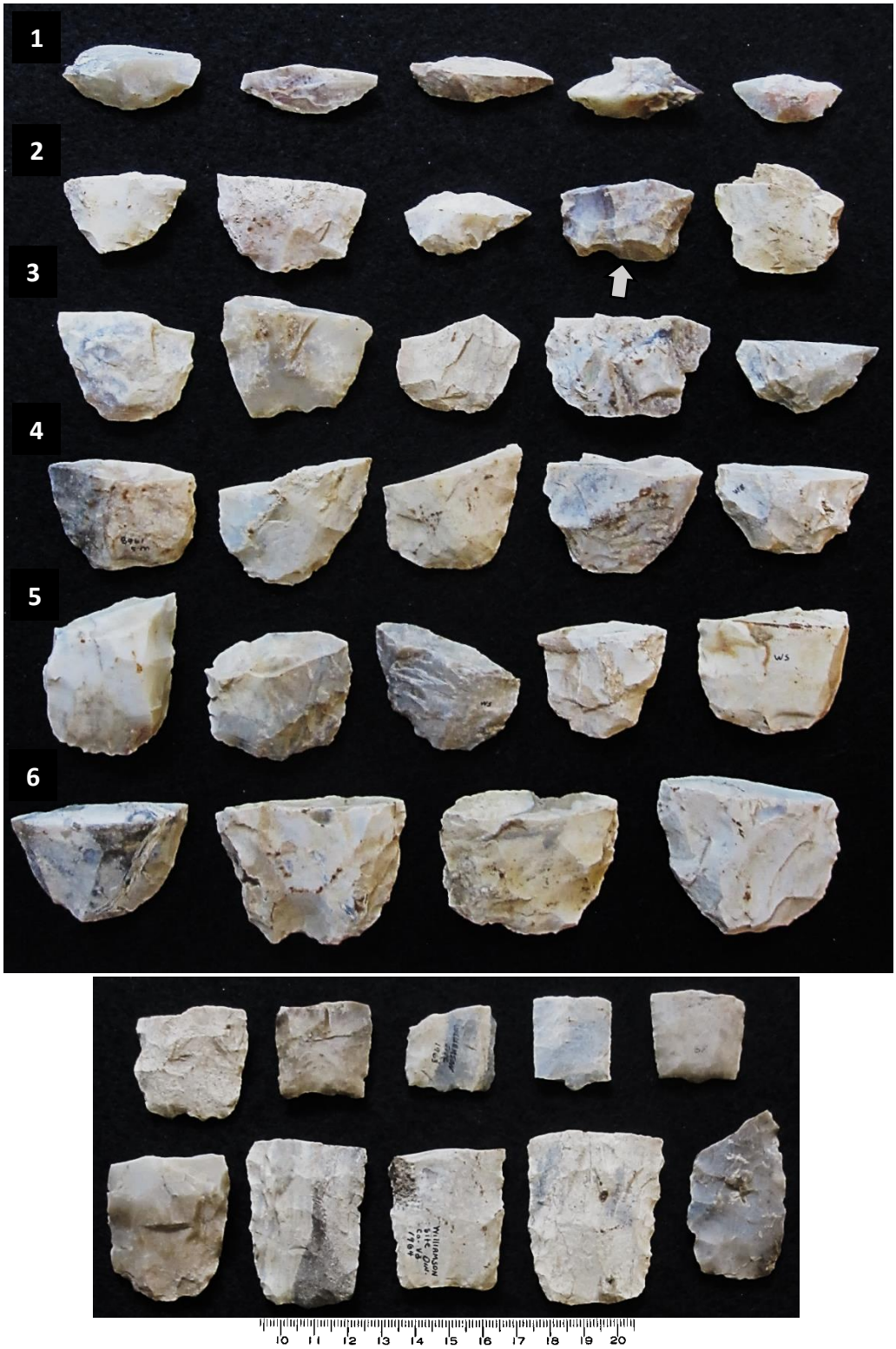


Figure 36. Williamson site Clovis biface fragments: **top image**, row 1 is thought by NRS to be intentionally snapped bases from Clovis preforms when making platforms for longitudinal thinning; rows 2 and 3 are thought to be mostly unintentional bend-break failures when fluting; the arrow points to a rare example with a prior snapped base; rows 4 through 6 are all thought to be unintentional bend-break failures when fluting; **bottom image**, all are thought by NRS to be later-stage Clovis point manufacturing failures, mostly fluting errors. (The scale, in cm, is for both images.) (NRS collection)

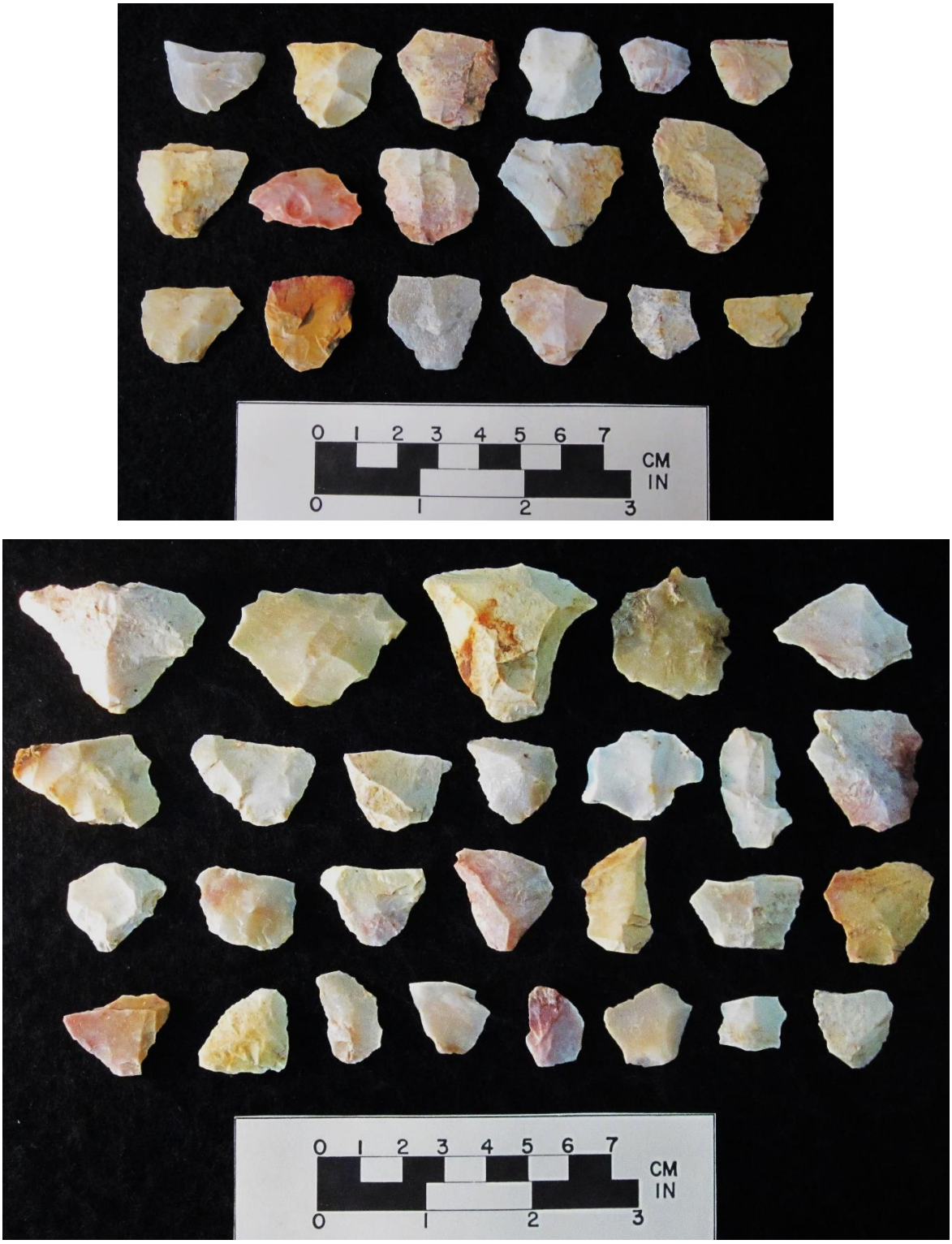


Figure 37. Biface reduction flakes from the GCrCS: **top image**, end-thinning flakes and flake fragments, and channel (flute) flakes and fragments from early through later stage Clovis biface manufacture; platforms are to the bottom; all are Brunswick County chert except for the bottom row, second and third from left, which are jasper and quartzite, respectively; **bottom image**, examples of biface reduction flakes of the Brunswick County chert more likely drawn from lateral blade edges of early through late stage Clovis preforms; platforms are to the bottom. (NRS collection)

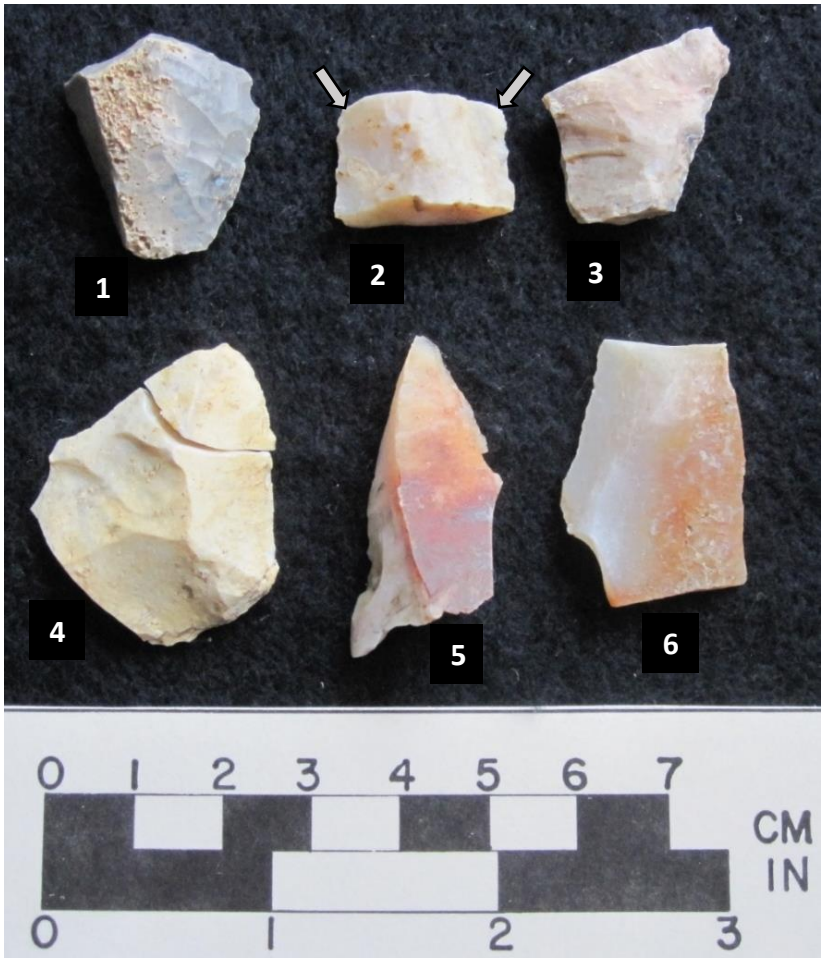


Figure 38. Small tools from the GCrCS: **top image**, **1**, end scraper of gray chert foreign to the site area; **2**, mid-section of a small Clovis point of Brunswick County chert (BCC) recycled into a scraping or planing tool on one broken edge (at arrows), also shown as a projectile point fragment in Figure 31; **3**, broken end scraper of BCC; **4**, a pointed edge-worked flake knife of BCC recently broken by the bulldozer; **5**, an edge-worked steeply pointed awl-like flake tool of BCC; and **6**, an edge-worked flake of BCC possibly used as a knife. **Bottom two images**, top and end view of the gray chert end scraper showing some cortex on the top surface; only one other artifact, a small flake, of this material was found on the GCrCS although quite a few tools and a few flakes of this material are known from the Williamson Clovis site, the Cactus Hill site Clovis levels, and the Greensville County hunting-related Clovis site. (NRS collection)

Figure 39. Enlarged views of different angles of the Brunswick County chert tools numbered 3, 4, and 6 in Figure 38 from the GCrCS. Arrows along the edges of tools numbered 4 and 6 indicate the extent of the trim work. (NRS collection)

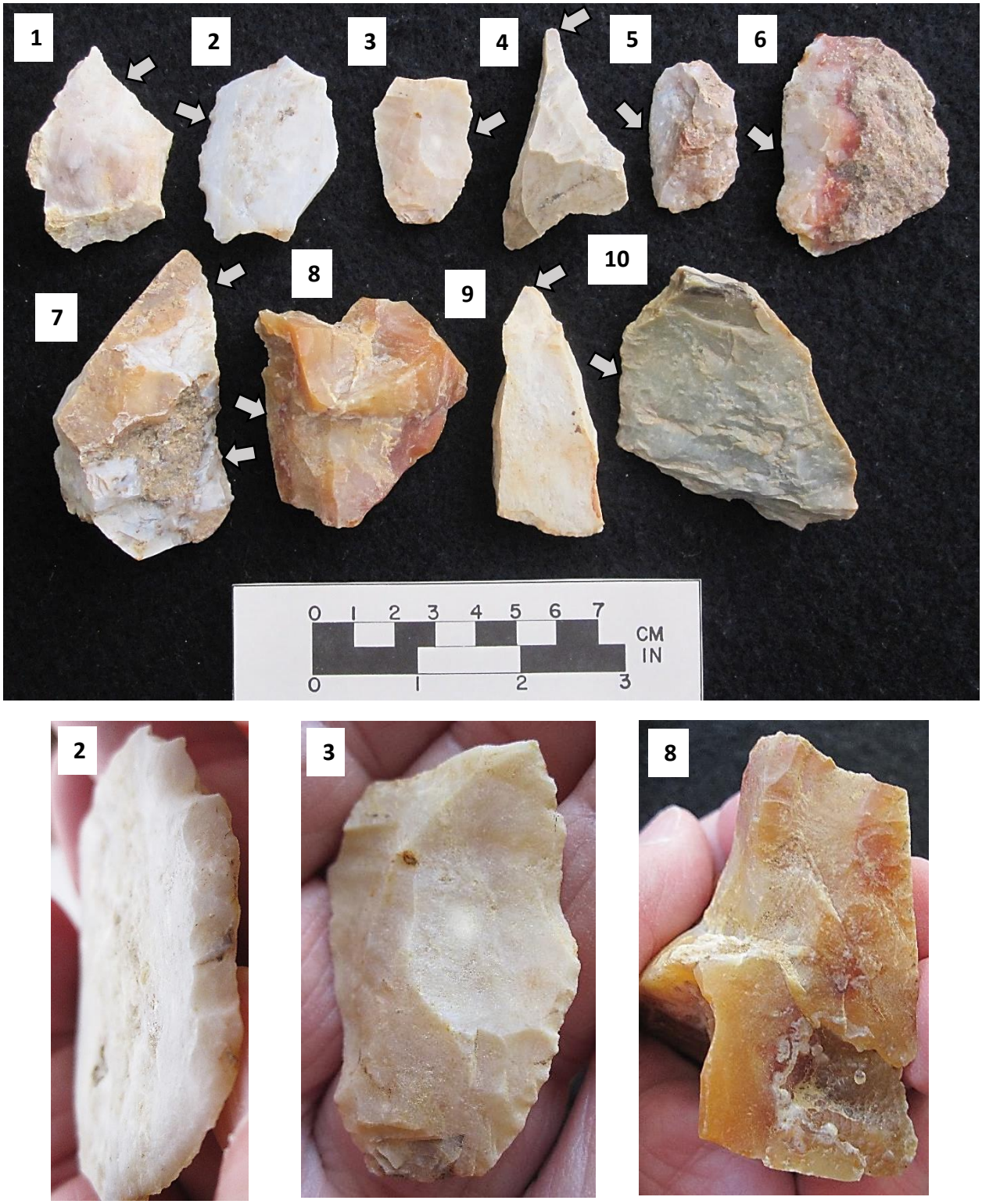


Figure 40. Brunswick County chert artifacts collected by NRS on the Greensville Creek Clovis site: **top image**, 1, 3, 6, and 10, edge-worked flakes; 2, 7, and 8, side scrapers, knives, or saws; 4 and 9, end-worked awl-like tools; 5, edge-used flake; the arrows indicate the location of trim-work or use-wear along edges. **Bottom images**, enlarged views of three of the artifacts, 2, 3, and 8, shown in the top image with matching numbers showing the edge-work on the right side of the artifact in each image. (NRS collection)

Figure 41. **Top image**, ten of 12 examples of edge-used flakes of Brunswick County chert recovered by NRS on the Greensville Creek Clovis site. **Bottom images**, enlarged views of three of the flakes shown in the top image with matching numbers 1, 7, and 10; the locations of edge-damage on these flakes from use are indicated by the arrows. (NRS collection)

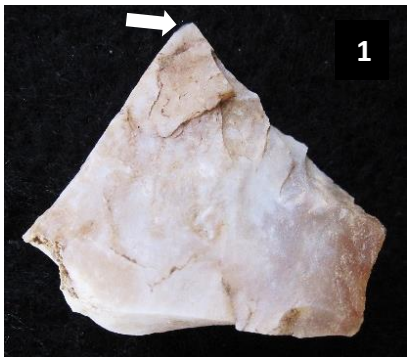


Figure 42. **Top**, Four of nine recovered snapped-flake tools with tip wear, possibly used as gravers or scoring tools for work in bone or wood. All are of the local Brunswick County chert.
At right, arrows on the enlargements of items 1 and 4 indicating the areas of use-wear. (NRS collection)

Figure 43. Examples of small, blocky, blade-like flakes and blade-like-flake fragments from prepared blade or block cores from the GCrCS; all shown are of Brunswick County chert. Where present, platforms are to the bottom. These flakes usually differ from longitudinal biface thinning flakes in thickness and in the general absence of flakes drawn from the edge across the surface. (NRS collection)

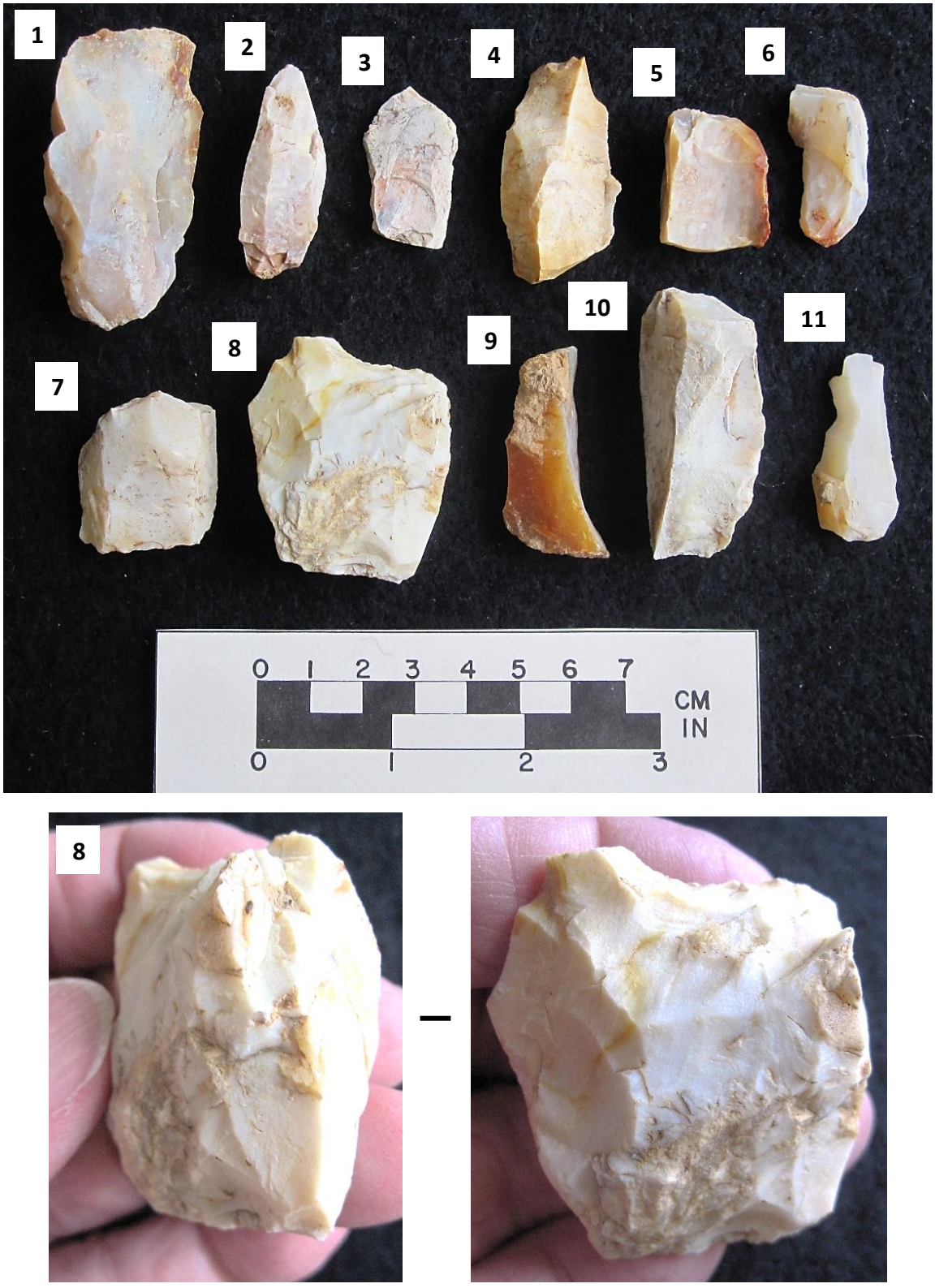


Figure 44. **Top image**, selected sample of Brunswick County chert chisel-wedges, chisel-wedge fragments, and chisel wedge spalls, all recovered on the Greensville Creek Clovis site. Shown are 5 chisel-wedges (1, 2, 3, 7, 8), 3 chisel-wedge fragments (4, 5, 10) and 3 chisel-wedge spalls (6, 9, 11) of 19 total objects related to chisel-wedges from the site. **Bottom images**, two magnified views of chisel-wedge #8 in the top image showing a side and face view. (NRS collection)

Figure 45. Four magnified views of artifact #2 of Figure 41, an expended chisel-wedge described as a "wedge core" of pinkish-white Brunswick County chert from the Greensville Creek Clovis site showing the multiple bipolar fracture surfaces forming the sides of the tool. The bottom image shows the impacted end (top) of the expended core of this chisel-wedge tool with a surface which is splintered but not crushed. This type of splintered surface is indicative of impact with a softer material such as wood or bone, but not stone. (NRS collection)

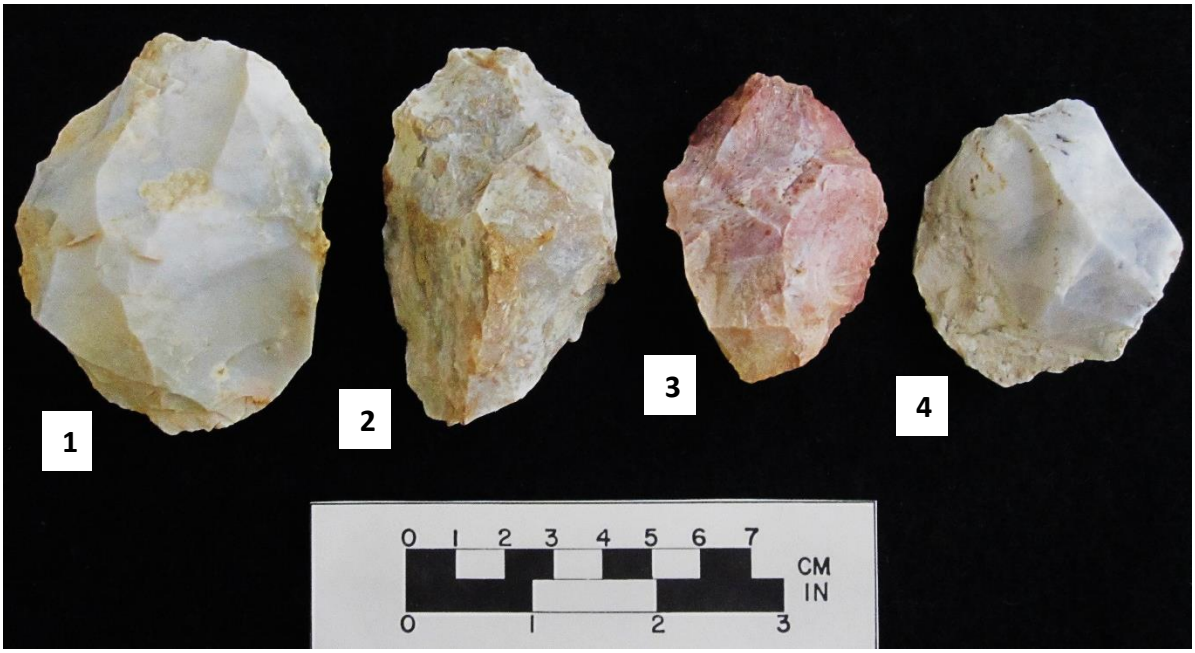


Figure 46. **Top image**, four small bifacial cores of Brunswick County chert from the Greensville Creek Clovis site. **Bottom three images**, obverse, reverse and side views of bifacial core #1 in the top image showing flake scars. The largest flakes from this core appear to have been about 50 mm in length. (NRS collection)

Figure 47. Top and side views of a circular, flat, or truncated conical core of gray-white Brunswick County chert with short, blade-like, or blocky, flakes removed around the circumference; the artifact was collected by NRS on the Greensville Creek Clovis site. (NRS collection)

Figure 48. **Left image**, Brunswick County chert conical blade core viewed from the bottom. **Right image**, the conical blade core viewed from the side. Collected by NRS on the Greensville Creek Clovis site. (NRS collection)

Figure 49. **Left image**, Gray-white BCC block core viewed from the front face. **Right image**, the block core viewed from the edge. The expended core was used as a chopper and possibly as a very large chisel-wedge. It may have been eventually discarded due to cracks or flaws. Collected by NRS on the Greensville Creek Clovis site. (NRS collection)

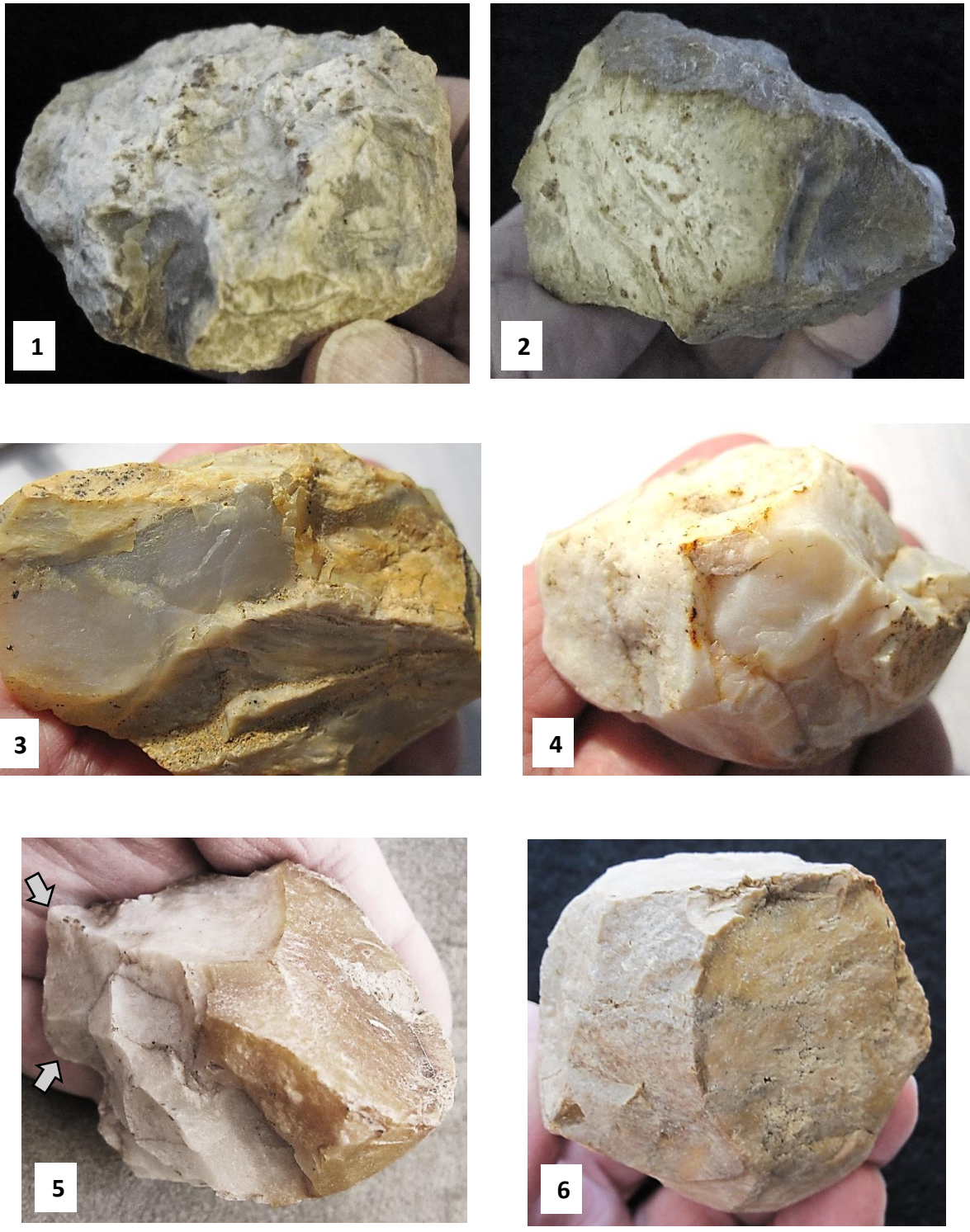


Figure 50. Small nodules of Brunswick County chert from archaeological contexts: **1** and **2**, small chert nodules with test flakes from the Terrace site close to the outcrops, Greensville County, Virginia; **3** and **4**, small chert nodules with test flakes from the deposit on Greensville Creek in Brunswick County, Virginia; **5**, small chert nodule partly worked into a chopper (arrows at squared-off cutting edge of the tool) from the Greensville Creek Clovis site, Brunswick County, Virginia, and identical to some found on the Williamson Clovis site in Dinwiddie County, Virginia; **6**, small nodule core of jasper-like Brunswick County chert with test flakes from the Greensville Creek Clovis site in Brunswick County, Virginia. (all NRS collection)

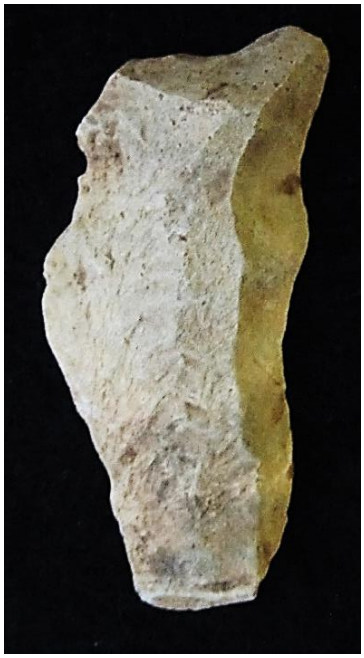


Figure 51. Four argillite and a green tuff artifact from the GCrCS Clovis assemblage: **top two images**, an argillite core fragment or "chunk" from two different angles; **middle two images**, left, two argillite core blades and the tip of a very early stage Clovis biface of a similar tuff-like stone; right image, enlarged view of the middle artifact in the left image, a large, well-made core blade or blade-like flake; **bottom image to right**, enlarged view of an as-found, recently broken argillite small core fragment, which is 32 mm wide, exposing the grainy, dark black structure of the unweathered inside portion of the artifact; the deeply weathered gray-green surface portion or rind, approximately 1 mm in thickness, is evident in this cross-section view. (all NRS collection)

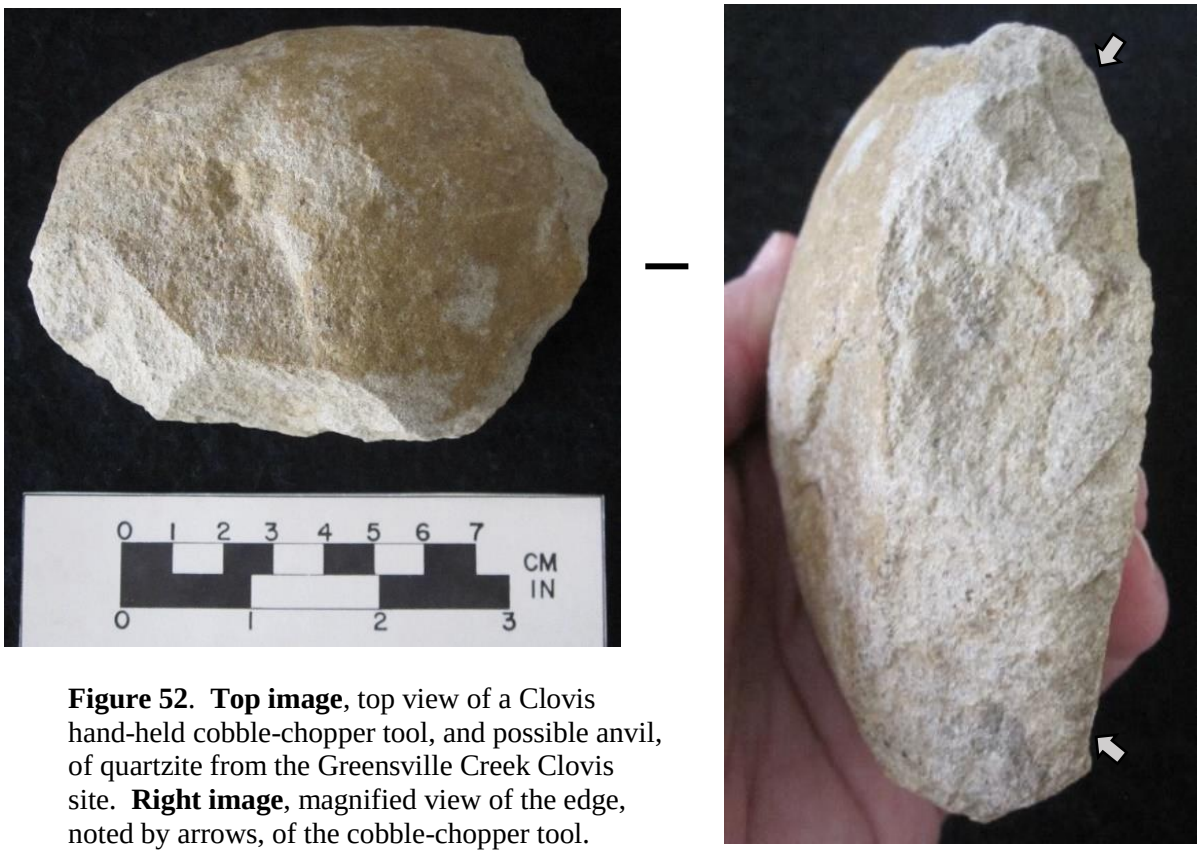


Figure 52. **Top image**, top view of a Clovis hand-held cobble-chopper tool, and possible anvil, of quartzite from the Greensville Creek Clovis site. **Right image**, magnified view of the edge, noted by arrows, of the cobble-chopper tool. (NRS collection)

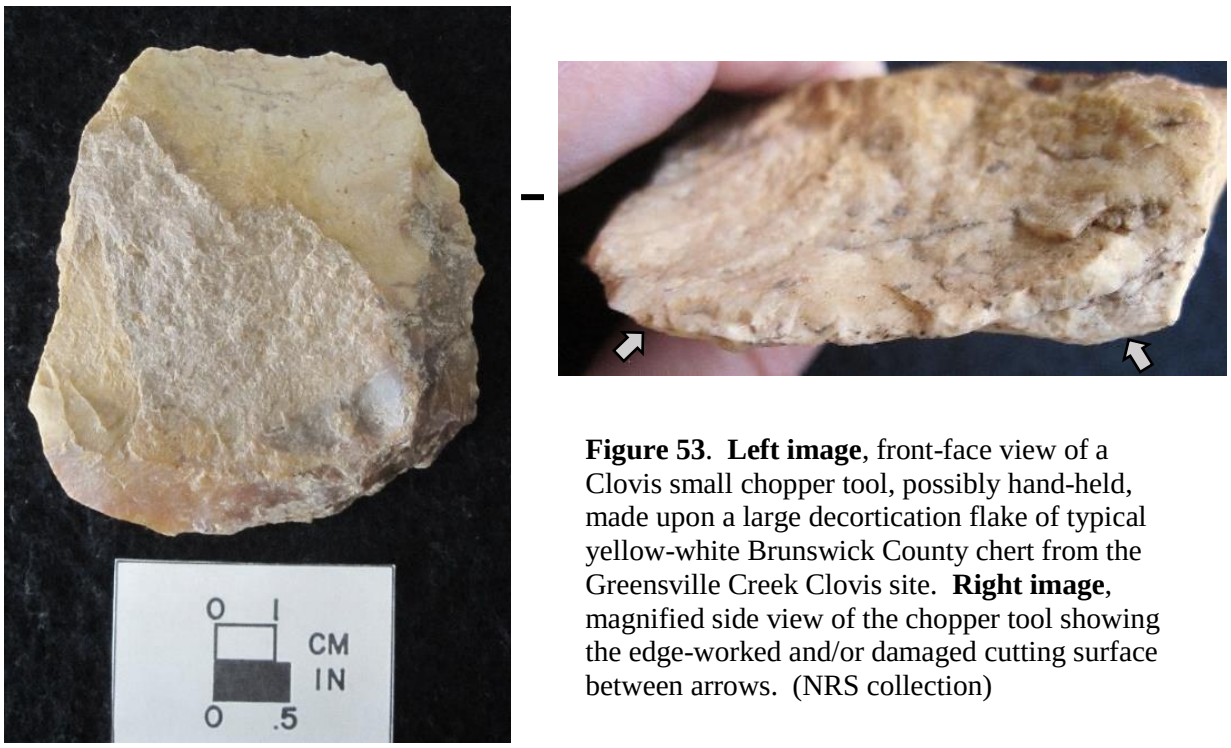


Figure 53. **Left image**, front-face view of a Clovis small chopper tool, possibly hand-held, made upon a large decortication flake of typical yellow-white Brunswick County chert from the Greensville Creek Clovis site. **Right image**, magnified side view of the chopper tool showing the edge-worked and/or damaged cutting surface between arrows. (NRS collection)

Figure 54. Large 3.5 kg hammerstone of gray-white Brunswick County chert (BCC) from the Greensville Creek Clovis site: **top image**, side view of the hammerstone; **bottom images,** left, end view of the hammerstone showing the battered surface of the tool, and right, the typical Brunswick County chert orangish-tan cortex surface remaining on one face of this tool. This tool was likely made upon a very large expended or discarded core. (NRS collection)

Figure 55. Hammerstone of yellow-white Brunswick County chert from the Greensville Creek Clovis site: **top image**, side view of the hammerstone; **bottom image**, end view of the hammerstone showing the battered surface of the tool. This tool was likely made upon an expended or discarded core. (NRS collection)

Figure 56. The Terrace site in Greensville County, Virginia as seen in 2010 looking east across the large agricultural field that produced chert cores, flakes, and tools thought to be Clovis related. This location is near a spring and is high above Greensville Creek about 1200 feet to the west (see Figure 1, inset 4).

Figure 57. Brunswick County chert cores and core fragments of the typical size recovered on that portion of the Terrace site shown in Figure 56 above. Most of these discarded artifacts have some remaining surface cortex, and they reflect the small size and irregular shape of the quarry nodules and platelets upon which they were made. (NRS collection)

Figure 58. Terrace site biface and biface-related artifacts: **1**, **2**, both faces of a thin, late stage quartzite Clovis preform over-shot (fluting) failure, 1, obverse face with flute scar, 2, reverse face with lateral over-face flake scar; **3**, late stage, thin preform tip of yellow Brunswick County chert (BCC); **4**, base of a preform on a thin flake of very translucent green BCC; **5** two end thinning (channel flakes) of jasper and quartzite; **6**, two early stage biface fragments of BCC recycled into other tools, left, a snapped biface graving/scoring tool, right, an edge-used tip fragment; **7**, **8**, two biface snapped-base fragments, top, gray-white BCC, bottom, green BCC; **9**, large BCC biface, or bifacial point preform, discard (crack at bottom); **10**, two early stage BCC biface edge fragments possibly used as expedient cutting or scraping tools; **11**, both faces of part of a BCC biface over-shot flake; **12**, a BCC discarded thick preform or an expended bifacial core; **13**, a BCC bifacial core; **14**, both faces of a BCC biface with a snapped-base platform at bottom, likely for removal of the remaining obverse cortex. (NRS collection; all same scale)

Figure 59. Artifacts typical of Terrace site "expedient" tools most of which, except for numbers 1 and 2, were likely made for a single-time use on site and then discarded: **1**, a curated end scraper apparently recycled upon a flake-knife of metarhyolite; **2**, a curated end scraper of Brunswick County green chert made upon an irregular flake; **3**, an end scraper made from a small, thick, core fragment of Brunswick County chert; **4**, a Brunswick County chert end-scraper-like tool on an irregular cortex flake; **5** and **6**, Brunswick County chert small edge-worked flakes; **7** and **7a**, a side scraper of jasper-like Brunswick County chert with remaining cortex, a well formed denticulate or graver spur is located on the right edge as shown in image 7a (image 7a is not to scale); **8**, a Brunswick County chert edge-worked and notched flake with remaining cortex; **9**, a Brunswick County chert edge-worked core-fragment side scraper; **10**, a core fragment of yellow-white Brunswick County chert with a thin, worked edge (between arrows) possibly used as a knife; **11**, a thick bipolar core of blue-white Brunswick County chert, possibly recycled as a chisel-wedge(?); **12**, a bipolar core or chisel-wedge(?) of gray-green Brunswick County chert with remaining cortex; **13**, a Brunswick County chert pointed flake heavily edge-used as a knife or saw; **14**, a Brunswick County chert pointed-flake heavily end-used as a drill, piercer, or graver, and edge-used as a knife or saw; and **15**, an Awl, drill, perforator, or piercer of Brunswick County chert. The worked edge, or used edge or tip of these tools, except for 1, 2, 3, 7, 11, 12 and 15, is indicated by the presence of an arrow, or arrows, in the images. (All were collected by NRS, and all are from the NRS Terrace site collection; all are to the same scale.)

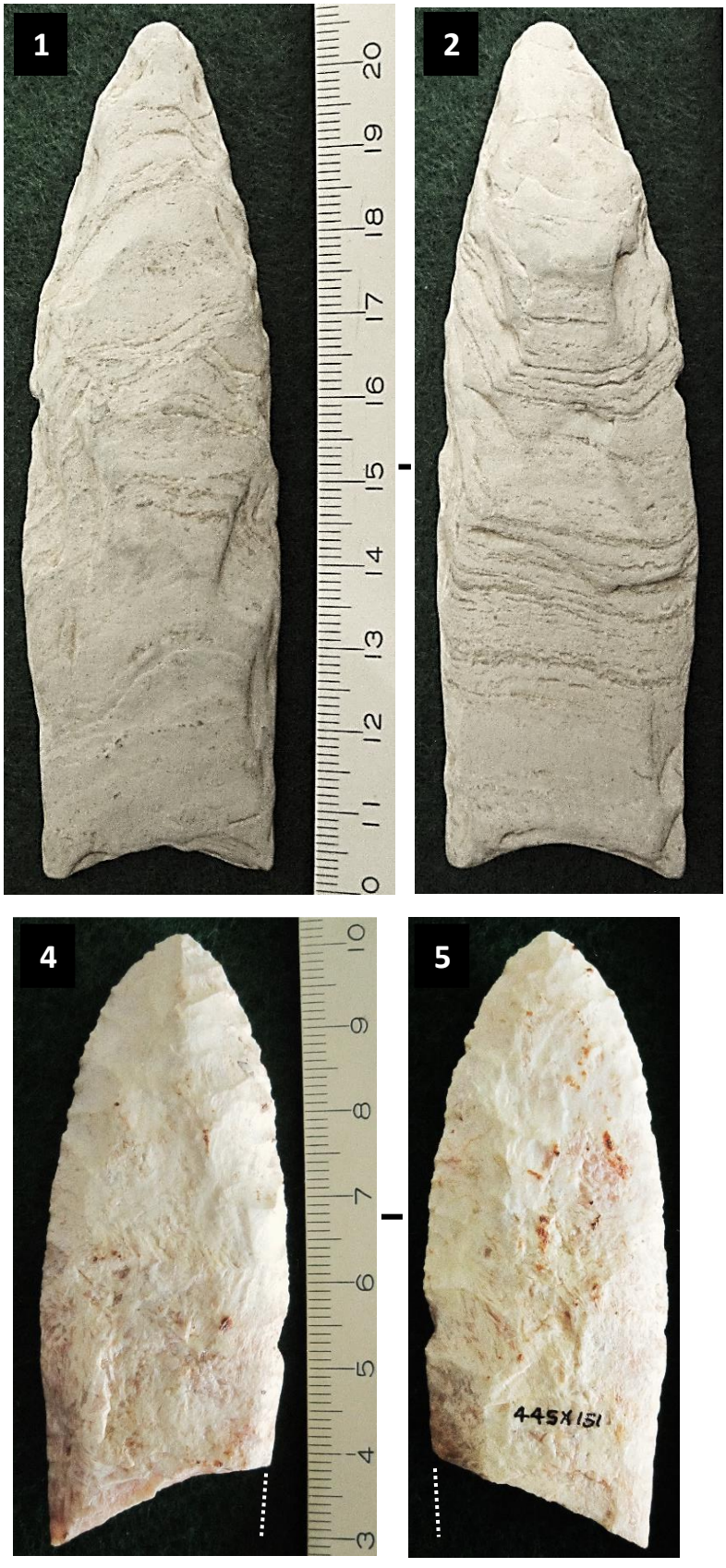
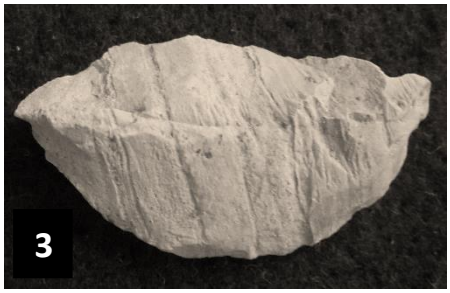
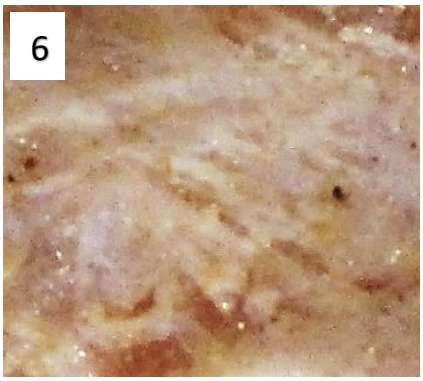


Figure 60. Images **1**, **2**, **4**, and **5**, the two Clovis points found near each other on the old Baskerville Farm site in Sussex County, Virginia at an apparent Clovis kill site (Scale is cm). Image **3**, snapped base of a point preform of the identical material to Clovis point 1-2, but found on the Greensville Creek Site in Brunswick County, Virginia. Image **6**, the micro-structure of a typical flake of BCC from the Greensville Creek Clovis site, which is identical to image **7**, the micro-structure of Clovis point 4-5 found on the old Baskerville Farm site. The same group of people were likely at both sites. (NRS collection)





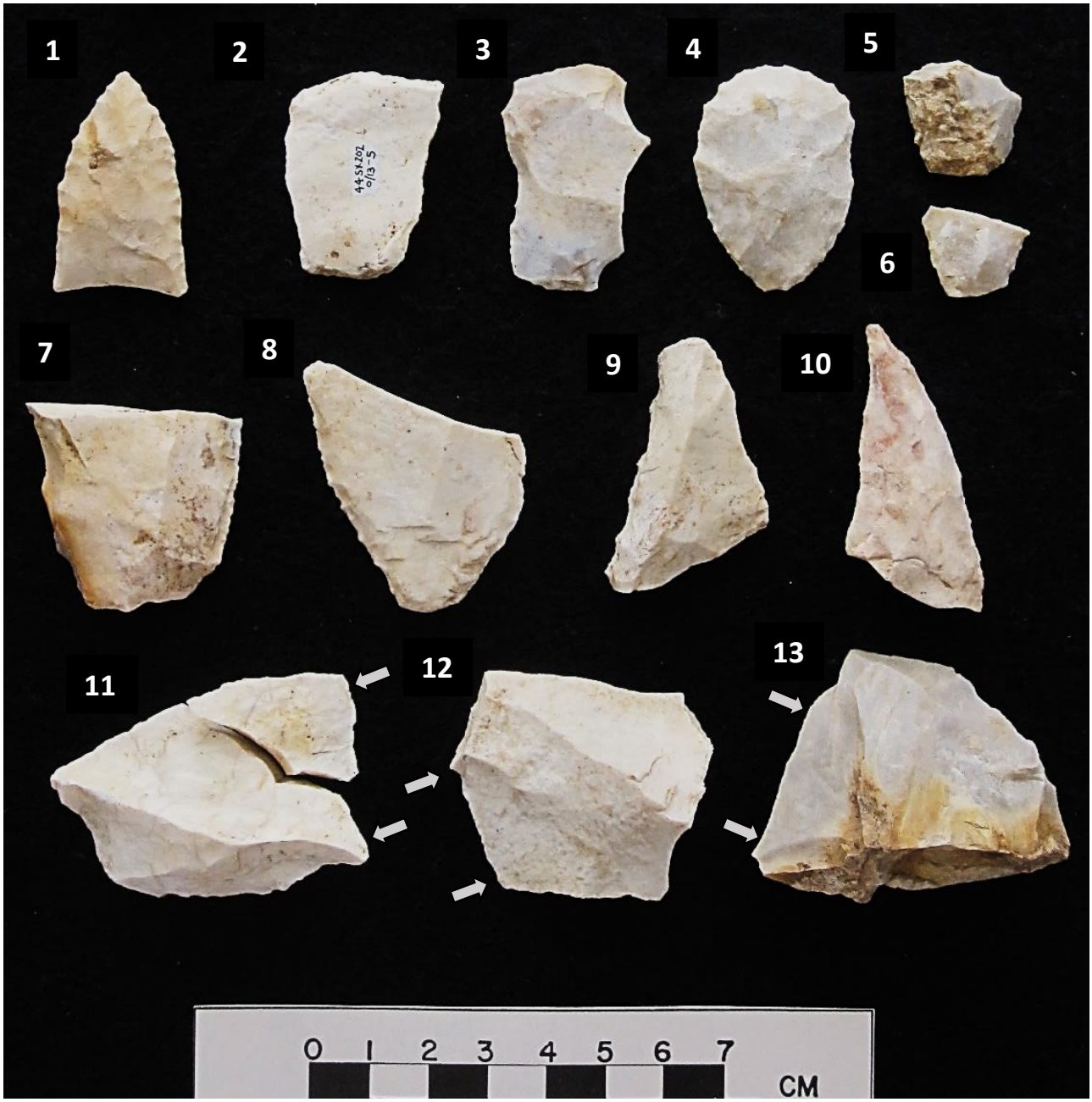


Figure 61. Examples of Clovis-age artifacts of typical yellow-white and gray-white Brunswick County chert recovered from the excavations on the Cactus Hill Site (44SX202) in Sussex County, Virginia (Figure 5, location 4): **1**, Clovis point (Lithic Casting Laboratory epoxy cast); **2**, **3**, **4**, **5** and **6,** end scrapers; **7**, **8**, **9**, and **10**, side scrapers (item 8 was excavated adjacent to the Clovis hearth that produced a radiocarbon date of 10,920+/-250 on southern hard pine charcoal); **11**, Clovis preform snapped-base (two fragments excavated in the same unit and level together) edge-worked into a knife in the location between the arrows (also see this artifact viewed from three sides in Figure 34, item A); **12**, core fragment worked along the edge into a knife (edge-worked between arrows); **13**, core fragment, edge-used between arrows. (NRS Collection except #6, an epoxy cast of a point from the Tim Shelor Family collection that was recovered at Cactus Hill in a private excavation made there in the early 1990s.)

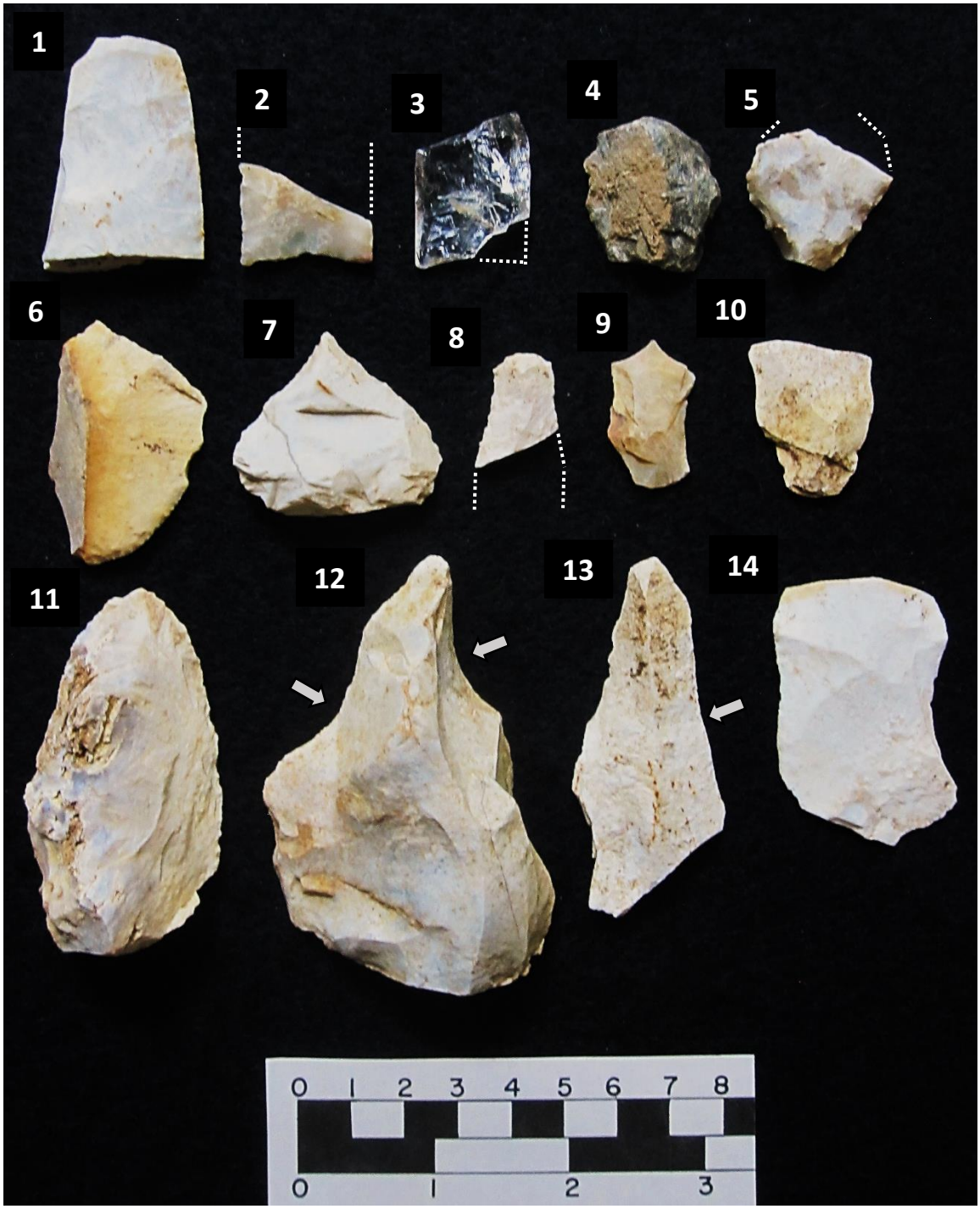


Figure 62. Examples of artifacts, mostly of Brunswick County chert (BCC), from the J. F. Slade Farm site (44SX7) small Clovis camp in Sussex County, Virginia along the Nottoway River near the Town of Stony Creek: **1**, Clovis point tip fragment of BCC; **2**, Clovis point basal end of Williamson chert; **3**, Clovis point basal end of quartz crystal; **4**, end scraper of BCC; **5**, end scraper fragment of BCC; **6**, flake knife of BCC; **7**, piercer of BCC; **8**, broken tip of a chisel-graver-like tool of BCC, similar to some found on the Williamson Clovis site; **9**, a snapped-flake graver with tip wear of BCC; **10**, a biface end-thinning flake of BCC; **11**, a side scraper/saw/knife of BCC; **12**, a large perforator on a core fragment of BCC with heavily worn concavities/notches (at arrows); **13**, an edge-used (on side at arrow) blade-like flake of BCC; and **14**, a thin flake knife on a large biface end-thinning flake of BCC. (NRS Collection, artifacts were surface recovered and excavated) (Scale is shown in cm over inches.)

Figure 63. **Top image**, examples of Early, Middle, and Late Archaic period projectile points and point fragments, and one Early Woodland period point (bottom row right), found by NRS in Brunswick and Greensville counties, Virginia near Greensville Creek, and from within 100 yards to about one mile of the Greensville Creek Clovis site concentration of artifacts. Many of these points were recovered on the Terrace site about 0.8 miles north of the Greensville Creek Clovis site. The lithic materials by number recovered are: quartz, 3; quartzite, 6; argillite, 1; rhyolite, 2; and chert, 2. **Bottom image**, enlarged view of the Early Archaic Palmer or Kirk point in 1 above, which is of Fall Zone chert with small pyrite crystals, recovered on an Archaic period site about one mile east of the Greensville Creek Clovis site.

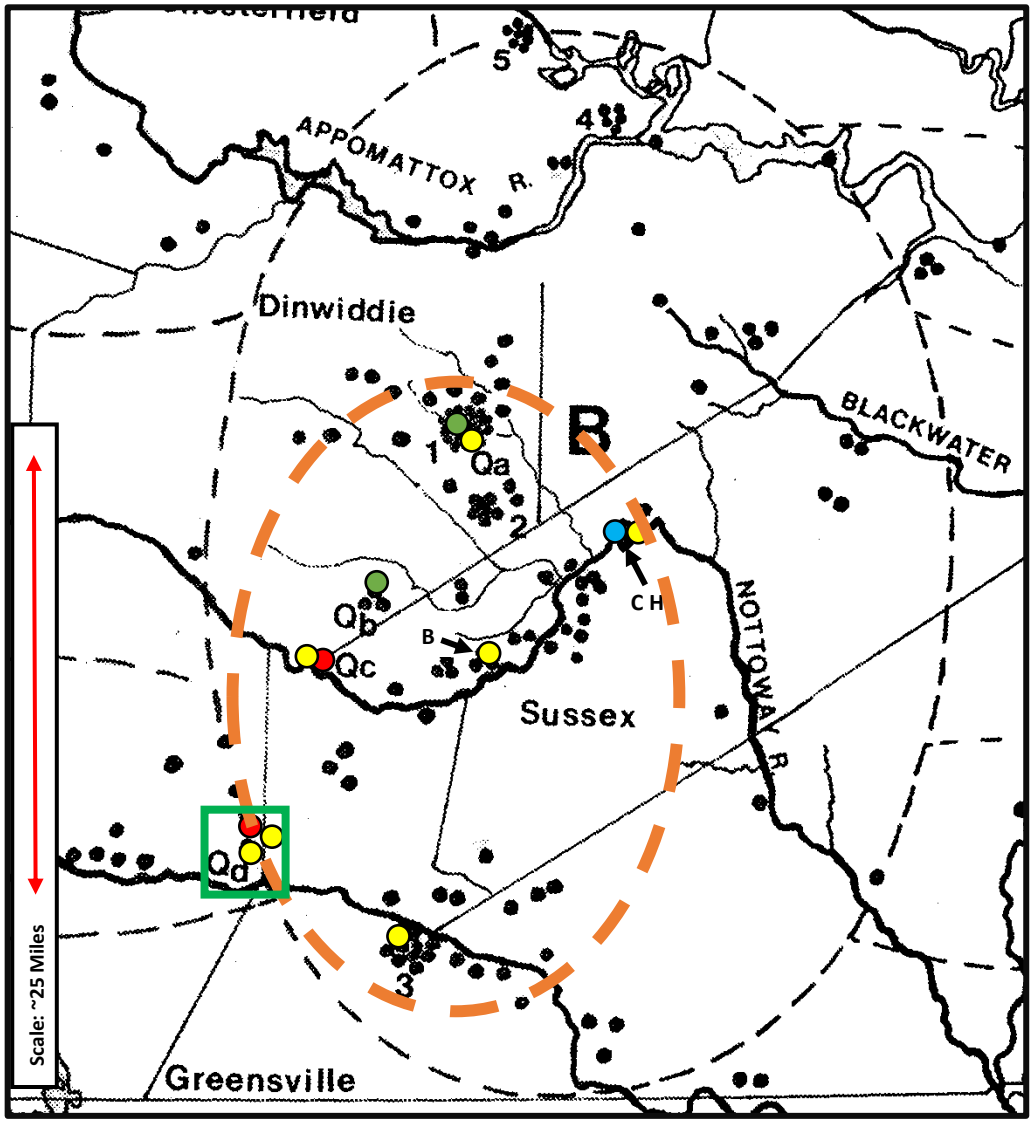


Figure 64. The Virginia Clovis macroband settlement area B in southeastern Virginia primarily in the counties of Greensville, Brunswick, Sussex, Southampton, Dinwiddie, and Prince George as defined within the black dashed-line oval. The drawing is from the 1992 publication: Nottoway River Survey, Part-I, Clovis Settlement Patterns, Figure 97, page 154. This figure is shown with the addition of a brown dashed-line oval representing a local Clovis landscape of approximately 875 square miles (25 by 35 miles) encompassing local tool-stone quarries, Qa through Qd. The green rectangle contains the Greensville Creek Clovis activity area. The three largest Clovis sites as known in the general area in 1992 are designated 1 (the Williamson site), 2 (the Conover site), and 3 (the Greensville County Clovis site). Red circles are the Brunswick County chert quarry (Qd) and the Mitchell chert quarry (Qc), which produce similar types of silicified fault breccia generally referred to as Brunswick County chert; Green circles are the Williamson chert quarry (Qa) and the Bolsters Store chert quarry (Qb), which produce a different type of chert; and the blue circle (CH with black arrow) is the Cactus Hill site quartzite cobble quarry. The yellow circles are Clovis sites that have produced artifacts of the Brunswick County quarry-like chert, or the similar Mitchell quarry-like chert, at or some distant from these quarries. These sites are from top: 1, the Williamson site; CH with black arrow, the Cactus Hill site; B with black arrow, the Baskerville Farm site; Qc, the Mitchell Quarry and Clovis camp site; Qd, two nearby locations, the Greensville Creek site and the Terrace site; and, 3, the Greensville County Clovis hunting camp site. The small black dots represent reported fluted point finds, mostly Clovis.

ATTACHMENT

Petrographic Report

Analysis of Siliceous Fault Breccia Samples from the Brunswick County, Virginia Greensville Creek Native American Tool-Stone Quarry and Associated Sites

(Spectrum Petrographics, Inc. Internal Report Designation 0KS*)

August 20, 2017

Prepared for:
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Spectrum Petrographics, Inc.

(*SP Report 0KS Modified by NRS through Shortening, Addition of Hand-Sample and Sectioned-Sample Images, and a few Editorial Corrections and Clarifications)

Summary Comments

All of these samples except NRS3 (S1,S2) are silicified fault breccias. Some also are described in more specific terms as siliceous schist, and as preferred by NRS "chert" or "Brunswick County chert." All samples but NRS3 (S1,S2) formed by the deposition of silica and calcite in open spaces during heating, boiling, and subsequent cooling of a hydrothermal fluid. Most samples have also experienced later ductile deformation, likely during regional dynamothermal metamorphism.

Sample NRS3 (S1,S2) is a ductily deformed extremely fine-grained rock of probable sedimentary origin. It did not form in a fault zone.

Key to Petrographic and Photomicrographic Descriptions - v. 170118

Clay minerals common in altered rocks must often be identified by X-ray diffraction either because their optic properties are not diagnostic or because they are too fine grained to be reliably identified by optical methods. The term "clay" is used herein to denote fine grained phyllosilicates in general. Under ideal conditions, it is often possible to optically discriminate between 4 major groups: kaolinite, smectite, mica (including illite), and chlorite. This is done whenever conditions permit.

The term "sericite" is applied to fine grained colorless phyllosilicates that show upper 2nd order maximum interference colors. These could include muscovite, illite, paragonite, lepidolite,margarite, clintonite, pyrophyllite, and talc. The term "intermediate clay" is applied to fine grained very pale or colorless phyllosilicates that show upper 1st order maximum interference colors. These are probably dominated by chlorite, smectite, and mixed-layer illite/smectite.

The term "opaques" is used to refer to all materials opaque (and sometimes semi-opaque)to transmitted light. The term "FEOH" is herein used to indicate fine grained, yellowish to reddish brown, earthy materials of varying opacity in transmitted light. FEOH is probably mostlyFe oxy-hydroxides but may sometimes include sphalerite, realgar, orpiment, jarosite, a number of Mn oxy-hydroxides, and organic matter.

A question mark after a rock or mineral name in a petrographic description means that there is uncertainty about the identification of that rock or mineral.

Particle size distributions are given as (A-B μm), where A and B are the median andlargest particle sizes, respectively, in microns. A question mark (?) in the position of A or B indicates that the value of A or B was indeterminate, probably because of excessively large or small particle size or statistically insignificant numbers of particles.

Mineral abundances are visual estimates for an entire slide. For multi-lithologic materials (cuttings, etc...), mineralogy, textures, and alteration are described only for the dominant lithology.

Section preparation codes are as follows: (1) Format: 27 x 46 mm; 51 x 76 mm; or 1" round; (2) Finish: standard lapping (STD); or polished (POL); (3) Stains: sodium cobaltinitrite (SCN); alizarin red S + potassium ferricyanide (ARSPF); and barium chloride + potassium rhodizonate (BCPR); and (4) Cover: none; or permanent Loctite acrylic (PLA).

Photomicrograph captions contain the following items of information in consecutive order separated by forward slashes: (1) sample identifier; (2) JPG image file name composed of concatenated [job identification code + sequence number]; (3) illumination type; and (4) field of view (FOV). For illumination types: "PPL" indicates plane-polarized light; "XPL indicates cross- polarized light; "R" indicates reflected light. "550" means that a 550-nanometer wavelength plate was inserted in the light path. "C" indicates that the substage condenser was in (sometimes used for Fe-oxides). "O" indicates oblique incident illumination. These various illuminations can be combined. "CON" indicates conoscopic illumination. POL means that a polarizing filter was used with the lens, and DAY means the sample was photographed in diffused daylight. Unless

otherwise noted, sequential images are taken in XPL and PPL of a single field of view.

Features on photomicrographs are indicated by the number of the feature in the ALTERATION section of the text or by a mineral name abbreviation, e.g., **Q**uartz, **P**lagioclase, **K**-feldspar, **ser**icite, **b**io**t**ite, **fe**rroan **c**al**c**ite, **act**inolite.

Igneous rock classifications are according to IUGS (1973; 1979); sandstones are classifiedaccording to McBride (1963); mud rocks are classified according to Picard (1971); carbonates are classified according to Folk (1959); and metamorphic rocks classified according to IUGS (Fettes and Desmons, 2011).

The term "protolith" is used for the interpreted primary lithology. The term "precursor" is used for a secondary lithology from which the current rock was derived.

All samples were stained for K-feldspar, but none was found. They were all then polished, but no opaque minerals were observed.

SAMPLE # NRS1/S1,S2,S3 August 20, 2017

ROCK NAME SILICEOUS SCHIST -- probably formed by (1) hydrothermal precipitation of quartz + carbonate in open spaces in a fault zone; (2) minor cataclastic and hydrothermal brecciation; and (3) ductile deformation, probably during regional dynamothermal metamorphism.

MINERALS Quartz (99%) + FEOH (1%).

TEXTURES This sample formed in two main phases, probably separated by a significantamount of geologic time: (1) hydrothermal silicification of a brittle fault zone;and (2) ductile deformation of the silicified fault zone during regional dynamothermal metamorphism.

Silicification of the fault zone probably occurred in the following steps: (1) cataclastic (brittle) brecciation related to minor fault movement resulting in; (2) sudden reduction of fluid confining pressure from lithostatic to hydrostatic, resulting in boiling and hydrothermal (brittle) brecciation; (3) direct precipitation of quartz + calcite in open spaces from the boiling to near-boiling hydrothermal fluid followed by (4) replacement of bladed calcite by quartz as the hydrothermal pulse cooled. Such silicification would episodically self-seal the fault zone so that confining pressure would rebuild from hydrostatic to lithostatic in advance of the next fault movement.

Ductile deformation, probably during much later regional dynamothermal metamorphism, has rotated linear features into a moderately directed fabric and destroyed most of the original features of the fault zone phase and giventhe rock its current appearance.

ALTERATION Alteration features in relative chronological order from oldest to youngest are:

(1) hydrothermal deposition of quartz in open spaces; (2) hydrothermal deposition of calcite by boiling of the fluid in response to fault rupture; (3) replacement of calcite by quartz as the fluid cooled; and (4) much later ductiledeformation of the silicified fault zone during regional dynamothermal metamorphism.

SECTIONING Format: 51 x 76mm Finish: POL
Stains: SCN (center 2/3) + ARSPF (none)
Cover: None

IMAGES (None of those identified below are in this copy of the report except: OKS 003 and 0KS 004)

NRS1/S1 0KS_001.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of strongly lineated fabric formed by rotation of elongate silicified calcite crystals during ductile deformation.

NRS1/S1 0KS_002.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_001.jpg

NRS1/S1 0KS_027.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS1/S1 0KS_028.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_027.jpg

NRS1/S2 0KS_003.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of strongly lineated fabric formed by rotation of elongate silicified calcite crystals during ductile deformation.

NRS1/S2 0KS_004.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_003.jpg

NRS1/S2 0KS_029.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST

showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS1/S2 0KS_030.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_029.jpg

NRS1/S3 0KS_005.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of strongly lineated fabric formed by rotation of elongate silicified calcite crystals during ductile deformation.

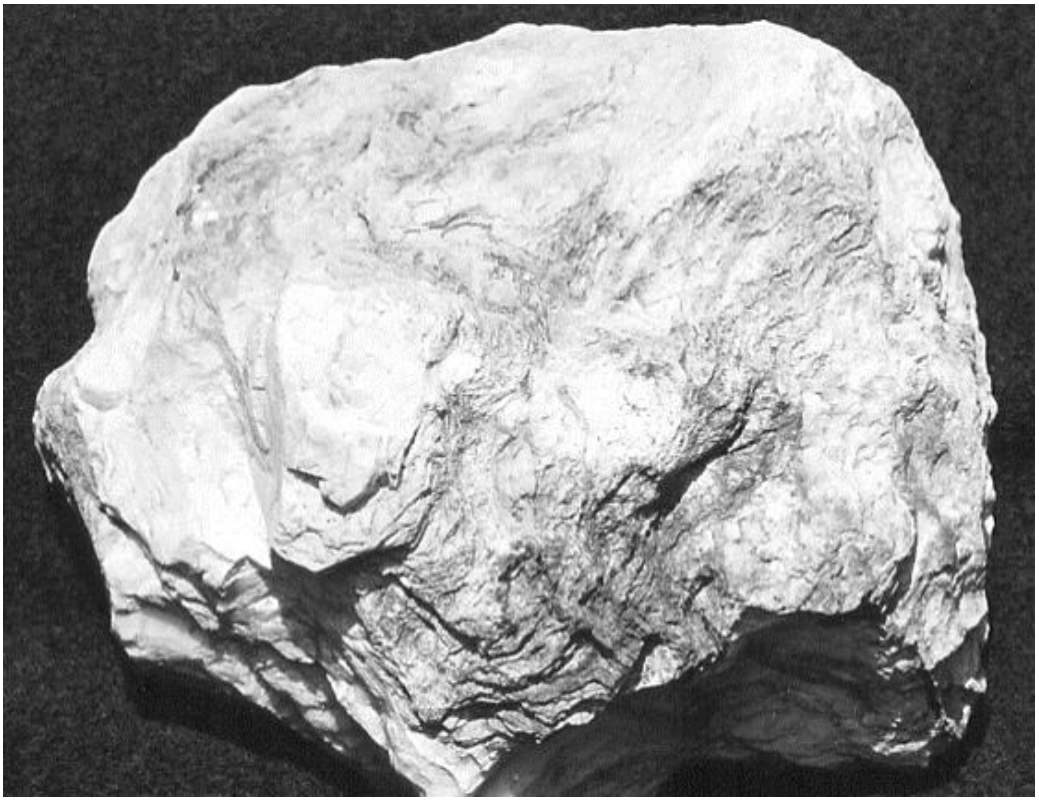
NRS1/S3 0KS_006.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_005.jpg

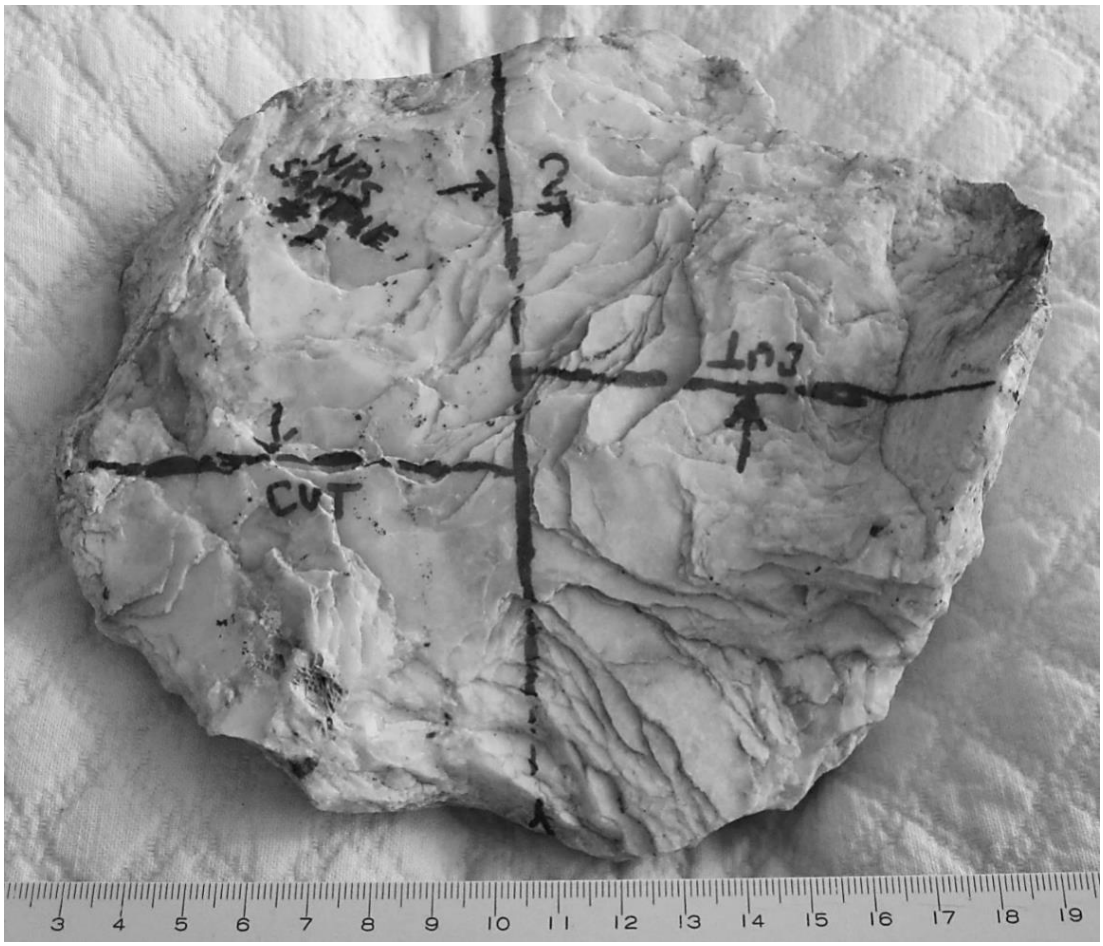
NRS1/S3 0KS_031.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST

showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated and folded during ductile deformation.

NRS1/S3 0KS_032.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_031.jpg

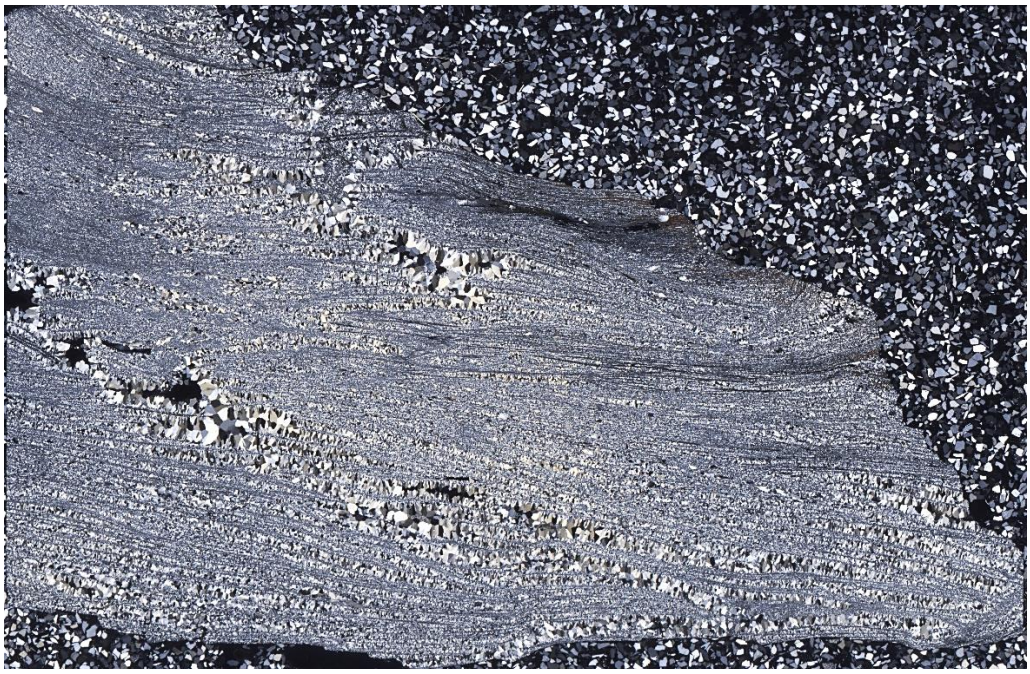
Images of NRS Sample #1: Siliceous Schist (Brunswick County Chert)





NRS Sample #1

NRS Sample #1



NRS Sample #1, NRS1/S2 0KS_003.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of strongly lineated fabric formed by rotation of elongate silicified calcite crystals during ductile deformation.

NRS Sample #1, NRS1/S2 0KS_004.jpg/PPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of strongly lineated fabric formed by rotation of elongate silicified calcite crystals during ductile deformation.

SAMPLE # NRS2/S1,S2,S3 August 20, 2017

ROCK NAME SILICEOUS FAULT BRECCIA -- probably formed by (1) hydrothermal precipitation of quartz + carbonate in open spaces in a fault zone; and (2) minor cataclastic and hydrothermal brecciation. This sample is very important because it has not experienced ductile deformation and thus clearly shows the sample's origin.

MINERALS Quartz (99%) + FEOH (1%) + sericite (<1%).

TEXTURES Silicification of the fault zone probably occurred in the following steps: (1) cataclastic (brittle) brecciation related to minor fault movement resulting in; (2) sudden reduction of fluid confining pressure from lithostatic to hydrostatic, resulting in boiling and hydrothermal (brittle) brecciation; (3) direct precipitationof quartz + calcite in open spaces from the boiling to near-boiling hydrothermalfluid followed by (4) replacement of bladed calcite by quartz as the hydrothermal pulse cooled. Such silicification would episodically self-seal the fault zone so that confining pressure would rebuild from hydrostatic to lithostatic in advance of the next fault movement.

ALTERATION Alteration features in relative chronological order from oldest to youngest are: (1) hydrothermal deposition of quartz in open spaces; (2) hydrothermal deposition of calcite by boiling of the fluid in response to fault rupture; (3)replacement of calcite by quartz as the fluid cooled; and (4) minor brittle brecciation (probably renewed movement on the fault.

SECTIONING Format: 51x76 mm Finish: POL
Stains: SCN (center 2/3) + ARSPF (none)
Cover: None

IMAGES (None of those identified below are in this copy of the report except: 0KS 009 and OKS 010)

NRS2/S1 0KS_007.jpg/XPL/FOV = 27 x 46 mm SILICEOUS FAULT BRECCIA showing typical appearance of coarsely crystalline euhedral quartz and silicifiedcarbonate crystals in a sample not affected by ductile deformation.

NRS2/S1 0KS_008.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_007.jpg

NRS2/S1 0KS_033.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS FAULT

BRECCIA showing typical appearance of coarsely crystalline euhedral quartz and silicified carbonate crystals in a sample not affected by ductile deformation.

NRS2/S1 0KS_034.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_033.jpg

NRS2/S2 0KS_009.jpg/XPL/FOV = 27 x 46 mm SILICEOUS FAULT BRECCIA showing typical appearance of coarsely crystalline euhedral quartz and silicified carbonate crystals in a sample not affected by ductile deformation.

NRS2/S2 0KS_010.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_009.jpg

NRS2/S2 0KS_035.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS FAULT

BRECCIA showing typical appearance of coarsely crystalline euhedral quartz and silicified carbonate crystals in a sample not affected by ductile deformation.

NRS2/S2 0KS_036.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_035.jpg

NRS2/S3 0KS_011.jpg/XPL/FOV = 27 x 46 mm SILICEOUS FAULT BRECCIA showing typical appearance of coarsely crystalline euhedral quartz and silicified carbonate crystals in a sample not affected by ductile deformation.

NRS2/S3 0KS_012.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_011.jpg

NRS2/S3 0KS_037.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS FAULT

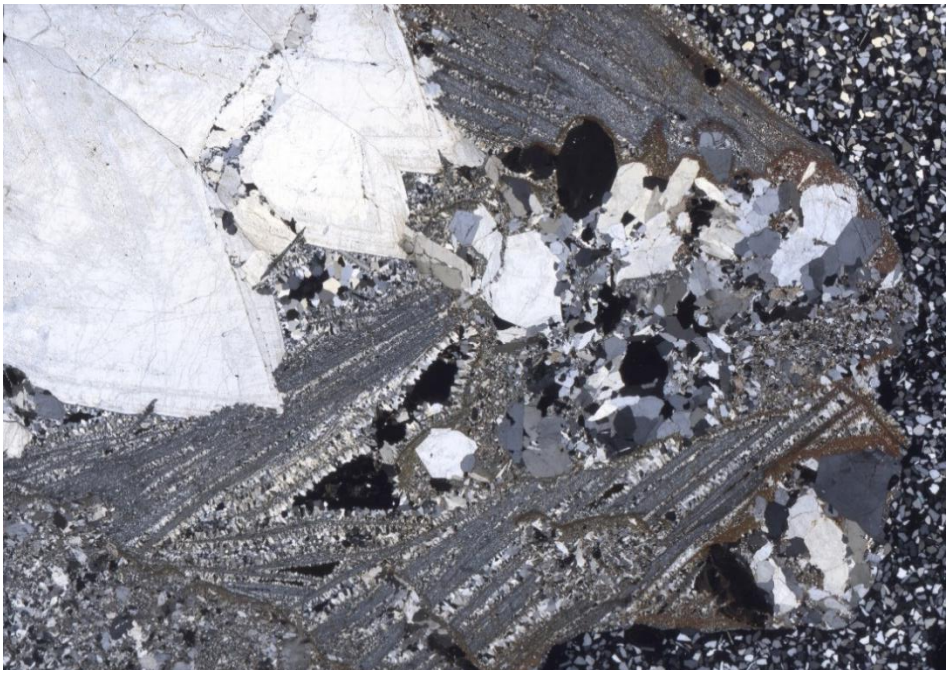
BRECCIA showing typical appearance of silicified carbonate crystals in a sample not affected by ductile deformation.

NRS2/S3 0KS_038.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_037.jpg

Images of NRS Sample #2: Siliceous Fault Breccia

NRS Sample #2

NRS Sample #2



NRS Sample #2, NRS2/S2 0KS_009.jpg/XPL/FOV = 27 x 46 mm SILICEOUS FAULT BRECCIA showing typical appearance of coarsely crystalline euhedral quartz and silicified carbonate crystals in a sample not affected by ductile deformation.

NRS Sample #2, NRS2/S2 0KS_010.jpg/PPL/FOV = 27 x 46 mm SILICEOUS FAULT BRECCIA showing typical appearance of coarsely crystalline euhedral quartz and silicified carbonate crystals in a sample not affected by ductile deformation.

SAMPLE # NRS3/S1,S2 August 20, 2017

ROCK NAME CHLORITE-SERICITE-QUARTZ SCHIST -- probably formed by ductile deformation of a very fine grained sedimentary (?) protolith.

MINERALS Quartz (39%) + sericite (39%) + chlorite (15%) + leucoxene (4%) + FEOH (2%) + clinozoisite (1%).

TEXTURES Ductile deformation has produced a moderately directed fabric.

ALTERATION Alteration features in relative chronological order from oldest to youngest are: (1) ductile deformation during regional dynamothermal metamorphism; and (2) veinlets of quartz + chlorite + FEOH.

SECTIONING Format: 51 x 76 mm Finish:

POL Stains: SCN (center 2/3) + ARSPF (none)
Cover: None

IMAGES (None of those identified below are in this copy of the report except: 0KS 13 and OKS 14)

NRS3/S1 0KS_013.jpg/XPL/FOV = 27 x 46 mm CHLORITE-SERICITE-QUARTZ SCHIST showing typical appearance.

NRS3/S1 0KS_014.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_013.jpg

NRS3/S1 0KS_039.jpg/XPL/FOV = 0.96 x 1.40 mm CHLORITE-SERICITE-QUARTZ SCHIST showing typical appearance of lighter sericite-rich domains and darker chlorite-rich domains.

NRS3/S1 0KS_040.jpg/PPL/FOV = 0.96 x 1.40 mm Same view as0KS_013.jpg

NRS3/S2 0KS_015.jpg/XPL/FOV = 27 x 46 mm CHLORITE-SERICITE-QUARTZ SCHIST showing typical appearance.

NRS3/S2 0KS_016.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_013.jpg

NRS3/S2 0KS_041.jpg/XPL/FOV = 4.00 x 5.83 mm CHLORITE-SERICITE-QUARTZ SCHIST showing typical appearance of lighter sericite-rich domains and darker chlorite-rich domains.

NRS3/S2 0KS_052.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_013.jpg

Images of NRS Sample #3: Chlorite-Sericite-Quartz Schist

NRS Sample #3

NRS Sample #3, NRS3/S1 0KS_013.jpg/XPL/FOV = 27 x 46 mm CHLORITE-SERICITE-QUARTZ SCHIST showing typical appearance.

NRS Sample #3, NRS3/S1 0KS_013.jpg/PPL/FOV = 27 x 46 mm CHLORITE-SERICITE-QUARTZ SCHIST showing typical appearance.

SAMPLE # NRS4/S1,S2 August 20, 2017

ROCK NAME SILICEOUS SCHIST -- probably formed by (1) hydrothermal precipitation of quartz + carbonate in open spaces in a fault zone; (2) minor (?) cataclastic and hydrothermal brecciation; and (3) ductile deformation, probably during regional dynamothermal metamorphism.

MINERALS Quartz (99%) + FEOH (1%).

TEXTURES This sample formed in two main phases, probably separated by a significantamount of geologic time: (1) hydrothermal silicification of a brittle fault zone;and (2) ductile deformation of the silicified fault zone during regional dynamothermal metamorphism.

Silicification of the fault zone probably occurred in the following steps: (1) cataclastic (brittle) brecciation related to minor fault movement resulting in; (2) sudden reduction of fluid confining pressure from lithostatic to hydrostatic, resulting in boiling and hydrothermal (brittle) brecciation; (3) direct precipitation of quartz + calcite in open spaces from the boiling to near-boiling hydrothermal fluid followed by (4) replacement of bladed calcite by quartz as the hydrothermal pulse cooled. Such silicification would episodically self-seal the fault zone so that confining pressure would rebuild from hydrostatic to lithostatic in advance of the next fault movement.

Ductile deformation, probably during much later regional dynamothermal metamorphism, has rotated linear features into a moderately directed fabric.

ALTERATION Alteration features in relative chronological order from oldest to youngest are:

(1) hydrothermal deposition of quartz in open spaces; (2) hydrothermal deposition of calcite by boiling of the fluid in response to fault rupture; (3) replacement of calcite by quartz as the fluid cooled; and (4) much later ductile deformation of the silicified fault zone during regional dynamothermal metamorphism.

SECTIONING Format: 51 x 76 mm Finish: POL Stains: SCN (center 2/3) + ARSPF (none) Cover: None

IMAGES (None of those identified below are in this copy of the report except: 0KS 17 and 0KS 18))

NRS4/S1 0KS_017.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS4/S1 0KS_018.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_017.jpg

NRS4/S1 0KS_042.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST

showing typical appearance of coarser grained quartz and elongate silicified calcite crystals.

NRS4/S1 0KS_043.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as0KS_042.jpg

NRS4/S2 0KS_019.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS4/S2 0KS_020.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_019.jpg

NRS4/S2 0KS_044.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST

showing typical appearance of coarser grained quartz and elongate silicifiedcalcite crystals.

NRS4/S2 0KS_045.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as 0KS_044.jpg

NRS4/S2 0KS_046.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST

showing typical appearance of intergrown chalcedony microspherulites.

NRS4/S2 0KS_047.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as 0KS_046.jpg

NRS4/S2 0KS_048.jpg/XPL/FOV = 0.96 x 1.40 mm SILICEOUS SCHIST

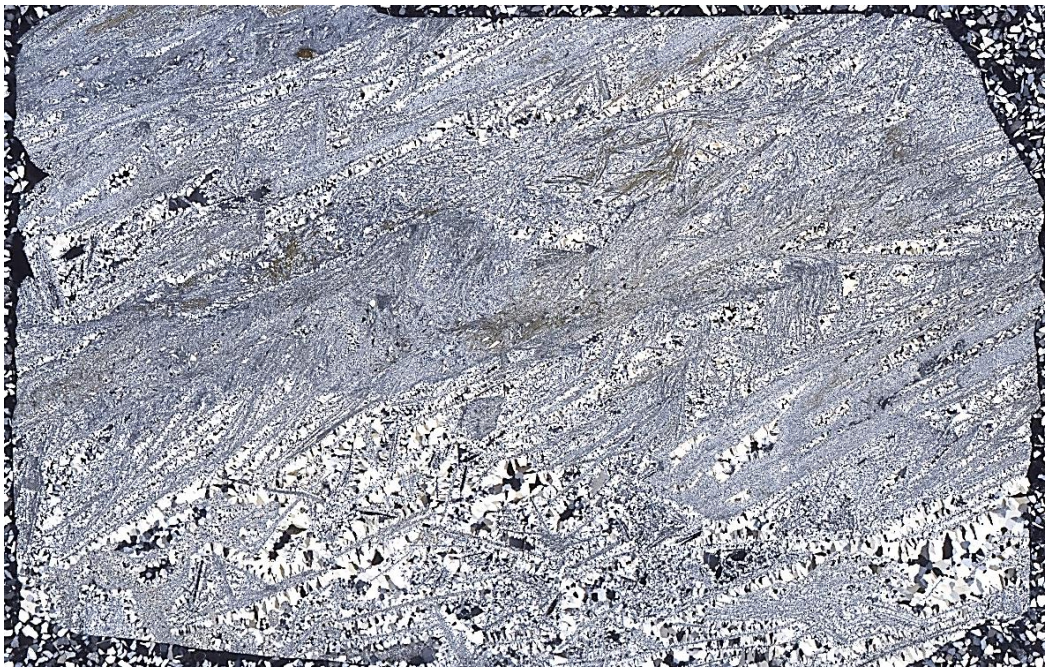
showing typical appearance of intergrown chalcedony microspherulites.

NRS4/S2 0KS_049.jpg/PPL/FOV = 0.96 x 1.40 mm Same view as 0KS_048.jpg

Images of NRS Sample #4: Siliceous Schist (Brunswick County Chert)

NRS Sample #4

NRS Sample #4



NRS Sample #4, NRS4/S1 0KS_017.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS Sample #4, NRS4/S1 0KS_018.jpg/PPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

SAMPLE # NRS5/S1 August 20, 2017

ROCK NAME SILICEOUS SCHIST -- probably formed by (1) hydrothermal precipitation of quartz + carbonate in open spaces in a fault zone; (2) minor (?) cataclastic and hydrothermal brecciation; and (3) ductile deformation, probably during regional dynamothermal metamorphism.

MINERALS Quartz (99%) + FEOH (1%).

TEXTURES This sample formed in two main phases, probably separated by a significant amount of geologic time: (1) hydrothermal silicification of a brittle fault zone; and (2) ductile deformation of the silicified fault zone during regional dynamothermal metamorphism.

Silicification of the fault zone probably occurred in the following steps: (1) cataclastic (brittle) brecciation related to minor fault movement resulting in; (2) sudden reduction of fluid confining pressure from lithostatic to hydrostatic, resulting in boiling and hydrothermal (brittle) brecciation; (3) direct precipitation of quartz + calcite in open spaces from the boiling to near-boiling hydrothermalfluid followed by (4) replacement of bladed calcite by quartz as the hydrothermal pulse cooled. Such silicification would episodically self-seal the fault zone so that confining pressure would rebuild from hydrostatic to lithostatic in advance of the next fault movement.

Ductile deformation, probably during much later regional dynamothermal metamorphism, has rotated linear features into a moderately directed fabric.

ALTERATION Alteration features in relative chronological order from oldest to youngest are:

(1) hydrothermal deposition of quartz in open spaces; (2) hydrothermal deposition of calcite by boiling of the fluid in response to fault rupture; (3) replacement of calcite by quartz as the fluid cooled; and (4) much later ductiledeformation of the silicified fault zone during regional dynamothermal metamorphism.

SECTIONING Format: 51 x 76 mm Finish: POL Stains: SCN (center 2/3) + ARSPF (none) Cover: None

IMAGES (None of those identified below are in this copy of the report except: 0KS 21 and 0KS 22)

NRS5/S1 0KS_021.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcitecrystals rotated parallel by ductile deformation.

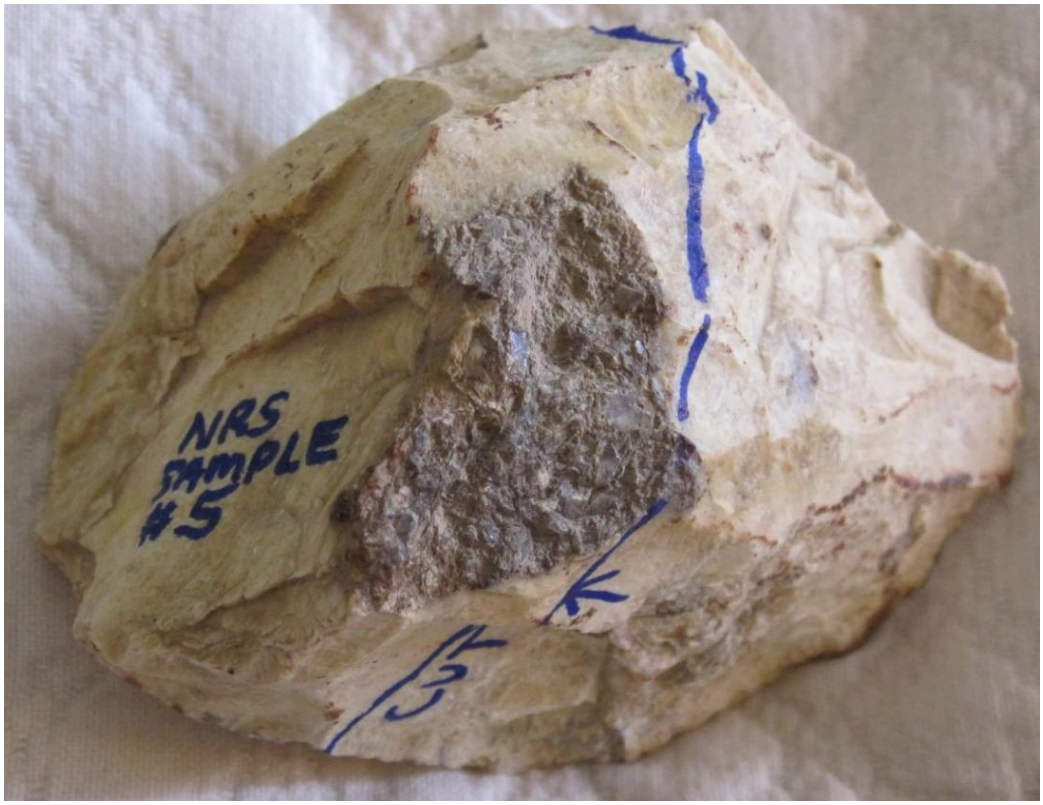
NRS5/S1 0KS_022.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_021.jpgNRS5/S1

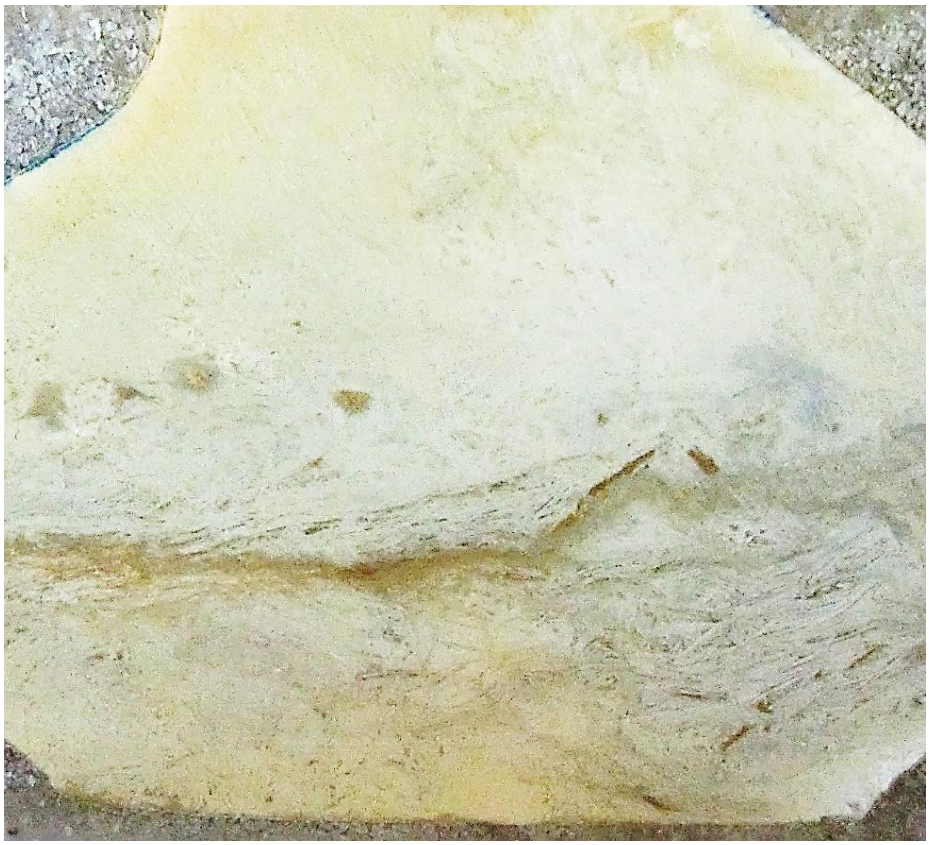
0KS_050.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST showing typical

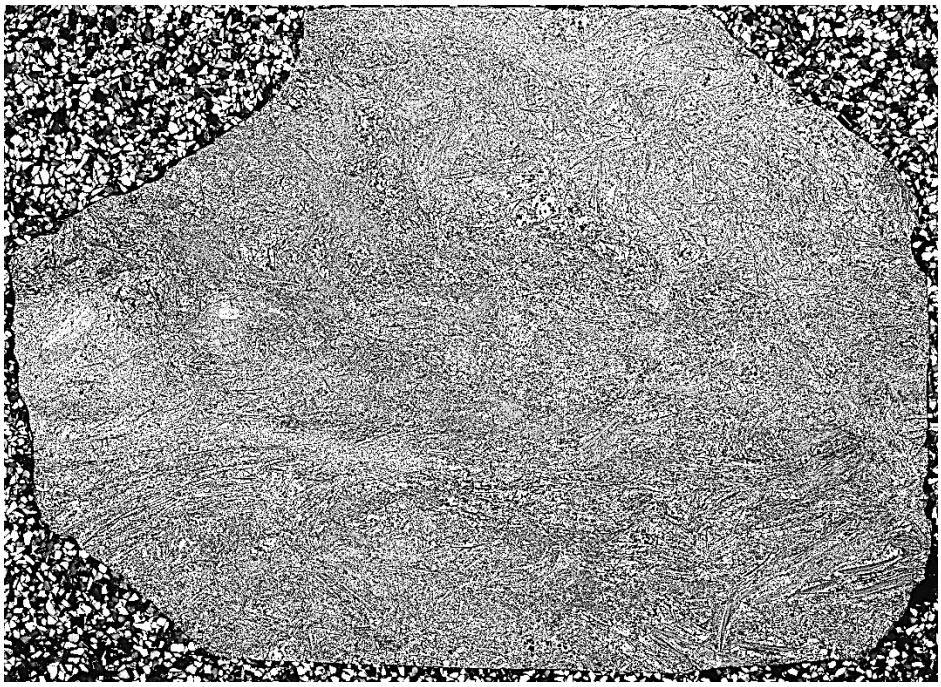
appearance of intergrown chalcedony microspherulites.

NRS5/S1 0KS_051.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as 0KS_050.jpg

Images of NRS Sample #5: Siliceous Schist (Brunswick County Chert)







NRS Sample #5, NRS4/S1 0KS_021.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS Sample #5, NRS4/S1 0KS_022.jpg/PPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

SAMPLE # NRS6/S1,S2 August 20, 2017

ROCK NAME SILICEOUS SCHIST -- probably formed by (1) hydrothermal precipitation of quartz + carbonate in open spaces in a fault zone; (2) minor (?) cataclastic andhydrothermal brecciation; and (3) ductile deformation, probably during regional dynamothermal metamorphism.

MINERALS Quartz (99%) + FEOH (1%) + muscovite (<1%).

TEXTURES This sample formed in two main phases, probably separated by a significantamount of geologic time: (1) hydrothermal silicification of a brittle fault zone; and (2) ductile deformation of the silicified fault zone during regional dynamothermal metamorphism.

Silicification of the fault zone probably occurred in the following steps: (1) cataclastic (brittle) brecciation related to minor fault movement resulting in; (2) sudden reduction of fluid confining pressure from lithostatic to hydrostatic, resulting in boiling and hydrothermal (brittle) brecciation; (3) direct precipitationof quartz + calcite in open spaces from the boiling to near-boiling hydrothermalfluid followed by (4) replacement of bladed calcite by quartz as the hydrothermal pulse cooled. Such silicification would episodically self-seal the fault zone so that confining pressure would rebuild from hydrostatic to lithostatic in advance of the next fault movement.

Ductile deformation, probably during much later regional dynamothermal metamorphism, has rotated linear features into a moderately directed fabric.

ALTERATION Alteration features in relative chronological order from oldest to youngest are:

(1) hydrothermal deposition of quartz in open spaces; (2) hydrothermal deposition of calcite by boiling of the fluid in response to fault rupture; (3) replacement of calcite by quartz as the fluid cooled; and (4) much later ductiledeformation of the silicified fault zone during regional dynamothermal metamorphism.

SECTIONING Format: 51 x 76 mm Finish: POL Stains: SCN (center 2/3) + ARSPF (none) Cover: None

IMAGES (None of those identified below are in this copy of the report except: 0KS 23 and 0KS 24)

NRS6/S1 0KS_023.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS6/S1 0KS_024.jpg/PPL/FOV = 27 x 46 mm, Same view as 0KS_023.jpgNRS6/S1

0KS_053.jpg/XPL/FOV = 4.00 x 5.83 mm SILICEOUS SCHIST showing typical

appearance of coarser grained quartz and elongate silicified calcite crystals.

NRS6/S1 0KS_054.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as 0KS_053.jpg

NRS6/S2 0KS_025.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.

NRS6/S2 0KS_026.jpg/PPL/FOV = 27 x 46 mm Same view as 0KS_025.jpg

NRS6/S2 0KS_059.jpg/XPL/FOV = 4.00 x 5.83 mm

SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals.

NRS6/S2 0KS_060.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as 0KS_059.jpg

NRS6/S2 0KS_055.jpg/XPL/FOV = 4.00 x 5.83 mm

SILICEOUS SCHIST showing typical appearance of quartz, chalcedony, and elongate silicified calcite crystals.

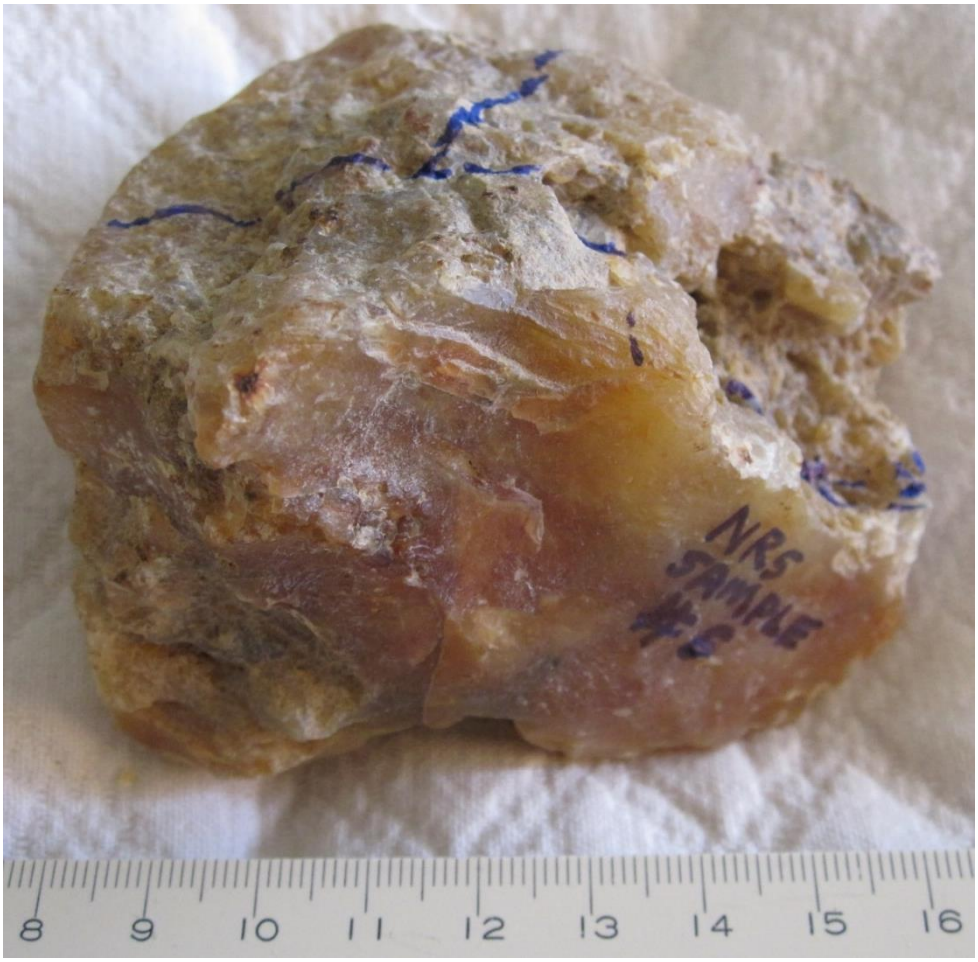
NRS6/S2 0KS_056.jpg/PPL/FOV = 4.00 x 5.83 mm Same view as 0KS_055.jpg

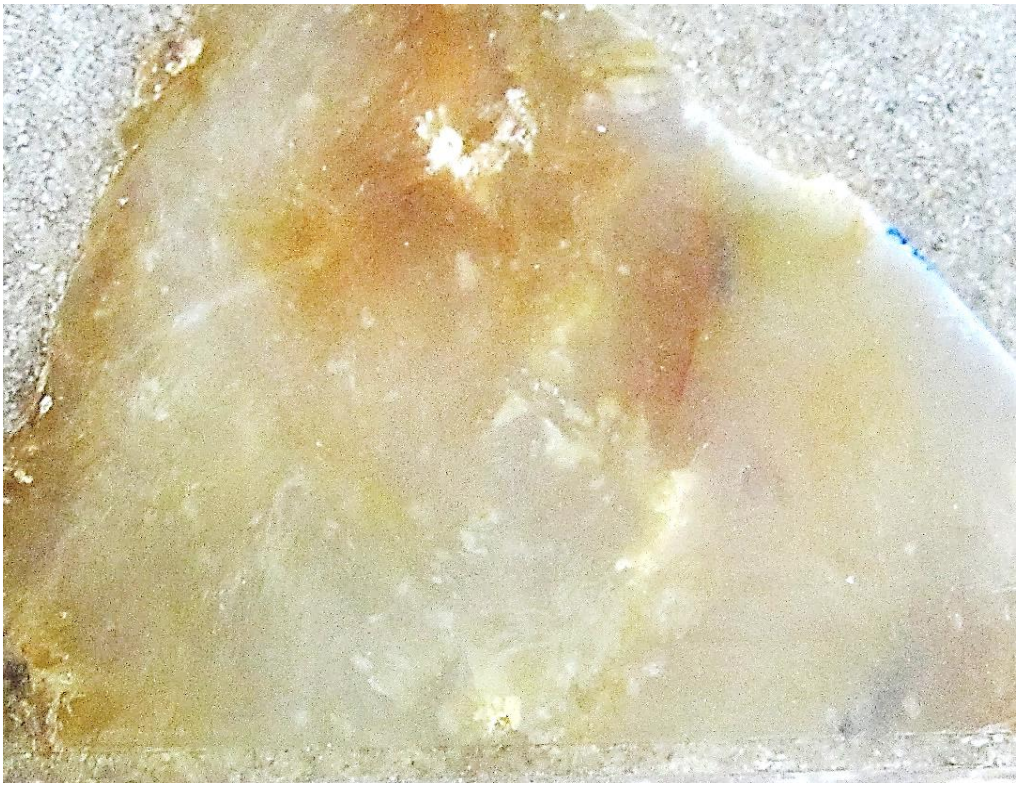
NRS6/S2 0KS_057.jpg/XPL/FOV = 0.96 x 1.40 mm SILICEOUS SCHIST

showing typical appearance of intergrown chalcedony microspherulites.

NRS6/S2 0KS_058.jpg/PPL/FOV = 0.96 x 1.40 mm Same view as 0KS_057.jpg

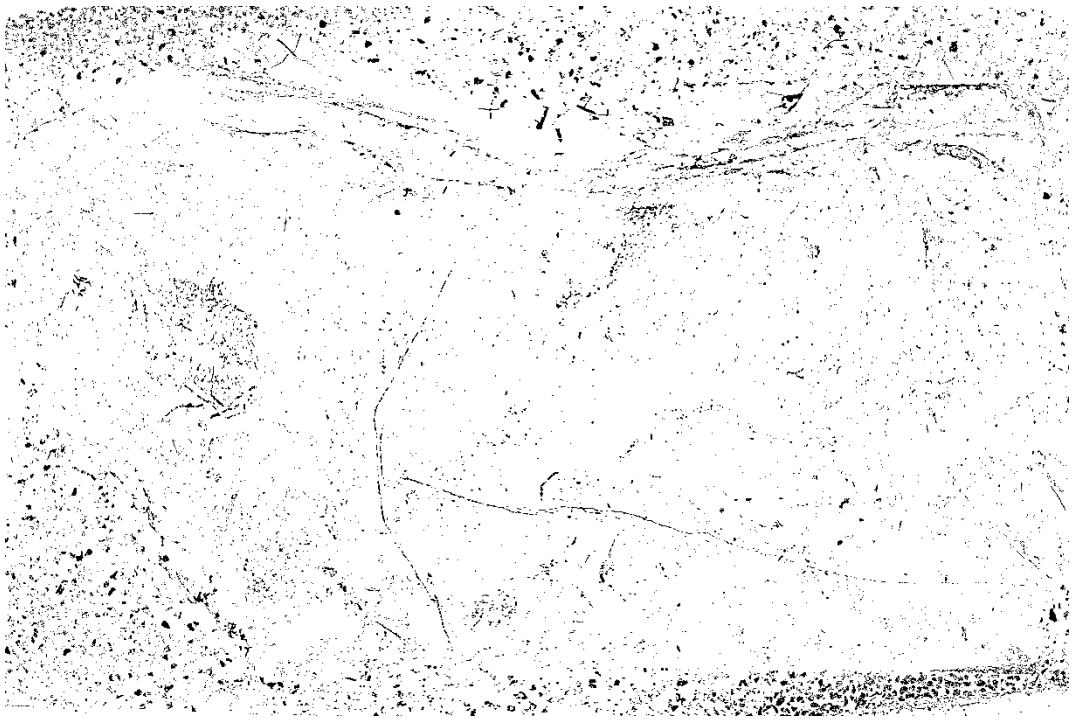
Images of NRS Sample #6: Siliceous Schist (Brunswick County Chert)





NRS Sample #6

NRS Sample #6, NRS4/S1 0KS_023.jpg/XPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.



NRS Sample #6, NRS4/S1 0KS_024.jpg/PPL/FOV = 27 x 46 mm SILICEOUS SCHIST showing typical appearance of coarser grained quartz and elongate silicified calcite crystals rotated parallel by ductile deformation.