CHAPTER 8

Columbia Hills Toolstone Geography

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Cryptocrystalline silicate (CCS) material was extensively used as a pre-contact toolstone for millennia throughout the Columbia Plateau region of North America. This lithic material occurs in great abundance in the Columbia Hills, a group of grass-covered ridges and hills that tower above the Columbia River along the southern boundary of central Washington State in the semi-arid, eastern portion of the Columbia River Gorge. Archaeological examination of the Columbia Hills lithic landscape and analysis of lithic debris associated with pre-contact lithic procurement sheds important light on regional lithic procurement strategies and their relationship to patterns of settlement and subsistence.

This chapter discusses the results of archaeological field investigations within the Columbia Hills. Evidence of CCS toolstone procurement has been identified at sites ranging from ephemeral lithic scatters to large quarries. Analyses of lithic material from the quarries and their spatial relationship to traditional modes of settlement and subsistence are used to develop a model for toolstone procurement within this lithic landscape. By drawing on previous theories of toolstone quarrying and its relationship to settlement, this model provides important insights into past lithic procurement strategies in a geographically and culturally distinctive area that was one of the major pre-contact population centers of the Columbia Plateau region.

CCS Toolstone in the Columbia Plateau

CCS, most commonly referred to as chert, tends to be, by far, the most abundant raw material type used for making stone tools in archaeological assemblages on the Columbia Plateau (Adams and Ozbun 2011; Ozbun et al. 2002; Stevens and Galm, 1991; Dumond and Minor 1983). Large CCS outcrops are found scattered throughout the region and are associated with Miocene basalt flows that form the Columbia River Basalt group (Reidel and Hooper 1989). During the Miocene, major basalt flows were extruded across parts of Washington, Oregon, and Idaho. The flows were deformed by compression which created the Columbia Hills and other east-west trending ridges found in central Washington (Orr and Orr 1996).

Various mineralization processes associated with the basalt flows led to the formation of CCS lithic material. One of the primary processes that creates chert in this context is related to the leaching of silica minerals from water moving through the basalt. This silica precipitated in cooling joints and between basalt columns to form cherts and opals (Hess 1996:52; Lindberg 1989).

Much of the CCS in the Columbia Plateau is also attributable to the basalt flows trapping sediments and organic matter, which later transformed into CCS lithic material through mineralization processes. In the process of their formation, these basalt flows trapped sediments and organic matter that had accumulated on the surface of the previous flow since its emplacement. Successive basalt flows were separated by as much as 100,000 years, during which time soils and associated organic matter became trapped between successive flows. In some cases, basalt flows dammed rives and created large lakes that accumulated lakebed sediments that also became trapped between the basalt flows (Orr and Orr 1996). Silica leached from the basalt replaced the trapped organic matter and created fossiliferous chert, such as petrified wood, which represent some of the most beautiful and high-quality toolstone

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material found in the Columbia Hills and elsewhere on the Columbia Plateau (Edmondson 1991).

Columbia Hills Cultural Context

The Columbia Hills are situated in the eastern portion of the Columbia River Gorge in Klickitat County, Washington, rising above the north bank of the river to maximum elevations of between 500 and 900 m above mean sea level. The archaeological record of the area includes large pithouse villages along the Columbia River and a continuous human occupation for the last 8,000 years (Cressman 1960; Minor and Toepel 1986). By the Late Archaic period (2000 B.P.-A.D. 1720), this area was an important center for regional trade (particularly at The Dalles) and contained one of the richest salmon fishing locations in North America at Celilo Falls, located directly across the river from the Columbia Hills in Oregon (Butler and O'Connor 2004; Hayden and Schulting 1997).

Ethnographically, the Columbia Hills vicinity was occupied by speakers of the Sahaptin language who resided in politically autonomous winter villages on the Columbia River at the base of the hills (Ray 1936:). The villages within the immediate vicinity included *wálawitsis* at the present-day town of Maryhill, up to three apparently related villages (*wayám, wanwáwi*, and *tḱu*) at Miller Island and adjacent areas at the confluence of the Columbia and Deschutes Rivers, and *¾ mÍł* at the confluence of the Columbia River and Rock Creek. It has been estimated that a combined 3,442 people (more than 70% of whom lived in the Miller Island vicinity) resided in these villages during the winter months in the late 18th century (Boyd 1985; Hunn and French 1998:393).

While subsistence among these groups was largely centered around the large scale procurement of salmon and its storage for winter consumption, more than 50 percent of peoples' food energy was likely derived from gathered plant foods, particularly roots (Hunn 1990:176; Spier and Sapir 1930:174). A relative abundance of root species can be found on the ridge crests of the hills, especially on lithosols which have conditions favoring the growth of bitter-root and various species of edible lomatiums (Hunn 1990:93). Due to their proximity to large winter villages on the Columbia River, the Columbia Hills would have been ideally situated for procuring these important food resources.

Root collecting traditionally involved families setting up camps in the hills and mountains above the Columbia River at progressively higher elevations (as high as 1,800 m) between April and June (Hunn 1990:107; Hunn and French 1998:380-382; Spier and Sapir 1930:182). During these times, men accompanying root-gathering parties (root gathering being a subsistence endeavor traditionally undertaken by women and girls) hunted wild game, particularly deer and elk (Hunn 1990:138). Isolated projectile point finds, some associated with small lithic scatter sites, in the Columbia Hills could have been related to these hunting forays. Of particular importance and relevance to the discussion of lithic procurement, the lithosol areas where edible roots are typically found also often contain naturally outcropping CCS toolstone material. It is conceivable that men accompanying root-gathering expeditions procured CCS lithic raw material from outcrops situated on the lithosols where roots were most abundant.

In addition to their association with subsistence, the Columbia Hills are considered an important spiritual area among native groups. Within the Columbia Hills are several legendary sites that are incorporated into local Native oral traditions (Griffin and Churchill 2001:57). The Columbia Hills were also traditionally associated with vision quest activities, during which young people ventured to a remote location, maintained a vigil and accomplished tasks, such as stacking rocks, with the goal of acquiring a guardian spirit who could act as a protector throughout life (Griffin and Churchill 2001:36; Historical Research Associates, Inc. 1995:5-3; Ray 1942:235, 236; Spier and Sapir 1930:238-240). Many stacked rock features located along the crest of the Columbia Hills in the vicinity of CCS quarries and outcrops were likely created as part of vision quest activities. While these vision quests were probably not associated with toolstone procurement and flintknapping, their significance with regard to the materiality of the Columbia Hills may pertain to the cultural value of Columbia Hills CCS.

Lithic Procurement and Related Sites in the Columbia Hills

Archaeologists from Archaeological Investigations Northwest, Inc. (AINW) conducted several successive archaeological surveys of the Columbia

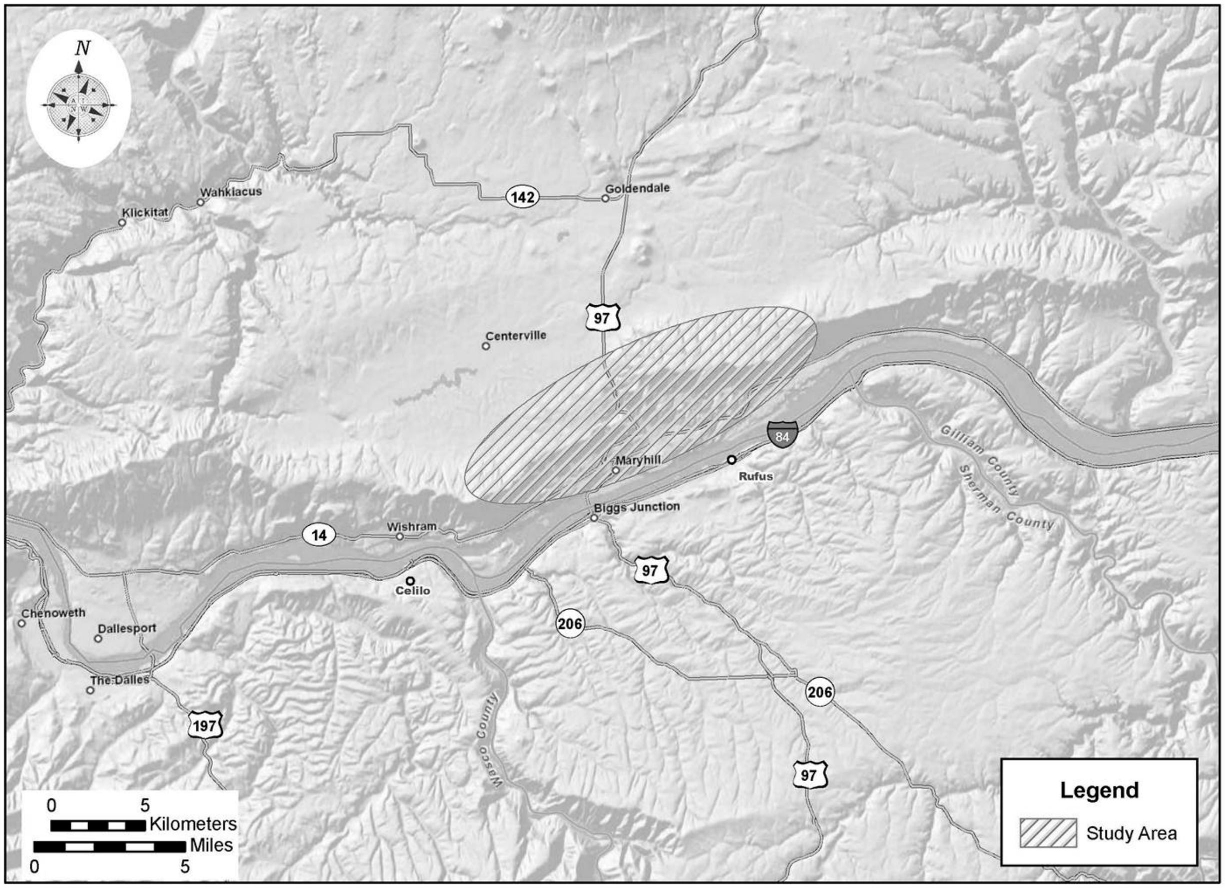

Figure 8-1. Map showing AINW study area and vicinity.

Hills for wind energy projects between 2005 and 2010 (Adams and Ozbun 2007, 2008, 2009a, 2009b; Adams et al. 2008, 2009a, 2009b, 2009c, 2009d, 2010). The surveys resulted in the identification of myriad pre-contact archaeological sites, the vast majority of which were associated with lithic procurement. A total of approximately 95 pre-contact lithic procurement and 2 apparent pre-contact camp sites were identified during pedestrian archaeological surveys that covered combined area of approximately 1,042 ha in the Columbia Hills (Figure 8-1). Subsurface archaeological testing and evaluation has been conducted at the 2 camp sites and within 24 of the lithic procurement sites.

The two sites (45KL590 and 45KL1479) identified as likely pre-contact camps were both located on the lower-mid slope of the Columbia Hills in an area containing several lithic procurement sites, including a small CCS quarry site (45KL1505) recorded during the AINW survey within 1.6 km of the camps in the same mid-slope setting. Site 45KL1479 is situated on a terrace approximately 100 m west of an unnamed creek and was found to contained large quantities of lithic debris in addition to tools associated with food procurement and processing (e.g., a pestle, projectile point fragment, biface blanks, flake tools, and a basalt chopper) (Adams 2009b). Blood residue analysis of stone tools recovered from 45KL1479 indicate that birds, deer, fish (salmon or trout), and rabbit were likely processed at the site location (Adams 2009b). Approximately 2 km northeast of 45KL1479, site 45KL590 is located on a benched landform on the mid-slope of the Columbia Hills at the location of a spring. The site also contained large quantities of lithic debris as well as faunal bone fragments and a small number of CCS stone tools (Adams 2009c). Importantly, neither 45KL590 nor 45KL1479 was situated in a locale with naturally occurring CCS toolstone material, indicating that they were most likely not directly associated with lithic procurement and making them unique in relation to the vast majority of pre-contact sites recorded in the Columbia Hills.

Spread out over distances of up to several kilometers from the probable camp locals are 95 lithic procurement sites identified in the Columbia Hills that range in size from small lithic scatter sites to large quarries with extensive scatters of CCS debitage and cores. For the purpose of illustrating this variability, the lithic procurement sites have been divided into the categories of Ephemeral Lithic Procurement Locales and Quarries.

Ephemeral Lithic Procurement Locales

The small, ephemeral CCS lithic scatter sites range from those containing an abundance of poor quality CCS material to sites comprised of very discrete, limited amounts good quality CCS material. The lithic artifacts at these locales reflect very limited lithic procurement activities and comprise the overwhelming majority of sites identified within the study area.

The assay sites containing poor quality material are often marked by the presence of abundant light and crumbly chunks of chert or opal that are easily shattered. From a distance, these sites can appear as spectacular lithic scatters. However, upon closer examination the poor quality of the material is apparent. The high water content of the opal material makes it susceptible to crumbling as it dehydrates on exposure to the atmosphere. Natural fractures caused by freezing and thawing are also common for these materials.

A small boulder-sized chunk of this type of CCS material from the Columbia Hills was tested for its suitability as a toolstone by John L. Fagan at the AINW laboratory. After striking the material once with a hammerstone, the boulder completely shattered into small, angular chunks (Figure 8-2). None of the chunks removed from the boulder were suitable for further reduction to produce tools. Indeed, among hundreds of pieces of this naturally fractured, low quality CCS material at these types of sites, there are sometimes a few flakes that have resulted from deliberate flintknapping either from the poor-quality CCS material or from a very limited quantity of better quality CCS that is often found in association. These flakes are evidence of episodes of assaying or testing lithic raw material. After gauging the quality of the easily shattered material or the limited quantities of usable CCS, pre-contact flintknappers likely moved on in search of better prospects elsewhere.

Figure 8-2. Low-quality CCS boulder after being subjected to experimental reduction in the AINW laboratory.

The remaining minor lithic procurement sites include those containing moderate quantities of medium-quality CCS or limited quantities of very good quality CCS material. These sites are found on deflated lithosols and in and around drainages where lithic material has been exposed through erosional processes (Figure 8-3). Within these areas, there is often a concentration of flakes and cores in the vicinity of a few small exposed CCS cobbles or boulders. Cultural material in even the more concentrated areas within these sites occurs in relatively low densities both on and beneath the surface, ranging between about 1 and 100 artifacts per cubic meter in test excavations. These densities indicate that toolstone material was more than likely procured periodically or even during a single episode at the small lithic procurement sites. Prehistorically, these locales may have been occasionally checked to see if good toolstone material was exposed as people passed through the area on root-gathering or hunting forays. Importantly, the high degree to which the usable CCS lithic material at these ephemeral lithic scatters was utilized illustrates the importance of the Columbia Hills as a toolstone landscape.

Quarry Sites

The largest and richest lithic procurement sites in the Columbia Hills can be classified as quarries.

Figure 8-3. Drainage exposure of CCS boulders in the Columbia Hills.

Figure 8-4. Typical example of superior-quality Columbia Hills CCS toolstone.

The quarry sites in the Columbia Hills range from expansive scatters to discrete, high-density clusters of CCS lithic material. These "hot spots" are found amongst much larger numbers of smaller lithic assay sites. Subsurface archaeological testing was conducted at significant artifact concentrations within six Columbia Hills quarry sites (45KL1131, 45KL1237, 45KL1263, 45KL1400, 45KL1401, and 45KL1505). The quarries are all associated with 1) high densities of exceptional quality CCS flakes and cores found both on and beneath the surface; 2) natural outcroppings of CCS cobbles and boulders; and 3) lithic artifacts displaying early stages of core and biface reduction technologies.

Artifact loci within the most substantial quarries contained lithic material densities of over 1,000 artifacts per cubic meter. These artifacts include flakes and cores of high quality toolstone material with clearly identifiable attributes related to conchoidal fracturing resulting from deliberate lithic reduction activities. This high quality material is characteristically caramel-brown translucent chalcedony that is very hard and durable with clean and smooth fracture surfaces (Figure 8-4). In addition, there is often poorer quality white chert that often forms a "crust" around the high-quality CCS. Thousands of fragments resulting from the deliberate removal of this white chert from the exterior of CCS boulders and cobbles also occur at Columbia Hills quarry sites.

Mining pits are found at some of the largest quarry sites in the Columbia Hills (namely, 45KL1146, 45KL1237, and 45KL1400). The mining pits are oval or circular in shape, 2-3 m in diameter, and approximately 0.5-1 m in depth. A large quarry site (45KL1400) on the crest of the Columbia Hills contains one mining pit at which CCS boulders dug from the pit appear to have been deliberately placed in a linear alignment at the pit's south end overlooking the Columbia River (Figure 8-5). The highest density of CCS debitage and cores is typically found adjacent (primarily downslope) to the quarry pits.

Quarry pits are also found at sites nearby the study area, including the Walawateese Quarry site (45KL612), which contains five quarry pits ranging in size from approximately 32 m^2 to 300 m^2. The Walawateese quarry is situated at the base of the southern slopes of the Columbia Hills and contains a very high density of CCS flakes and cores on its surface, with the greatest density occurring downslope from the quarry pits, similar to the pattern found at quarry pits higher up on the crest of the Columbia Hills (Hess 1995).

Figure 8-5. Mining pit at quarry site 45KL1400.

Archaeological test excavations at the Columbia Hills quarry sites have revealed the utility of mining for toolstone material at CCS quarries. These large quarry sites are all situated at or near the crest of the Columbia Hills, where soils are shallow. In test excavations in this environment, basalt bedrock was typically encountered between 25 and 50 cm below the ground surface (Figure 8-6). Within the basalt bedrock, CCS seams or beds are present that can be accessed with relatively little effort. The large quarry pits likely represent areas where large amounts of exceptional toostone material found in the CCS seams or beds were repeatedly excavated over a long period of time.

At sites without mining pits, the lithic material has been exposed naturally by way of stream down-cutting on the upper slopes of the hills and aeolian processes at the crest of the hills where basalt bedrock and outcropping CCS seams or beds have been exposed. At the largest quarry sites, naturally occurring cobbles and boulders can be found in these settings. At the drainages in particular, there is often an abundance of exposed large CCS cobbles and boulders that have been "mined" naturally through stream down-cutting. These drainages were likely checked periodically for toolstone material. The largest quarry in the study area (45KL1237) covers an area of approximately 36 ha marked by several deeply incised drainages around which high densities of flakes and cores litter the ground surface**.**

The smallest quarries in the study area are found at discrete locales where CCS material has been exposed on deflated surfaces at the crest of the Columbia Hills around the heads of drainages. While not extensive in size, these areas contain loci with high densities of toolstone material.

Test excavations at these small quarries reveal high densities of subsurface flakes and cores comparable to those found in the larger quarries. The high concentration of artifacts at these small quarries is illustrative of the high degree to which all sources, both big and small, of good quality CCS material were utilized prehistorically.

Lithic Material and Procurement Strategies

The lithic artifacts collected from archaeological testing work at Columbia Hills lithic procurement sites were analyzed by Dan Stueber and Terry L. Ozbun at the AINW laboratory to model reduction technologies represented in the assemblage. Stone tool and debitage classifications were based on technological and morphological attributes defined from flintknapping experimentation and common to the lithic technological literature (Crabtree 1982; Flenniken 1981; Holmes 1919; Titmus 1985). This discussion focuses on the analysis of lithic artifacts recovered from the two probable camp sites (45KL590 and 45KL1479) and six quarries where subsurface archaeological testing and evaluation was conducted at major artifact concentrations (45KL1131, 45KL1237, 45KL1263, 45KL1400, 45KL1401, and 45KL1505).

Figure 8-6. Shallow exposure of CCS bedrock in 1x1-m test unit at quarry site 45KL1505.

The artifacts consist of 2,036 CCS and 15 basalt artifacts from limited surface collections and archaeological test excavations. Of these, 420 CCS and 11 basalt artifacts were from the probable camp sites (45KL590 and 45KL1479), while the remaining 1,616 CCS and 4 basalt artifacts were collected from the quarries (45KL1131, 45KL1237, 45KL1263, 45KL1400, 45KL1401, and 45KL1505). The sites with the greatest numbers of artifacts analyzed include the large quarry sites 45KL1400 and 45KL1237, with 559 and 498 artifacts respectively. The highest densities of lithic artifacts were also encountered at these two sites, with densities up to 3,657/m^3 at 45KL1400 and 1,554/m^3 at 45KL1237 (densities extrapolated from small excavation volumes).

The analyses of lithic material from the quarries found that tools were very rare, consisting primarily

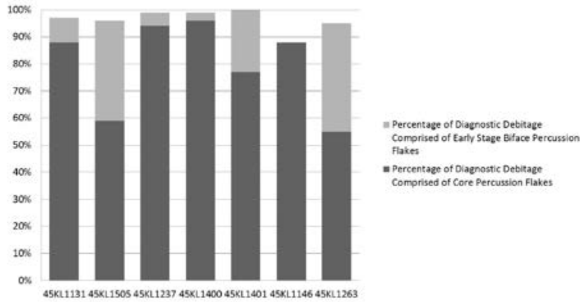

Figure 8-7. Bar graph illustrating the dominance of early-stage reduction technologies in debitage assemblages at Columbia Hills toolstone quarries.

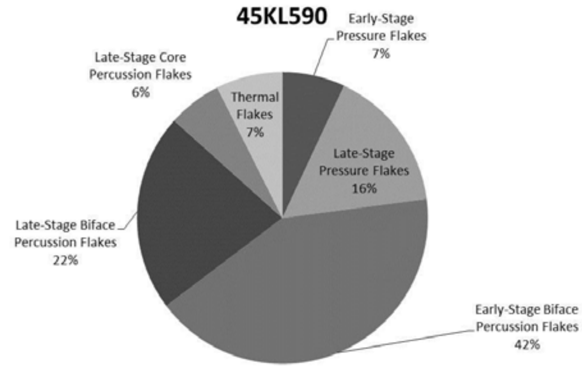

Figure 8-8. Pie chart showing the variety of reduction technologies associated with the debitage assemblage at pre-contact camp site 45KL590.

of cores and a few early-stage blanks, while lithic debitage from the sites (consisting primarily of core percussion flakes and early stage biface percussion flakes) generally reflected early stages of lithic reduction, and not the manufacture of formal tools. Between 80 and 100 percent of all recovered diagnostic lithic debitage from the quarries consists of CCS core and early stage biface percussion flakes. In contrast, debitage associated with tool-making activities of lithic reduction typically includes a much higher concentration of later stage of biface percussion flakes and pressure flakes. At the largest quarries (45KL1237 and 45KL1400), these later stages of lithic reduction comprise less than five percent of the analyzed debitage (Figure 8-7). While not formally analyzed, the lithic debitage found on the surface at the nearby Walawateese quarry also primarily consists of flakes reflecting early stages of lithic reduction (Hess1995).

The lithic material from the probable camp sites (45KL590 and 45KL1479) bore visual similarities to that from quarry sites, particularly the nearby site 45KL1505. However, these sites contained more formed tools and far fewer pieces of debitage indicative of early stages of lithic reduction. The debitage assemblages from 45KL590 and 45KL1479 are instead dominated by bifacial percussion flakes and pressure flakes. This pattern is indicative of later stages of lithic reduction and tool-making and a scenario in which earlier stages of raw material reduction were being done at the nearby quarry sites (Figures 8-8 and 8-9) (Adams et al. 2009b:11, 12).

These data suggest that formal tool-making occurred at lithic workshops away from the quarries at sites such as 45KL1479 and 45KL590. Other similar camp-type occupation sites may exist outside the study area in the Columbia Hills, given the expansiveness of the Columbia Hills lithic landscape. The proximity of the Columbia Hills quarries to pre-contact and ethnographically documented villages on the Columbia River suggest that much of the lithic material from the quarries was also taken directly to village sites for further reduction and tool-making without going through an intermediate workshop site.

Indeed, previous archaeological studies of toolstone quarrying behavior indicate that in cases where quarries were situated within close proximity (approximately 10 km or less) to residential contexts, minimal (primarily early-stage) lithic reduction activities occurred at the toolstone sources (Beck et al. 2002; Elston 1992a:798). Studies that have modeled this type of quarrying behavior are derived from "central place foraging models" (e.g., Bettinger et al. 1997; Metcalfe and Barlow 1992) which assert that the greater the distance traveled from the central place (i.e., a settlement) to obtain resources, the more cost-effective it is to conduct in-field processing of the resource. If the distance to the central place is relatively short, it is more cost effective to limit the time devoted to processing the resource in the field. When central place models are applied to lithic reduction analyses, field processing time, the increase in the resource utility due to field

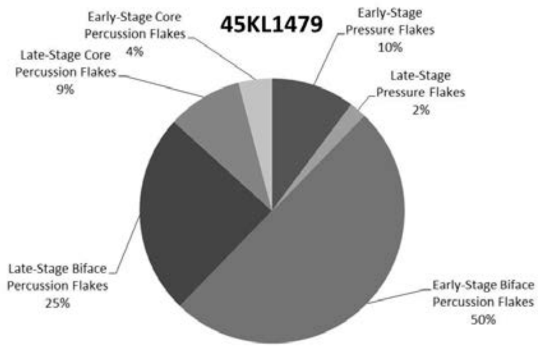

Figure 8-9. Pie chart showing the variety of reduction technologies associated with the debitage assemblage at pre-contact camp site 45KL1479.

processing, and transport distance are key components for determining the degree to which lithic reduction activities take place at the quarries proper (Beck et al 2002:492).

From the perspective of efficiency, central place models focus on the expenditures of time and energy associated with different stages of lithic reduction. According to these models, when the toolstone source is near lithic workshops of a residential site, it is most cost-effective to limit reduction to the initial stages at the quarry location due to the fact that the most cost-effective (in terms of effort) reduction occurs at the beginning of the reduction sequence and diminishes thereafter. In support of this notion, Bettinger et al. (1997) noted that the initial flakes of a biface reduction sequence typically have, on average, the greatest weight and are the most efficient in terms of increasing the utility of the core, assuming that 50 percent of the core consists of waste flakes.

When looking at the issue solely from the perspective of ease of transport, those living near toolstone quarries would not have needed to expend a lot of energy breaking down lithic material into easily transportable pieces due to the relatively light energy expenditures associated with travel between the quarries and village sites. If a village is within close proximity to a quarry, the most cost-effective option is to complete later stages of reduction at the residential workshop, given the absence of a need to break down the cores further for ease of transport. On the other hand, initial stages of reduction at the quarries could also be employed to assay the quality of the lithic raw material, so as not to incur unnecessary transport costs for unusable materials however small those costs might be due to proximity. In all cases, it is also assumed that the quarries could be visited more frequently due to their proximity, eliminating the need to transport an abundance of toolstone that has already been reduced into usable pieces at one time.

The relatively close proximity of the Columbia Hills quarries to pre-contact village sites warrants the application of the principals of central place foraging models. Archaeological evidence for human settlement within the immediate vicinity of the Columbia Hills has been dated to as early as 8,000 years before present (Cressman 1960; Minor and Toepel 1986). By the late prehistoric period (2,000 B.P.-A.D. 1720), pithouse villages were abundant along the Columbia River throughout the Columbia Plateau (Andrefsky 2004:32). Some of the largest Columbia Hills quarries (particularly 45KL1237) are situated within 5 km to the northeast of two large prehistoric pithouse village sites on Miller Island (Figure 8-10). Combined, these two sites are comprised of nearly 200 housepit features (Boxberger et al 1993:10; Strong et al. 1930).

CCS toolstone from the hills undoubtedly made its way to these settlements and the time depth and extent of nearby settlement likely accounts for the apparent intensity of lithic procurement in the Columbia Hills at a wide range of locales. Furthermore, in addition to the quarry sites within the study area, at least five other large quarry sites (including the Walawateese quarry discussed above) have been recorded in the Columbia Hills area. All of the Columbia Hills quarries are situated in the vicinity of traditional ethnographic winter village locations in an area stretching 51 km between The Dalles, Oregon in the west and the confluence of Rock Creek and the Columbia River in the east.

The quarries nearest to the river would have obviously been the most accessible and therefore most attractive for those seeking toolstone. The Walawateese quarry is located within several hundred meters of the *wálawitsis* village site at present-day Maryhill and much closer to the Columbia River (700 m from the river) than the quarries near the crest of the Columbia Hills, making it much easier to access. While the Walawateese quarry was most definitely a rich

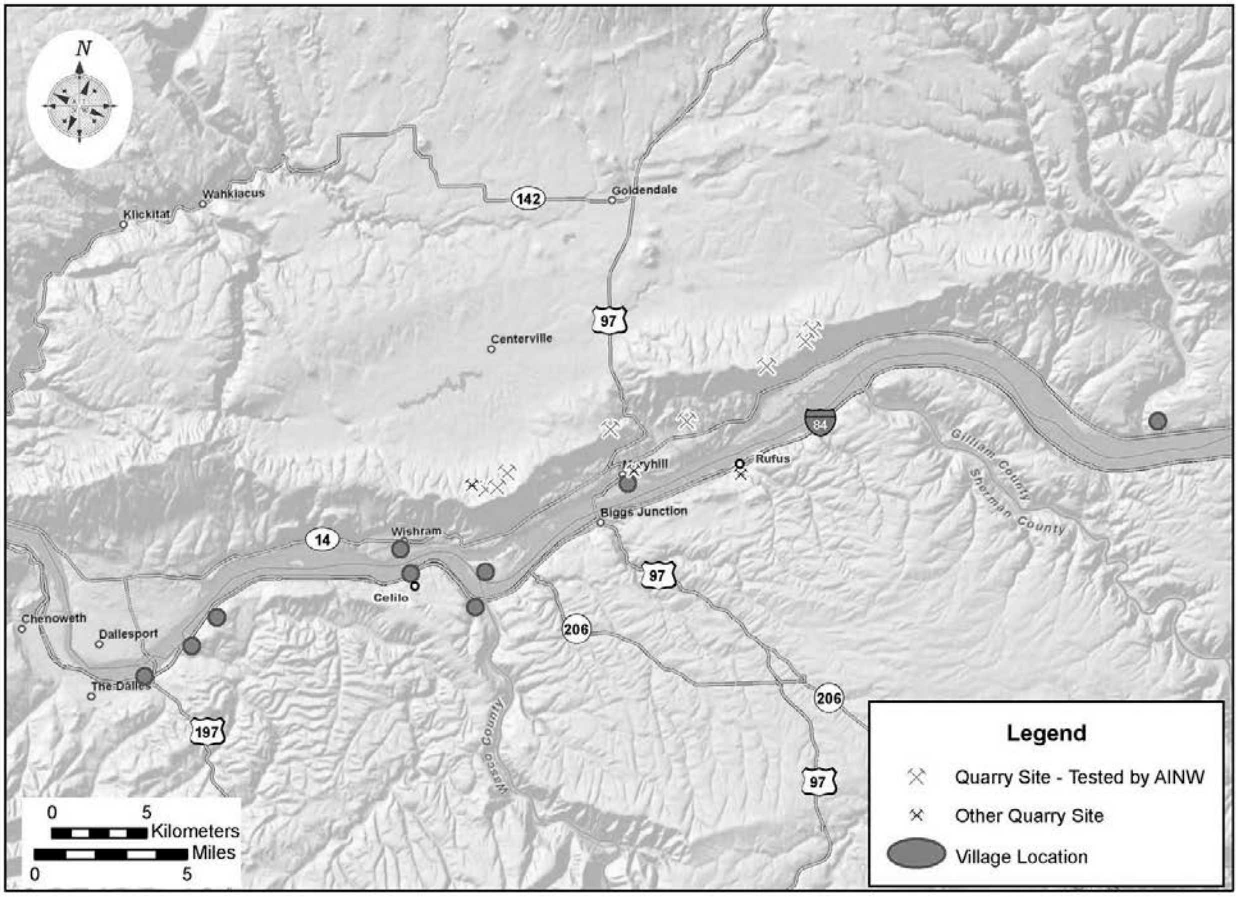

Figure 8-10. Map showing the location of ethnographic villages in relation to Columbia Hills toolstone quarry sites and other nearby quarries.

source of toolstone, the extensive quarrying of CCS material reflected in the large quarry pits at the site is likely attributable to its proximity to the river and the *wálawitsis* village. As Wilson (2007) has demonstrated, when toolstone sources are of comparable quality, the closer the source is to a central place the more likely it will be utilized extensively.

Accessing the quarries higher up in the hills would likely have involved well established trails extending from the Columbia River to the Columbia Hills and beyond. Historic maps of the area appear to depict some of the routes used to access the quarries at or near the crest of the Columbia Hills. Travel routes extending through the Columbia Hills depicted as trails on historic maps pass nearby two of the largest quarries located at the crest of the hills. Davies Pass, one of the main historic (and current) travel routes from the Columbia River through the Columbia Hills and beyond extends within close proximity to the large quarry site 45KL1400 as depicted on the 1861 General Land Office (GLO) map of Township 3 North, Range 16 East, Willamette Meridian (GLO 1861b). A trail is also depicted extending through the largest quarry site in the study area (45KL1237) from the south slope of the Columbia Hills on the 1862 GLO map of Township 2 North, Range 15 East, Willamette Meridian (GLO 1862a). However, it would have required traversing up the slopes of the Columbia Hills with an elevation gain of nearly 670 m to reach this quarry from the village sites at Miller Island in spite of the short distance (approximately 3.5 km) from Miller Island to the quarry.

Despite the geographic proximity of the quarries to settlements, establishing an iron-clad, verifiable link between the toolstone material found at Columbia Hills quarries and that found at nearby residential sites will require further analysis of lithic material. Photographic images of CCS tools from pithouse village sites on Miller Island and projectile points referred to as "gem points" from various sites between The Dalles and the John Day River depict artifacts that appear to have been made from toolstone material with visual attributes very similar to those of the CCS found at quarry sites in the Columbia Hills (Strong 1959:154-146; Strong et al. 1930). However, macroscopic comparisons of CCS samples is limited in its accuracy in comparison to the measurement of trace element concentrations through ICP-MS analyses, which have been found to be more effective in identifying the source locations of CCS toolstone (Hess 1996:77). These types of analyses have not been conducted for the CCS from sites near the Columbia Hills, although toolstone from the hills very likely made its way to the large nearby villages, particularly Miller Island given its proximity to large Columbia Hills quarries.

Modeling Columbia Hills Lithic Procurement

Taken together, the lithic material analyses and the distances from the quarries to settlements and camps strongly suggest that trips to quarry sites were relatively short and the time spent reducing toolstone at quarries would have likewise been brief. In order to better characterize the pre-contact strategies of obtaining toolstone in the Columbia Hills, it is useful to examine the other activities traditionally carried out in the area, namely foraging behavior.

As noted previously, root crops were very important sources of nutrition for native groups by the contact period. The proximity of the quarry sites to edible roots suggests that CCS lithic procurement in the Columbia Hills was often associated with foraging. In this scenario, pre-contact toolstone procurement in the Columbia Hills would have been an activity "embedded" in the seasonal subsistence round documented ethnographically in the region, much like what Binford (1979) observed among the Nunamiut, who procured toolstone during subsistence gathering forays. These strategies of lithic procurement embedded in subsistence practices are in contrast to what are referred to as "direct" lithic procurement strategies in which the main goal of the journey is to obtain toolstone.

Certainly, the CCS procurement sites located the greatest distance from camps and villages (particularly small ephemeral lithic scatters) were most likely visited primarily in association with root-gathering forays. As noted previously, the women and girls who traditionally gathered roots were typically accompanied by men who hunted in the vicinity of the root gathering grounds (Hunn 1990:138). A scenario in which the men also gathered toolstone during these root-gathering trips as an embedded practice is highly plausible.

However, the dichotomy of "direct" vs. "embedded" lithic procurement can lead to the unnecessary pigeon-holing of activities into abstract categories that may not reflect the fluidity and complexity of human behavior. Gould and Saggers (1985) observed a combination of both direct and embedded strategies of lithic procurement in ethnoarchaeological work among Western Desert Aborigines in Australia. The lithic procurement activities among the Western Desert Aborigines referred to as "direct" lithic procurement were often associated with the maintenance of long-distance social networks or were done from base camps that were occupied for subsistence purposes (Gould 1978:830-832; Gould and Saggers 1985:120, 123). What distinguished this activity from more embedded lithic procurement were statements by informants indicating that the primary goal of these forays was to obtain lithic raw material, in spite of the fact that other activities were taking place during the forays. In short, it is difficult, if not misleading, to put strict classifications of "embedded" or "direct" procurement on pre-contact toolstone quarrying.

When examining the range of lithic procurement sites that occur in the Columbia Hills, a model for lithic procurement in the Columbia Hills is perhaps best viewed as combining both direct and embedded strategies. The more ephemeral lithic scatters and smaller quarries in the Columbia Hills were likely locales in which lithic procurement was practiced in association with subsistence-related tasks or while traveling through the hills en route to areas further afield. It is also possible that very limited lithic procurement occurred during vision quests, as stacked rock features likely constructed in ritual contexts are located throughout the Columbia HIills. At the ephemeral lithic scatter sites, lithic procurement would have been limited in its duration and intensity, although certain desirable spots were likely visited repeatedly. The archaeological evidence for this type of limited-scale toolstone procurement includes lithic procurement locales with one or more of the following characteristics: relatively low densities of lithic debitage, very discrete areas with high densities of lithic debitage, and abundant CCS lithic material of poor or uneven quality.

As opposed to the embedded procurement that was likely linked to the ephemeral lithic procurement sites situated some distance from habitation sites, more direct toolstone procurement likely occurred at the quarry sites nearest to villages and camps. The most obvious candidate for direct procurement would be the Walawateese quarry which would have been the most accessible from villages on the Columbia River, particularly the *wálawitsis* village at Maryhill. The abundance of large quarry pits at the site attests to this type of use. The quarry sites within close proximity to Columbia Hills camp sites 45KL590 and 45KL1479, which include an expansive quarry containing a mining pit (45KL1400), were likely, at least occasionally, visited for the sole purpose of obtaining CCS toolstone. Likewise, direct procurement of CCS likely occurred at the large CCS quarry (45KL1237) located approximately 3.5 km from large pithouse villages at Miller Island. Not surprisingly, lithic debitage assemblages at these two large quarries contained the most substantial concentrations of early-stage core percussion flakes among the quarry sites investigated for this study (Figure 8-7).

Summary and Conclusions

The Columbia Hills represent an important source of CCS toolstone for one of the most densely populated areas within the Columbia Plateau region during the pre-contact period. This lithic landscape contains several large quarry sites and myriad smaller lithic procurement locales within relatively close proximity to large villages and seasonal camps. Analysis of lithic material from Columbia Hills quarry sites and applying the principles of central place foraging models indicate that pre-contact flintknappers procuring CCS in the hills most likely limited their activities to the early stages of toolstone reduction at the quarries, choosing to conduct later stages of reduction and toolmaking at nearby villages and camps. Much of this quarrying and assaying of CCS lithic material in the hills was likely embedded in foraging for the abundant edible roots found in the Columbia Hills lithic landscape, as root procurement was a very important aspect of the local and regional subsistence regime. However, visits to the largest quarry sites likely also occurred outside of root gathering forays as a direct procurement strategy, especially in the cases of the large quarries most accessible to villages and camps.

To conclude, this study is best viewed as an exploratory analysis of Columbia Hills toolstone geared to providing preliminary insights into the pre-contact lithic procurement strategies utilized in this landscape. Further studies could provide additional insights into the relationship between toolstone procurement and subsistence. In addition, the spiritual significance of the Columbia Hills and how it may relate to the materiality and cultural value of Columbia Hills toolstone is a topic worthy of future exploration.

To develop a more complete picture, establishing a time depth for pre-contact CCS toolstone procurement with radiometric dating and an analysis of the chemical signatures of the Columbia Hills CCS are necessary to better understand the relationship between the Columbia Hills lithic landscape and the villages and camps in which the toolstone was used, as well as how widespread this toolstone is throughout the region. In particular, establishing a chronology for quarrying in the Columbia Hills could allow for a diachronic analysis of reduction technologies to determine whether these strategies change through time and whether there is variability between the strategies used at specific quarries and workshops.

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