The *Nii'ii* Hunting Stand Site: Understanding Technological Practice as Social Practice in Subarctic Prehistory

by

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Abstract

I argue that by understanding lithic technology as a total social fact, that is, as socially, culturally and politically constituted, it is possible to gain some insight into prehistoric social practice. An archaeological examination of the *Nii'ìi* site (KdVo-5), a prehistoric hunting stand locality in southwestern Yukon Territory, serves as a case study for this argument. Spatial reconstruction of this site indicates the presence of several social actors engaged in face-to-face interaction. Technological analysis of the lithic assemblage demonstrates that the observed variability in tool forms cannot be explained solely in terms of tool function; instead, it appears that the technical choices made by the occupants of KdVo-5 were socially and culturally mediated. I outline a theory of technological practice, based on practice-oriented social theory, in an attempt to understand the importance of these technical choices in the construction of social relationships at *Nii'ìi*.

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Acknowledgements

Yukon: I thank the White River First Nation for accommodating our archaeological field projects in their traditional territory, and especially Mr. Joseph Johnny, an Elder who guided us through the landscape and history of the Scottie Creek Valley. I thank my friend and colleague Norm Easton of Yukon College for facilitating my thesis research and teaching me the finer points of subarctic archaeology and ethnography. I thank the volunteers and students who participated in the excavation of the *Nii'ii* hunting stand: Duncan Armitage, Christopher Baker, and Ken Hermanson.

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Chapter One: Introduction

Our narratives of subarctic prehistory, which tend to emphasize scarce resources, immanent starvation and simple tools while overlooking culture and history, are nightmares from which our representations of prehistoric hunter-gatherers of the northern boreal forest are trying to awake. In his paper *Subarctic "Prehistory" in the Anthropological Imagination,* a recent critique of theory in subarctic archaeology, Holly (2002:16) points out that our interpretations of the past continue to be informed by the idea that the boreal forest environment was so forbidding to prehistoric hunter-gatherers and their simple toolkits that it "narrowly dictated hunter-gatherer adaptations in the subarctic." This environment was so constraining that prehistoric hunter-gatherers endured continuous labour just to survive: "the specter of starvation stalk[ed] the stalker" (Sahlins 1972:1). Indeed, previous to archaeological investigations that established widespread and continuous prehistoric occupation of the subarctic, it was commonly assumed by anthropologists that these areas were first occupied in the historic period, only after "firearms and trading posts made survival possible and economic incentive made the risk worthwhile" (Holly 2002:12). What emerges from this view, argues Holly (2002:10), is a prehistory that is "ahistorical, acultural and devoid of social actors." In this version of subarctic prehistory, the scarce resources of a marginal environment and a lack of technical sophistication force hunter-gatherers into a narrow ecological adaptation. Social and cultural institutions are shaped by the relentless pursuit of subsistence and social actors are dehumanized by a lack of choice, their behaviour determined by the cold, hard task of survival in an unforgiving place.

Reminiscent of the image of hunter-gatherers convincingly refuted by Sahlins (1972) in *Stone Age Economics*, this view of subarctic hunter-gatherers is based on a presumed condition of scarcity in the boreal forest. Yet scarcity, argues Sahlins (1972) is a concept of bourgeois economics imposed on the past rather than a reality faced by hunter-gatherers. Scarcity is created by unlimited wants and insufficient means and from this perspective, many hunter-gatherers do appear to live in utter scarcity. Their meager possessions indicate an inability to satisfy unlimited wants and thus their means are judged inadequate:"[h]aving equipped the hunter with bourgeois impulses and paleolithic tools, we judge his situation hopeless in advance" (Sahlins 1972:4). But in light of evidence indicating that some modern hunter-gatherer groups living in marginal places tend to work approximately three hours per working adult per day to fulfill their subsistence needs, Sahlins (1972:2) proposes that the opposite is more likely the case: "that human material wants are finite and few, and technical means [relatively] unchanging but on the whole adequate…[and that] a people can enjoy an unparalleled material plenty – with a low standard of living." Of course, interpretive problems arise from projecting this ethnographic information into the past, not the least of which is accounting for the consequences of the colonial contexts in which modern hunter-gatherers are embedded (see Wobst 1978). Nonetheless, Sahlin's critique of scarcity amongst hunter-gatherers living in marginal places should compel subarctic archaeologists to leave ajar interpretive doors that are closed by the tacit assumption of this condition.

A significant corollary of Sahlin's critique of scarcity is that it loosens the hold of the environment on prehistoric hunter-gatherer societies. Like the Arnhem Land hunters who spent some of their time in "the provision of diversity over and above mere sufficiency" (Sahlins1972:18), prehistoric hunter-gatherers probably had sufficient leeway in their survival adaptations to make culturally specific choices in their subsistence activities. Instead of a single rational adaptation mandated by the environment, based on principles of energy expenditure and economic efficiency, subarctic archaeologists should expect a diversity of social organizations and culturally mediated strategies to have been brought to bear on the economic problems posed by the subarctic environment and, importantly, on the social contradictions internally inherent in human societies. To be sure, the northern boreal forest placed constraints on the practices of hunter-gatherers using stone tools to harvest dispersed resources, but as Holly (2002:13) says: "The question is whether the environment was so constraining as to deny hunter-gatherers the ability to negotiate their own socially and historically relevant strategies – to carve their own unique pathways through prehistory. This is not to suggest that all pathways are possible in the subarctic, but merely that there is more than one in any given environmental setting." It is thus one of the tasks of subarctic archaeologists to determine the social processes that lead to the unfolding of diverse historical pathways.

But can these pathways be inferred from the usually ephemeral subarctic archaeological record: bits of stone and bone often found in unstratified deposits? Focusing on subsistence-settlement systems in prehistoric Newfoundland, Holly (2004) presents compelling evidence that they can be reconstructed. Hunter-gatherer groups occupying the island chose between a diversity of possible strategies depending, it appears, on whether or not they co-occupied the island with a different group. At the time of the appearance of Recent Indian populations on Newfoundland at approximately

AD 100, the Dorset inhabitants practiced a highly mobile, generalized foraging strategy, leaving a record of geographically dispersed campsites with fairly ephemeral material traces. Upon the arrival of the Recent Indians, the record of the Dorset subsistence-settlement system changed to one characterized by subterranean houses and midden deposits, indicating a semi-sedentary population. At this time, the Recent Indians practiced a similar subsistence-settlement mode, the archaeological record indicating population aggregations on the outer coast and deep in the interior (for caribou hunting). Interestingly, when the Dorset left the island around AD 1000, the Recent Indians adopted a highly mobile foraging strategy, evidenced in the archaeological record by a return to dispersed, ephemeral campsites. These observations indicate significant variability in the ways prehistoric hunter-gatherers chose to use a marginal, subarctic environment, and these choices appear to have been based on social factors relating to the co-occupation of Newfoundland rather than an adaptation narrowly dictated by the distribution of resources in the environment (Holly 2002, 2004).

In this thesis, I also seek to delineate socially and culturally mediated choices made by subarctic hunter-gatherers but I focus on the microscale social interactions of a single site rather than the broader scale of the subsistence-settlement system. The premise for this analysis is that prehistoric technicians made socially and historically specific choices concerning their technologies. Like our acultural and ahistorical conceptions of prehistoric hunter-gatherer adaptations in the subarctic, paleolithic technicians, argues Wobst (2000:44), "have been presented as if they had no agency. All artifact production was forced upon them by hostile nature, and all of it was directed toward these hostile forces of nature." That is, artifact production is conceptualized solely in terms of a universal logic based on functional optimality and economic efficiency. Yet, recent perspectives in the anthropology of technology indicate that technological practice is also shaped by the social and cultural contexts in which it is embedded and that it is a "medium through which social relationships, power structures, worldviews, and social production and reproduction are expressed and defined" (Dobres and Hoffman 1994:212). Clearly, this is a definition of technology that goes beyond the domains of functional efficiency and economic rationality to one that includes the social shaping of technology. Viewed from this perspective, technological acts recorded in the archaeological record can provide a window into social processes other than functional adaptation to the environment.

Can the technical choices made by social actors interacting in the context of a site shed any light on the "socially and historically relevant strategies" proposed by Holly (2002: 13)? I attempt to address this question through the spatial and technological analyses of a hearth-associated assemblage from the KdVo-5 site in southwestern Yukon Territory (Figure 1.1, p.8). Located in the traditional territory of the Scottie Creek band of the Upper Tanana Athapaskans, the KdVo-5 site, called *Nii'ìi* / lookout (away from) village / in the Scottie Creek dialect, consists of four localities in the vicinity of a prominent hill: a historic village site at the base of the hill, a historic graveyard associated with the village, a prehistoric 'crematorium' reputedly located atop a rise behind the village, and a hunting lookout located atop the hill. The analysis presented in this thesis is based on excavations carried out at the hunting lookout locality. Chapter Two describes some preliminary details concerning the site, including a site description, history of research, field methods, stratigraphy, an introduction to the assemblage and relative dating of the assemblage. In Chapter Three, I undertake a spatial analysis of the KdVo-5 assemblage in order to discern how social actors might have engaged with each other in the vicinity of the hearth feature. The technological analysis of the assemblage begins with the study of the debitage found associated with the hearth to determine the stages of lithic tool production that were undertaken at the site (Chapter Four). These data are integrated with a design analysis of the tool assemblage and anthropological models of hunter-gatherer subsistence-settlement systems to ascertain the function of the site. More importantly, I ask if the observed variability in the design of the tools found associated with the hearth can be explained, with reference to site function, by purely functional aspects, or if other considerations were implicated in their design (Chapter Five). I pick up this topic of 'other considerations' in Chapter Six by introducing ideas regarding the social shaping of technology and discussing their relevance for understanding the social practices that took place in the vicinity of the hearth feature.

Overall, my goal is to propose that the study of lithic technology, often the only prehistoric remains that survive the shallow soils of the boreal forest, can lead to insights into the social practices of prehistoric hunter-gatherers, and to outline some theoretical and methodological ideas for apprehending these practices in the archeological record. Recent engagement with practice-oriented social theories has compelled archaeologists to consider the importance of socially constituted daily practice in the construction of social relationships and the structuring of archaeological sites (Dobres 1995, 2000; Hodder and Cessford 2004; Wobst 1999, 2000). Social practice unfolds in the context of everyday, face-to-face social interactions and plays a part in creating, maintaining, contesting and reproducing social structures; thus, a practice-oriented approach to understanding specific moments in the archaeological record necessitates the reconstruction of face-to-face interactions from the spatial patterning of a site. I argue that the archaeological record of the northern boreal forest is ideal for the investigation of everyday social practices at the microscale of face-to-face interactions. Prehistoric sites in the subarctic often comprise single component, short-term occupations, which tend to leave relatively ephemeral archaeological deposits. Complete, detailed excavations of these deposits are practicable and the small assemblages that result are amenable to the multifaceted spatial and technological analyses needed to infer daily social practice from the archaeological record. My analysis of the KdVo-5 site demonstrates some interpretive tools useful for implementing this type of small-scale analysis in subarctic archaeology, and points out how a social archaeology of the subarctic might contribute to wider issues in archaeological method and theory.

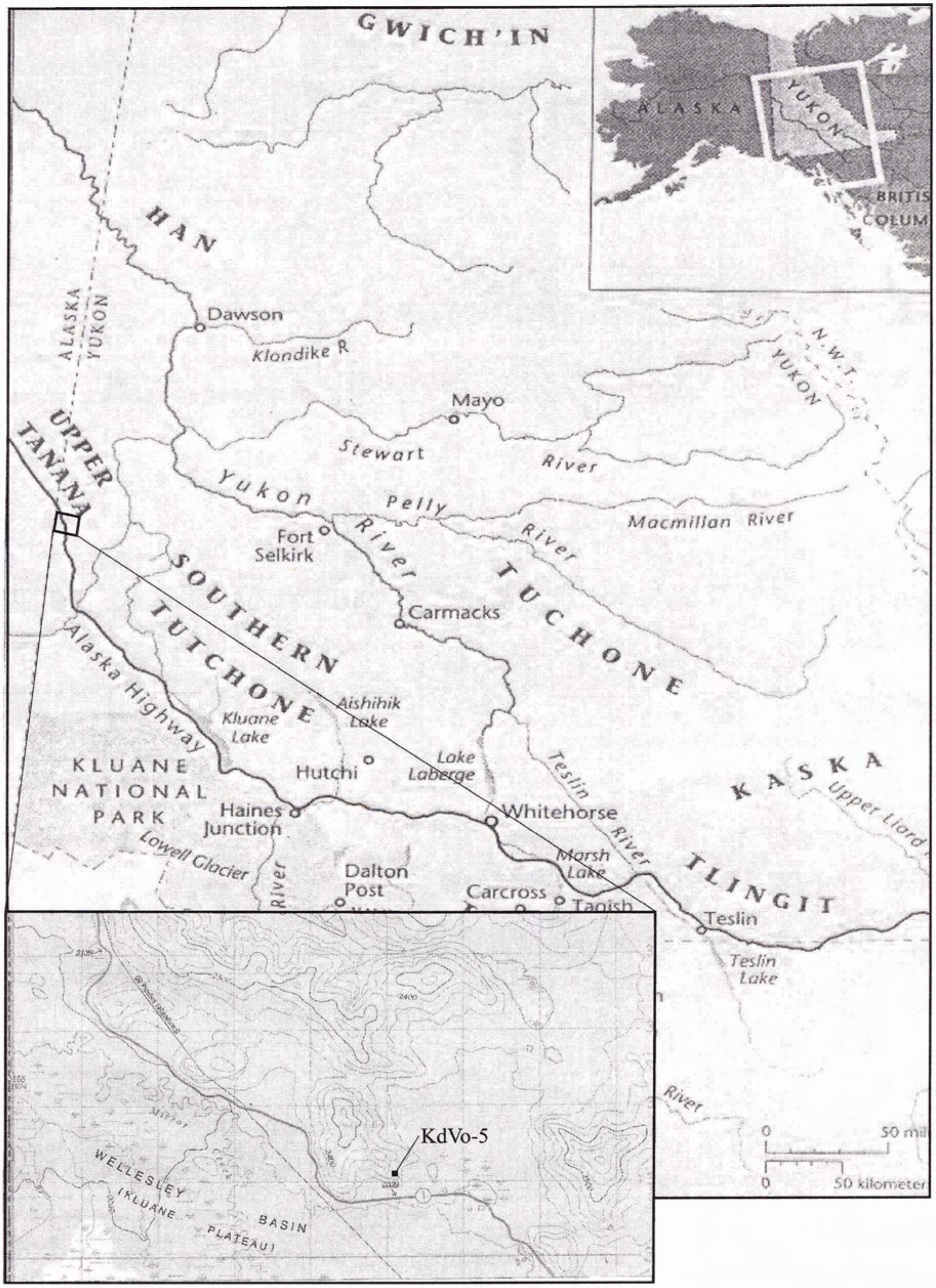


Figure 1.1. Map showing the location of the KdVo-5 site in Yukon Territory (adapted from Cruikshank 1999: xxvi).

Chapter Two: The KdVo-5 Site

Site Description

The hilltop lookout to the northeast of the traditional village known as *Nii'ìi* / lookout (away from) village / is connected to the village site by a trail that winds up the flank of the hill through a forest of white spruce and paper birch. Fifty or so meters shy of the summit the trail ends, opening onto a clearing lightly covered with low-growing rosebushes. Subduing the steep slope of the hill, the clearing comprises roughly one hundred square meters of relatively level terrain, gently sloping in each direction towards the steeper edges of the hillside (Figure 2.1c, p.20; Figure 2.2, p.21). Oral history of the Upper Tanana inhabitants of this area maintains that this clearing was used as a hunting lookout by occupants of the village below, and this is evidenced not only in the historical debris scattered across the site, but also in a swath of poplar trees breaking the continuity of the largely spruce forest of the hillside, secondary growth from previous efforts to clear a field of view. According to Mr. Joseph Johnny, an Elder of the White River First Nation, it was here that Chief Johnson, a prominent *Dineh Su Ha'skeh* /" respected man" or "leader"/, who from the early 1920s to 1944 made his main camp at *Nii'ìi,* watched in disbelief as an airplane, which came to be known locally as 'the big eagle', made a first reconnaissance of the future corridor of the Alaska Highway, and where, only months later, the inhabitants of *Nii'ìi* watched as a battery of U.S. Army bulldozers inched its way across the Beaver Creek Plain. Of course, the main function of the lookout was not to observe the unfolding of major historical events but to monitor the surrounding landscape for the movement of game. Overlooking a broad expanse of the Beaver Creek plain to the south, a low relief flatland of tussock muskeg and bogs, punctuated here-and-there by frost mounds forested with black spruce, dwarf birch, alder and willow the lookout affords an almost unending vista of ideal moose habitat (Figures 2.1a-b, p.20). This northern boreal forest environment, according to a paleoecological study of the Scottie Creek District by MacIntosh (1997), has persisted much as it is today for the last five thousand years.

History of Research

In 1994 Mr. Norm Easton initiated a project to investigate the culture history of the Scottie Creek Band of the Upper Tanana Athapaskans. Along with other traditional sites identified by First Nation Elders, Easton and his Yukon College Fieldschool conducted an archaeological survey of the *Nii'ii* village and lookout sites (see Easton 2002). Subsurface testing of the lookout site uncovered an area of relatively high lithic density at the center of the landform. A trench excavated at this time to further investigate this area is shown on the sitemap (Figure 2.2, p.21). In addition, three 1x1m units contiguous to this trench were started in 1994 but not completed on account of time constraints. In my thesis research at the KdVo-5 hunting stand, conducted in the summers of 2002 and 2003, I sought to continue and expand the unit excavations initiated in 1994. One of the 1994 units, TP16W, was completed as Unit B; the other two, contiguous to the east wall of the trench, only minimally excavated beyond the A horizon in 1994, were not pursued in 2002-2003, except for the north half of TP16E1, which overlaps with the south half of Unit I. Seven 1 x 1m units, A through G, were excavated in 2002 and units H and I were excavated in 2003.

Field Methods

1 x 1m units were established to investigate the putative activity area located in 1994. Early on in the 2002 excavations a hearth feature containing charcoal, debitage and burnt bone fragments was located in Unit B. Subsequent units were placed to determine the extent of the hearth-associated artifact scatter. Units were trowel-excavated by quadrant and natural stratigraphic level. All artifacts found in place were fully provenienced, except for dense scatters of microdebitage, which were mapped and collected *en masse*. Depths were recorded from a datum established in the NW corner of each unit and the relative elevations of the unit datums were established by reference to a fixed site datum using a transit and stadia rod (see Figure 2.2, p.21). All excavated soil was dry screened through ¼ inch mesh.

Stratigraphy

The general stratigraphic profile of the units excavated at KdVo-5 is depicted in Figure 2.3 (p.22). Comparable to the stratigraphy encountered at many shallowly buried sites in the subarctic boreal forest, the processes of sediment formation are difficult to determine but likely comprise some combination of the frost fracturing of bedrock, eolian deposition and the dissolution of surface organics (Thorson 1990). The resulting stratigraphic profile consists of fairly homogenized, unstratified brown soil (B horizon) lying atop a layer of frost-fractured bedrock (C horizon), and capped by a layer of organic detritus and the modern root mat (A horizon). Some units exhibit a B/C horizon characterized by brown soils mixed with small bedrock fragments, possibly caused by the *in situ* disintegration of bedrock and its introduction to the soil matrix.

As is the case for most shallow boreal forest sites, the presence of an unstratified B horizon poses problems for delineating distinct archaeological deposits (Thorson 1990). At KdVo-5 this problem is partially alleviated by the presence of the White River tephra, which separates this horizon into two components: B1 and B2. The White River tephra was deposited as distal air fall across large tracts of the Yukon in the wake of the volcanic eruption of Mt. Bona. Located at the southern end of the Alaska-Yukon border, Mt. Bona erupted twice in the late Holocene, distributing a northern lobe of ash between 1900 and 1500 ^{14}C years BP and an eastern lobe at approximately 1200 ^{14}C years BP (Clague et al 1995). The KdVo-5 site lies within the northern ash-fall zone (West and Donaldson 2002:239); thus, the White River tephra provides a fairly precise chrono-stratigraphic marker, dividing the B horizon into pre- and post-1900-1500 ^{14}C years BP components.

Assemblage

Prehistoric cultural material was found in the B1, B2 and B/C levels. Unfortunately, though KdVo-5 is a multicomponent site, its utility for delineating changes through time in the local technological sequence is hampered by the extremely ephemeral nature of the cultural deposits in all of the stratigraphic levels except for the B2 horizon. The total prehistoric assemblage includes 10 stone tools, illustrated in Figure 2.4 (p.23), 535 pieces of debitage and approximately 1100 pieces of highly fragmented bone. Nine of the 10 stone tools, 495 of the 535 flakes and approximately 1000 of the 1100 bone fragments are from the B2 level. The chipped-stone tools in the B2 assemblage include 5 notched or lanceolate projectile point bases (Figure 2.4a-e, p.23), 2 projectile point tips (Figure 2.4i-j, p.23), 1 bifacial preform fragment (Figure 2.4h, p.23) and 2 retouched/utilized bifacial thinning flakes (Figure 2.4f-g, p.23). Detailed spatial and technological analyses of the B2 tool and debitage assemblages comprise the main content of my thesis; thus, I do not enter into a fuller description of these artifacts in this section. The B2 faunal assemblage appears to contain bird, small mammal and large mammal bone but due to its highly fragmented state, I do not attempt to determine the relative frequencies of these types or to identify individual elements to the species level. Thus, analysis of the faunal remains is limited to their spatial patterning, which is described in Chapter Three.

The other two prehistoric components of the KDVo-5 site, B1 and B/C, bracket the B2 cultural deposit. The material record of the B1 layer is limited to a discrete scatter of basalt flakes in the northeast quadrant of Unit A (n=15), a small concentration of bone fragments (n= 33) at the interface between the A and B1 horizons in the northeast quadrant of Unit D and a scatter of bone fragments in the southeast quadrant of Unit F (n=15). Cultural material in the B/C stratigraphic layer was found primarily in Unit I. It consists of a scatter of flakes (n=25), bone fragments (n=12) and a projectile point base that may be associated with a patch of fire-reddened sediment at the top of the B/C layer. The projectile point base (Figure 2.4a, p.23) is a basally thinned lanceolate form of uncertain cultural affinity, though, as is described in Chapter Five, it is technologically quite distinct from the bases in the B2 assemblage.

Historic artifacts were found on the surface of the site and in the A horizon. A .22 cartridge was found in the A horizon of the southwest quadrant of Unit A, and a 30-30 cartridge was found in the southeast quadrant of Unit D. Contemporary use of the lookout was apparent in the surface scatter of historic debris at the site, which included a chair, bedding, pop tins, whittled sticks and toilet paper.

In the following section I outline the culture-history of the southern Yukon and attempt to situate the KdVo-5 components within this framework.

Culture-History of the Southern Yukon

In 1978 Workman proposed a technological sequence for the archaeological record of the southern Yukon. Hare (1995) made slight revisions to this scheme and added two new technological complexes in order to account for data emerging from recent excavations. Figure 2.5 (p.24) shows the culture-historical sequences of the southern Yukon as proposed by Workman and Hare (dates in this section are presented in uncalibrated ^{14}C years BP). The earliest assemblages are thought to represent small highly mobile colonizing groups, while the later phases reflect permanent settlement of the southern Yukon (Hare 1995). The Late Prehistoric period corresponds to the subarctic Athapaskan cultures described in the ethnographic present. Slightly revising Hare's (1995) scheme, recent work in the Scottie Creek area compels the addition of a technological complex new to culture-historical syntheses of southern Yukon prehistory: the Nenana Complex.

Evidence of the earliest human occupation of eastern Beringia is found in the Tanana River Valley. The Nenana complex, found at several sites in central Alaska, dates to between approximately 11,500 BP and 9,500 BP (Hoffecker et al. 1993; Holmes 2001). It is found in the Tanana River Valley at the Healy Lake, Chugwater and Broken Mammoth sites (Cook 1996; Holmes 1996; Holmes 2001; Lively 1996). The lithic assemblage of the Nenana complex includes small teardrop-shaped and triangular bifacial points, collectively known as Chindadn points, bifaces, large blades, endscapers, side scrapers, gravers and scraper planes (Hoffecker et al. 1993:49). There is no evidence of a microblade industry and, indeed, at the Healy Lake and Chugwater sites, the non-microblade Nenana Complex is found stratigraphically below a microblade culture: the Denali Complex. A large quantity of faunal material was recovered from the Broken Mammoth Nenana deposit, which indicates that people were hunting elk, caribou and bison (Holmes 1996). Goebel et al (1991) argue that the lithic technology of the Nenana complex is similar in most aspects to the Clovis complex, except that it lacks the characteristic fluted Clovis projectile points, and Carlson (2004) maintains that the Nenana Complex is the most likely antecedent of pre-microblade components on the Northwest Coast.

Recent excavations at the KdVo-6 site have geographically extended the Nenana occupation of the Tanana watershed to its uppermost tributary, the Scottie Creek area of the southern Yukon (Easton et al. 2004). The Nenana assemblage at KdVo-6 was found in a loess layer, distinct from an overlying brown soil layer containing a microblade component. To date, it includes three Chindadn-type points, a large bifacial knife and several unifacial implements, though evidence of blade technology is thus far lacking. This component remains to be conclusively dated but its clear relationship to early assemblages in interior Alaska make it a good candidate for the earliest human occupation of the southern Yukon. Not so clear is its technological relationship to the Northern Cordilleran Tradition, a construct proposed by Clark (1983) to classify archaeological assemblages in the southern Yukon that pre-date the earliest appearance of microblades in the region.

The Northern Cordilleran Tradition represents the earliest dated human occupation of the southern Yukon. Found in the basal deposits of only four sites, the artifact assemblage of this tradition is poorly defined. In general, the diagnostic artifacts of the Northern Cordilleran Tradition include large blades and lanceolate projectile points with round or pointed bases; evidence of a microblade industry is absent but, like the Nenana Complex, the Northern Cordilleran Tradition occasionally underlies a microblade-bearing component. It first appears in the archaeological record of the southern Yukon between 10,670 and 10,130 BP at the KaVn-2 site near Beaver Creek (Hefner 2002). Though these dates overlap partially with the span of the Nenana Complex in interior Alaska and both traditions lack microblades, a lack of distinctive Chindadn-type points in the KaVn-2 assemblage precludes the assignation of the Nenana Complex and the Northern Cordilleran Tradition as equivalent. The temporal relationship of these traditions to microblade technology is also in open debate. For example, Hefner (2002) contends that the lower component of KaVn-2, though lacking microblades, contains diagnostic artifacts of both Nenana/Northern Cordilleran and biconvex knives characteristic of the microblade-bearing Denali Complex. With West (1996), he suggests that putative pre-microblade components, such as Nenana, might be regional or functional variants of the Denali Complex rather than temporally distinct technological traditions. Only tentatively defined, the early culture-historical sequence of the southern Yukon awaits additional well-dated archaeological evidence.

Microblade technology makes its first known appearance in the southern Yukon at approximately 8,000 BP. The diagnostic artifacts of the Little Arm Phase, the name Workman (1978) proposed for the manifestation of this technology in the Yukon, are microblades and frontally fluted wedge-shaped microblade cores, leaf-shaped bifaces, lanceolate projectile points, "Donnelly burins", and endscrapers (Clark and Gotthardt 1999). The microblade technology of the southern Yukon is equivalent to the Denali Complex of Alaska, which makes its debut around 10,700 BP (Clark 2001:184). The time lag between occurrence in central Alaska and the southern Yukon has not been explained, but it may reflect the lack of early sites found and excavated in the Yukon to date.

Though microblade technology persists in the interior of Alaska and the Yukon into the Late Prehistoric (Clark and Gotthardt 1999; Potter 2004; Thomas 2003), after about 5000 BP, the assemblages of most sites in the Yukon indicate a new tradition characterized by notched and straight or slightly concave-based lanceolate spear points, large leaf-shaped bifaces, endscrapers, notched cobble sinkers and hide-scraping stones (Clark 1981:115). This phase, known as the Taye Lake Phase, a geographic variant of the Northern Archaic Tradition (Anderson 1968), lasts for approximately 4000 years in the archaeological record of the southern Yukon. At the Annie Lake site, a brief occupation by a distinct technological complex separates the Little Arm and Taye Lake phases (Greer 1993; Hare 1995). The diagnostic artifact of the Annie Lake Complex is a deeply concave-based lanceolate projectile point. The place of this complex in Yukon prehistory is unclear. Hare (1995:122) suggests that it may represent the migration of a new group into the region, which was subsequently replaced by the widespread Taye Lake phase.

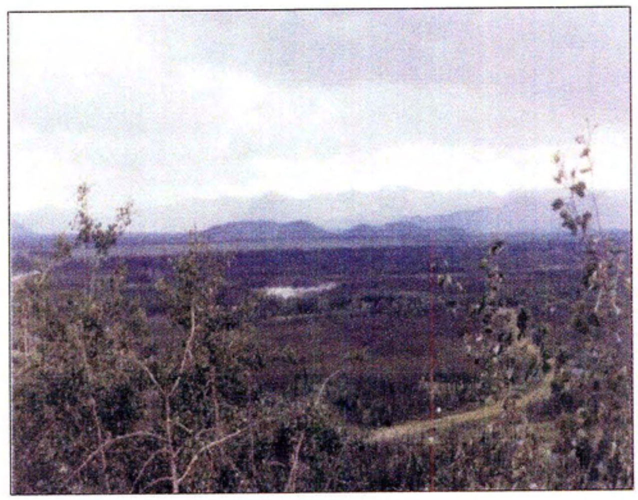
Around 1200 BP, most of the southern Yukon was blanketed in ash by the White River volcanic eruption (Workman 1978; Hare 1995). As a widespread chronological marker, the eastern lobe of the White River tephra represents a natural boundary between the Late Prehistoric period and the Taye Lake Phase. The Late Prehistoric period corresponds to the Athapaskan cultures ethnographically documented in the historic period. Prehistoric post-ash assemblages, Workman's Aishihik phase, are characterized by the introduction of native copper implements, including small stemmed projectile points, prongs and gorges; a lithic industry of diminutive side-notched arrow points, end scrapers, side scrapers, hide scrapers, ground adzes and bifacial knives; and a well-preserved bone tool assemblage, which includes barbed points, bunting points, awls and fishing implements. According to Hare et al.'s (2001, cited in Thomas 2003) analysis of organic artifacts recovered from alpine ice patches in the southern Yukon, a shift from atlatl technology to bow and arrow technology took place sometime around 1300 BP, which explains the appearance of diminutive stone and bone points. Large amounts of fire-cracked rock are often found in Late Prehistoric sites, indicating the use of stone boiling for cooking. Marine scallop shells found at the Annie Lake site suggest the presence of regional trade during this period. Workman's (1978) Bennett Phase marks the introduction of European trade goods to the southern Yukon. Stone, bone and copper tools are replaced by iron and steel in the archaeological record, and a dramatic decline in fire-cracked rock reflects the use of metal cooking containers. Faunal evidence indicates an increasing emphasis on fur-bearing animals.

In view of the overall culture-historical framework of the southern Yukon, it is quite clear that the B2 component of the KdVo-5 site, with its notched and lanceolate projectile point bases, represents a Taye Lake Phase occupation. Based on the temporal span of this phase and its stratigraphic location below the northern lobe of the White

River tephra, the B2 component likely dates to between 5000 and 1900-1500 BP. The B1 component contains no diagnostic artifacts; however, as it is above the northern lobe of the White River tephra (1900-1500 BP), it most likely corresponds to the tail end of the Taye Lake Phase or represents a Late Prehistoric occupation. The B/C component, based on the principle of superposition, predates the B2 component but it would be hazardous to propose its cultural affiliation based on only one projectile point base (Figure 2.4a, p.24). Its basally thinned, slightly concave base and tendency towards a collateral flaking pattern (more apparent on the obverse of the piece, which lacks prominent basal-thinning scars) is almost reminiscent of some of the Mesa Complex lanceolate points from Arctic Alaska, though it lacks the edge and base grinding and the thick lenticular cross-sections typical of Mesa forms (see Kunz and Reanier 1994, 1995 for descriptions of the Mesa Complex). The place of the B/C component in the culture-historical sequence of the southern Yukon will have to await further excavation of the potential feature emerging in Unit I and further delineation of the local technological sequence in the Scottie Creek region. The historic components relate to use of the lookout during the occupation of the *Nii'ii* village site and after its abandonment in the early 1950s.

In the remainder of this thesis I undertake detailed spatial and technological analyses of the archaeological remains found in the B2 horizon of the KdVo-5 site.

a



b

c

Figure 2.1. a) Landscape in the vicinity of KdVo-5; b) View to the southeast from the KdVo-5 hunting stand; c) The KdVo-5 hunting stand site.

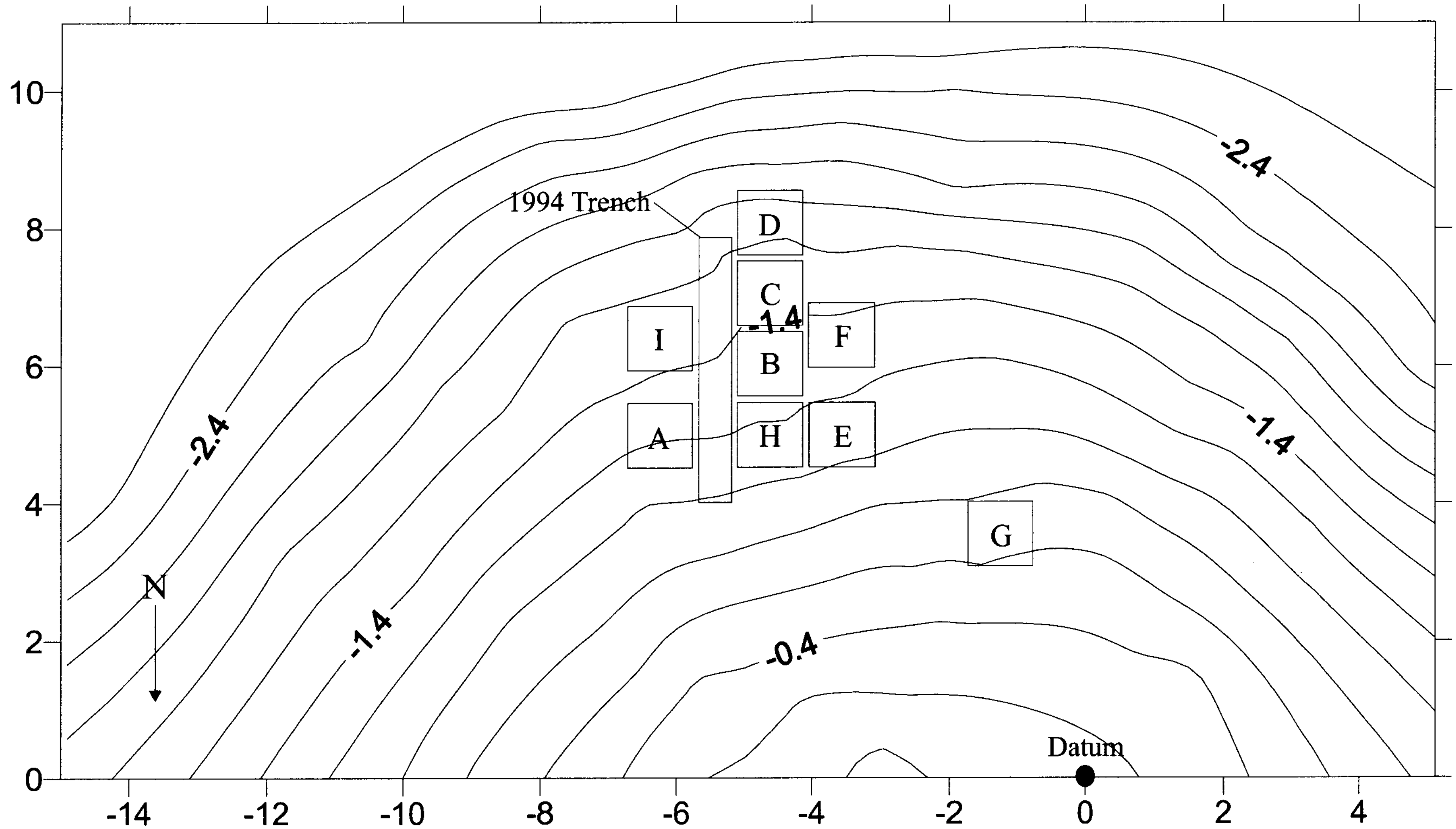


Figure 2.2. Contour map of the KdVo-5 site showing the trench excavated in 1994 and the 1 x 1 m units excavated in 2002 and 2003.

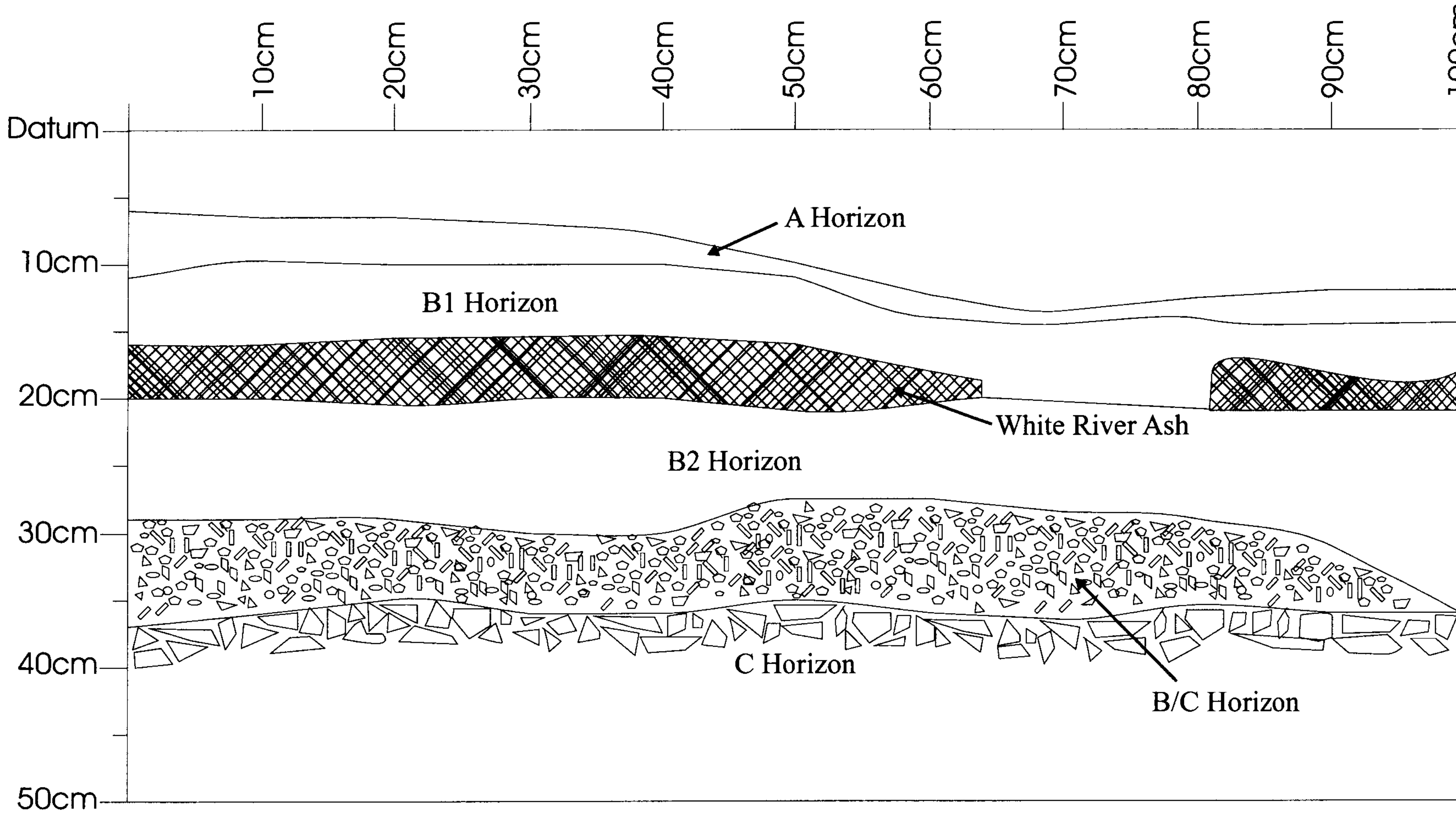
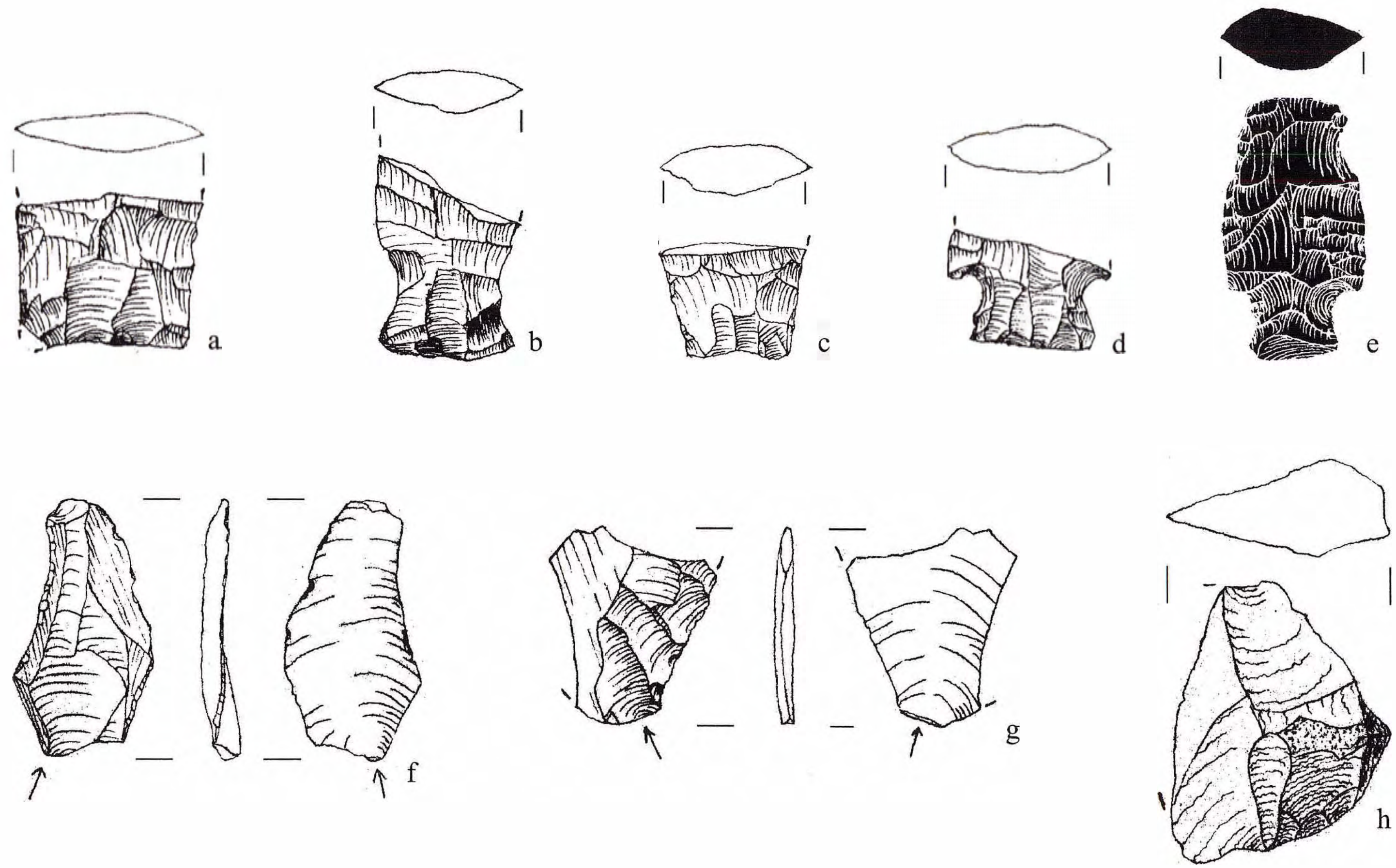


Figure 2.3. Profile of the north wall of Unit F showing the general stratigraphy encountered at the KdVo-5 site.



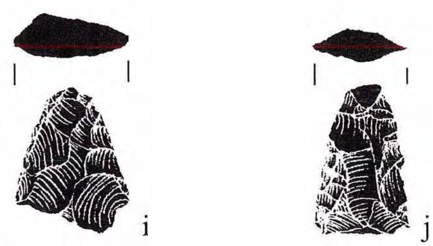


Figure 2.4. Lithic artifacts from the KdVo-5 site: projectile point bases (a-e); unifacial flake tools (f,g); bifacial preform fragment (h); projectile point tips (i, j). Drawings by Duncan McLaren.

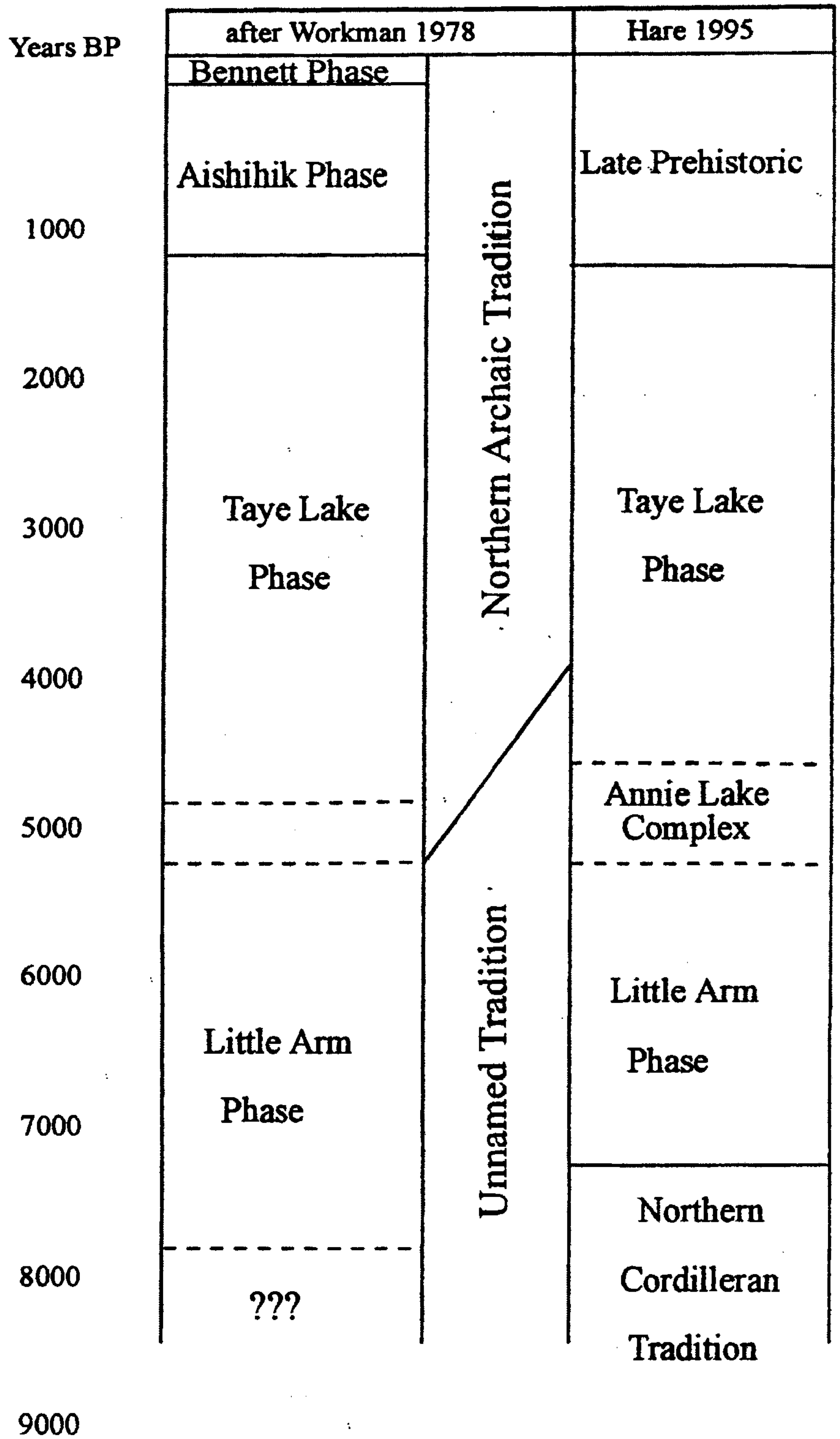


Figure 2.5. Culture-historical sequences of southwest Yukon Territory (adapted from Hare 1995:130).

Chapter Three: Spatial Analysis of the KdVo-5 Site

Introduction

This chapter is to presents a paleo-ethnological account of the cultural formation processes that led to the spatial patterning of material remains preserved in the archaeological record of the KdVo-5 site; that is, I want to determine how people were organized in space as they watched for game in the valley below, made and repaired tools and snacked on bone marrow. While models of the spatial aspects of refuse disposal and camp organization derived from ethnoarchaeological research on modern hunter-gatherer camps provide a direct link between the spatial patterning of an archaeological assemblage and human behavior, applying this interpretive approach to the KdVo-5 assemblage depends on two important assumptions about the archaeological record of the site: i) the patterning of artifacts is primarily the result of human activity and not natural site transformation processes (Schiffer 1976, 1986); ii) the horizontal distribution of artifacts represents a discrete episode of site use, not superimposed material remains from numerous intermittent occupations deposited over a long period of time. Unwarranted in many cases, these assumptions have to be evaluated before making behavioral inferences from spatial data (Audouze and Enloe 1997; Camilli 1989). As Audouze and Enloe (1997:198) point out, "if we want to make paleoethnological inferences it is vital to discriminate successive occupations. The more we want to draw assumptions from the positions of artifacts, the more strictly we must control stratigraphy. Otherwise, the inferences drawn from the data may turn out to be biased through mixing of several occupations."

Discriminating successive occupations at KdVo-5 is complicated by the shallow stratigraphy of the site. In a depositional context characterized by the slow deposition of a homogenous soil matrix, the material remains of numerous intermittent occupations can be highly superimposed and difficult to disentangle. Natural site formation processes exacerbate this problem. Shallowly buried deposits are extremely susceptible to disturbance and even minor post-depositional changes in artifact elevation can confound the identification of artifact associations. Thus, before interpreting the horizontal spatial patterning of the KdVo-5 assemblage in terms of human organizational behavior, it is prudent to demonstrate the post-depositional integrity of the B2 archaeological deposit in horizontal and vertical space and to establish the occupational history of the site represented by the vertical distribution of artifacts.

Natural Site Formation Processes

Though several types of natural site formation processes are common in subarctic depositional contexts (see Esdale et al. 2001; Hilton 2003; Thorson 1990), they appear to have had only minimal effects on the horizontal distribution of artifacts in the B2 stratum. The absence of a gravity effect in the distribution of artifact concentrations indicates that slope movement, a concern posed by the slight incline of the site (Figure 2.2, p.21), has not noticeably affected the horizontal distribution of artifacts shown in Figure 3.1 (p.46). This is evident in the separation of the hearth-associated artifact scatter from the concentration of basalt debitage and bone fragments in Unit D by an area of lower artifact density. In addition, the conditions necessary for solifluction, the severe slope movement of water-saturated sediments on an impervious permafrost substrate, are not currently present at KdVo-5. The sediments are dry and though the site is in a region underlain by discontinuous permafrost deposits, no permafrost layer currently exists at KdVo-5. As Esdale et al.'s (2001) study of the Dog Creek site in the northern Yukon indicates, this does not mean that these conditions were not present in the past; however, none of the stratigraphic structures characteristic of solifluction, including the mixing of sediment layers over broad areas and the 'folding' of younger strata beneath older strata, are evident in the stratigraphic profiles of KdVo-5 excavation units (see Esdale et al. 2001 for good examples). Other natural factors, though active at the site, were likely not disruptive to the extent that they re-patterned the horizontal distribution of artifacts. Small rosebush roots penetrate into the B2 stratum and the presence of small burrows (<5 mm in diameter) in several units indicates the activity of burrowing insects but no signs of rodent holes or more severe bioturbation were encountered during excavation.

While this root and insect activity likely caused only minor vertical movement of artifacts, other potential sources of vertical displacement have to be examined as sources of more drastic disturbance. Frost processes caused by the freezing pressures exerted on sediments by underground ice growth are an important source of vertical artifact displacement in subarctic depositional contexts. Frost heaving can cause artifacts to move up in a soil matrix towards a freezing front (usually the ground surface). Thorson (1990:404) states, "artifacts can be selectively moved upwards with the object's effective height (vertical dimension perpendicular to the freezing front) governing the rate of motion." The longer an artifact is exposed to frost heave the more vertically oriented it will become relative to its horizontal stratum (Esdale et al. 2001). Frost heaving is also a key factor in cryoturbation, the mixing of sediment layers (and associated artifacts) during cycles of freezing and thawing. As in the case of solifluction, cryoturbation is most active in sediments with high water content underlain by a shallow permafrost layer (Esdale et al. 2001). Sedimentary sequences affected by cryoturbation exhibit convoluted lenses of organic material mixed into mineral soil, often accompanied by frost cracks filled with organic material (see Esdale et al. 2001 for examples). Frost heaving and cryoturbation do not appear to have been active at KdVo-5. Field observations and examination of photographs of artifacts found in place suggest that the vast majority of pieces were oriented horizontally relative to the stratum, indicating an absence of frost heaving, and wall profiles from the site do not exhibit any of the stratigraphic features characteristic of cryoturbation.

Trampling cannot be so easily discounted as a mechanism of vertical disturbance at the site, as small items, such as the debitage and bone fragments that dominate the KdVo-5 assemblage, are particularly susceptible to downward movement by trampling (Stevenson 1991). Figure 3.2 (p.47) shows all of the provenienced artifacts from Units B and C plotted on the north wall of Unit C. Most of the artifacts form a well-delimited lens of material in the middle of the B2 stratum, except for six flakes of green obsidian, which were found at the transition between the B2 and B/C layers, approximately 4-6 cm beneath the artifact lens. All of these flakes are from a 20 x 20 cm area of Unit B directly below the hearth feature and might have been displaced by trampling out a fire. Trampling experiments (Gifford-Gonzalez et al. 1985; Villa and Courtin 1983) conducted in a variety of soil matrices suggest that vertical movement of 4-6 cm as a result of human trampling is common; in addition, the other 103 green obsidian flakes (*in situ* and from the screen), shown below to represent a single knapping episode, were found at a depth consistent with the artifact lens. Localized trampling seems to be a plausible mechanism for the vertical discontinuity shown in Figure 3.2 (p.47).

My analysis of the natural site formation processes affecting the archaeological deposit in the B2 stratum of the KdVo-5 site demonstrates that most of the artifacts, whether they were struck from a projectile point in manufacture or tossed aside, were found where people left them. Over what period of time people discarded material at the site, resulting in the spatial pattern shown in Figure 3.1 (p.46), is the next question to be addressed.

Occupational History of the B2 Horizon

In their paper *High resolution archaeology at Verberie: limits and interpretations*, Audouze and Enloe (1997) confront the problem of discriminating successive occupations of a site with stratigraphic features similar to KdVo-5. They suggest that this is difficult at Verberie, a late Paleolithic site in the Paris Basin, "firstly because of the proximity of the successive living floors (five in 25 cm), and second because of the homogeneity of the sediment which does not permit any discrimination on the basis of sediment layers" (Audouze and Enloe 1997:198). Though the site is composed of superimposed lenses of artifacts, they suspect, on the basis of the spatial integrity of artifact concentrations and features, that the archaeological deposit represents several short-term occupations. They use a simple statistical method based on Leroi-Gourhan and Brezillon's (1972) idea of the 'optimum de decapage' to discriminate between separate living floors. Leroi-Gourhan and Brezillon (1972) found that the distribution of vertical elevations of artifacts associated with a living floor tend to approximate a normal distribution curve, such that most artifact elevations plot close to the mean elevation, with a decreasing, but predictable, proportion of artifact elevations representing the tails of the normal curve. Figure 3.3a (p.48) shows the vertical distribution of artifacts plotted on the north wall of square N8 at the Verberie site and Figure 3.3b (p.48) shows a histogram of the frequency of artifact elevations from the same square. Using this method, Audouze and Enloe (1997) are able to isolate five 'optima de decapage'; that is, five separate normal distributions of artifact elevation, each peak in Figure 3.3b (p.48) corresponding to the mean elevation of artifacts from a single occupation level.

As discussed above, Figure 3.2 (p.47), showing all of the artifacts with precise three-dimensional provenience from Units B and C plotted on the north wall of Unit C, indicates that most of the artifacts fall within a fairly discrete vertical lens (note that artifact elevations are adjusted by 1.5 cm below datum per 10 cm of horizontal distance from the north wall of Unit C in order to account for the slope of the site). On account of the predominance of microdebitage (<1 cm in maximum dimension) in the assemblage, the sample size of provenienced artifacts is low, most of the small flakes being recovered in the screen. Fortunately, precise vertical measurements were taken for successive batches of screened soil from the northeast quad of Unit C, the 50 x 50 cm subunit exhibiting the highest lithic density of the site (109 flakes). These data can be used to plot a histogram of artifact elevations for the northeast quad of Unit C (Figure 3.4, p.47). The vertical distribution of artifacts shown in the histogram indicates a single 'optimum de decapage' in this area of the B2 stratum, with a mean elevation between 18.5 and 20 cm below datum, which corresponds well with the lens of provenienced artifacts in Figure 3.2 (p.47) and the elevation of the hearth feature in Unit B. In addition, most of the provenienced artifacts from other units tend to cluster roughly in the center of the B2 stratum and contain debitage shown below to have originated from the same knapping episodes as several subsets of debitage found in Unit C. Based on these data I argue that the horizontal distribution of hearth-associated artifacts (see Figure 3.1, p.46) represents a single occupation lens or living floor of the KdVo-5 site.

This conclusion, based on the applicability of the method devised for dealing with the Verberie assemblage to KdVo-5, is problematic due to a key difference between the depositional contexts of these two sites. While both assemblages are contained within a relatively thin (10-15 cm for KdVo-5 and 25 cm for Verberie), homogenous soil matrix, they were most likely embedded by sediment in different ways. Verberie was buried by multiple layers of silt deposited by repeated flooding of the River Oise. The reason distinct flood episodes are indistinguishable in the stratigraphy of the Verberie site is that the sediments have been homogenized by the long-term activity of worms and insects. On the other hand, the sediment embedding the artifact assemblage at KdVo-5, as discussed in a previous chapter, was most likely deposited by long-term eolian deposition. The consequence of this difference is that occupations of the Verberie site were likely buried a relatively short time after site abandonment, allowing for vertical discrimination between occupation lenses, while the material remains of numerous intermittent occupations of the KdVo-5 site could have accumulated at a faster rate than sediment. The concern is that the 'optimum de decapage' shown in Figure 3.4 (p.47) actually represents several highly compressed optima. This concern is partially alleviated by the distribution of different raw material subsets of debitage within the vertical lens of artifacts in Figure 3.2 (p.47); for example, the elevations of brown and green obsidian flakes, each representing a distinct knapping episode, encompass the full vertical range of the lens – but it remains a problem that needs to be considered in interpreting the horizontal distribution of artifacts.

Despite this problem, I propose that there is sufficient evidence to support the two assumptions outlined in the introduction and thus proceed with a behavioral analysis of the horizontal distribution of artifacts in the B2 stratum. My hope is that a high level of consistency between behavioral models of spatial organization and the KdVo-5 assemblage data will provide additional support for the interpretation of the B2 assemblage as a single occupation episode of the site. Of course, it may be the case that the remains of previous occupations of the site, such as the presence of a hearth and its associated debris, would guide the organizational behavior of later occupants of the site, which would produce a consistent spatial pattern over time that could also be assessed in behavioral terms.

Interpretation of Horizontal Spatial Patterning

Archaeologists employ several methodological approaches for interpreting the horizontal spatial patterning of archaeological sites (Kroll and Price 1991; Gamble 1991). One subset of approaches makes use of statistical pattern recognition methods, such as k-means cluster and nearest-neighbor analyses applied to piece-plotted artifact distributions, to identify non-random spatial associations of different categories of artifacts in an archaeological site (see papers in Hietala 1984). For example, a statistically significant clustering of utilized flakes with large skeletal elements might differentiate a primary butchering area from a cluster of bifacial reduction flakes associated with a hearth area where hunters refurbished their projectile points. Another approach, which includes ethnoarchaeological observation of the living spaces of modern hunter-gatherers and experimental archaeology, focuses on how activities carried out in a living context, such as butchering an animal or making tools while sitting around a hearth, create distinct patterns of material refuse. In cases where these patterns are preserved in the archaeological record, spatial models derived from ethnoarchaeology provide a direct interpretive link between the static archaeological record and the behaviors that led to its creation. My analysis of the KdVo-5 artifact scatter is based primarily on models derived from ethnoarchaeology and experimental archaeology. The relative homogeneity of the KdVo-5 artifact assemblage – consisting mainly of flakes, bone fragments and projectile point bases – and the low density of artifacts indicates that visual inspection of the artifact scatter is sufficient for recognizing any significant spatial associations of artifacts.

Ethnoarchaeological research encompasses a broad scope of spatial scales, including single activity areas, campsites and entire settlement systems, and various theoretical initiatives, each of which identify different causal factors in interpreting material culture patterning. Binford's (1978a, 1978b, 1983) work with the Nunamiut Eskimos of Alaska tends to emphasize the dimensions of the human body and rational behavior in explaining site structure. For example, certain behaviours have predictable effects on patterns of refuse around outside hearths. People seated around a hearth tend to sit away from blowing smoke and throw large items away from high-use areas where people are less likely to sit on them, while smaller, less obtrusive objects are dropped in the vicinity of the hearth. Of course, the patterns of disposal are adapted for different social contexts. Activity around an inside hearth is not necessarily conditioned by blowing smoke and refuse is not thrown haphazardly but collected and dumped outside, resulting in different spatial patterns of material remains. It should be mentioned, however, that the discard of refuse cannot always be explained solely in terms of the maintenance of a comfortable living space. Historically specific cultural values also have a structuring effect on the archaeological record. In an ethnoarchaeological study of bone refuse among the Nuba, Hodder (1982) found that cattle bones and pig bones were discarded in separate places. The pig bones were often stuffed into crevices so that there was no chance of scavengers bringing them into contact with cattle refuse. The reason for this was a fear of ritual pollution of cattle and cattle milk by pig products. This symbolic expression also extended to a fear felt by men of pollution by women, cattle being associated with men in Nuba culture, pigs with women. Other studies (Gargett and Hayden 1991; Whitelaw 1991) foreground social organization as a factor in the spatial organization of camps, in some cases demonstrating that the proximity of living spaces is predictable in terms of the kinship distance between site occupants. Due to the cross-cultural usefulness of the factors Binford employs in his interpretation of refuse patterns that accumulate around outside hearths, in contrast to the other theoretical approaches mentioned, I begin my analysis of the KdVo-5 artifact distribution by applying Binford's (1978a, 1983) outside hearth model to the artifact scatter associated with the single hearth feature identified at the site.

Binford's (1978a, 1978b, 1983) outside hearth model, shown in Figure 3.5 (p.49), is a generalization based on his observations of the material remains produced by Nunamiut Eskimos working and interacting around outside hearths in a variety of contexts. He finds that refuse enters the archaeological record in three main ways. The dropping of items, often the result of pieces being detached from an item held in the hand, such as bone being cracked for marrow with the back of a hunting knife or wood shavings produced by carving, results in a drop zone in the immediate vicinity of the person performing the activity. Dropped items are usually small and unobtrusive. Larger items, such as the articular ends of long bones or sardine cans, tend to be tossed either to the front of a hearth where no one is sitting or over the shoulder out of the main activity area, resulting in the forwards and backwards toss zones. Not depicted in Figure 3.5 (p.49) is dumped material, which is usually restricted to high-density aggregates of materials held in a container, such as bone fragments from bone grease preparation or coffee grounds. This behavior produces dense patches of homogenous material out of the way of the main activity area of the hearth. Binford also observes that there is always a vacant side of the hearth depending on the wind direction at the time of site occupation; this results in low- and high-density debris sides of the hearth, the high-density area being defined by an arc of debris representing the overlapping drop zones of people sitting side-by-side around the fire. Binford (1978a) provides measurements for the spatial orientation of men sitting around a hearth. For groups of three or four men, the average distance from the left kneecap to the ember edge of the fire is 62 +/- 6.8 cm and 71 +/- 8.2 cm, respectively, and the distance between the left and right kneecaps of adjacent men is 33 +/- 4 cm and 24 +/- 3 cm, respectively. The number of people sitting at a hearth concurrently can be estimated by applying these measurements to the spatial extent of the drop zone.

Binford's outdoor hearth model is useful for interpreting the spatial patterning of hearth-associated assemblages in a number of contexts, both ethnoarchaeological and archaeological. In their ethnoarchaeological research among the Chipewyan of northwestern Saskatchewan, Jarvenpa and Brumbach (1983:180) made observations of two hunters eating and talking around a hearth intermittently over a six-day period:

> Generally, the men face west towards the trapping cabin, surveying the progress thus far, and plans for the next phase of construction are a prominent topic of mealtime conversation. The residue of each meal collects around the main hearth in patterns associated with fairly consistent discard behavior. In the course of the meal, unwanted pieces of gristle and sinew and small slivers of bone drop into the spruce-bough mattress in the immediate vicinity of each diner. However, large bone fragments from the ribs, lower legs and vertebrae are purposely thrown away from the hearth area, most often in a stylized flinging action.

Though the men face a single direction for a different reason than the wind, their behavior creates a similar material distribution to that predicted by Binford's model. The outside hearth model has been found useful for the interpretation of archaeological sites ranging from the subarctic of northern Alberta (Stevenson 1985, 1991) to the Middle (Vaquero 1999) and Upper Paleolithic of Europe (Audouze and Enloe 1997; Cahen and Keeley 1980). For example, Cahen and Keeley (1980: 170) find that the artifact distribution in one concentration of the Meer II site conforms well to the drop zone pattern, stating that "the debris from core preparation, from the striking of blanks and the retouching of these blanks into tools is concentrated in a rough semi-circular band centered on the hearth but separated by it by a band with a lower density of finds." The apparent validity of this model in a variety of cultural settings indicates that it may be useful for delineating the human behaviors that formed the KdVo-5 archaeological deposit.

Figure 3.1 (p.46) shows the spatial distribution of artifacts in the B2 layer of the KdVo-5 site. The distribution of bone fragments and flakes correspond fairly well except for the high-density patch of bone fragments found in Unit D. A plausible interpretation for this patch is that it represents a dumping event wherein a container used for the production of bone juice or grease was dumped away from the hearth. This interpretation corresponds well with Binford's (1983) observations of bone juice preparation at the Anaktiqtauk kill site shown in Figure 3.6 (p.49). In this case, bone splinters used for the production of bone juice were dumped away from the hearth resulting in a homogenous aggregate of bone fragments. The spatial relationship of the high-density patch of bone in Unit D to the hearth feature is similar to that shown in Binford's (1983) site plan of the Anaktiqtauk site, indicating a similar turn-and-dump behavior at KdVo-5. As the remainder of the bone fragments at the site, most likely the result of cracking bones for marrow, are distributed in a similar manner to the debitage assemblage, I will focus the rest of my analysis, in the interest of maintaining a degree of clarity in the site plans I use to form my argument, on the spatial distribution of the lithic assemblage.

Figure 3.7 (p.50) shows the spatial distribution of lithic artifacts at the KdVo-5 site. Note that the majority of the debitage was not fully provenienced during excavation and is plotted randomly by 50 x 50cm quadrant for representational purposes. Rough distribution maps of debitage prepared during excavation indicate that this method provides a reasonably good approximation of the actual distribution of debitage. Several features of the spatial distribution of lithic artifacts shown in Figure 3.7 (p.50) parallel the spatial patterning of refuse predicted by Binford's outside hearth model. There are clearly low- and high-density debris sides of the hearth, likely relating to wind direction, and the area exhibiting the highest density of debitage forms a semicircular arc on the high-intensity use side of the hearth. This is consistent with Binford's drop zone area both in its proximity to the hearth and the nature of the debris, as flakes struck from an objective piece held in the hand conform to Binford's (1978a) definition of dropped items. Figure 3.8 (p.51) shows three people positioned with their left knees approximately 60 cm from the edge of the hearth and 30cm between adjacent left and right knees. The proposed drop zone is consistent with dropped items falling just in front and between the legs of a seated person. Several of the projectile point fragments, which would have been held in the hand as they were removed from their hafts, are in a forward toss zone relative to the seated persons. No larger debris is found in the backwards toss zone, a portion of which is unexcavated but this could relate to the close proximity of the steep edge of the hill, which might have added some incentive to fling some obtrusive objects off the site. The spatial distribution of the KdVo-5 site satisfies the predictions outlined by Binford's outside hearth model, suggesting that the general site formation behaviors observed by Binford also led to the spatial structure of the KdVo-5 site.

Independent evidence to support this conclusion is provided by a closer examination of the dispersal of debitage in the proposed drop zone. While my analysis of natural formation processes indicates that artifacts were not significantly disturbed by natural mechanisms, cultural formation processes, such as the systematic cleaning of activity areas and subsequent dumping of collected debris in a context secondary to its original production (see Schiffer 1978, 1986), can also create aggregates of cultural material. The obsidian debitage at the site, comprising roughly half of the lithic assemblage, can be separated into four raw material subsets based on color: black, gray, green and brown. These subsets likely originated from different nodules of raw material and thus represent the manufacture of separate tools. Figure 3.9 (p.52) shows the distribution of these obsidian subsets across the excavated portion of the site. The black and brown obsidian flakes are almost exclusively located in the northeast quadrant of Unit C and the gray obsidian is largely confined to the northwest quadrant of Unit C. Interestingly, 7 of the 19 black obsidian flakes refit into two separate conjoined pieces of 3 and 4 flakes, indicating that their close proximity is a function of being detached in the same place from the same objective piece (Morrow 1996). Although, I was unsuccessful in refitting the gray, green and brown obsidian subsets (most of these flakes are very small and lack sufficient landmarks for establishing clear refits), their clustering to a single 50 x 50 cm quadrant, and the nearly complete segregation of the brown and black obsidian from the gray subset, indicates that their location also represents the point of detachment from an objective piece rather than secondary context. The green obsidian subset is considerably more dispersed than the other subsets. To assess the spatial context of its distribution, I consult an experimental study by Kvamme (1997), which attempts to model the dispersal of debitage in percussion flaking events.

In his paper *Patterns and Models of Debitage Dispersal in Percussion Flaking*, Kvamme (1997:122) experimentally demonstrates that the "debitage spatial distributions resulting from percussion knapping exhibit regular and predictable patterns of dispersal that can be closely modeled mathematically." He finds that debitage dispersal from a defined locus fits an exponential probability distribution, which he expresses as a survival function: $1\text{-}F_x = e^{(-\theta x)}$, where F_x is the probability of an observation 'surviving beyond' a given value of x, x is the distance from the knapping locus and θ is a parameter estimated by the expression 1/ mean distance from the knapping locus. Thus, a theoretical curve of the proportion of debitage 'surviving' beyond various distances can be approximated by the above function using 1/mean distance from the empirical dispersal data as the constant θ. This curve can then be compared to a plot of the empirical dispersal data for goodness of fit. For example, Figure 3.10 (p.53) shows plots based on the debitage dispersal resulting from the manufacture of an obsidian biface with a soft antler hammer. Building on work by Newcomer and Sieveking (1980) and Schick (1986), Kvamme (1997) shows that controlled variables such as knapper position (standing, kneeling, squatting, and sitting) and hammer type (hard and soft) affect the spatial distribution of debitage for different types of reduction events, including core reduction and biface manufacture, but that these variables tend to affect the steepness of the exponential curve form as opposed to its general shape. Thus, to determine if the dispersal of green obsidian flakes represents an *in situ* knapping event, I plot the distance from knapping locus (x) vs. proportion of flakes beyond distance x and compare it to the theoretical curve derived from the mean distance of green obsidian flakes from the knapping locus.

Figure 3.11 (p.54) is a schematic of the method used to collect the empirical data for this plot. In his experimental system, Kvamme (1997) divides the knapping space into a 20 x 20 cm grid and assigns any flake larger than 5 mm in maximum dimension the center coordinate of the grid unit in which it falls. He defines the knapping locus as a circular region 20 cm in radius in front of the knapper and all distance measurements are taken from the perimeter of this circle, with flakes falling within the knapping locus assigned a distance of 0 cm. I approximate this method by defining the knapping locus as a circle, 25 cm in radius (the radius of a circle fitting the 50 x 50 cm quadrant), located in the northeast quadrant of Unit C, the area of highest debitage density; all flakes within this quadrant are assigned a distance of 0 cm and distances are measured from the perimeter of the circle to the centers of 50 x 50 cm quadrants containing green obsidian flakes. Although these larger collection units yield somewhat coarser data than Kvamme's (1997) method, the dispersal pattern of the green obsidian is still evident in the plot.

Figure 3.12 (p.53) compares the theoretical curve, calculated using the constant $\theta = 1/1.83$ (based on a mean distance of green obsidian flakes from the knapping locus of 1.83 m) to a distance vs. 'proportion of flakes beyond distance' plot of the empirical data. The close fit between the two curves indicates that the dispersal of the green obsidian is consistent with the spatial distribution of debitage expected for an *in situ* knapping event. Based on these data and my previous discussion of the spatial distributions of the other obsidian debitage subsets, I am confident that the proposed drop zone represents the primary context of flakes dropped during tool manufacture in the proximity of the hearth.

Yet, a significant problem with the placement of the drop zone is that the people sitting around the hearth have their backs to the view, which seems inconsistent with the proposed lookout function of the site. Binford's (1978a) observation of the Mask site, a Nunamiut Eskimo hunting stand, suggests that this is not out of the ordinary. Rather than spending all of their time, eyes glued to the surrounding landscape, looking for game, the men at the Mask site engaged mostly in 'boredom reducing' activities: eating, talking, craft activities, card playing. Occasionally a man would move to position close by where he could survey the surrounding landscape for game but this activity comprised only 3% of the total man-hours of activity that Binford observed at the site. Seating positions during other activities were conditioned far more strongly by wind direction than a good view of the landscape. Indeed, the small concentration of basalt debitage in the southeast quadrant of Unit D of the KdVo-5 site (Figure 3.7, p.50) might represent a person sitting away from the hearth and watching for game. Moose observed in the valley below KdVo-5 usually foraged there for several hours at a time and archaeological crew member Mr. Joseph Johnny would intermittently take a break from excavating to monitor their movements with binoculars; the information gathering function of the site only requires brief episodes of lookout activity over the span of longer stretches of 'boredom reduction'. Thus, in this case, the orientation of persons relative to the hearth implied by the spatial structure of the site is insignificant in terms of the putative site function, leading me to conclude that the spatial organization of the KdVo-5 site exhibits a high level of consistency with Binford's behavioral observations of outside hearths.

At the tentative conclusion of the 'B2 occupational history' section of this chapter, I suggest that if a high level of consistency between behavioral models of spatial organization and the KdVo-5 assemblage data were to be demonstrated, this would act as additional support for the interpretation of the B2 assemblage as a single occupational episode of the KdVo-5 site. Does the consistency of the spatial organization of the KdVo-5 hearth with Binford's behavioral model provide any clues regarding the occupation span of the site and the likelihood of intermittent re-use of the hearth feature? Stapert and Street (1997) note that the re-use of hearths in periods of variable wind direction would lead to the formation of drop zones on all sides of a hearth, effectively erasing the low-/high-density debris distinction predicted by Binford's model. This does not appear to be the case with the KdVo-5 hearth, which exhibits well-delimited low- and high-density debris sides; of course, a constant wind direction at various times of occupation, related somehow to the topography of the hill and the surrounding valley, cannot be discounted. Also related to the spatial consequences of hearth re-use, Stevenson (1985, 1991) adds a temporal dimension to Binford's outside hearth model by defining a 'displacement zone'. This zone is a half meter wide zone directly behind the drop zone; it is formed by the 'brushing aside' of debris from the drop zone before sitting down and is expected to increase in artifact density as the use or re-use of a hearth area intensifies. Interestingly, Binford (1978a) also observed the expedient brushing aside of debris around outside hearths at the Mask site. Stevenson (1985:76-77) proposes that "[d]isplacement zones might be expected to form some time after the initial formation of drop and toss zones...[A]rtifacts embedded in displacement zones clearly should be traceable to activities that occurred prior to those that produced equivalently-sized or disruptive refuse concentrated on the surface of drop zone areas." The ratio of debris in the drop zone of the KdVo-5 site to the quadrants immediately adjacent to the drop zone (the south side of Unit C, the north side of Unit D and the west side of Unit F), a reasonable approximation of Stevenson's (1985, 1991) displacement zone, is about six to one; this indicates that the 'brushing aside' of artifacts from the drop zone was minimal at KdVo-5. There are three explanations for the apparent lack of displaced artifacts. First, the debris in the drop zone is too small to be obtrusive to sitting. Second, the use of the hearth was a transient, short-term event and maintaining it, even in an expedient way, was not a concern. Indeed, Schiffer (1972:162) suggests that with "increasing intensity of occupation, there will be decreasing correspondence between use and discard locations for all elements used in activities and discarded at the site"; that is, as occupation span increases, systematic refuse clearing is likely to increase, leading to the redeposition of artifacts from their original discard locations to secondary contexts such as a dump areas. Thus, the deposition of the obsidian debitage in its primary context in the drop zone, as demonstrated above, indicates a relatively short occupation span of the site. And third, the hearth area was not reused, so that repeated refurbishment of the hearth and sitting areas did not take place. These observations support the claim, based on a single 'optimum de decapage' in the vertical distribution of artifacts, that the hearth feature and its associated artifacts represents a short-term occupation of the excavated portion of the KdVo-5 site during the time circumscribed by the B2 stratigraphic level.

Thus, several lines of evidence converge to indicate a single, short-term occupation of the B2 level of the KdVo-5 site. The vertical distribution of artifacts represents a single 'optimum de decapage', the horizontal patterning is highly consistent with Binford's outside hearth model, and the artifacts found in the drop zone of the hearth do not appear to have been displaced from their primary contexts. Yet, is it likely that such an accessible hunting lookout was not reused? The only explanation I can offer to account for such limited prehistoric use of the KdVo-5 site is that the Beaver Creek plain, the expanse of muskeg that the KdVo-5 site overlooks, is surrounded by low hills, any of which could serve as a lookout. It may be the case that hunters tracking game made situational use of these hills rather than revisiting specific lookout localities, which resulted in hunting lookout sites exhibiting ephemeral archaeological traces.

Conclusion

In view of the spatial evidence presented in this chapter, I argue that the B2 artifact assemblage represents a single, short-term occupation of the KdVo-5 site, wherein three or four people sat around a hearth cracking bones for marrow, un-hafting broken spear points and flint-knapping. Facing away from the smoke, their backs were to the view, but every now and again a person would turn and survey the landscape to locate game or track the movements of game foraging below. At some point, a person might have gathered up some bone fragments and smashed up the articular ends to prepare bone juice for the site occupants. The site was likely abandoned when the occupants agreed on a suitable hunting strategy to pursue game located in the valley below.

While Binford's (1979) hearth model is a useful interpretive tool for reconstructing hearth-associated activities at the KdVo-5 site, Gamble (1999) proposes that this model might be used as more than a descriptive tool for understanding spatial patterning in the archaeological record, for it also indicates the presence of several social actors engaged in face-to-face interaction. That is, it provides a social context for the technological practices that were undertaken in the vicinity of the hearth. In following chapters, I attempt to determine what kinds of tools people manufactured while sitting around the hearth, and then try to relate this information to site function and the potential social strategies pursued by the actors that occupied the KdVo-5 site.

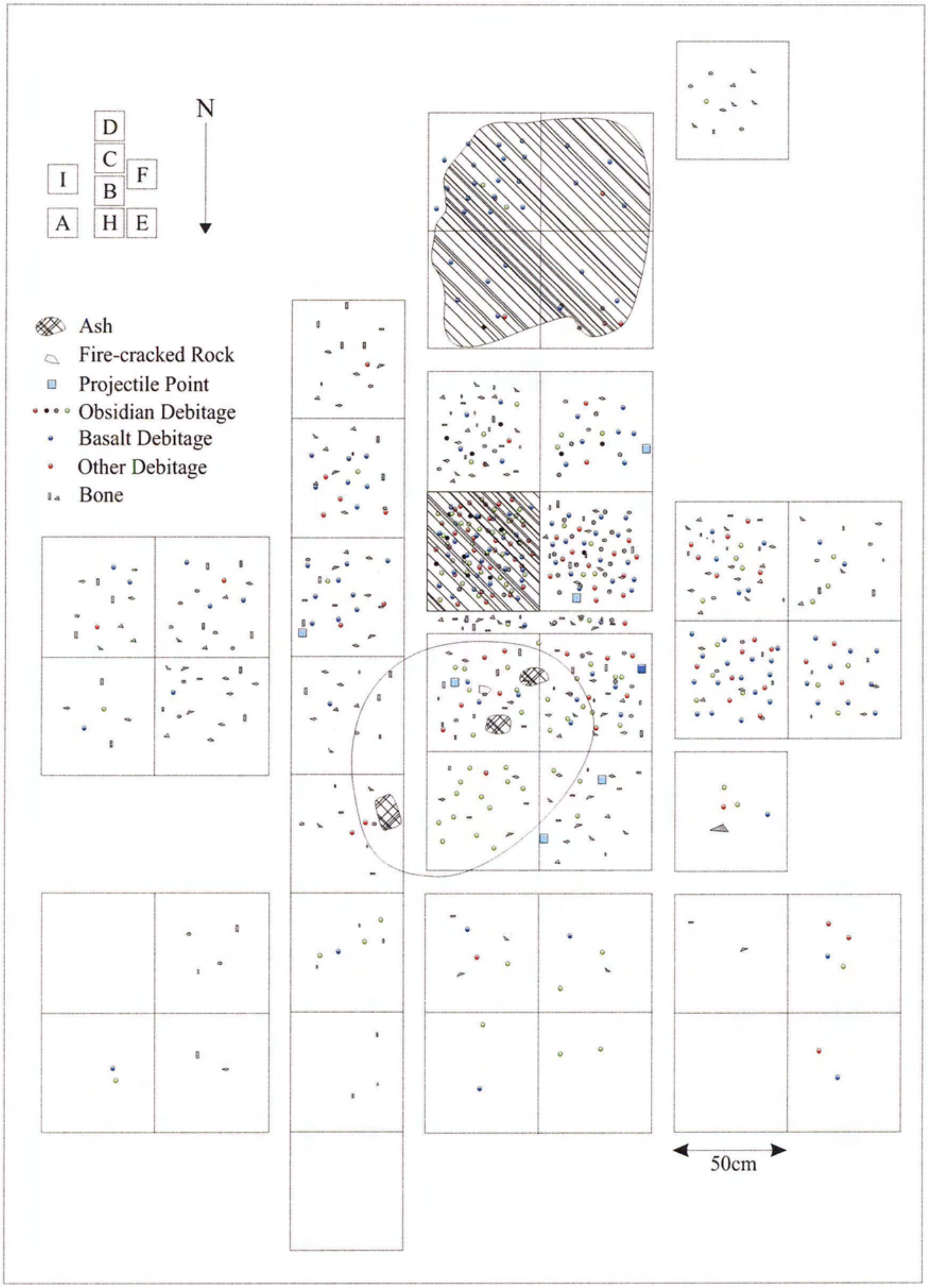


Figure 3.1. Distribution of faunal and lithic artifacts in the B2 level of the KdVo-5 site.

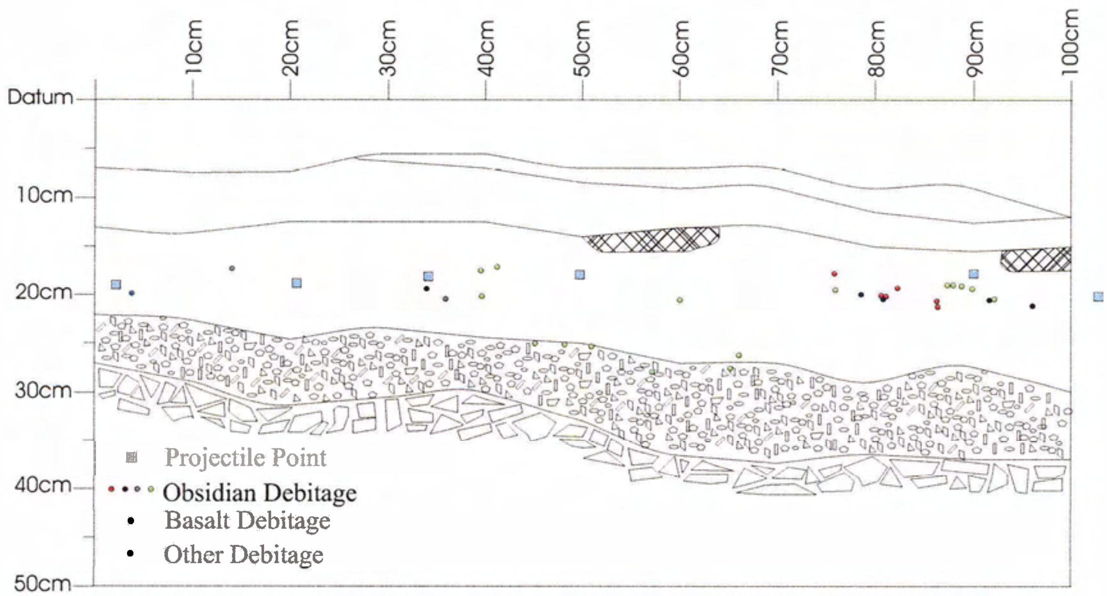


Figure 3.2. Provenienced artifacts from Units B and C plotted on the north wall of Unit C

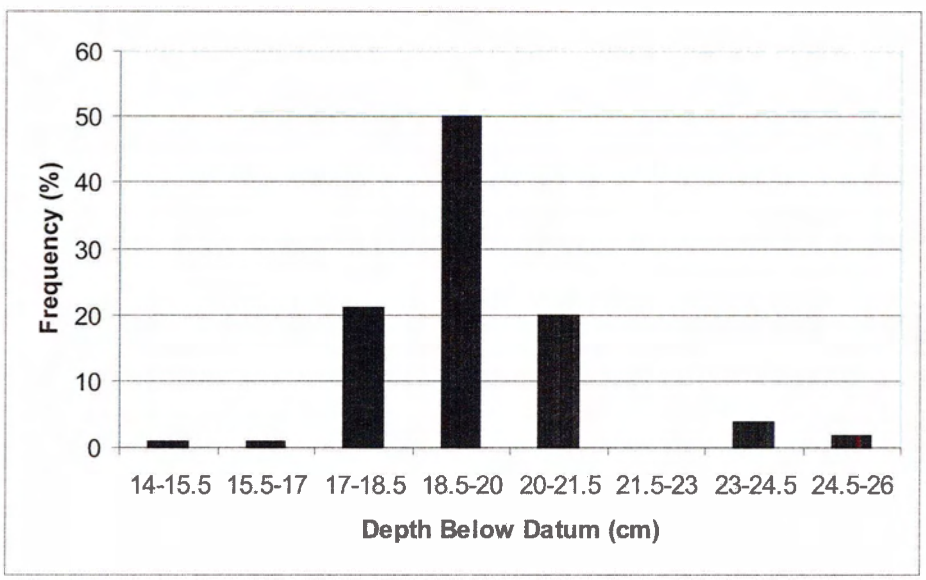
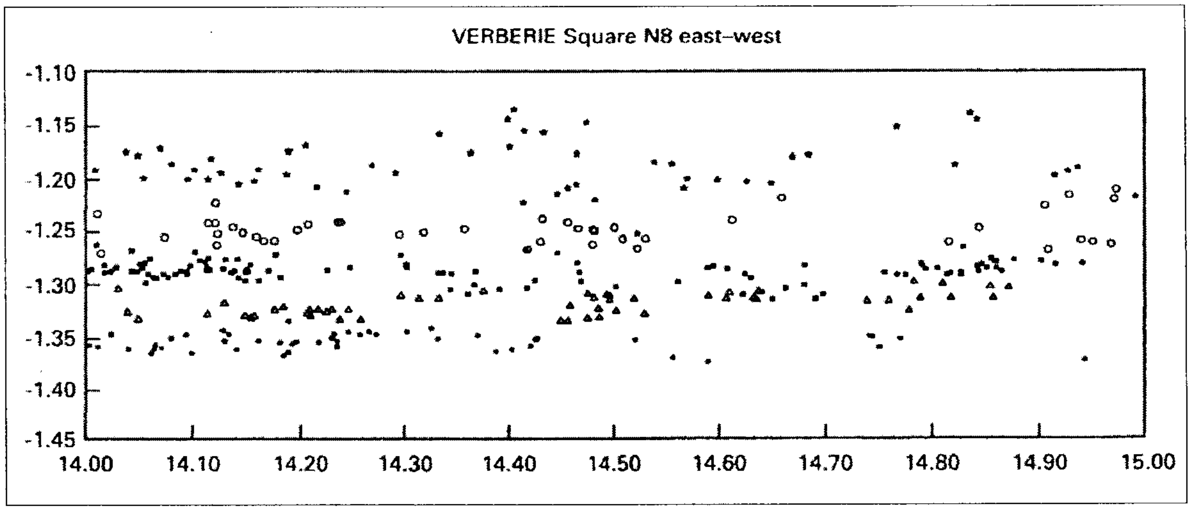


Figure 3.4. Histogram of artifact elevations for the northeast quadrant of Unit C.

a)



b)

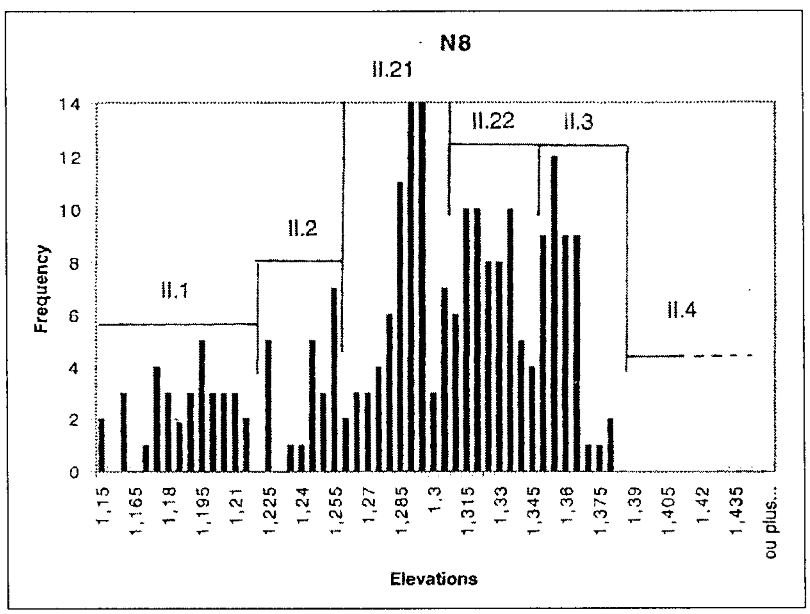


Figure 3.3. a) Vertical distribution of artifacts plotted on the north wall of square 8 of the Verberie site (adapted from Audouze and Enloe 1997:199). b)'Optimum de decapage': Histogram of the artifact elevations for the north wall of square 8 of the Verberie site (adapted from Audouze and Enloe 1997:200).

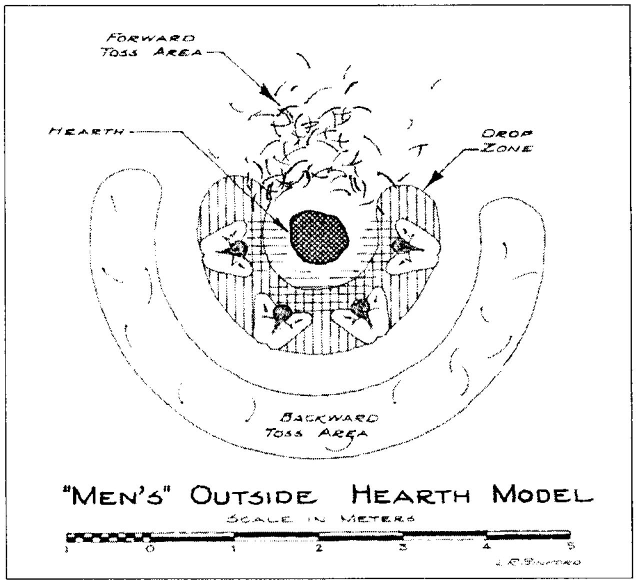


Figure 3.5. Binford's outside hearth model (adapted from Binford 1983:153).

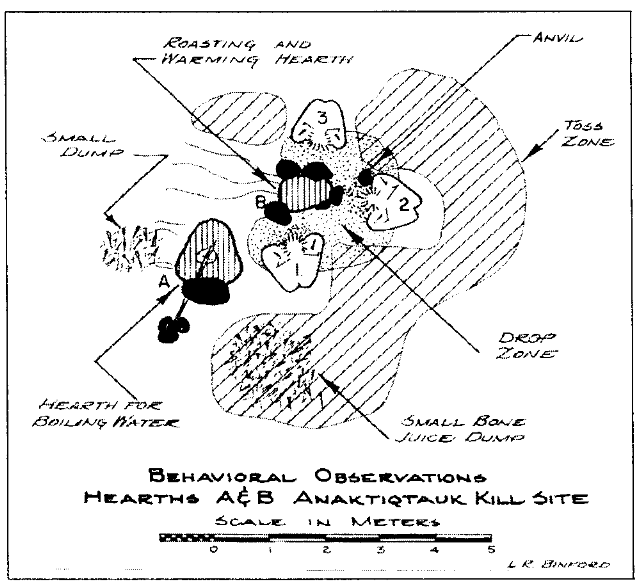


Figure 3.6. Binford's behavioural observations at the Anaktiqtauk Kill Site (adapted from Binford1983:154).

Figure 3.7. Spatial distribution of lithic artifacts in the B2 level of the KdVo-5 site.

Figure 3.8. Binford's outdoor hearth model applied to the B2 deposit of the KdVo-5 site (after Binford 1978a).

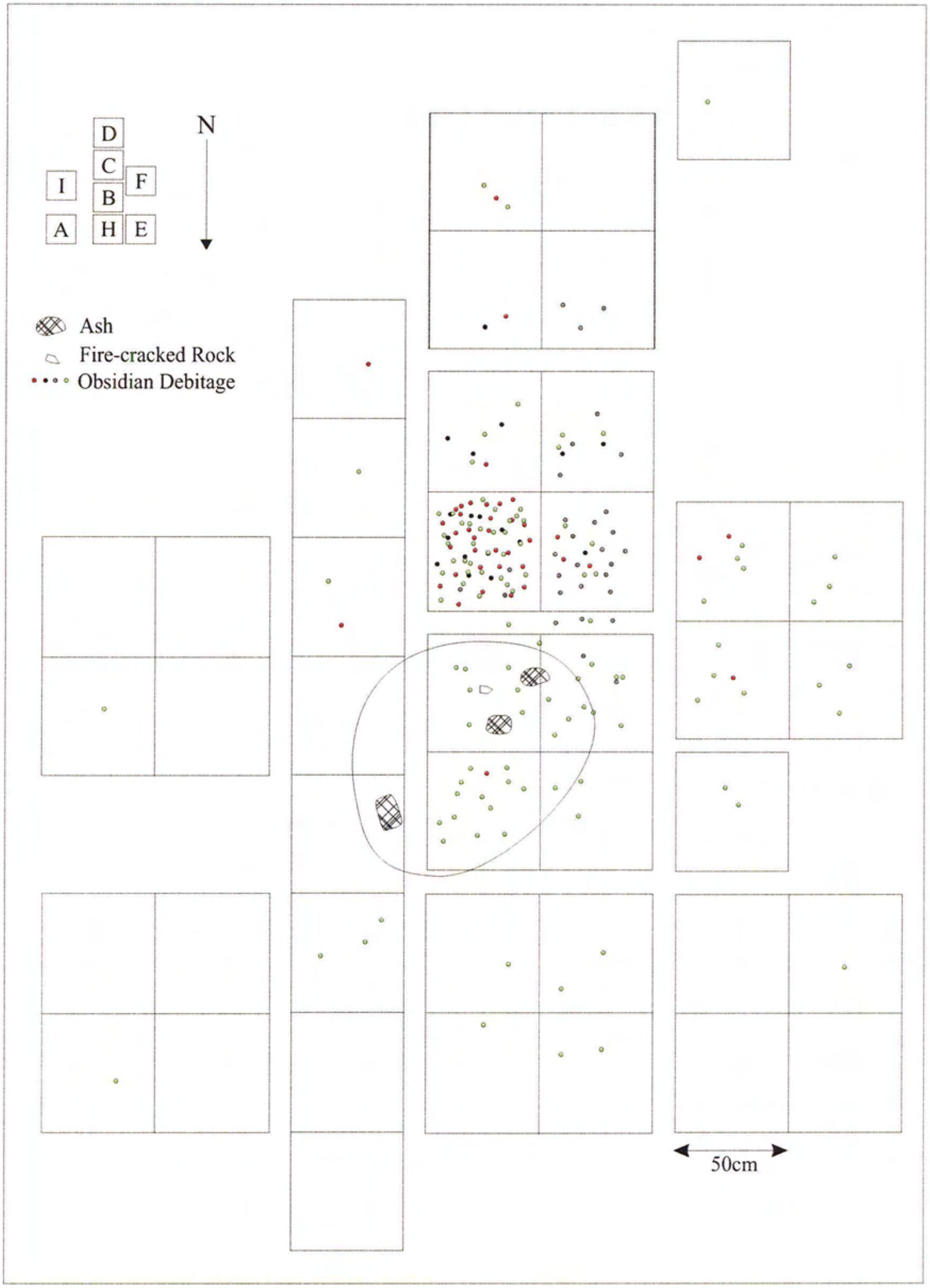


Figure 3.9. Spatial distribution of obsidian debitage in the B2 level of the KdVo-5 site.

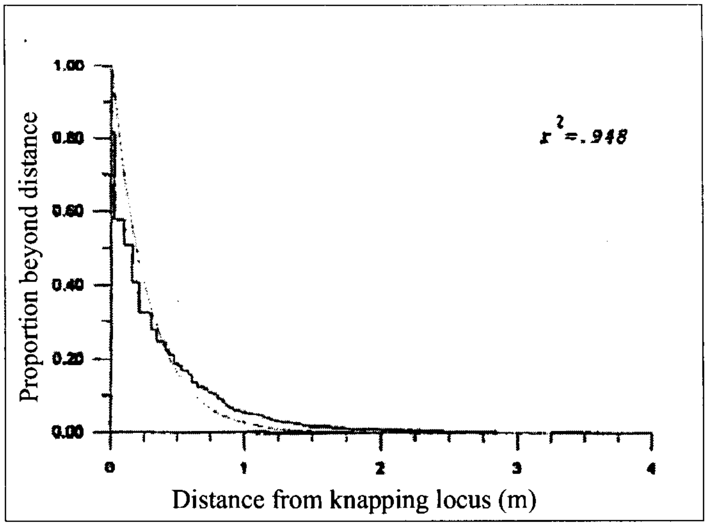


Figure 3.10. Debitage dispersal plot for the manufacture of an obsidian biface with a soft antler hammer (adapted from Kvamme 1997:131).

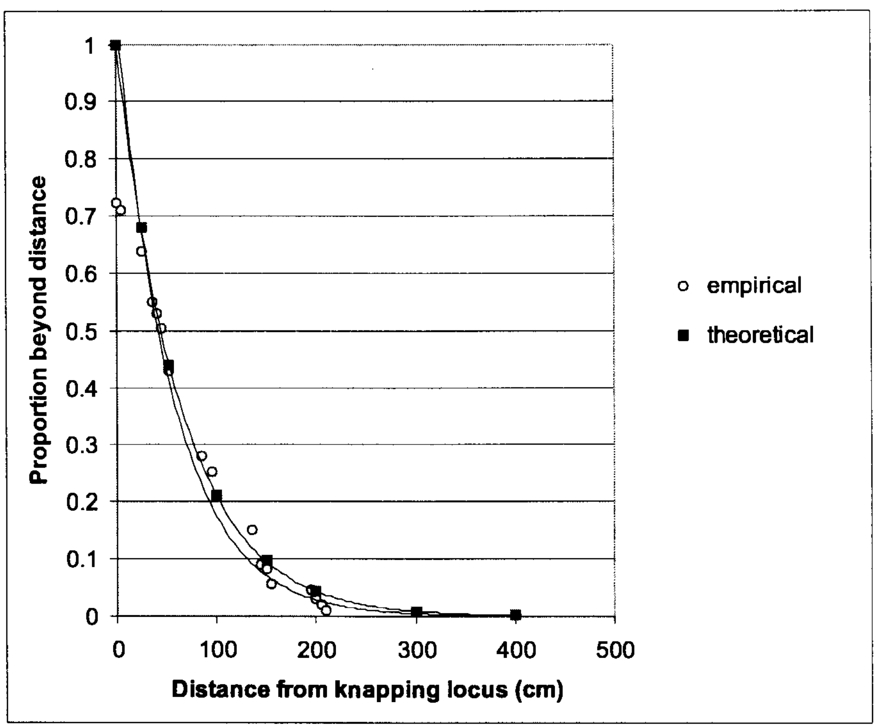


Figure 3.12. Debitage dispersal plot for the distribution of green obsidian flakes in the B2 level of the KdVo-5 site.

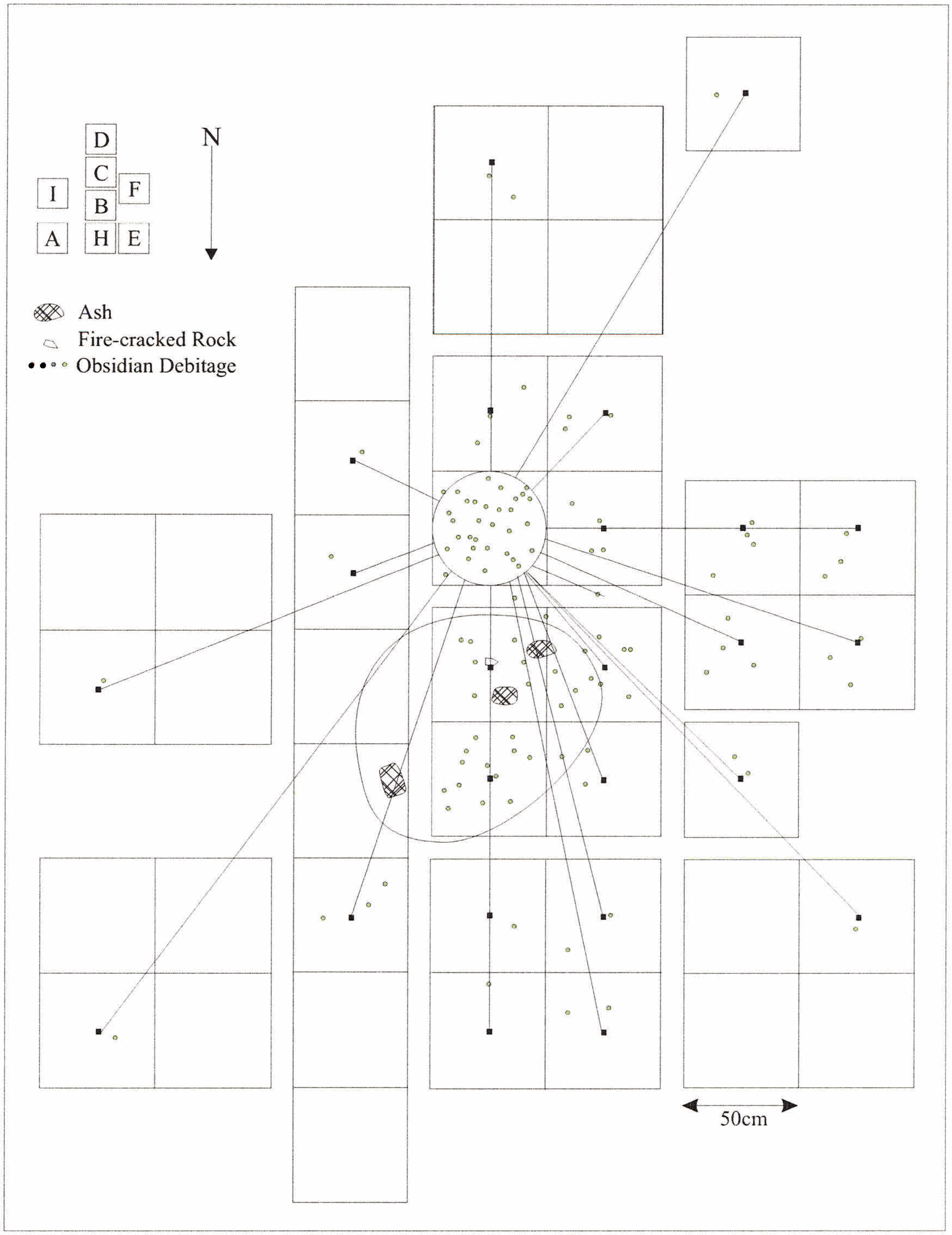


Figure 3.11. Schematic of the method used to collect the empirical data to determine the dispersal pattern of green obsidian flakes in the B2 level of the KdVo-5 site. The circle represents the knapping locus.

Chapter Four: Debitage Analysis

Introduction

Debitage analysis is a useful tool for determining the types and stages of lithic reduction undertaken at different locales in an archaeological landscape. This information can provide valuable clues for delineating the relationships between technological strategies and social strategies of land use and mobility. For example, Patterson (1990:555-556) proposes that the archaeological record exhibits three common scenarios for the reduction trajectory of bifaces: "(1) all manufacturing stages [occur] at or near the lithic raw material source location; (2) manufacture of flake blanks at the raw material source location, with all bifacial reduction at another location, commonly a campsite; (3) manufacture of bifacial preforms at the lithic source location, with remaining bifacial reduction at another location, commonly a campsite." The adoption of one strategy over another is related to how people organize their technology, including their lithic procurement and tool manufacturing strategies, within the wider social context of their subsistence-settlement system (Binford 1979; Cowan 1999). Highly mobile foragers, uncertain of when they will return to a lithic source, might opt to carry lightweight but versatile bifacial preforms, while people stationed at base camps near a raw material source might conduct all of their lithic reduction near the quarry. Particularly at sites lacking extensive formed tool assemblages, debitage provides the best evidence of the technological strategies employed at specific locales and for how technology was organized within the larger context of a subsistence-settlement system.

The interpretive value of debitage analysis for delineating the technological organization of prehistoric hunter-gatherers is inherent in the way that debitage is deposited in the archaeological record. While tools used by highly mobile people are often made, modified and discarded at different points on the landscape, most flakes are deposited at the time of tool manufacture or refurbishment (Magne 1985). In addition, each flake left behind records a discrete point in the processes of lithic reduction that took place at a site: "reductive technologies leave a record of the manufacturing process on the pieces removed" (Steffen et al. 1998:132). This point is illustrated by Figure 4.1 (p.77), which shows the reduction trajectory for the manufacture of a bifacial projectile point from a flake blank. The characteristics of the flakes removed at each stage are likely to be dramatically different: the amount of cortex on the dorsal surfaces of flake removals diminishes as reduction proceeds; the number of dorsal scars/removal increases; and flake removals generally become thinner and smaller (see Figure 4.2, p.78 for an illustration of general flake morphology and the flake attributes discussed in this chapter). If the morphologies of flakes from different stages of tool manufacture and the production of different tool types can be shown to exhibit patterned variability, as might be expected from Figure 4.1 (p.77), then a debitage assemblage should be able to provide a record of what stages of lithic reduction occurred at a site.

Indeed, the identification of robust patterns of variability in flake attributes has been the focus of many debitage studies. Lithic reduction experiments conducted by archaeologists have identified several flake attributes that tend to change in predictable ways as reduction proceeds. The first section of this chapter is a literature review of experimental results and methodological considerations useful for assessing the KdVo-5 debitage assemblage. I have organized this section by integrating the methods I use in my analysis within the literature review of each flake attribute I propose to evaluate. This is followed by the results and interpretations of my analysis of the KdVo-5 debitage assemblage. In subsequent chapters these data are integrated with archaeological models of subsistence-settlement systems to situate the technological choices made at the lookout within a larger context of prehistoric land-use and mobility and within the social context of the site.

Theory and Method in Debitage Analysis

Flake Type

As an initial classification of the KdVo-5 debitage assemblage, I used a simple typology consisting of four mutually exclusive categories (adapted from Andrefsky 1998). Flakes lacking clearly distinguishable dorsal and ventral surfaces were classified as angular shatter; flakes with discernable surfaces were classified as complete, proximal or flake shatter. Platform-bearing flakes were separated into complete or proximal depending on the presence of intact edges; flakes with discernable surfaces but lacking platforms were termed flake shatter (Figure 4.2c, p.78).

Several debitage studies suggest that the relative proportions of these flake types in experimental (Baumler and Downum 1989; Ingbar et al. 1989; Prentiss 2001; Prentiss and Romanski 1989) and archaeological (Sullivan 2001, Sullivan and Rozen 1985) assemblages are sensitive to different types of lithic reduction. By comparing the artifact and debitage assemblages at several sites, Sullivan and Rozen (1985) find that collections characterized by a high proportion of cores contained the highest percentages of complete flakes and angular shatter; in contrast; assemblages dominated by tools had high proportions of proximal flakes and flake shatter. They attribute these differences to two distinctions between core reduction and tool manufacture: i) the high proportion of proximal flakes and flake shatter is related to the "mechanical failure of very thin flakes that separate into several pieces during biface or tool manufacture" (Sullivan and Rozen 1985:769); ii) angular shatter is most likely pieces of shattered striking platform and bulbs of percussion and the frequency of these is likely to increase as core reduction becomes more intensive. By comparing their typological analysis to assemblage characteristics and other avenues of debitage analysis, Sullivan and Rozen (1985) demonstrate that their typology is able to accurately distinguish tool manufacture debitage assemblages from core reduction assemblages.

However, numerous experimental studies designed to test this typology indicate that flake breakage patterns are significantly more variable than envisioned by Sullivan and Rozen (Baumler and Downum 1989; Prentiss 1998; Prentiss and Romanski 1989). Prentiss and Romanski (1989) agree that there are differences between tool manufacture and core reduction assemblages but that tool production is characterized by numerous complete flakes and flake shatter and few angular shatter fragments, while core reduction collections contain moderate numbers of complete flakes and a high proportion of angular shatter. Baumler and Downum (1989) find that core reduction produces higher percentages of angular shatter and lower proportions of complete flakes than scraper manufacture. Each experimental system seems to distinguish core reduction from tool manufacture but in different ways than predicted by Sullivan and Rozen (1985). Prentiss (1998) attributes this variability to different reduction techniques, raw material properties and taphonomic processes such as trampling. For example, "chert is generally tougher and less brittle than obsidian, and may be expected to produce higher numbers of complete flakes during tool production" (Prentiss and Romanski 1989:93).

Further experiments by Prentiss (1998, 2001) indicate that much of the observed variability in flake breakage patterns is graded by size. He introduces four size grades into Sullivan and Rozen's (1985) typology: extra large (>64 cm^2), large (16-64 cm^2), medium (4-16 cm^2) and small (0.64-4 cm^2). This size-graded typology effectively distinguishes tool manufacture from core reduction in both experimental and archaeological assemblages. Core reduction assemblages produce more numerous large complete and proximal flakes, medium flake fragments and medium and small angular shatter, while more frequent flake fragments and proximal fragments and very little angular shatter characterize tool production. Yet, for a debitage assemblage dominated by small-sized flakes, the expectations for the flake type distribution of tool manufacture are essentially the same whether the typology is size-graded or not. I assess flake size as a source of variability in Sullivan and Rozen's typology in my analysis of the KdVo-5 debitage by examining the typological data in terms of the flake size measurements described in the next section.

Flake Size Distribution

Several experimental reduction studies indicate that the size distribution of a debitage assemblage can distinguish tool manufacture from core reduction (Ahler 1989; Baumler and Downum 1989; Patterson 1990). In general, as the size of an objective piece decreases, the frequency of large flake removals also decreases. Patterson (1990) shows that flake-size distributions generated by the experimental reduction of flake blanks to dart point preforms exhibit an exponential decrease in the percentage of total flakes/size category as flake size increases; this pattern is distinct from flake-size distribution curves for the reduction of platformed cores, which contain higher frequencies of larger flakes. Based on the experimental production of several bifaces, Patterson (1990) argues that this exponential curve form is a replicable flake-size distribution pattern unique to bifacial reduction; thus, biface manufacture can be inferred from archaeological flake assemblages that exhibit this pattern. To support his argument, Patterson demonstrates that the flake-size distribution of 1,949 archaeological flakes from an assemblage dominated by finished dart points and bifacial preforms fits an exponential curve form

It is unclear from Patterson's (1990) study if this exponential curve form effectively differentiates bifacial reduction from the manufacture of unifacial tools. In a study comparing scraper reduction and core reduction debitage, Baumler and Downum (1989) manufacture several side-scrapers and end-scrapers of varying sizes and shapes using an antler hammer. Their size data show that the majority of debitage from scraper manufacture is captured in the 4 mm^2-2 mm^2 size grade. Only 39/3119 (1.3%) of the flakes from the manufacture of 16 scrapers are larger than 6.3 mm^2. The smallest size grade considered by Patterson (1990) is 10 mm^2-15 mm^2; thus, it is likely that in a mixed assemblage containing biface reduction debitage and debitage from the reduction of scrapers similar to those produced by Baumler and Downum, the unifacial component would have a negligible affect on the flake-size distribution.

In my analysis of the KdVo-5 debitage assemblage, I applied the following method, outlined by Patterson (1990), to determine if the flake-size distribution of the KdVo-5 debitage assemblage is indicative of bifacial reduction:

> To measure flake-size range, a series of squares with metric dimensions is used. For example, a flake in the 10-15 mm^2 size range is larger than or equal to a square with 10mm sides and smaller than a square with 15mm sides. Flakes can be fitted in squares in any orientation that permits a fit, so there is no need for a

> consistent special orientation of the length and width of a flake measurement… Flakes measuring less than 10 mm^2 [are] not used, as the exponential curve can be observed without working with very small flakes…This is important since recovery of flakes of sizes less than 10 mm^2 is usually poor in archaeological assemblages, especially because 6-mm (1/4-inch) mesh screens are commonly used (Patterson 1990:552-553).

The size grades increase in 5mm^2 intervals and all flake types are included in the analysis.

Dorsal Cortex

Cortex is the weathered outer surface of a stone; it typically covers the entire surface area of an unaltered nodule. The amount of cortex on the dorsal surfaces of flakes (Figure 4.2b, p.78) decreases as reduction takes place and more of the interior of a nodule is exposed. Reduction experiments conducted by Ahler (1989) show that the frequency of flakes exhibiting some dorsal cortex decreases from 73.1% to 0% as a flake blank is reduced to a finished biface (Figure 4.1, p.77). In contrast, over 70% of all flakes generated by prepared core reduction experiments using the same raw material have dorsal cortex. Schroth and Yohe (2002) find that the reduction of an obsidian cobble and trimming of the three resulting flake blanks produced a debitage assemblage in which 26.5% of the flakes had some dorsal cortex. In their archaeological assemblage of obsidian debitage (presumably from the same source as their experimental cobble) only 6.8% of the flakes had any cortex. They infer from these data that core reduction took place elsewhere and that obsidian entered the site in a partially reduced form. In Tomka's (1989) replication experiments, approximately 44% of flakes resulting from the production of flake blanks from a multidirectional core exhibited 1-50% cortical cover compared to 20% of flakes from the manufacture of a dart point from a flake blank.

All of these studies suggest that high proportions of flakes with dorsal cortex are indicative of an early reduction stage; they also show that the prevalence of dorsal cortex for similar reduction sequences seems to vary widely between experimental settings. Bradbury and Carr (1995) demonstrate that nodule size is an important factor in determining the distribution of dorsal cortex through a reduction sequence. They find that only 34% of the debitage produced by the reduction of a large nodule (1,373.2g) exhibited dorsal cortex, whereas 65% of the debitage from a small nodule (90.7g) had some dorsal cortex. In the case of larger nodules, early flakes containing no cortex would be misclassified as late stage if cortex was the only attribute considered in assigning reduction stage. The geological form of a raw material – cobble, boulder, geological stratum or vein – can also affect the incidence of dorsal cortex in a flake assemblage (Scroth and Yohe 2002). An experiment discussed by Mauldin and Amick (1989) in which two cores of similar weight and slightly different shape were reduced to produce a bifacial preform, shows that considerable variability in the distribution of dorsal cortex can arise between very similar reduction events; they argue that, considered alone, these data might be misinterpreted as indicating significant differences in reduction trajectories between two archaeological assemblages.

To assess the incidence of dorsal cortex in the KdVo-5 assemblage, I visually assigned each flake to one of the following categories: absent; present: <50%; present; >50% (after Tomka 1989). Platform cortex was not included as dorsal cortex.

Platform Facets

The faceting of striking platforms is a result of platform preparation during the reduction of an objective piece. As the margins of an objective piece become progressively thinner, the risk of platform collapse and failed flake removal increases (Ahler 1989). Removal of small flakes along a margin and/or edge grinding is often employed to strengthen a tool edge in order to form an adequate impact point for flake removal. The frequency of platform preparation increases as the objective piece is thinned; thus, the number of small flake scars/platform (known as facets) is expected to increase as reduction progresses (Figure 4.2b, p.78). Reduction experiments conducted by Magne (1985) indicate that the average number of facets/platform increases from 0-1 facets/platform to 3 or more facets/platform over the course of a reduction sequence starting with core reduction and ending in a finished biface. Consistent with these data, Will (2001) shows that the frequency of flakes with multifaceted platforms increases as reduction proceeds. In his experiments, the ratio of flat platforms (1 facet) to facetted platforms (>1 facets) increases from 1:0.78 for the reduction of a flake blank to a thinned biface to 1:8.8 for the reduction of a thinned biface to a finished biface. Tomka's (1989) reduction experiments demonstrate that the frequency of platform-bearing flakes with only 1 facet is significantly higher for the reduction of a multidirectional core than for the manufacture of a biface.

I counted platform facets at 16x magnification for all platform-bearing flakes in the KdVo-5 assemblage. Platforms containing cortex were classified as cortical, platforms with >3 facets as complex, and platforms that were significantly crushed or for which the facet count could not be accurately determined as indeterminate. Small dorsal flake scars originating from the dorsal edge of the platform often accompany platform faceting; these scars are not counted as platform facets (Magne 1985, Odell 1989). Odell (1989) cautions against misidentifying fractures or breaks from the dorsal surface directed into the platform as facets. I attempted to distinguish between this type of modification and actual platform scars by inspection at 16x magnification.

Dorsal Flake Scar Count

Dorsal flake scars (Figure 4.2b, p.78) are "the impressions found on the dorsal surface of a flake debitage specimen caused by the removal of previous flakes from the objective piece" (Andrefsky 1998:104). Bifacial reduction experiments indicate that the number of dorsal scars/flake increases as reduction proceeds. Magne (1985) shows that the average number of dorsal scars increases from approximately 1 dorsal scar/flake to more than 3 dorsal scars/flake over the course of a trajectory starting with core reduction and ending in a finished biface. Reduction experiments conducted by Mauldin and Amick (1989) show that the early stages in the reduction sequence from nodule to bifacial preform produce on average <3 dorsal scars/flake, while the later stages exhibit >3 dorsal scars/flake. Mauldin and Amick (1989) point out, however, that the number of dorsal scars/flake is also a function of flake size: 60% of flakes with >6 dorsal scars are also >5cm in maximum dimension; 65% of flakes with 0-1 dorsal scars are between 1-3cm maximum dimension. They caution: "high dorsal scar counts among early debris may be more a function of flake size than reduction stage" (Mauldin and Amick 1989:74). Magne (1989:17) disputes this position, proposing that "[w]hile it may be argued that scars will not continue to increase in frequency because the flakes are getting smaller, the size factor is not a strong one, and besides, if the flakes are smaller, then the scars become proportionally smaller."

I counted dorsal scars greater than 5 mm in length for all the debitage in the KdVo-5 assemblage (after Magne 1985). I classified flakes with 100% dorsal cortex as having 0 dorsal scars. Some studies (Odell 1989, Tomka 1989) caution against counting platform preparation scars – distinct from platform facets - as dorsal scars because they are indicators of a different process (platform preparation) than dorsal flake scars (general reduction); however, I chose to use Magne's (1985) method because I intended to use the data as an input variable for his reduction stage determination scheme. I found that counting scars only greater than 5mm in length avoided the enumeration of most platform preparation scars.

Reduction Stage Determination

Figure 4.3 (p.79) shows Magne's (1985) experimentally derived debitage classification scheme. Platform-bearing flakes are assigned to a reduction stage based on platform facet count; flake shatter fragments (lacking platforms) are assigned to a reduction stage by dorsal scar count. Magne's definition of early, middle and late reduction stages are outlined in the following passage:

> Early reduction stages are defined as all events of core reduction, including both single platform and bipolar core forms, regardless of the number of events involved. Middle stages are the primary trimming stages of tools, measured as all the reduction events of marginal retouch tools, and the first half of the reduction events of all other tools, whether unifacial or bifacial. Late stage reduction then, is defined as the latter half of the reduction events of unifacial and bifacial implements. I believe that this is a justifiable way to divide the reduction process, since core reduction is undertaken to derive flake blanks, regardless of method, marginal flaking and initial unifacial and bifacial flaking all involve straightening edges and removing the most excessive mass, and the later events of unifacial and bifacial flaking are undertaken to refine the intended shape of the tool (Magne 1985:106-107).

In addition, the classification detects distinct reduction types by differentiating flakes exhibiting the specific morphologies of bifacial reduction flakes (BRFs) – flakes with extremely facetted, narrow angled, often lipped platforms – and bipolar reduction flakes

(BPOs) – flakes exhibiting simultaneous percussion from opposite directions, often with crushing – from the early, middle and late stages.

I used this classification scheme to assign individual flakes in the KdVo-5 debitage assemblage to reduction stages. In applying this system to archaeological assemblages, Magne suggests that it is often useful to pool BPOs, early flake shatter and early platform-bearing flakes into an early stage; middle flake shatter and middle platform-bearing flakes into a middle stage; and BRFs, late shatter, and late platform-bearing flakes into a late stage. In the interest of avoiding subjective morphological interpretations of bifacial and bipolar reduction flakes, I employed this variation in my analysis.

Reduction Continuum Model

In their paper *Examining Stage and Continuum Models of Flake Debris Analysis: An Experimental Approach,* Bradbury and Carr (1999) address the problem that most reduction stages proposed by lithic analysts are heuristic classification devices that often do not parallel actual prehistoric changes in technological behavior; specifically, they observe that flakes from the end of one reduction stage and the beginning of the next often have very similar attributes. For example, in Magne's (1985) classification scheme, the transition from middle to late stage does not necessarily signal any change in reduction strategy or hammer type; thus, there is likely considerable overlap between late-middle stage and early-late stage flake assignments and the potential for misclassification is significant. Indeed, Magne's (1985:119) multiple discriminant analysis of debitage produced by experienced knappers - based on several flake attributes, including platform facet count and dorsal scar count, flake weight and flake width - assigned approximately 30% of late stage flakes to the middle stage. Only 8% of middle stage debitage was misclassified as early stage, suggesting that core reduction can be considered a separate technological stage from tool manufacture (often accompanied by a change from hard hammer to soft hammer percussion).

In order to avoid some of the problems inherent in reduction stage classification, Bradbury and Carr (1999) suggest that tool manufacture be conceptualized as a continuum. In their reduction experiments, they collected all flakes in the order of removal during the production of three hafted bifaces from flake blanks. By employing multiple regression analyses between variables in a set of 12 flake attributes, they were able to devise a regression equation that predicted the order of flake removals in their experimental assemblage:

> Percent complete=(0.0898 * # of platform facets) + (0.0713 * natural log of maximum width) + (0.1638 * natural log of # of dorsal scars/flake weight)

Percent complete measures the relative position of a flake removal over the course of the reduction of a flake blank (0%) to a hafted biface (100%) (Figure 4.4, p.79).

I applied this formula to the KdVo-5 assemblage data. Since Bradbury and Carr (1999) developed their model for platform-bearing flakes captured in a ¼ screen, I restricted my analysis to complete and proximal flakes that were retained in the ¼ inch screen after sorting through a set of nested screens. Maximum width was measured to the nearest 0.1mm with calipers and flake weight was measured to the nearest 0.1g on an electronic balance. For platform facets coded as complex, I entered a facet count of 3, which is consistent with the parameters used to derive the regression equation.

Results

Figure 4.5 (p.89) shows the flake type distributions of all debitage, obsidian debitage, basalt debitage and other raw materials. The results are generally consistent with Sullivan and Rozen's (1985) expectations for tool reduction debitage assemblages: high proportions of flake shatter and proximal flakes and low frequencies of angular shatter. This pattern does not appear to be conditioned by raw material properties as all of the debitage subsets exhibit similar distributions. The data also correspond well to Prentiss' (1998, 2001) size-graded typology. Ninety-seven percent of the KdVo-5 debitage assemblage falls into Prentiss' small category with the remaining 3% in the medium size grade. The absence of large and extra-large complete flakes and medium-sized angular shatter indicates the near absence of core reduction debitage and the distribution of small flakes is consistent with Prentiss' (1998, 2001) prediction that numerous small flake shatter fragments and proximal flakes and very little angular shatter characterize tool manufacturing assemblages.

This typological approach is not adequately sensitive to distinguish different types of tool production. For example, Prentiss and Romanski (1989) find that the flake type distributions for experimental biface and end-scraper manufacture are virtually identical, though both are distinct from core reduction. Thus, this approach indicates that the KdVo-5 debitage assemblage is the product of tool reduction but lacks the ability to segregate different types or stages of manufacture.

Figure 4.6 (p.81) compares the flake size distributions of all debitage, obsidian debitage, basalt debitage and other raw materials to the flake size distributions of Patterson's (1990) bifacial and core reduction experiments. Strong similarity between all of the sub-assemblages and the exponential curve form derived for bifacial reduction – a pattern that Patterson claims to be unique to bifacial reduction – indicates that the manufacture of bifaces comprises the majority of the reduction events that took place at the site. That the pattern holds for all of the debitage and the various raw material subsets is consistent with Patterson's observation that flakes from several reduction experiments mixed together maintain an exponential flake size distribution.

The minor distinctions between the flake size distributions of the different raw materials do not appear to relate to any subtle technological differences in tool manufacture but are most likely random deviation resulting from the inherent variability in lithic manufacturing events and the application of an analytical method to an incomplete archaeological assemblage. Patterson (1990) attempts to distinguish different stages of bifacial reduction by comparing the flake size distribution of the reduction of a flake blank to a thinned biface (see Figure 4.1, p.77) to that of the reduction of a thinned biface to a finished biface. He compares the equation coefficients of straight-line semilog plots of the exponential flake size curves in order to determine if they exhibit any patterned variability that distinguish reduction sequences; however, this attempt failed to yield the interpretive tool Patterson sought. Instead, he attributes the small differences in flake size distributions to the highly variable size and shape of starting flake blanks, which often require different strategies for thinning during the bifacial reduction process. Thus, flake size distribution demonstrates that bifacial reduction was the focus of tool production at the site but is limited in its ability to distinguish what stages of bifacial reduction were undertaken.

Analysis of flake type and flake size, taken together, indicates that tool manufacture was the dominant technological activity undertaken at KdVo-5 and that bifacial reduction was the primary focus of this tool production. Evidently, core reduction took place at a different location than the stages of bifacial reduction associated with the lookout site. This eliminates the first of the bifacial reduction scenarios outlined by Patterson (1990) but it still remains unclear if biface production began with flake blanks or bifacial preforms, or if it was restricted to the refurbishment of broken bifaces carried to the site, or if some other technological strategy was being practiced. To address this question, I turn to the analysis of individual flake attributes, which tend to exhibit more patterned variability between reduction stages than flake type or flake size.

Figure 4.7 (p.82) shows the frequencies of dorsal cortex for all debitage, obsidian debitage, basalt debitage and other raw materials. The proportion of flakes exhibiting 0% dorsal cortex ranges from 88 – 100%; the obsidian assemblage has the highest incidence of dorsal cortex: approximately 10% <50% and 2% >50%. Examination of the various subsets of obsidian shows that the green obsidian - also the largest subset - accounts for >90% of the dorsal cortex in the obsidian assemblage. The remaining obsidian subsets, basalt and other raw materials exhibit an incidence between 0 – 3%.

A cursory comparison of dorsal cortex incidence between sub-assemblages indicates that the green obsidian underwent a longer reduction sequence relative to the other raw materials. This interpretation is confounded, however, by Bradbury and Carr's (1995) data showing that nodule size has a large effect on dorsal cortex incidence. A flake blank struck from a relatively small nodule can be expected to produce cortical flakes farther into a reduction sequence than a blank struck from the interior of a larger nodule. These data and the high variability in dorsal cortex incidence between the reduction experiments discussed above make it difficult to assign reduction stage based on dorsal cortex alone. While all of these experiments show that an absence of dorsal cortex in 88 – 100% of the KdVo-5 debitage assemblage indicates tool reduction as opposed to core reduction, consistent with the flake type and flake size data presented above, supporting evidence from other flake attributes is required to accurately infer reduction stage from the debitage assemblage.

Platform facet count and dorsal scar count are the main variables used for reduction stage determination in Magne's (1985) scheme and Bradbury and Carr's (1999) reduction continuum model. Figure 4.8 (p.83) shows the distribution of platform facet count for all debitage, obsidian debitage, basalt debitage and other raw materials. The frequencies of platform facet count among the obsidian debitage and other raw materials is skewed towards 3 or more facets/platform while the basalt debitage indicates a distribution centered on 2 – 3 facets/platform. These distinctions are discussed in the context of the reduction stage determination. Similar to the distribution of dorsal cortex, the subset of green obsidian accounts for all of the cortical platforms (n=3) and 70% of the platforms with 1 facet in the obsidian debitage assemblage (n=10), indicating a longer or different reduction trajectory than the other obsidian subsets.

Figure 4.9 (p.84) shows the distribution of dorsal scar count for all debitage, obsidian debitage, basalt debitage and other raw materials. The mean values for # dorsal scars/flake range from 2.5 – 2.8 (all debitage = 2.7 +/- 0.14 s.d.; obsidian debitage = 2.8 +/- 0.12; basalt debitage = 2.5 +/- 0.16; and other raw materials = 2.7 +/- 0.14). The main difference accounting for the variable means between the raw material sub-assemblages appears to be the frequencies of flakes with 4 or more dorsal scars/flake. This distinction does not appear to be conditioned by flake size, as has been cautioned by Amick and Mauldin (1989). The flake size distribution in Figure 4.6 (p.81) shows high consistency in size distribution between all of the raw materials and the flakes with > 4 dorsal scars are not restricted to the higher size grades. The technological significance of the dorsal scar count and platform facet count frequencies and the differences between the raw material sub-assemblages for each of these attributes are discussed in the context of the results of Magne's (1985) reduction stage determination scheme and Bradbury and Carr's (1999) reduction continuum model.

The results obtained by applying Magne's (1985) reduction stage scheme to the platform facet and dorsal scar count data presented above are shown in Figure 4.10 (p.85). While all of the raw material subsets contain 15 – 20% early stage reduction debitage, there is considerable variability in the frequencies of middle and late stage reduction between basalt and the other two sub-assemblages, which are remarkably similar in their ratio of late to middle stage (1.9 for obsidian and 2.0 for other raw materials compared to 0.8 for basalt). These data are generally consistent with the platform facet count data and the lower mean dorsal scar count for the basalt debitage relative to the other debitage sub-assemblages.

To convert his reduction stage data to meaningful technological information, Magne (1985) conducts a multivariate statistical comparison of the reduction stage distributions of 38 debitage assemblages in his study area. Based on this analysis of inter-assemblage variability, he finds that these reduction stage distributions can be separated into three distinct technological categories: early/core reduction, middle/wide ranging reduction, and late/maintenance reduction. He confirms this pattern with tool assemblage data, which shows that cores dominate early/core reduction sites while late/maintenance sites tend to have more formed tools, particularly bifaces. The relative proportions of early, middle and late stage debitage is the most important determinant of the technological category assigned to an individual assemblage. For example, the proportions of early, middle and late stage for five excavated house-pit assemblages that Magne classifies as middle/wide ranging reduction sites are early = 42.1%, middle = 34.0% and late = 23.0%; the average proportions for excavated house-pits classified as late/maintenance assemblages are early = 23.7%, middle = 28.4% and late = 46.8%. That 23.7% of the debitage from late/maintenance sites is classified as early does not necessarily mean that this proportion of the assemblage represents core reduction activity – Magne's (1985) scheme provides ca. 60% correct stage discrimination for experimental knapping assemblages – but that the overall pattern of reduction stage frequencies is meaningful for comparing the technological activities undertaken at a site.

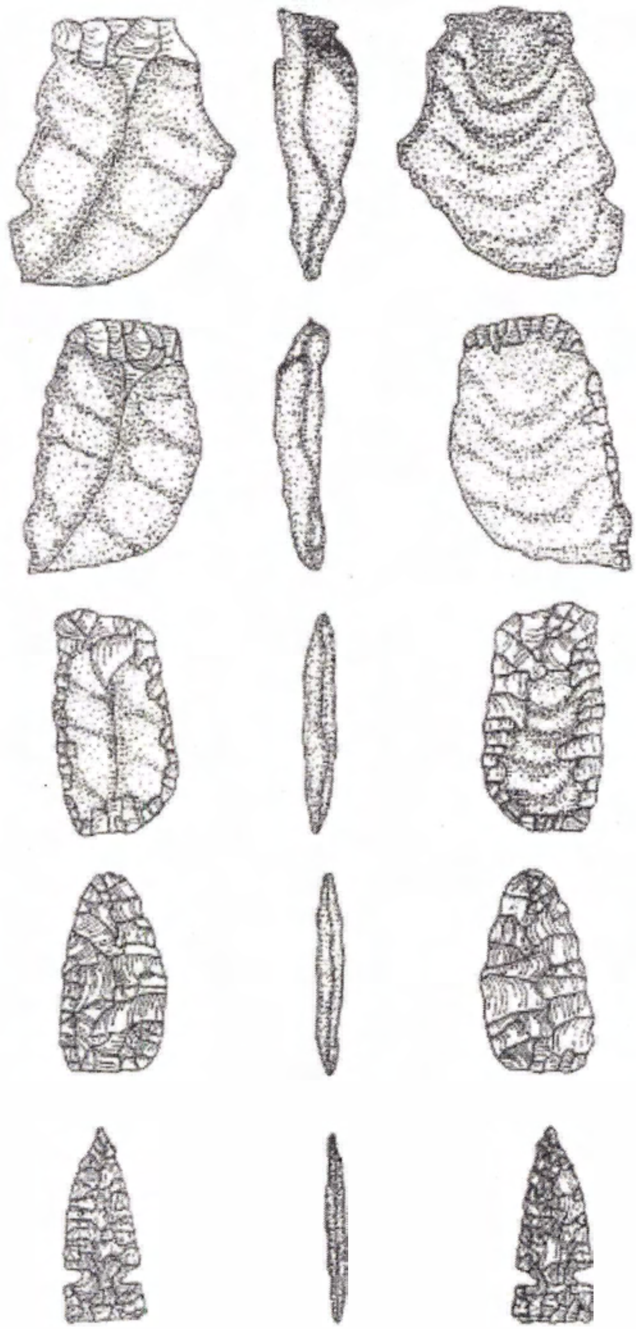
The reduction stage distributions for the obsidian and other raw materials debitage sub-assemblages appear to fall within the late/maintenance category. Based on the low frequency of early stage flakes and higher proportions of middle and late stage flakes in the basalt debitage sub-assemblage, I also suggest that this subset represents a late/maintenance assemblage but that it is closer to the middle/wide ranging reduction end of the late/maintenance spectrum than the other two sub-assemblages. According to Magne's (1985) stage definitions (see above) these data indicate that most of the KdVo-5 debitage assemblage represents the latter half of the bifacial reduction trajectory shown in Figure 4.1 (p.77), perhaps the reduction of a thinned biface to a finished biface for the obsidian and other raw materials and the reduction of a well-edged biface to a finished biface for the basalt debitage.

This interpretation is generally confirmed by the application of Bradbury and Carr's (1999) reduction continuum model to the KdVo-5 debitage assemblage. Figure 4.11 (p.86) shows the percent complete values assigned to individual flakes for the four varieties of obsidian debitage (gray, black, brown and green), all obsidian debitage, basalt debitage and other raw materials. Percent complete, based on the regression equation derived by Bradbury and Carr, measures the point of detachment for individual flakes in the reduction of a flake blank to a finished biface (dart point). Figure 4.4 (p.79) shows percent complete plots for several bifacial reduction experiments conducted by Bradbury and Carr (1999). Experiments 10 and 11 represent the production of hafted bifaces "using both hard and soft hammer biface reduction and minor amounts of pressure flaking" (Bradbury and Carr 1999:110). Experiment 10 started with a broken bifacial core and Experiment 11 started with a flake produced during freehand core reduction. The final product in both cases was a large straight-stemmed dart point. These points were broken and resharpened in Experiments 10.5 and 11.5. Flakes with >100% percent complete are expected for resharpening since they occur after the completion of the hafted biface (100% complete). Bradbury and Carr (1999:113) explain the overlap between Experiments 10 and 11 with their resharpened counterparts in the following way: "Given that the reworking was accomplished using the same tool (a small antler billet) and a similar flintknapping technique, this is not altogether surprising." Experiment 5.5 shows the production of a biface, which was not modified for hafting.

Comparing Bradbury and Carr's (1999) experimental results to the reduction continuums of the KdVo-5 debitage subsets (Figure 4.11, p.86) reveals several congruencies. The gray, black and brown obsidian subsets indicate resharpening. Indeed, fine retouch along the platform edges of several small flakes in the gray obsidian subset suggests that it was struck from a finished tool. Based on refitting data for the black obsidian subset, indicating several overlapping flakes, it appears that this subset represents the reduction of a preform to a finished biface rather than a resharpening event. The green obsidian appears to be debitage from the reduction of a hafted biface that started fairly early in the bifacial reduction trajectory, perhaps at the thinned biface stage. This earlier start is consistent with the high incidence of dorsal cortex observed for the green obsidian subset. The other raw materials plot most likely is a mix of resharpening and biface production from the preform stage as most of the materials contain only between 10 and 20 flakes. The plot for the basalt debitage does not reach 100% complete, which is consistent with the difference in the distribution of reduction stage between basalt and the other raw material sub-assemblages noted above. Magne (1985:127) notes that "[the] slightly better discriminating power of obsidian in comparison to basalt is considered to be a sort of systematic error factor, due to the greater facility in actually observing flake scars on...obsidian than on basalt." The production of a hafted biface on fairly crude, granular basalt might produce flakes with less complex features than the finer raw materials, which could account for the differences seen in the reduction stage distributions and reduction continuums. The presence of basalt projectile point bases in the tool assemblage suggests that this may be the case.

Conclusions

My analysis of the KdVo-5 debitage assemblage shows that the production and refurbishment of hafted bifaces were the main technological activities undertaken at the lookout site. Consistent with Patterson's (1990) third scenario for bifacial reduction trajectories, raw material for biface manufacture appears to have entered the site in partially reduced form – likely as a thinned biface in the case of the green obsidian and as bifacial preforms for the other sub-assemblages. In the following chapter, this technological data is integrated with tool assemblage data and archaeological models of settlement and mobility in order to place the lookout site within a regional context of prehistoric land use.



Stage One: Flake Blank

Stage Two: Edged Biface

Stage Three: Thinned Biface

Stage Four: Preform

Stage Five: Finished Biface

Figure 4.1. Reduction trajectory for the manufacture of a bifacial projectile point from a flake blank (adapted from Andfrefsky 1998:183).

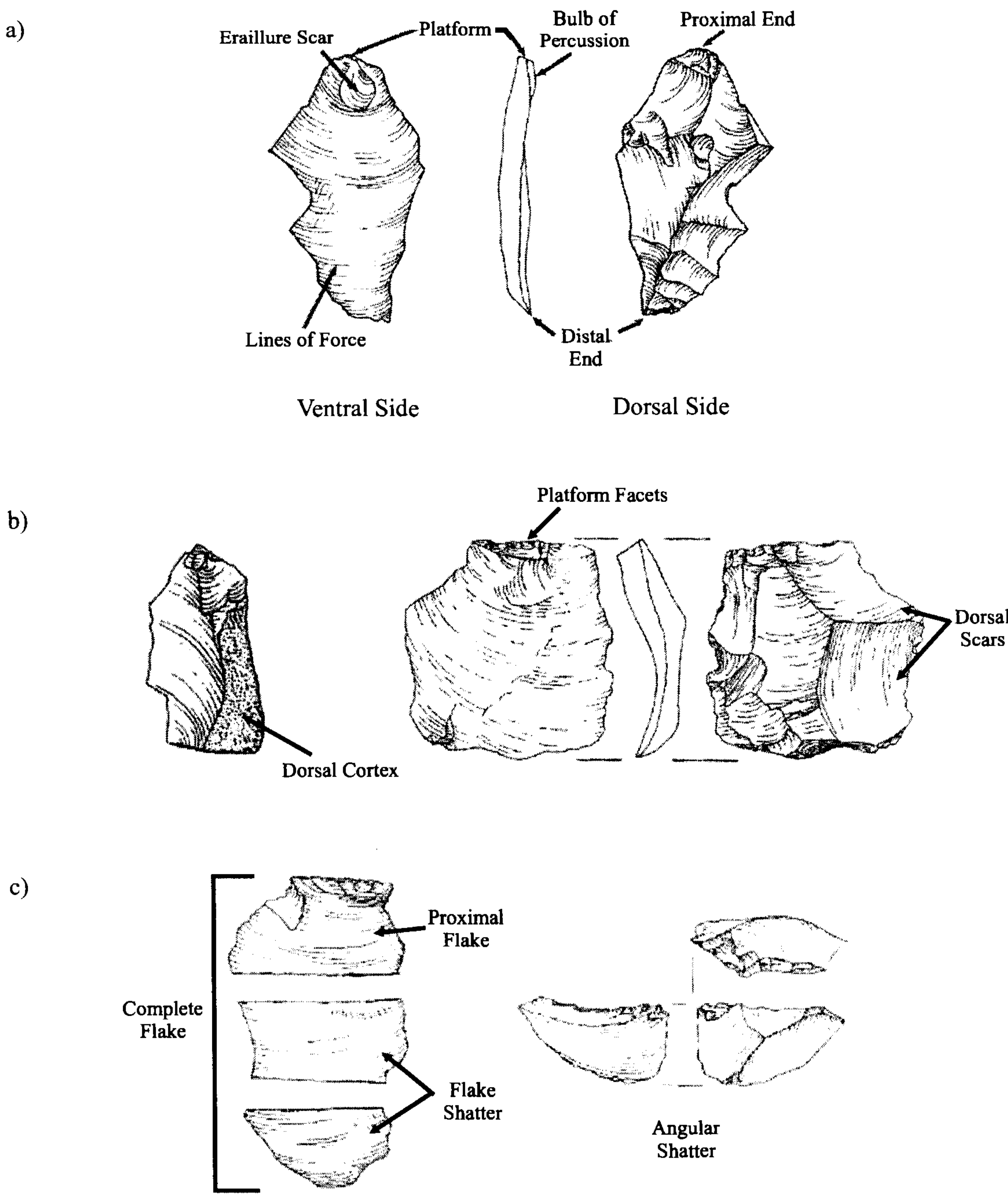


Figure 4.2. a) Flake morphology and terminology (adapted from Andrefsky 1998:17); b) Flake attributes (adapted from Anfrefsky 1998:104,119; c) Flake types (adapted from Andrefsky 1998:87).

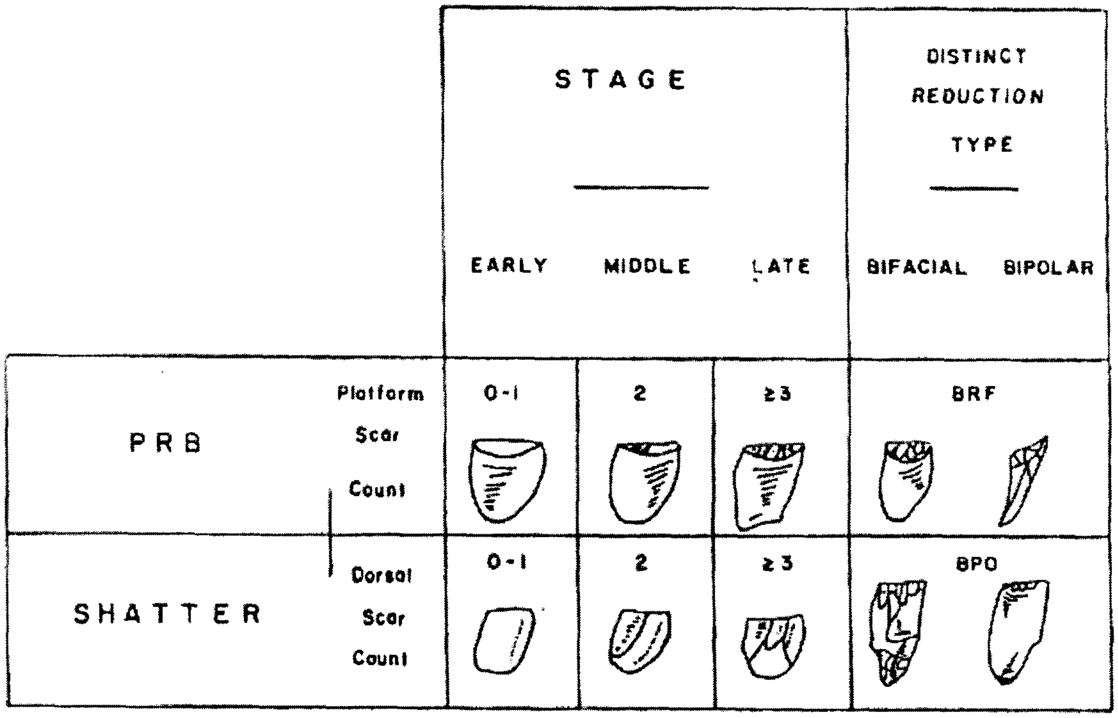


Figure 4.3. Magne's experimentally derived debitage classification scheme (adapted from Magne 1985:129).

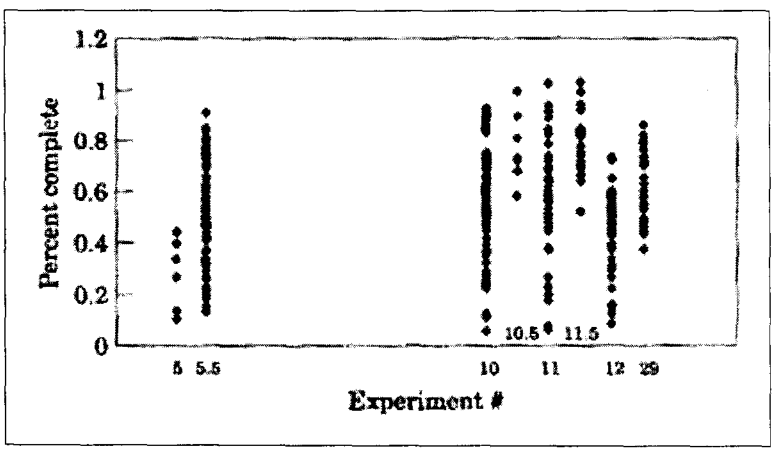


Figure 4.4. Percent complete plots for several bifacial reduction experiments conducted by Bradbury and Carr (adapted from Bradbury and Carr 1999:113).

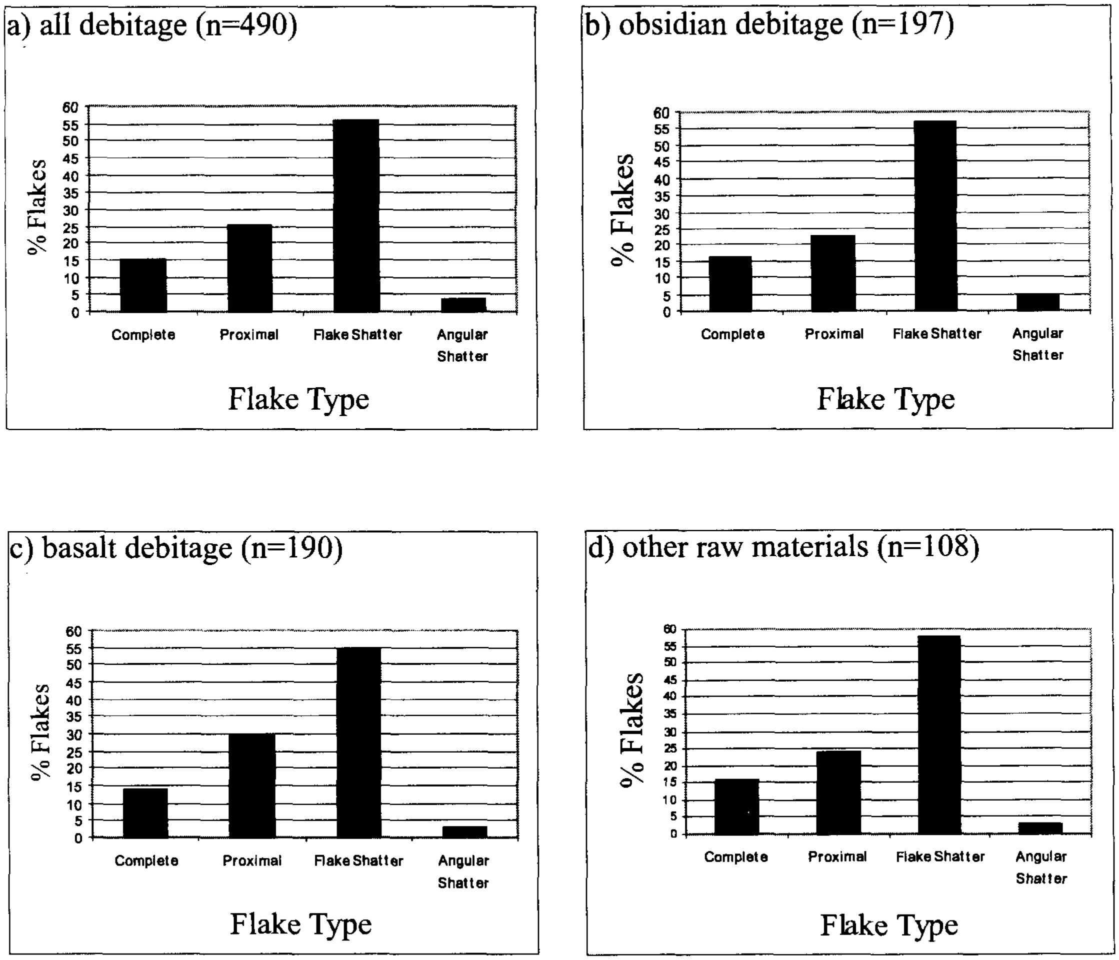


Figure 4.5. Distribution of flake types in the KdVo-5 debitage assemblage.

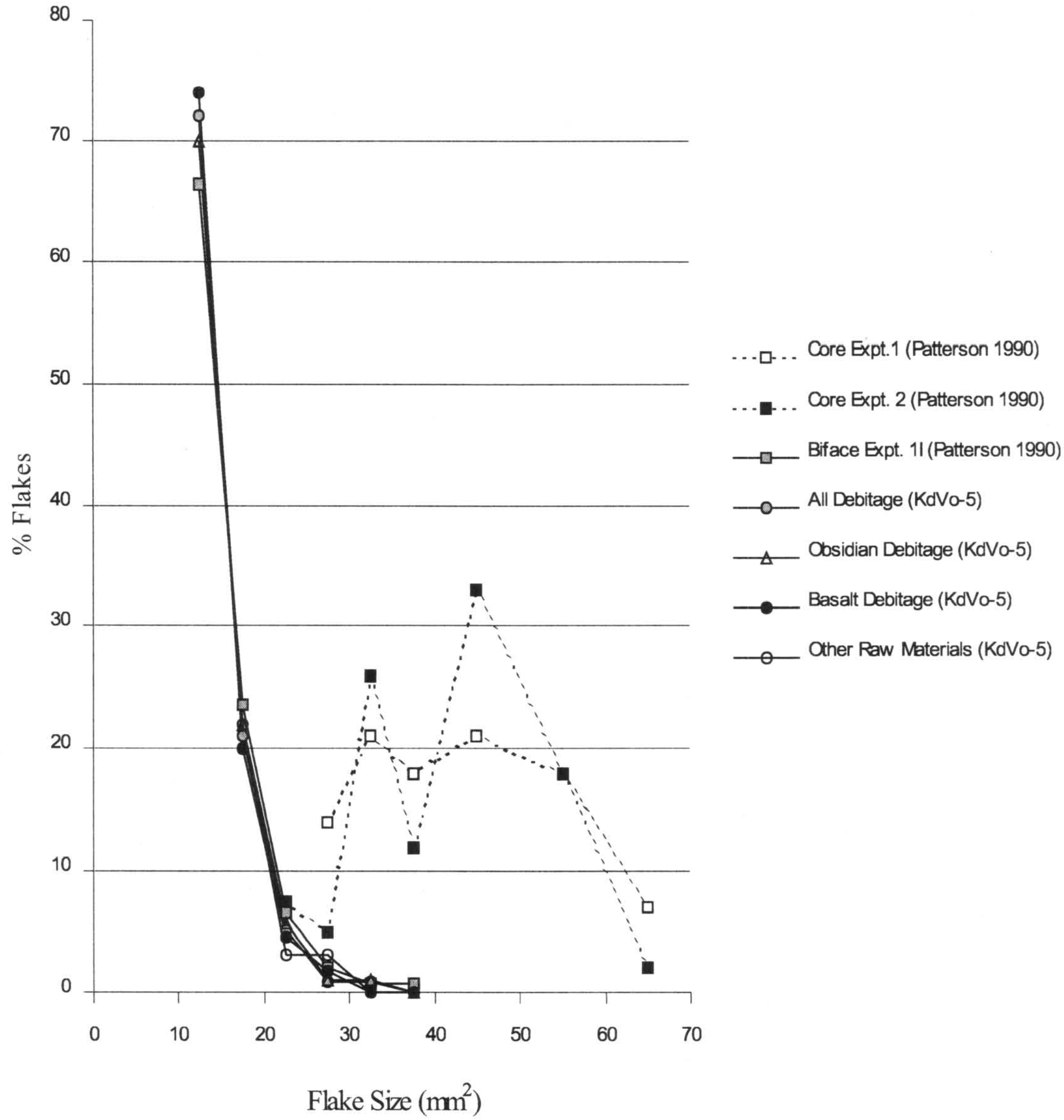


Figure 4.6. Plot comparing flake size distributions of experimental bifacial and core reduction events to the flake size distribution of the KdVo-5 debitage assemblage. (experimental data taken from Patterson 1990).

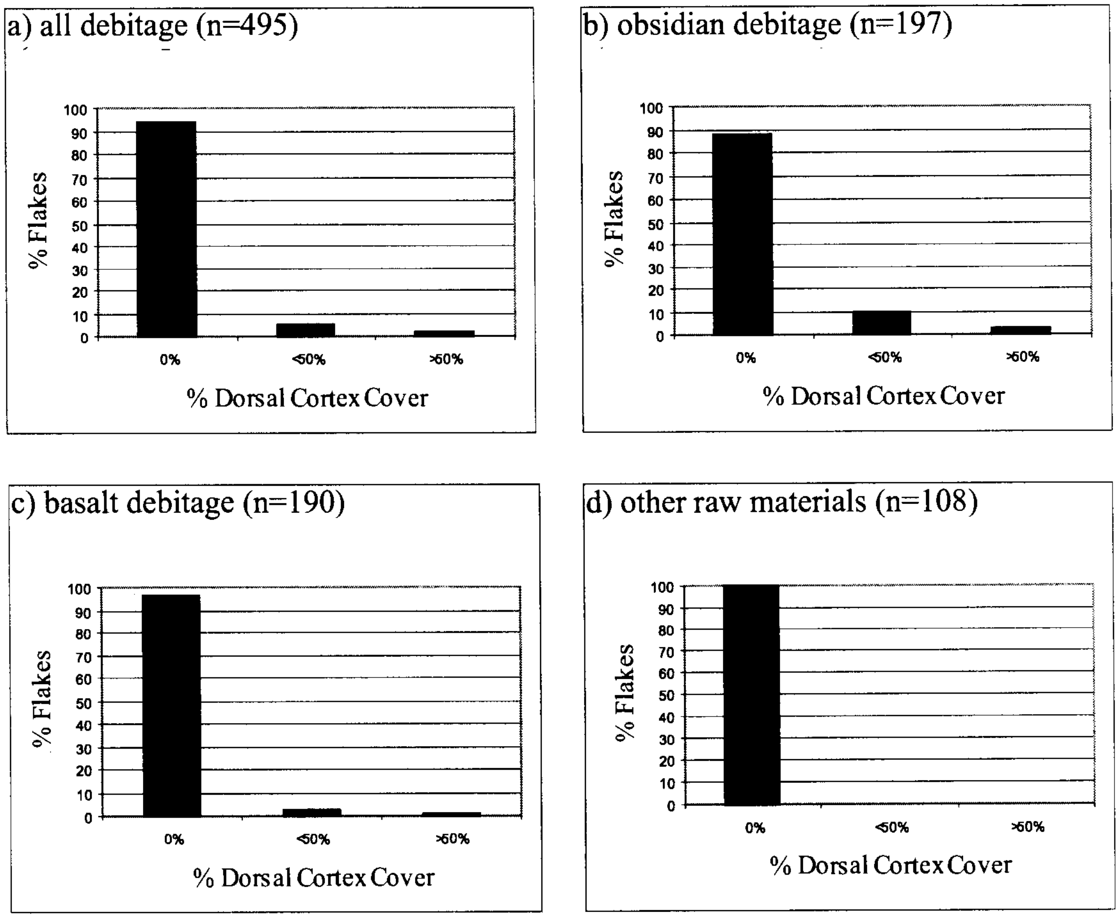


Figure 4.7. Distribution of % dorsal cortex cover in the KdVo-5 debitage assemblage.

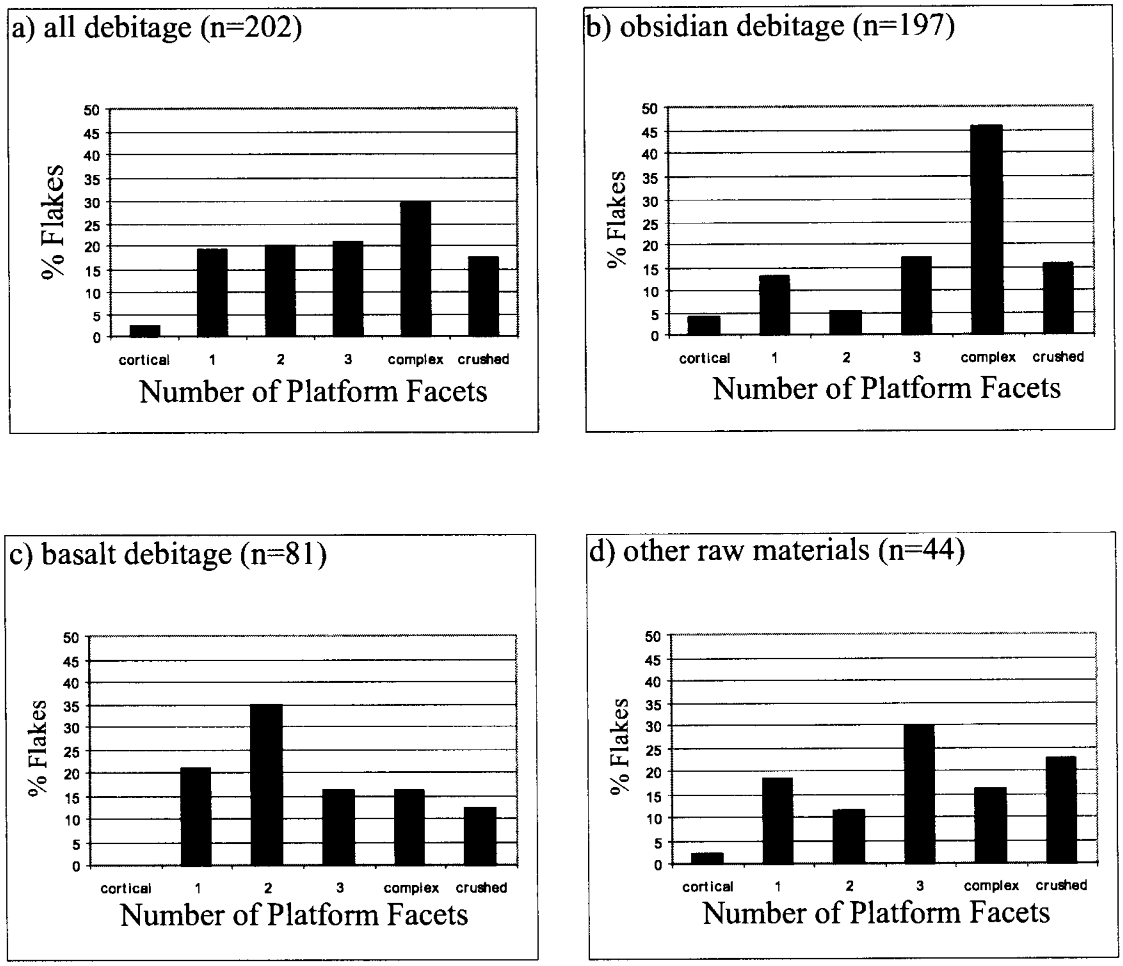


Figure 4.8. Distribution of platform facet count for all complete and proximal flakes in the KdVo-5 debitage assemblage. Platforms exhibiting 100% cortex coverage are 'cortical'; platforms with 4 or more facets are 'complex'; and partially crushed platforms with indiscernible facet counts are 'crushed'.

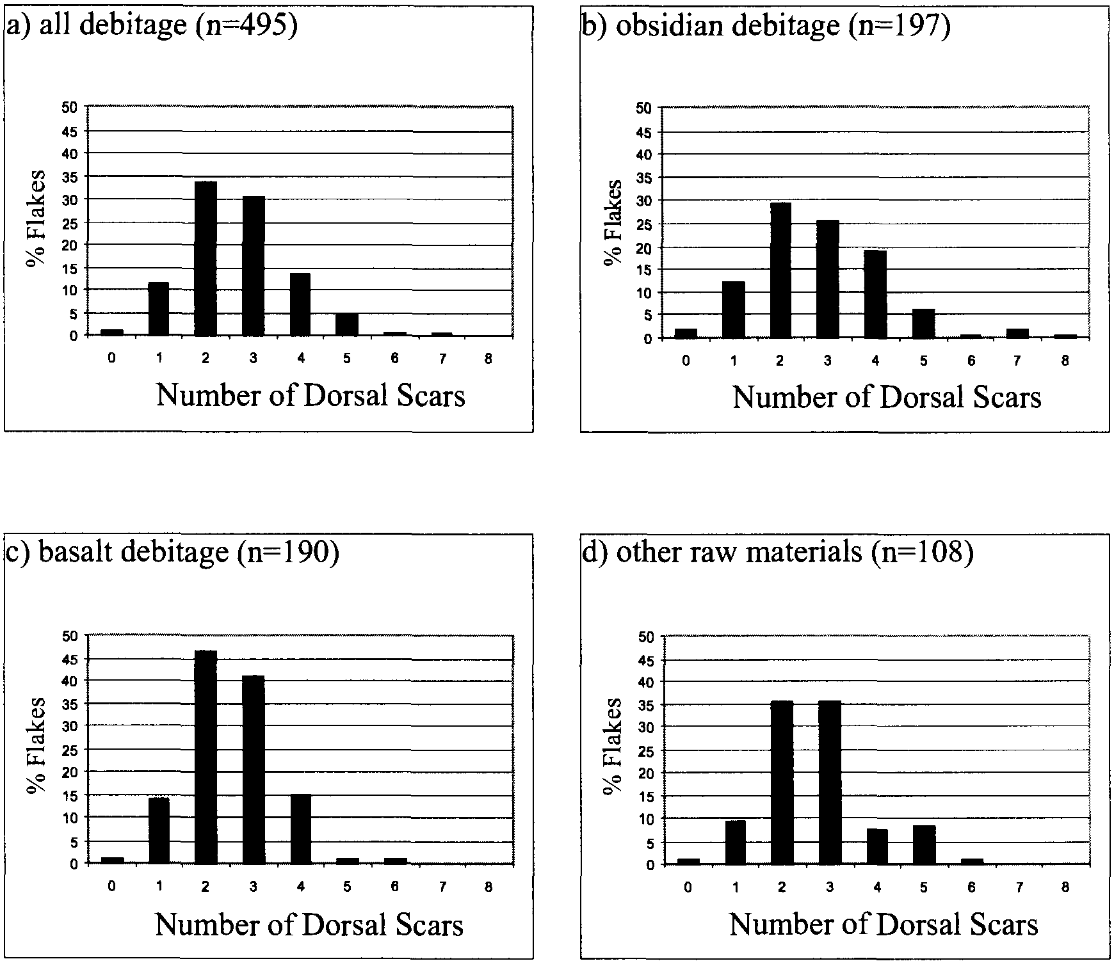


Figure 4.9. Distribution of dorsal scar count in the KdVo-5 debitage assemblage.

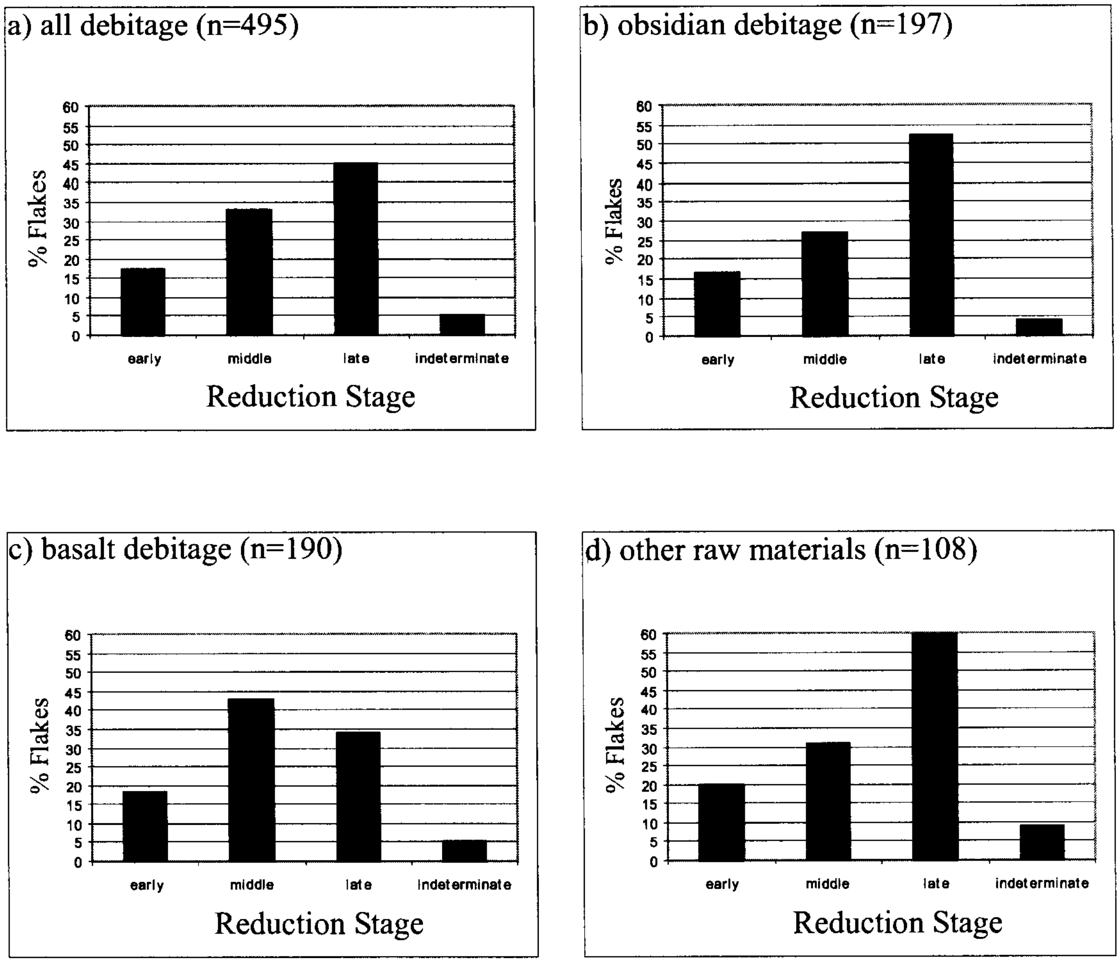


Figure 4.10. Application of Magne's (1985) reduction stage determination to the KdVo-5 debitage assemblage. 'Indeterminate' includes angular shatter and other flakes for which stage could not be adequately determined.

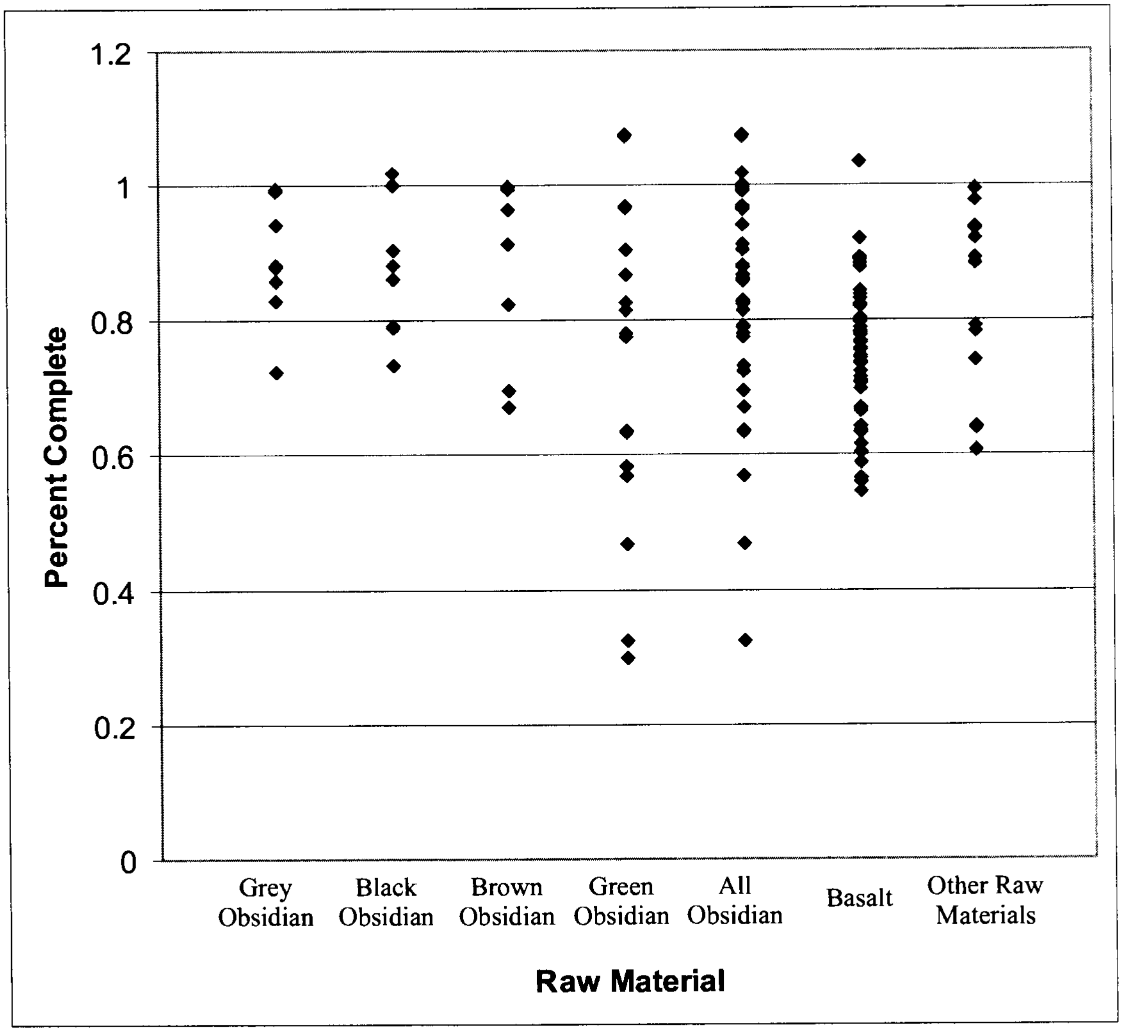


Figure 4.11. Plot of individual flakes assigned to a reduction continuum model developed by Bradbury and Carr (1999). Percent complete measures the point of detachment for individual flakes in the reduction of flake blank to a finished biface.

Chapter Five: The Technological Organization of the KdVo-5 Assemblage

Introduction

So far my analysis of archaeological assemblage of the KdVo-5 hunting stand has focused on the activities that took place within the vicinity of the hearth feature. The archaeological assemblage can also provide information on the place of the KdVo-5 hunting stand within the broader context of a subsistence-settlement system. For example, did the occupants simply walk up the hill from their village down below to take a look around, as was the case in the historical period, or did they travel some distance to get there? Did they travel to this site specifically, or occupy it incidentally to seek game within the context of a hunting expedition? In this chapter, I attempt to answer these questions by situating the KdVo-5 site within Binford's (1980) forager-collector dichotomy of hunter-gatherer land-use. I then test the predictions derived from Binford's (1980) model by examining the technological organization of the KdVo-5 assemblage. Can all of the artifact variability in the B2 assemblage be explained by the functional requirements posed by the subsistence-settlement system, or were other factors at play in shaping the technological practice of the occupants of the site?

Binford's Hunter-Gatherer Subsistence-Settlement Model

In his paper *Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation,* Binford (1980) outlines the characteristics of two alternative mobility strategies used by hunter-gatherer societies in the pursuit of their annual subsistence activities: 'mapping on' or 'residential' mobility and 'logistical' mobility. Chatters (1987:337) describes these strategies in the following passage:

> "Foragers" utilize a "mapping on" mobility strategy in which people move their residences frequently for direct proximity to food resources which are gathered as needed during daily excursions. Food resources are acquired opportunistically using an "encounter strategy"... "Collectors" employ "logistical" mobility, changing residences less frequently, while task-oriented groups travel to resource patches to amass foodstuffs for future consumption. Collectors tend to focus, through a pursuit-type predation strategy, on those resources that can be gathered in quantity and stored.

Several authors (Carr 1994; Chatters 1987; Kuhn 1989) make explicit that Binford (1980) conceptualizes these alternative strategies as opposite poles on a continuum of land-use practices. Most hunter-gatherer groups employ both strategies to varying degrees and considerable variation in the frequencies and distance of movements exists between peoples living in different environments. Indeed, Binford (1980:18) states "...in some environments we might see high residential mobility in the summer or during the growing season and reduced mobility during the winter, with accompanying increases in logistical mobility." Chatters (1987) also stresses that the dichotomy between foragers and collectors is not meant to be interpreted in terms of increasing cultural complexity; rather, it is a heuristic framework useful for classifying the material correlates of different mobility strategies in the archaeological record of hunter-gatherer societies.

Each mobility strategy, according to Binford (1980), has different consequences for the structure of the archaeological record: archaeological sites will vary according to their organizational roles within the systemic whole of a subsistence-settlement system. Based on ethnoarchaeological data, he predicts that foragers practicing a residential mobility strategy will create two types of sites: residential bases and locations. Residential bases are "the locus out of which foraging parties originate and where most processing, manufacturing and maintenance activities take place" (Binford 1980:9). They are expected to be visible in the archaeological record, particularly if they are reused annually, and their assemblages should reflect a broad range of activities. Locations are points on the landscape where the extraction of resources takes place. Since foragers tend to gather resources on a daily basis, with minimal resource processing taking place in the field, locations typically exhibit low archaeological visibility, their assemblages often limited to the odd tool broken during procurement activities.

In addition to residential bases and locations, collectors leave traces of three site types unique to logistical mobility: field camps, stations and caches. Field camps are the living places of small task groups during logistical forays. Since collectors set out on extended trips to secure specific resources circumscribed in time and space, the assemblages and structures of field camps tend to reflect the task at hand; for example a caribou hunting camp may contain evidence of hunting weapons, butchering implements and heavier tools used for the maintenance of fence structures, while a fishing camp might be located next to a weir site and contain exhausted fish processing implements and evidence of drying racks and associated hearths. Caches are sites created by the storage of bulk resources in anticipation of future transport to the people at the residential base and stations are sites produced by task groups engaged in information gathering, such as watching for game at hunting stands. Binford (1980) suggests that stations are rare for foragers engaged in an 'encounter' strategy of resource procurement but would be useful to collectors in their pursuit of a specific target resource. Thus, the presence of field camps, caches and stations in the archaeological record is indicative of the use of a logistical mobility strategy, which Binford (1980:10) proposes will be used in "situation[s] where consumers are near to one critical resource but far from another equally critical resource."

Given Binford's (1980) model of hunter-gatherer land-use, does the KdVo-5 site, interpreted as a hunting stand, indicate the use of a station by a small task group engaged in a logistical foray keyed on the procurement of a critical resource? The drop zone associated with the hearth suggests the presence of three or four individuals, consistent with the size of a specialized task-group, the discreteness of this feature indicates a short-duration occupation of the site, and the predominance of hunting weapons suggests that a specific task was anticipated by the occupants. Yet, in the absence of other excavated Northern Archaic site types in the Scottie Creek Valley against which the organizational role of the KdVo-5 hunting stand can be assessed, this conclusion remains tenuous. Thus, a closer look at the tool assemblage and debitage data presented in the previous chapter, with the goal of determining if the technological strategy utilized by the occupants of the site is consistent with a logistical mobility strategy, is warranted.

Technological Organization and Design Theory

Prehistoric hunter-gatherers designed their chipped stone tool technologies in relation to a number of constraints posed by the organization of their subsistence-settlement systems, including mobility strategies, the anticipated functional requirements of tools in different contexts, and raw material variability and availability. A passage from Kelly (1988:718) illustrates some of the factors prehistoric peoples considered in organizing their lithic technologies:

> [A] stone tool must solve the problem of spatial and temporal differences between the locations of [tool] raw material and the locations of stone tool use while meeting the functional needs of the task(s) for which the tool is used. Stones weigh too much for a mobile people to carry more than needed, yet tool needs cannot always be anticipated precisely; therefore, mobility simultaneously dictates tool needs and access to raw material.

The study of technological organization seeks to understand how technological strategies reflect the structure of subsistence-settlement systems and how technological concerns, such as raw material procurement, can, in turn, influence the organization of these systems. A common approach to interpreting hunter-gatherer technological organization is to make general correlations between technology and mobility strategy (Binford 1979; Shott 1986). For example, Binford (1977:35) relates logistical mobility to curated technology: "[i]t should be clear that a logistic strategy in which foods are moved to consumers should be correlated with increases in curation and maintenance of tools…", where curation refers to tools that are multifunctional, manufactured in anticipation of use, maintained through multiple uses, transported, and recycled. Bamforth (1986) suggests that this formulation implies a link between foragers and expedient technologies, defined as "tools that are manufactured, used, and discarded according to the needs of the moment" (Bamforth 1986:38). Several authors (see Bamforth 1986; Odell 1996) have deconstructed the concept of curation, indicating that some of its components, such as maintenance and recycling are more closely related to raw material availability than mobility. Indeed, many studies (for example Andrefsky 1994; Beck et al. 2002; Johnson 1989) show that the availability of quality raw material in the area exploited by a group, as well as the distance to sources of quality raw material, have profound effects on technological organization. For example, Johnson's (1989) study of biface production trajectories in Mississippi demonstrates that, in general, the assemblages of sites furthest from a raw material source are comprised mainly of late-stage bifacial preforms and late-stage debitage, whereas sites nearer the source area contain higher amounts of early biface rejects and evidence of core reduction. He argues that this relationship is explained, in part, by the costs of having to transport stone tools over long distances. As Beck *et al* (2002:495) show, people "will invest greater or lesser time processing toolstone at a quarry depending on how far they intend to travel upon their departure." Clearly, technological strategies are constrained by several factors, which can be expected to vary between social contexts, and general correlations of technological strategies to mobility type are not sufficient to account for the variability in modes of technological organization. Accordingly, Kelly (1988:719) states: "[s]tone tool production and use are not responsive to logistical and residential mobility per se, but to a set of conditions concerning tool needs and raw-material availability." Thus, a theoretical framework that will account for all of the constraints acting on technological decisions within a particular context is required to gain an understanding of how prehistoric peoples sought to organize their lithic technologies.

Design theory provides a useful conceptual framework for analyzing the constraints that influence the organization of stone tool technologies (Bleed 1986; Hayden et al. 1996; Hayden 1998; Horsfall 1987; see Schiffer and Skibo 1997 for a similar approach applied to pottery). In this approach, the design process is defined as "a means of creating or adapting the forms of physical objects to meet functional needs, within the context of known materials, technology and social and economic conditions" (Horsfall 1987:333). "Functional needs" are broadly defined, ranging from practical activities, such as effectively dispatching a deer, to Hayden's (1998) conception of prestige technologies, wherein an artifact's primary task is to symbolically store social inequalities. These functional needs are conceptualized as problems for which a technological strategy is designed to solve. Horsfall (1987:333 says that "[t]he fundamental assumption of design theory is that artifacts are made in an attempt to solve an activity-related or adaptive "problem"...The problem is always embedded in a specific context, and the definition of that problem is determined by that context."

The design process is mediated through a system of conflicting constraints posed by the "problem" and the context in which it is situated (Horsfall 1987; Schiffer and Skibo 1997). These constraints influence both the production and final morphology of an artifact. Potential constraints include the anticipated functions a tool is required to fulfill; the quality of raw material required for its production and the economic costs of its procurement; the technological knowledge and skill needed to implement a design; social factors, such as mobility and tool portability; and ideological considerations, such as aesthetic value or symbolic content. All of these constraints, particularly the functional needs of an implement, can impact the choices made in the design process. Consider the following examples. Horsfall's (1987) analysis of maize grinding metates used by the contemporary Highland Maya shows that people choose to import vesicular basalt rather than use locally available raw materials for maize metates. The people using these stones prefer to absorb the added costs of procuring vesicular basalt because of its increased grinding efficiency and use-life compared to local raw materials, which, Horsfall (1987:347) suggests, "reflects the importance of [maize] grinding stones in a self-sufficient subsistence economy." In fact, grinding stones used for less crucial tasks such as clothes washing are made from lower quality raw materials procured locally even though they have shorter use-lives. Schiffer and Skibo's (1997) analysis of the technological choices involved in pottery manufacture provides another instructive example. Design traits that enhance the heat shock resistance of a pot, such as increased temper, lower firing temperature and thinner walls, also decrease its impact resistance, potentially reducing its portability. Here, the anticipated functional needs of a pot have to be weighed against the degree to which it will be transported, so that its use-life will be optimized within the context of its anticipated use. These examples indicate that the design process involves a tradeoff between conflicting constraints on tool production and that contextual details, such as the importance of maize in the Mayan subsistence economy, influence what constraints are most important in making technological decisions.

Hence, design constraints tend to be weighted differently according to their perceived importance in a specific context: designing is a balancing act, favouring some variables over others, depending on the circumstances (Nelson 1997:376). The result is an artifact that "represents a *satisfactory* response to a total set of particular constraints" (Horsfall 1987:334). Horsfall (1987) is explicit in stating that there is rarely a 'best' solution to a given problem; indeed, the 'best' solution is inestimable in most instances of human decision-making. The corollary to this point is that there can be more than one satisfactory solution to a problem within the same system of constraints, a conception of technological organization that seems more plausible than the overly precise cost-benefit optimization implied by some behavioral-ecological models (see Beck et al. 2002; Kelly 2000). Close's (1996) analysis of the prehistoric use of the Safsaf sandsheet in the eastern Sahara provides a good example of two satisfactory solutions to the same problem. During the Neolithic this area was used seasonally for the procurement of grass seeds. It contains no lithic raw material, and the nearest source is 10-15 km away. Sharp stone edges were used to harvest the grass seeds so that transporting a source of stone into the Safsaf area was a requirement of procuring this resource. One way in which this was accomplished was to carry in portable flake tools. Close (1996) terms these "isolates" because they do not refit to any of the other flakes or cores also found in Safsaf sites. These isolates tend to be highly retouched, well-made flakes or blades, which were often resharpened and recycled into small cores. Though these tools are highly portable, the evidence for maintenance and recycling indicates severe constraints in the amount of usable raw material available for grass seed harvesting. Evidence of the other strategy is comprised of many unretouched, expediently made flakes that refit to other flakes and cores at high rates. In this case, entire cores, sometimes unaltered nodules, were transported into the Safsaf area and stockpiled. Flakes were struck from these cores as needed and discarded when exhausted. While retouched edges last longer than unretouched edges, the latter tend to be better cutting tools. Thus, this strategy is characterized by an abundance of fresh cutting edges compared to the first. The associated cost, of course, is the transport of heavy cores into the area. Though Close (1996) indicates that this might have been partially alleviated by using cattle as beasts of burden, this strategy bears greater transport costs than carrying portable flake tools. Each of these strategies places relative importance on a different constraint, leading to two satisfactory technological solutions to a problem mediated by the same system of constraints.

My goal for the technological analysis of the KdVo-5 assemblage is to use a design theory approach to determine what problem(s) these tools were designed to solve. Horsfall (1987:335-336) outlines a method for applying design theory to artifact analysis in the following passage:

> In order to use design theory for interpreting material culture it is necessary to work backward from the effect (artifact) to the cause (problem)...[C]onflict between constraints should lead to some apparent diseconomy with respect to one or more human resources, which would be balanced by an increased economy with respect to some other human resource or constraint. Thus, evaluating the apparent relative economy of human resource allocation in the production and use of artifacts should lead to an understanding of the relative importance of different constraints in the design process in the culture under investigation, and, therefore, of the nature of the adaptive problem[s] being dealt with in that culture.

Here, I compare the effects of functional, technological, raw material and socioeconomic (mobility) constraints on the design of the KdVo-5 artifacts (both the formed artifacts and the artifacts made or repaired there and taken away) in order to isolate the specific problem(s) that they were designed to solve. Figure 5.1 (p.109) shows a schematic of the design process for chipped stone artifacts, adapted from Hayden (1998), which details some of the considerations important for evaluating each class of constraints.

Design Theory Analysis of the KdVo-5 Assemblage

Functional Constraints

The debitage analysis presented in the previous chapter indicates that the production of hafted bifaces from bifacial preforms and the resharpening of use-damaged dart points comprise the majority of tool manufacturing events at the KdVo-5 hunting stand. This is consistent with the discard of exhausted projectile point bases in the vicinity of the hearth feature. Several functional constraints define the size and shape of points. Ahler and Geib (2000:803) note that to effectively dispatch an animal a projectile needs "a sharp point for hide penetration and sharp distal blade edges to open a hole for passage of the binding and shaft," and Hughes (1998) points out that the weight of a projectile point is an important factor in the flight characteristics of the projectile to which it is attached (i.e. arrow or dart). The sharpness of a projectile's edges is defined by its width to thickness ratio (W:T). For example, a ratio of 3:1 limits the lateral edge angle, an approximation of edge sharpness, to 37^0, while ratios of 4:1 or 5:1 yield more acute (sharper) edge angles of 28^0 and 23^0, respectively (Ahler and Geib 2000). In general, for projectiles launched at relatively low initial velocity, a projectile point with a "thin elliptical cross section" is required for effective penetration (Hughes 1998:353), that is, a thinner, wider point will penetrate better than one more conical in shape. The problem here is that thinner points are also more susceptible to breakage, so that a balance has to be struck in the design process between penetrating efficiency and resistance to breakage (Ahler and Geib 2000). To assess the relative importance of these factors in the design of the projectile points found at KdVo-5, I compare their W:T ratios to values reported for other North American projectile point types. I approximate the W:T ratios of the projectile points manufactured and discarded at KdVo-5 by measuring the maximum width and thickness of the projectile point bases found at the site. Figure 5.2 (p.109) indicates that the W:T values for most of the bases, apart from one obvious outlier, cluster between 2.6 and 3.6 (mean of 3.1). The outlier (Figure 2.4a, p.23), exhibiting a W:T ratio of 5.3, was found in the B/C level of the KdVo-5 site, indicating that previous occupants might have designed their projectiles differently than later occupants of the site. Callahan (1979) notes a W:T range of 4.1-6.0 for the finished biface stage of his generalized bifacial reduction trajectory (Figure 4.1, p.75), and Ahler and Geib's (2000) analysis of Paleoindian forms indicates W:T ratios of 5.8:1, 4.5:1 and 3.2:1 for Folsom, Goshen and Agate Basin points, respectively. Though the KdVo-5 points found associated with the hearth feature (Figure 2.4 b-e, p.23) are not directly comparable to any of these types, in general, it appears that they are relatively thick. This is an indication that they were designed to resist breakage and be reused, which is consistent with evidence for resharpening at KdVo-5. Interestingly, the obsidian point base in the KdVo-5 assemblage exhibits the lowest W:T ratio. Nelson (1997) suggests that due to its brittleness, this material is particularly susceptible to breakage and that obsidian points intended for reuse are designed to be fairly thick, and Hughes (1998: Table VIII) demonstrates that basalt and chert have high compressive strengths compared to obsidian, a property correlated positively to impact resistance. The points manufactured at KdVo-5 were probably designed to resist breakage while maintaining sharp enough edges to serve their penetrating function.

Though their sharp edges make them potentially useful as a cutting tool, dart points are not particularly multifunctional; the risk of use damage to their edges, crucial to their penetrating function, prohibits their use as multi-use tools and using them as a core for small flake tools could easily hamper their effectiveness by altering their weight and symmetry too dramatically or damaging the cutting ability of the edges. Still, even on a dedicated hunting trip, stone implements are required for a larger suite of tasks than dispatching game, which explains why raw material for the retooling of darts was transported to KdVo-5 in the form of bifacial preforms rather than finished projectile points.

Bifaces are multifunctional tools. Kelly (1988:718) outlines one role of bifaces in mobile toolkits in the following passage:

> [T]he "bifacialness" of some tools gives them the potential to be long use-life tools. A bifacially flaked edge can have a fair amount of cutting power...yet the less acute angle of a biface's edge makes it more durable than an unretouched flake...[S]hould the tool edge break or become dulled, it can be resharpened relatively easily and continue to be useful...Additionally, the generalized form of a biface allows it to be modified into other tools, such as scrapers.

A biface can be used for a variety of functions prior to being reduced to a dart point or some other tool. Bifaces can also be used as cores for the production of small, sharp flakes, useful for a variety of tasks; in fact Kelly (1988:718) claims that "[m]ore usable flake edge can be produced from a biface than from a percussion core of similar weight because each flake from a biface has a high edge-to-weight ratio." The presence of two expedient knives on biface thinning flakes in the KdVo-5 assemblage indicates that bifaces saw limited use as cores at this site. Indeed, bifaces or expedient knives derived from bifaces were probably used for small butchering tasks at KdVo-5. Thus, "storing" dart points in bifacial preforms alleviates the strict functional constraints that limit the use of dart points as multifunctional tools. Incidentally, this also serves to limit damage to the fragile edges of unhafted dart points during transport (Ellis 1997; Hayden 1996).

Though they are multifunctional and robust, there are also constraints to the usefulness of bifaces. A large prepared core or unaltered nodule of raw material is far more flexible than a biface in the size and variety of tools that can be manufactured. A core can produce blanks for projectile point manufacture as well as large flakes that can be modified into a variety of tools. Additionally, Kuhn (1994) notes that there are functions that bifaces or flake tools cannot fulfill as effectively as transported core tools, such as heavy pounding or chopping tasks. Thus, in the case of KdVo-5, the bifacial preforms likely represent a functional compromise between cores and finished dart points.

Technological Constraints and Raw Material Constraints as they Relate to Technological Considerations

There are several technological constraints that influence the manufacture and maintenance of bifaces. While bifacial reduction allows for a high degree of control over the shape of an artifact (Kuhn 1994), it also requires a high level of knapping skill and a "relatively high-energy investment" compared to the production of simple flake tools from cores (Cowan 1999; Kelly 1988:718). Due to the increased complexity of biface manufacture, it is generally accepted that high-quality raw materials, particularly chert and obsidian, are preferable for their production (Andrefsky 1994; Beck et al. 2002; Hayden 1996). Relatively coarse-grained materials, such as basalt, are more difficult to shape in a controlled manner because flake removals require more force (Andrefsky 1994; Edwards 2000). Despite this constraint, projectile points from KdVo-5 are made on a variety of materials - including relatively coarse and fine-grained basalts, a variety of cherts and obsidian - ranging in quality from poor to excellent. Functional projectile points, of course, can be made from basalt but it requires specific knowledge of the knapping contingencies that can arise from using a poor raw material, such as dealing with multiple step fractures caused by incomplete flake termination and irregular flaws and inclusions in an objective piece (Edwards 2000). The production (and discard) of basalt dart points at KdVo-5 indicates that the knappers occupying the site had sufficient mastery over the difficulties posed by the nature of this raw material. One potential drawback is that, due to the force involved and problems that tend to arise, it takes a long time to produce a basalt biface. In fact, Edwards (2000) estimates that two to three obsidian bifaces could be manufactured in the time it takes to make a basalt biface. While this may not be an issue in the context of the 'boredom reduction' activities expected during the occupation of a hunting stand (Binford 1978a), it could have significant implications in other contexts, such as the time a knapper would have to spend making preforms at a basalt quarry. But for the purposes of this analysis, it appears that the people at KdVo-5 had the requisite skill, knowledge and time to produce functionally equivalent dart points using raw materials of variable quality.

Of course, manufacturing mistakes are inevitable even for skilled knappers but manufacturing hafted bifaces from bifacial preforms rather than earlier stage bifaces has the technological advantage of minimizing production failures; indeed, it is likely that experiential knowledge of error rates were considered in the planning of technological strategies. In a study of 177 bifaces from a site in northeastern Mississippi, Johnson (1979, 1989) finds that the most common sources of production failures in biface production were successive hinge fractures occurring in the early stages of the bifacial reduction trajectory, which formed an impediment to further bifacial thinning, and lateral snap during the middle stages. He concludes: "[E]arly and middle stage bifacial production was a source area phenomenon in order to bring the biface beyond this critical stage before moving it to a non-source area where replacement costs would be higher" (Johnson 1989:132). The observation that most of the bifacial preforms in the KdVo-5 assemblage are beyond this "critical" point of reduction might be significant in terms of minimizing production failures. Returning briefly to the discussion of functional constraints, Johnson (1989:132) continues, stating that:

> Given the possibility of failure, the optimal strategy should have been to completely finish the biface in the resource area to eliminate the likelihood of production failure altogether. Why then do late stage preforms show up at all in extreme non-source areas? Kelly (1988) suggests that beyond their utility as tools, bifaces double as cores, thereby increasing their flexibility.

This interplay of constraints demonstrates how the optimization of one design feature (minimizing production failures) is tempered in the interest of another (production of a flexible tool). An additional advantage to carrying later-stage bifaces is that they can be maintained using soft antler billets and pressure flakers instead of hammerstones. This decreases the weight of a mobile toolkit (though a hammerstone can be surprisingly small), particularly in cases like the KdVo-5 hunting stand, where hammerstones are not locally available.

The hafting of bifaces to shafts presents a minor technological constraint. Residue on one of the projectile point bases in the KdVo-5 assemblage indicates the use of a mastic for hafting. Keeley (1982) points out that a fire would be required to release a point from its haft, which is consistent with the retooling of projectiles taking place in the vicinity of a hearth at KdVo-5.

Mobility Constraints and Raw Material Constraints as they Relate to Mobility

Mobility plays a key role in the design and production of stone tools (Cowan 1999; Kelly 1988; Kuhn 1994). Transport constraints limiting the weight of technological gear that can be carried in high mobility situations require the use of durable, multifunctional and portable tools, such as bifaces, which "maximize the total amount of stone cutting edge while minimizing the amount of stone carried" (Kelly 1988:719). Yet, bifaces are also an ideal design for people occupying areas of low raw material density regardless of the degree or type of mobility they practice, and different combinations of mobility and raw material availability can lead to different design imperatives; thus, before interpreting the mobility context of the KdVo-5 site, it is important to consider the role of raw material distribution in tool design.

Raw material distribution is an important consideration in technological planning and both the abundance and quality of raw materials within the regional scope of a subsistence settlement system can affect tool design (Andrefsky 1994, 1995, 1998). For example, Andrefsky's (1995, 1998) analysis of raw material use in the lower Snake River area indicates that bifaces and unifaces were made on high-quality cherts and basalts imported into the site while informal cobble and flake tools were made from locally abundant but coarse-grained basalt and quartzite. In regions characterized by highly abundant, high quality raw materials both informal (i.e. expedient flake tools) and formal (i.e. bifaces) tools are manufactured on local materials and assemblages of both long-term sedentary camps and short-term mobile camps tend to contain more informal than formal tools, including informal cores (Andrefsky 1994). In contrast, formal tools, such as bifaces and well-made unifacial tools, made on imported materials, dominate assemblages from regions with locally available poor-quality materials but very little high-quality materials; interestingly, these tools are usually transported to sites in near-finished or finished form while tools made of poor-quality local materials are manufactured on-site (Andrefsky 1994, 1995).

This pattern relates to the cost of transporting lithic materials from distant sites. As discussed above, studies by Beck et al. (2002) and Johnson (1989) demonstrate that, in areas characterized by a limited distribution of high-quality raw material, the further a site is from a raw material source, the further the bifacial reduction trajectory will proceed at the quarry site. Indeed, Johnson's (1989) data show that sites nearest the quarry often contain evidence of core reduction and early stage biface production while assemblages furthest from the source are comprised mainly of broken bifacial preforms and late stage debitage. The goal of staging biface manufacture in this way is to maximize the utility of the transported stone while minimizing the weight carried over long distances.

Is the structure of the KdVo-5 assemblage responsive to differences in the abundance and quality of raw materials in the local area? Detailed provenance data for different raw materials in the Scottie Creek area is absent. Some cherts and coarse basalts exist in local streambeds but their abundance and distribution is unknown. There are also no data concerning the average dimensions of raw material nodules in these streambed sources, which Wilhelmsen (2001) indicates could affect the time it would take to find nodules large enough for tool manufacture. Obsidian from known sources in the southern Yukon and northern British Columbia, both hundreds of kilometers from the Scottie Creek Valley, is found in southern Yukon archaeological sites but these studies also indicate the presence of several unknown sources (Hefner 2001; Thomas 2003). Appendix A shows the results of X-Ray fluorescence analysis of obsidian flakes from the KdVo-5 site. These data show that the brown, green and black obsidian subsets originated from the same source (Source 1) and that the gray subset came from two separate sources distinct from Source 1 (Sources 2 and 3). Sources 2 and 3 can be conflated into one source, as the small sample sizes of the gray flakes submitted likely resulted in some error in the source determinations. This is consistent with the technological uniformity of the gray flakes and their tight clustering in the northwest quadrant of Unit C. Unfortunately, none of the sources identified by X-Ray fluorescence are known, though obsidian from Source1 has also been found at a site approximately 150 km west of KdVo-5. Despite these uncertainties, for the purpose of my analysis I make the assumption that, on a relative scale, the obsidian comes from more distant locations than the coarse-grained basalt and it is likely more localized to a discrete source.

If this is the case, it is interesting that both of these materials enter the site at a similar reduction stage (bifacial preform), in roughly equal quantities, and are used to manufacture the same implement (projectile points). If the technological strategy at KdVo-5 was directly responsive to raw material distribution we might expect basalt and obsidian to appear in the site at different stages in the bifacial reduction trajectory relative to the distance of the site from the sources of these materials. Instead, the lack of differentiation in reduction stage indicates that all of the preforms, regardless of raw material, originated from the same point on the landscape. This point on the landscape, perhaps a residential base, takes the place of the term 'quarry' in the putative positive correlation between extent of biface reduction at a quarry and distance to travel from the quarry (Beck et al. 2002; Johnson 1989), and thus, the distance traveled from this point is the important factor in the technological strategy used at KdVo-5. I make the assumption that problems posed by raw material distribution were directly addressed by procurement strategies implemented at this other place and that the raw material composition of the KdVo-5 assemblage is a consequence of the relative abundance of raw materials accumulated at this staging point. Indeed, the reason the entire KdVo-5 assemblage was not manufactured using obsidian might be that this material was only accessed at certain times in the seasonal round or obtained via trade, or was otherwise not abundantly available at all times. This idea of a specific staging point, characterized by a variable inventory of raw materials, explains the use of raw materials of disparate quality for the same purpose at the KdVo-5 site, and also explains the presence of obsidian from two distinct sources. Hence, the form in which stone was transported to KdVo-5 relates to transport costs associated with the function of the site, and the use of lightweight, versatile bifacial preforms, instead of cores or flake blanks, or some other earlier stage in the biface reduction trajectory, indicates that the KdVo-5 site assemblage was designed to minimize weight, thereby enhancing mobility. This is consistent with the evidence indicating that the projectile points were designed to resist breakage: the potential to reuse/rejuvenate a projectile decreases the number of replacements that have to be carried.

Discussion: Balancing Design Constraints

Does the design of the artifacts in the KdVo-5 assemblage indicate any "apparent diseconomy with respect to one or more human resources, which would be balanced by an increased economy with respect to some other human resource or constraint" (Horsfall 1986:336)? I think that the foremost balance struck in this case is between the functional and mobility constraints; more specifically, an 'apparent diseconomy' imposed by the functional constraints on the use of bifacial preforms is balanced by an 'increased economy' in the transportability of these tools. Beck et al. (2000) demonstrate that the difference in transport costs between finished bifaces and late-stage bifaces, such as those that entered the KdVo-5 site, is minimal. The design of the projectile points to resist breakage and the decreased risk of production failure in reducing bifacial preforms to finished bifaces are consistent with a focus on limiting the amount of stone to be carried. In contrast, carrying bifacial preforms, though they are far more multifunctional than projectile points, limits the amount of raw material carried and thus the flexibility in tool manufacture afforded by a core or unaltered nodule of raw material. Thus, I propose that mobility was the most important consideration in the technological strategy employed in the context of the expedition in which the KdVo-5 hunting stand played a part. The use of a hunting stand implies that significant 'down time' was available to maintain hunting weapons, so that the time constraints imposed by manufacturing projectile points on course-grained basalt are not relevant in this case.

At first glance, this argument seems counter-intuitive to the discussion of raw material distribution presented above. If the occupants of KdVo-5 possessed the time and knowledge to manufacture projectile points on a locally available material (coarse-grained basalt), why did they take great pains to carry such a self-sufficient, mobile toolkit, which was so conservative in the amount of toolstone that could be carried? Kelly (1988:720) makes a useful distinction between actual and anticipated raw material scarcity that helps to explain this apparent inconsistency:

> Bifaces may also be used as cores [or as multifunctional tools]...most heavily during long logistical forays, where there is...a need to minimize the gear carried, and in which either the presence of local raw material cannot be anticipated and/or the destination(s) or tasks of the logistical party are not known entirely...The primary difference between this case and the use of [bifacial] cores in residential camps is that the latter is conducted under conditions of actual or supposed raw material scarcity while the former is conducted where raw material scarcity is one of the possible foray conditions.

This is particularly relevant to the case of the Scottie Creek Valley. The majority of this landscape was unglaciated during the Pleistocene epoch and consequently, it is largely cobble free. Streambed deposits of raw material are thus limited to its extreme southern fringe, and expeditions into the valley itself would experience situational scarcity of raw materials as a foray condition.

Conclusion

The conclusion that the tools carried to the KdVo-5 hunting stand were designed to be part of a mobile toolkit specialized for hunting supports the claim, based on Binford's (1980) model of hunter-gatherer subsistence-settlement systems, that this site was occupied by 3 to 4 individuals in the context of a logistical foray. This provides a context for my analysis of social relationships at the KdVo-5 site presented in the following chapter.

The design theory approach used in this chapter is useful to the extent that it considers multiple constraints on the design of tools and technological strategies. In this way, it avoids overly generalized statements such as 'foragers use expedient tools and collectors use curated tools' and shows how the balancing of constraints can lead to multiple satisfactory technical solutions, as in the Safsaf case study presented above. 'Multiple satisfactory solutions' implies a choice of technical strategies. I have shown that some of these choices relate to functional considerations; for example, the occupants of the KdVo-5 site designed their projectile points to resist breakage in the interest in limiting the amount of stone they had to carry. But do all technical choices relate to functional, raw material and mobility constraints? My analysis in this chapter has neglected a key point of artifact variability in the KdVo-5 hearth-associated assemblage: the base morphologies of the projectile point bases (Figure 2.4b-e, p.23). In the following chapter, I argue that a new term has to be added to the design theory approach to account for this variability: technologies are also shaped by socially mediated choices.

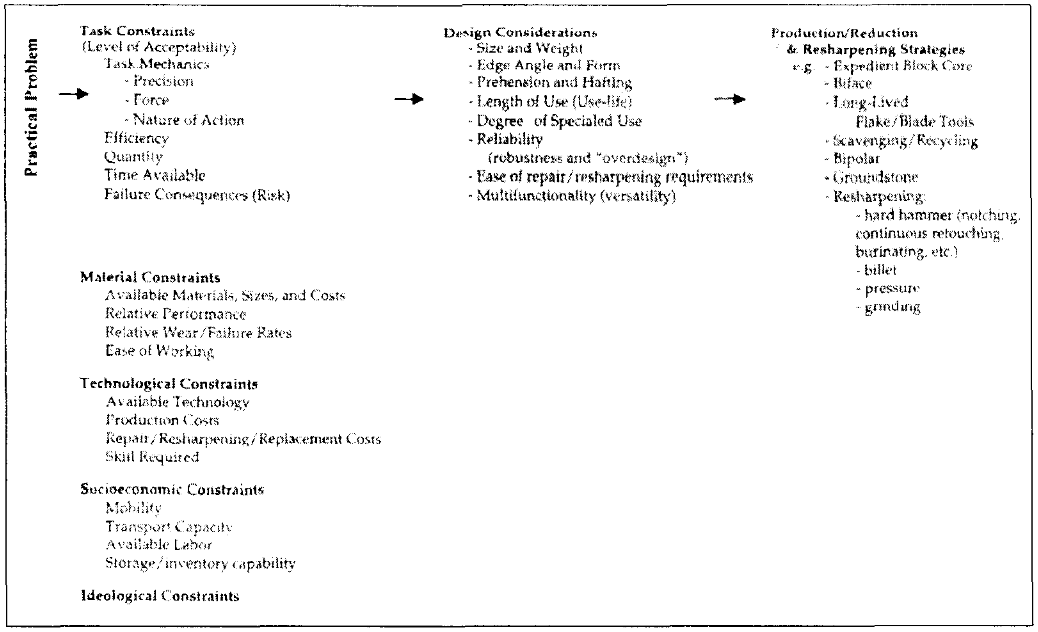
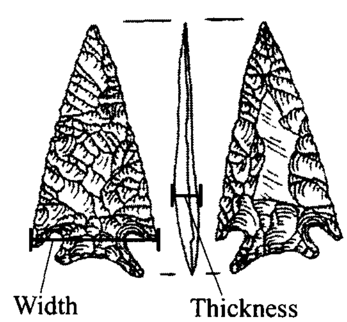


Figure 5.1. Schematic of the design process for chipped stone artifacts (adapted from Hayden 1998:5).

a)



b)

Projectile Fragment	Width (mm)	Thickness (mm)	Width:Thickness
Figure 2.4a	28.5	5.4	5.3
Figure 2.4b	21.6	7.0	3.1
Figure 2.4c	22.5	7.5	3
Figure 2.4d	25.3	7.0	3.6
Figure 2.4e	22.7	8.7	2.6

Figure 5.2. a) Schematic of maximum width and thickness measurements for projectile points (adapted from Andrefsky1998:22); b) Table showing width:thickness ratios for the projectile point fragments in the KdVo-5 assemblage.

Chapter Six: Technology as a Total Social Fact

Introduction

My goal for this chapter is to integrate the spatial and technological analyses of the KdVo-5 site and assemblage into an account of the social processes that unfolded as the occupants of this site engaged in the everyday, mundane activities of watching for game and fixing their tools. My premise for the analysis of past social processes at KdVo-5 is that it was a place where conversations took place and social information was exchanged. Indeed, Gamble (1999) proposes that Binford's (1979) hearth model should be viewed as more than a descriptive tool for understanding spatial patterning; it also indicates the presence of several social actors engaged in face-to-face interaction. Yet, even if this is the case, how can such micro-scale social exchanges be reconstructed from a static archaeological deposit formed by mundane technological acts? Recent approaches to understanding material culture propose that technological acts are a "medium through which social relationships, power structures, worldviews, and social production and reproduction are expressed and defined" (Dietler and Herbich 1998; Dobres 1995, 2000; Dobres and Hoffman 1994:212). Thus, in this chapter I outline a theory of technological practice that provides a useful framework for seeking out social process in spatial and technological data.

Technology as a Total Social Fact

In his essay *Fetishised Objects and Humanized Nature: Towards an Anthropology of Technology*, Pffafenberger (1988) argues that the notion of technology has been conceptualized in Western discourse in two principal ways: as technological determinism and technological somnambulism. Downplaying the imposition of technologies on social structures and human institutions, the somnambulistic view regards the relationship between humans and technology as obvious and transparent. Humans make and use technology; technology does not 'make' and 'use' humans, that is, it does not shape social relationships in any significant way. In contrast, the deterministic view implies that social and cultural forms are shaped by technology and that technological innovations dictate appropriate changes in these institutions, such that "when the plough replaces the hoe…the sexual division of labour alters in predictable ways (Pffafenberger 1988:243), or as Sassaman (2000:160) remarks, "change has a life of its own, with rationality, pragmatics and practicality being the agent, not the people." Both of these notions of technology, argues Pffafenberger (1988:241-242):

> gravely understate or disguise the social relations of technology. In the somnambulistic view, 'making' concerns only engineers and 'doing' concerns only users. Hidden from view is the entire network of social and political relations that are tied to making and influenced by doing. In the technological determinist view…technology [is] an independent variable to which the forms of social relations and politics stand as dependant variables…[T]echnology, under the sway of Western culture, is seen as a disembodied entity, emptied of social relations, and composed almost entirely of tools and products. It stands before us, in other words, in what Marx would call *fetishised* form: *what is in reality produced by relations among people appears before us in a fantastic form as relations among things* (emphasis in original).

Archaeology has not escaped 'the sway of Western culture' in its conception of technology. Particularly in archaeologies that define culture as 'man's extrasomatic means of adaptation' (Binford 1962), technological determinism is transmitted back into the past such that technology, already foregounded by the archaeological record, which is 'composed almost entirely of tools and products,' acts as the 'independent variable to which the forms of social relations and politics stand as dependent variables' (Dobres

2000). Inspired by functional ecological and cultural materialist causalities, these archaeologies "envisage social forms as mere epiphenomena of technologies and environments, either by direct causation or by some economic rationality which makes institutions the product of social optimization" (Friedman 1974:457). The diverse social organizations that humans have developed to contend with the adaptive problems posed by their environments are not given a role in shaping social formations. Thus, technology is viewed as the primary means by which a social formation reproduces itself, and technological innovation alone is the mechanism by which past societies have managed to adapt to ever-changing environments (Pffafenberger 1992). These technologies are shaped according to the standards of functional efficiency and economic rationality, the cornerstones of successful ecological adaptation. The social system, viewed as a consequence of this techno-ecological adaptation rather than an autonomous system, plays no recursive role in shaping technology.

Responding to the tacit acceptance of these 'fetishised' notions of technology in Western discourse, Pffafenberger (1988) proposes that technology is a *total social fact*, a concept he accredits to Mauss (1967), in which "any behavior that is technological is also, and at the same time, political, social and symbolic" (Pffafenberger 1988:244). Defined in this way, technological practice is inseparable from the social relations involved in its production and use, the political goals of social actors, worldviews, cultural values of the right and wrong ways to do things, practical knowledge gained through engagement with the material world, and the symbolic meanings attached to materials and tools as social objects (Dietler and Herbich 1998; Dobres 1995, 2000; Dobres and Hoffman 1994; Wobst 1999). For example, in his study of lithic raw material use by Aborigine adze makers, Gould (1980) finds that white chert is locally available and abundant, easier to work and holds its edge in woodworking activities better than exotic cherts, but that, despite these functional and economic advantages, a significant portion of adzes are made from inferior exotic cherts. He also finds that exotic stone comes from places associated with totemic mythical characters and that a man possessing an exotic adze knows the location (most often distant) of the raw material used in its manufacture; in fact he notes that "[t]he patrilineal totemic affiliation of the man being interviewed was always the same as that of the site from which the particular piece of isotropic stone had come" (Gould 1980:154). In this case, the cultural value placed on patrilineal descent - its rights, obligations and association to mythical and ancestral places - is embedded in technological practice, that is, cultural reason and social values mediate the technological choices made in the manufacture of adzes (Dobres 2000, Gould 1980). Of course, artifact physics, raw material properties and functional requirements play a key role in shaping technological systems: an adze has to be useful for wood-working just as a dart point has to pierce the hide of an animal. The point is that these problems are not solved according to a universal logic based on functional optimality and economic rationality, somehow distinct from the culturally constructed world; rather, they are embedded in universes of cultural logic, which, as the ethnographic record attests, can be infinitely diverse. Indeed, Gould (1980:156) concludes that "[i]n the presence of exotic stones for adze-making at Puntutjarpa, we have a "perturbation" that departs from any expectations or predictions based upon strictly utilitarian principles of mechanical efficiency or economy of effort."

So far my design analysis of the KdVo-5 artifacts has focused only on functional, technological and mobility constraints without any consideration of the social context in which these technological activities were performed. In so doing, I have constructed the inhabitants of the KdVo-5 hunting stand as *rational* actors, as "acultural adaptive engineers" (Dietler and Herbich 1998:246), not as *social* actors. As Dornan (2002:318) comments,

> Rational actor approaches assume a universal logic behind individual motives, neglecting the unique and creative aspects of human action often based on nonrational or situationally rational practices…[T]o leave out people's histories, habits, customs and feelings is insufficient for understanding human behavior and social processes.

This approach fetishises technology by affording it a universal and rational logic that operates independently of the cultural world in which it is situated. A central tenet of design theory is that actors find *satisfactory* solutions to technological problems. Satisfactory is equivalent to functional optimality and economic rationality only in Western culture; people embodying other cultural conceptions of the world foreground different values in making technical choices. If we accept that technological acts are a "medium through which social relationships, power structures, worldviews, and social production and reproduction are expressed and defined" (Dobres and Hoffman 1994:212), then to understand the social processes that unfolded at the KdVo-5 hunting stand, the technological practices undertaken there have to be reconstituted as *total social fact*, as cultural, social and political, *as well as* practical. In the following section I outline an approach to understanding technological practice that will assist in integrating these aspects into the design analysis presented in the previous chapter.

A Theory of Technological Practice

The foregoing discussion indicates that a useful theory of the conjunction between technology and culture must situate technological practice between the fetishised extremes of somnambulism and determinism; that is, technological processes, including innovation and change, have to be conceptualized as total social facts, hence making it clear that the implementation of a technology can bring about changes in patterns of human activity and relationships but that the process of implementation is in itself mediated by social and political structures. To this end, I outline a recent theory of technological practice (Dietler and Herbich 1998; Dobres 1995, 2000; Dobres and Hoffman 1994), which, combining practice-oriented social theory with the concept of *chaine operatoire*, adequately integrates cultural and technological processes.

Central to this theory is Bourdieu's (1977, 1990) concept of *habitus*. For Bourdieu, the relationship between the daily practice of social actors and the objective social structures and material conditions in which those actors live is best understood as a dialectic. Social structures come into being through the everyday practice of actors engaged in material production yet the same social structures *generate* the practices from which they are produced and thus tend to reproduce themselves. Mediating this dialectic is the *habitus*,

> systems of durable, transposable dispositions, structured structures predisposed to function as structuring structures, that is, as principles of the generation and structuring of practices and representations which can be objectively "regulated" and "regular" without in any way being the product of obedience to rules, objectively adapted to their goals without presupposing a conscious aiming at ends or an express mastery of the operations necessary to attain them (Bourdieu 1977:78).

The *habitus* is the mechanism whereby the structures conditioning social life are internalized, made natural and reproduced in practice. The social and material conditions structuring a given social formation are historically antecedent to individual actors, and thus, inculcated by early childhood experiences of the social world, these objective structures are internalized as durable dispositions that motivate practices, aspirations, perceptions, goals and tastes compatible with the objective conditions of the social formation (Bourdieu 1977; Thompson 1994). In this way, "history [is] turned into nature" (Bourdieu 1977:78) such that practice is "adapted to goals without presupposing a conscious aiming at ends." Indeed, historically constituted social structures are naturalized in the *habitus* to the point that dispositions are durably embodied in the ways actors stand, walk, speak and move through the social landscape (Bourdieu 1977; Fisher and Loren 2003; Gosden 1994). Yet, the *habitus* is not a system of rules or roles imposed by objective structures; rather, it is

> the durably installed generative principle of regulated improvisations [that] produces practices which tend to reproduce the regularities immanent in the objective conditions of production of their generative principle, while adjusting to the demands inscribed as objective potentialities in the situation, as defined by the cognitive and motivating structures making up the habitus...[P]ractices can be accounted for only by relating the objective *structure* defining the social conditions of the production of the habitus which engendered them to the conditions in which this habitus is operating, that is, to the *conjuncture* which, short of a radical transformation, represents a particular state of this structure. (Bourdieu 1977:78).

The *habitus* is the principle enabling individuals to generate strategies to cope with the 'potentialities' of changing social and material situations, which includes responding to the strategies of other social actors. These strategies are 'regulated' in the sense that the cultural knowledge and logic involved in the perception of these potentialities, and the practices generated to respond to them, are themselves the product of a *habitus* structured by structures similar, short of a radical transformation, to those structuring a given social situation. In this way, culturally acceptable or 'reasonable' practices are limited in their diversity by the generative principle of their production, that is, social actors are inclined, or predisposed, to pursue certain interests using strategies that past experiences have shown to be effective (Thompson 1994). As Fisher and Loren (2003:228) remark, "new experiences are structured in accordance with the structure of past experiences," and this explains why social structures, always in production, tend to be reproduced by the daily practices of social actors.

This 'improvisation within limits' prescribed by the *habitus* has important implications for understanding how cultural reason mediates technological practice:

> Techniques, as with other patterns of social activity, are formed through the *habitus*. This involves the development through practice of 'tendencies' and cultural perceptions of the limits of the possible patterns of choice at all stages of *chaines operatoires*. These dispositions of choice and perceptions of the possible in the technical domain are interwoven with similarly formed patterns of choice and perceptions in the domain of social relations and cultural categories in ways that evoke and reinforce each other (Dietler and Herbich 1998:246).

Consider the following example. In their study of Luo potters in western Kenya, Dietler and Herbich (1998) find that several potter communities associated with a certain market use ground sherd temper, obtained by smashing up old pots, for preparing potting paste. The procurement of temper comprises a major expenditure for these potters, as they have to trade one new pot for two old pots, which has prompted some potters to experiment with other tempering agents. A local natural temper that is compatible with local clays, relatively abundant, and is known by local artisans to work well for potters in other areas is available in the region but the potters of this market have focused their search for a new temper source on other fired artificial products such as bricks and blanks of clay fired alongside their pots. Dietler and Herbich (1998:253) suggest that this practice is due to a "technical disposition that guides practice." The 'improvisation within limits' that compelled potters to choose artificial tempers was shaped by a cultural perception of the 'right way to do things' inculcated in the *habitus*. Technical choices, such as the choice between natural and artificial tempers, occur at most stages of a production sequence (*chaine operatoire*), from material procurement, manufacture and use to the subsequent refurbishment and discard of a tool. In the bounds of minimal functional requirements and raw material availability, these choices are mediated by cultural logic and can appear to be quite arbitrary in respect to "what the natural environment or a strictly technical (material) logic would lead us to expect" (Dietler and Herbich 1998; Dobres 2000; Dobres and Hoffman 1994; Lemonnier 1986:171, 1993; Stark 1999; Wobst 1999). Lemonnier's (1986, 1989) study of the techniques of twelve Anga groups in Papua New Guinea demonstrates the apparent 'arbitrariness' of many technical choices made by these people. His study of the distribution of barbed and unbarbed arrows in the Anga region, for example, shows that an area comprised of the contiguous territories of six groups use barbed arrows while the other six groups use morphologically similar, but unbarbed, arrows. Yet, Lemonnier (1986) notes that the members of the groups using unbarbed arrows have had opportunity on many occasions to observe the undeniable functional superiority of barbed projectiles in terms of the enhanced fatality of wounds produced by the barbs. He also points out that this difference cannot be explained by reference to the type of game hunted or the woods in which hunting occurs. Seemingly unmotivated by reasons of functional efficiency or economic rationality, the examples of Luo potting temper and Anga arrows indicate that technical choices made at all stages of an operational sequence are mediated by the cultural dispositions inscribed in the *habitus*. Technological practice, then, can be viewed as 'improvisation within limits', with the term 'limits' referring to cultural perceptions of the possible patterns of choice at all stages of a *chaine operatoire*.

Viewed in terms of the structure-practice dialectic, mediated by the *habitus*, this statement indicates that "everyday sequential acts are bound by and at the same time give expression to collective attitudes about the right and wrong way to do things" (Dobres 2000). Cultural perceptions of the right and wrong way to do things come into being through the everyday practice of material production, which, in turn, is structured by the cultural tradition inculcated in the *habitus*. This dialectic can be extended to the social and political content of technological practice. Indeed, if technological practice is viewed as a total social fact, that is, as inherently technical, ideological, social and political, then the statement made at the outset of this chapter, that "technological acts…are a fundamental medium through which social relationships, power structures, worldviews, and social production and reproduction are expressed and defined" (Dobres and Hoffman 1994:212), becomes clear. For example, the selection of raw material for adze manufacture by Western Aborigines is influenced by the cultural importance of patrilineal descent. At the same time, the embodied use of this material by a man identifies his social relationship with a particular totemic character, and thus his lineage, and affirms the importance of the institution of patrilineal descent to the social formation in question. In his study of stone axe manufacture and use by the Yir Yoront of Australia, Sharp (1952, and cited in Dobres 2000) shows that technological practice involving stone axes was intimately associated with the social construction of gender, age and kinship. Stone axes were manufactured exclusively by adult men, usually from imported stone axe heads and local hafting materials, and were considered the property of the manufacturer. While women and children were able to borrow and use a man's axe, and did regularly, Sharp (1952:19) notes: "while a man might speak of 'my axe', a woman or child could not." Men typically took their axes when traveling away from camp, which necessitated the borrowing of axes from other men by their wives and children. An unmarried woman or a woman with an absent husband would first try to borrow an axe from her older brother or father, and only in rare situations would borrow an axe from other male kin. Similarly, in the absence of their fathers, children would attempt to borrow an axe from their older brother. This case illustrates how embodied technological practice can play a part in creating, maintaining, and reproducing social structures and hierarchies based on gender and age, and, if we imagine a child experiencing or observing these practices, how these structures can be inculcated in an individual's *habitus* at an early age. In the course of everyday activities, a child would observe that only men manufacture stone axes but that women use them for procuring firewood, and they would learn that deference is required in borrowing an axe from its male owner and from whom it is appropriate to borrow an axe; in so doing, they would learn their position in the gender, age and kinship structures structuring their social world. In this way, technological practice is intertwined with the processes of social production and reproduction.

Technology can also be implicated in the 'regulated strategies' individuals or groups use to manipulate or contest social hierarchies, conditions and contradictions. As described above, these strategies are 'regulated' in the sense that culturally acceptable practices, that is, practices that will be understood in a given cultural context, are limited in their diversity by the generative principle of their production, the shared *habitus* of the social actors involved. In her study of domestic pottery production and use in a small village in the Ecuadorian Amazon, Bowser (2000) finds that women express their political alliances, and effectively decode the cues of other women's alliances, in the painted decoration of domestic pottery. The village of Conambo consists of approximately 200 Achuar and Quicha people living in 25 households; the village is divided, roughly equally, into Achuar-allied and Quicha-allied districts, which correspond to the 'official' political factions comprising the village. In reality, political alliances in Conambo are unstable and constantly shifting, and like in many small-scale, egalitarian communities, political alliances are manipulated and negotiated in the course of daily activities in the domestic context. Pottery, particularly bowls used to serve chicha, a lightly fermented beer comprising a large part of the Conambo diet, plays an important part in these processes. For example, in the context of daily visits in which people discuss political issues and attempt to build consensus on appropriate political action:

> Serving and drinking chicha is required by social etiquette, is highly stylized, and constitutes a form of ritual that is effective in communicating the visitor's current political standing in the household and community. Based on the order, timing, and *type of bowl* (calabash or pottery) with which she chooses to serve chicha, a woman signals the visitor's social distance, status, and at times, political disfavour during a controversy, typically in full view of other guests and attendant family members. Even a subtle delay in offering chicha to a guest suggests an unresolved conflict and precarious political relationships (Bowser 2000:229, emphasis added).

The painted decoration of chicha bowls is particularly efficacious in expressing political alliances, and is often used by women to communicate shifting alliances or discontent with their social situation:

> A young woman, living patrilocally in this typically matrilocal society, desperate to leave a bad marriage and put an end to ill relations with her in-laws, paints noticeably different pottery. A respected Achuar woman, who realigned herself politically with the Quicha after her husband was killed by members of their Achuar coalition some 20 years ago, uses a symmetry pattern, design elements, and technique of surface finish that distinguish her style from both Quicha and Achuar (Bowser 2000:228).

In this case study, pottery decoration and use, like the manufacture and use of Yir Yoront stone axes, constructs gender relations in practice – only women make pottery in Conambo – but also plays an important role in the daily construction and dissolution of political relationships. Everyday technological practice, at least in the realm of chicha bowls, is a total social fact mediated by the *habitus*, which is the generative principle of the social and political interests individuals tend to pursue, just as it is the generative principle of the cultural perception of the limits of decoration choices that will be efficacious for their intended purpose in a given social context.

The theory of technological practice presented in this section has several implications for understanding prehistoric technology. Technological practice is embedded in schemes of cultural logic, inscribed in the *habitus*, which guide the perception of culturally reasonable technical choices at all stages of the *chaine operatoire*, a process characterized here as 'improvisation within limits.' This flexibility implies that, as Dietler and Herbich (1998:248) remark: "Practice may alter gradually without marked consequence as long as there continues to be a close fit between the objective conditions and the subjective organizational system of dispositions." In the universe of techniques, there is an immense variety of 'ways of doing things' and artifacts that can be used to accomplish the same material goal (Lemonnier 1986). Technical choices and the limits of their change in a given social formation are largely the product of cultural tradition. This is a very different conception of change than the process of need-driven technological evolution proposed by the New Archaeology, whereby technological innovations alone ensure the survival and reproduction of human groups in ever-changing ecological and social environments, and utilitarian technologies are mediated by a 'technical logic' distinct from any cultural context. People do make technical choices that enhance the functional efficiency of their tools but this is not the only trajectory of choices that shape technologies, and not the only choices that facilitate the production and reproduction of a social formation. Thus, it is incorrect to state that technology acts as the 'independent variable' in the development of social formations; rather, it is intertwined with culturally constructed knowledge of the world and historically constituted social and political arrangements: it is a total social fact. Technological innovation is also a 'total' phenomenon. Though beyond the scope of this discussion (see Lemonnier 1993), innovations with the potential to enhance the economic efficiency or productive capacity of a social formation, which could precipitate widespread changes in social structures, are not necessarily accepted blindly; instead, decisions to accept or reject innovations, or reshape them to fit into existing social institutions, are mediated by cultural reason in concert with the social and political goals of the social actors involved in these processes.

This approach to understanding prehistoric technology also has important implications for the way 'style' is conceptualized in archaeology (see Dietler and

Herbich 1998; Hegmon 1992, 1998 for reviews of this concept), particularly approaches that dichotomize 'function' and 'style' (Wobst 1977). This perspective indicates that the style of an artifact, the traits of an artifact related to cultural meaning, is secondary to its utilitarian function. Style is an entity added to the surface of an artifact that might play some role in signaling group identity, but the distinct functional component of an implement is what ensures group survival. This is true in a general sense: a technician has to manufacture an implement that will perform satisfactorily at its intended task; however, this definition of style obscures the fact, developed here, that technical choices at all stages of a *chaine operatoire* are culturally meaningful and can be used as resources in the signification of social distinctions (Dietler and Herbich 1998; Dobres 2000; Dobres and Hoffman 1994; Lemonnier 1986, 1993; Stark 1999; Wobst 1999). As Wobst (1999:123) says: "Production that remains invisible in use takes place in the social field and thus potentially talks, potentially is listened to, and potentially interferes with humans."

This material interference proposed by Wobst (1999) is manifested at the micro-scale of human interactions (Dobres 1995, 2000; Dobres and Hoffman 1994). Embodied by social actors, technological practice unfolds in the context of everyday face-to-face social interactions and plays a part in creating, maintaining, contesting and reproducing social structures. Viewed from this perspective, intrasite variability in technical choices, at all stages of the *chaine(s) operatoire(s)* present at a site, comprises the data for reconstructing these micro-scale social processes in the archaeological record (Dobres 2000). In the remainder of this chapter, I attempt to explain variability in technological practice at the KdVo-5 site in terms of the theory of technological practice outlined in this section.

Technological Practice at the KdVo-5 Site

Is there any significant intrasite variability in the technological acts that unfolded in the vicinity of the KdVo-5 hearth? Most of the debitage in the KdVo-5 assemblage is accounted for by the manufacture of projectile points from bifacial preforms and the refurbishment of projectile points. Thus, the primary *chaines operatoires* represented in the KdVo-5 assemblage include: i) the unhafting and discard of exhausted projectile point fragments and their replacement by points manufactured from bifacial preforms and; ii) the refurbishment of broken projectile points, which may or may not have been accomplished with the point still in its haft. In the absence of detailed refitting data on all of the manufacture and refurbishment steps, it is difficult to track variability in the technical choices made in the production/refurbishment of artifacts that were subsequently taken away from the site; however, I propose that the projectile point fragments discarded in the vicinity of the hearth likely bear traces of the technical choices made in the manufacture of their replacements. There are several functional constraints that limit the diversity of projectile points in terms of their weight, size and shape. They have to be effective at penetrating a hide, which presupposes a sharp tip and sharp leading edges; they have to be symmetrically shaped and weighted to conform to the aerodynamic properties of their haft and delivery system; and in situations of real or anticipated constraints on raw material availability, they might be designed to resist breakage. Yet, despite these constraints, the archaeological record of North America attests to a wide diversity of technical choices in projectile point design. For example, the width to thickness ratio can be varied to enhance resistance to breakage (low W:T) or leading edge sharpness (high W:T). In fact, as noted in Chapter Five, most of the projectile point fragments in the KdVo-5 assemblage appear to have been designed to resist breakage, as indicated by their relatively low weight to thickness ratios. Perhaps the greatest morphological variability exists in the bases of projectile points, that is, the elements that interface with a haft. Indeed, the most striking intrasite variability in the projectile points found in the vicinity of the KdVo-5 hearth is their base morphologies. Of the four fragments found associated with the hearth feature in the B2 level, two are corner-notched, one is side-notched and one is lanceolate (Figure 2.4b-e, p.23). These point fragments appear to be technologically similar in terms of their size and width to thickness ratios. In addition, they all exhibit random flaking patterns, as opposed to other common patterns such as collateral, oblique or subradial (illustrated in Figure 6.1, p.134). Again, I suggest that the base types of the discarded points were most likely replicated in the manufacture of their immediate successors. Replication experiments conducted by Flenniken (1985) indicate that notches are pressure-flaked close to the end of the bifacial reduction trajectory from a bifacial preform to a finished point, and that reduction techniques up to the point of notching are similar for corner-notched and side-notched forms; thus, this activity probably occurred at KdVo-5. Unfortunately, I have been unable to locate any unequivocal notching flakes (see Titmus 1985) in the KdVo-5 debitage assemblage, a problem I attribute to the use of ¼ inch screens, which tends to limit the recovery of small pressure flakes.

Can this diversity in base morphology be explained in terms of functional, technological or raw material constraints, or is this technical choice 'arbitrary' in respect to expectations based on functional requirements and economic rationality? In her analysis of over six hundred dart points from the Steens Mountain site in southeastern Oregon, Beck (1995) follows several lines of evidence in seeking an explanation for changes in the relative frequencies over time of corner-notched and side-notched dart points in the Great Basin. Both hafting techniques appear concurrently in the Great Basin at approximately 8,000 B.P. but, in general, the frequency of corner-notched points relative to side-notched points tends to increase markedly through time until both types are widely replaced by arrow points at approximately 1,000 B.P. (Beck 1995). Beck (1995:230) proposes that the explanation for this trend might be functional: "these two hafting techniques are alternatives that may not have been equally effective. One of these, corner-notching, may have had a slight advantage over the other, side-notching, and thus corner-notching came to dominate over time." Evaluating this hypothesis using her test assemblage, Beck demonstrates that "one hafting technique does not require a more durable material than the other" (Beck 1995:233), that is, there are no differences in the types of raw materials used for corner-notched versus side-notched points, and that the sharpness of the tip and edges of these different hafting techniques, and other variables relating to balance and symmetry, are relatively constant. Citing replication experiments by Flenniken (1985) she also indicates that there are no significant differences in manufacturing time or the risk of manufacturing failure between corner-notched and side-notched points. Instead, Beck (1985) finds that the main functional advantage of corner-notched over side-notched points is increased impact resistance and use-life. Specifically, her analysis of the Steens Mountain dart point assemblage indicates that it takes fewer breaks to exhaust the use-life of a side-notched point than a corner-notched point. Of the nonresharpenable points in the assemblage 30.3% of side-notched points were rendered inoperable after only one use compared to 19.1% of corner-notched points; 20.3% of corner-notched points were resharpened four times before they were discarded compared to 8.1% of side-notched points. Accordingly, the number of resharpenable versus nonresharpenable points in the assemblage indicate that 36.7% of the corner-notched points are reusable compared to 17.5% of side-notched points, and 63.5% of corner-notched points versus 18% of side-notched points exhibit resharpening. Beck (1995) attributes these differences, in part, to the greater tendency of side-notched points to break at the notch (45%) compared to corner-notched points (20.6%), which tend to break on the blade, barbs and stem. Notches create a weak point on the blade of a projectile point (Beck 1995; Flenniken and Wilke 1986; Howard 1995). Beck (1995:232) indicates that "if these notches are located more centrally in the blade, rather than at the base, this weakness may increase, since there is less mass at the distal end to absorb the impact force and also because the blade is narrower at the mid-section than at the base." This appears to be the case with side-notched points; consequently, if breakage occurs at their distally located notches, little blade material remains to be resharpened. Beck (1995:236) concludes:

> These data suggest that corner-notched points can sustain more damage than side-notched points and still remain in use, which in turn suggests that corner-notched points have a longer use-life as the same tool – that is, as a dart point – than do side-notched points. Thus, these data suggest that corner-notching has a lower cost and is thus a more effective hafting technique than side notching.

The place of lanceolate points in the spectrum of functional performance remains unclear. Their lack of notches distally located on the blade indicates that they are more functionally equivalent to corner-notched points than side-notched points, though their lack of notches may make them more difficult to haft. Thus, it appears that the technical choices of hafting techniques at the KdVo-5 site were 'arbitrary' in respect to expectations based on functional efficiency.

At first glance this phenomenon seems analogous to the 'arbitrary' technical choice of barbed or unbarbed arrows by different Anga groups. Individual technicians at KdVo-5 had different cultural perceptions, inscribed in the *habitus*, of the right way to haft a dart point, even though they observed first-hand other hafting techniques and might even have noticed the increased functional efficiency of the variants represented. Yet, the KdVo-5 case exists in very different context than the Anga case. Rather than between groups, often ambivalent to each other, the face-to-face interactions that unfolded at the KdVo-5 hunting stand were most likely between individuals of the same group, between members of a planned logistical hunting foray, which was a smaller unit of some larger interacting entity organized on the basis of kinship and marriage. I have outlined how technological practice, discursive or nondiscursive, can play a part in the construction of the social structures internalized in the *habitus*. 'Adze borrowing' by Yir Yoront women and children plays a role in constructing gender, age and kinship relationships in the course of everyday material activities in a nondiscursive way just as making harpoon barbs "just a little longer or sharper or thinner than one's neighbor" in the Late Magdalenian might have contributed to the construction of 'skilled' versus 'less skilled' technicians (Dobres 1995:37). Technological practice can also be discursive within the limits that it is culturally 'reasonable' enough to be recognized as contestation. Thus, a woman in Conambo communicates her distaste with living patrilocally with an abusive husband through the decorations she paints on her chicha bowls, and indeed, Lemonnier

(1986,1991) proposes the hypothesis that some of the 'arbitrary' technical choices made by the Anga might be based on the construction of group differences and boundaries. I propose that choices of hafting technique made by technicians at the KdVo-5 hunting stand also marked a social distinction in the relationships between these individuals.

I think that the social distinction that best explains the hafting technique variants in the context of a hunting stand occupied by three to four individuals is the difference between kin and affines, particularly in regard to postmarital residence practices. To elucidate this view, I have to invoke several details from the ethnographic record of the Upper Tanana Athapaskans and neighbouring subarctic Athapaskan groups. Of course, several interpretive problems arise from projecting ethnographic information into the past, particularly demonstrating cultural continuity between a culture experiencing a colonial encounter and an archaeological culture in the deep past (see Wobst 1978 for a discussion of this and related problems). Thus, the account I present here can only be regarded as an inference to be strengthened with additional archaeological data. Three ethnographic details will facilitate my analysis. The Upper Tanana Athapaskans and the Athapaskan groups in their vicinity are organized on the basis of matrilineal descent with a tendency towards matrilocal residence (Guedon 1974; McClellan 2001 [1975]; McKennan 1969). Cruikshank (1998:106) points out that marriage, and specifically postmarital residence practices, are an ongoing point of conflict in these societies:

> Marriage poses an inevitable conflict for both men and women. On one hand, it is essential to retain strong links with one's own maternal kin after marriage; on the other, one partner inevitably must move away from a protective network and establish residence with affines. Although postmarital residence patterns ideally were matrilocal, this did not always happen. A story pointing out possible dire consequences depicts the plight of a man who is living with his wife's people and is betrayed by her brothers. They pretend to take him hunting and then abandon him on an island to die.

Indeed, conflict between an individual and his or her affines is a prominent theme in several northern Athapaskan myths (Cruikshank 1998). This predicament is reminiscent of Richard's (1950) notion of the 'matrilineal puzzle', which indicates that in the case of matrilocal residence, male members of a matrilineage are dispersed from the people with whom they hold a degree of public authority. These postmarital residence patterns are important for the formation of logistical hunting groups, that is, men allied through marriage hunt together:

> Small groups of hunters would group together in units consisting of three to four men to hunt moose or sheep in the fall and winter months. Frequently these groups were members of an extended family, often consisting of a man, his son-in-law, or two brothers-in-law who were also cross cousins (Vitt 1971:22).

Finally, there is some ethnographic precedent to suggest that individuals that married into their spouse's groups sought to maintain their social identities:

> [E]ach individual was and still is identified with "his village," i.e., the village where he was raised, or sometimes the village from which his parents came. Even after forty years or so spent in another place, even when they had married and moved away early into their spouses' villages, the actual adults and old people still define themselves and are defined by their neighbors in terms of "their" village. This identification is strengthened by the slight differences in the native dialects spoken at Tetlin, Last Tetlin, Tanacross, Ketchumstuck, and so on. One informant proudly pointed out that in Last Tetlin, in "his" village, (only ten miles from Tetlin), some words designating birds were not the same as in Tetlin. Old people carefully preserve their former speech while learning to speak according to the norms of their new community and many jokes penalize a man or a woman who is not able to remember the accent of his or her former village (Guedon 1974:149).

Thus, it appears that the 'matrilineal puzzle', the tension provoked between a man and his affines by the institution of matrilocal residence, was an ongoing contradiction in some subarctic Athapaskan societies. Was the 'arbitrary' technical choice of hafting techniques a subtle way for young men living matrilocally to express their discontent with this institution, a means of communicating a desire to return to the people with whom they learned to make spear points and hunt (see Figure 6.2, p.134)? Several contextual details from the KdVo-5 hunting stand support this proposition. This social context places several hunters, engaged together in a logistical trip, in close face-to-face proximity for a significant period of 'downtime' (Binford 1980). It was in this 'conversation ring' (Gamble 1999) that individual hunters made the technical choice of hafting technique, that is, it was here that these technicians reduced bifacial preforms into haftable dart points. In conjunction with this process, broken points were unhafted and discarded. In this way, the hafting techniques embodied by these released base fragments, at most times obscured by the haft, entered the 'conversation ring' in naked form (Petrequin 1993). This interpretation of hunters from other places marrying into a new group might also explain the presence of obsidian from two distinct sources within the KdVo-5 hearth drop zone. Thus, the social context of the KdVo-5 hunting stand brought into proximity both men with potentially tense social relationships towards each other and the technical choices they used to negotiate this tension. In this context, the process of corner-notching, side-notching or not notching at all was a social performance at the same time that it fulfilled a functional purpose.

Conclusion

I regard this interpretation as an interesting idea to be substantiated with further archaeological data, particularly the excavation of additional sites that exhibit a similar pattern of technical choices. Yet, perhaps the greatest value of this approach is casting intrasite variability in technical choices in the light of social process. As Dobres (1995:42) points out: "These arguments can lead to the study of social processes operating at the microscale which may prove to have great importance to the overall workings of culture and culture change." That is, by viewing technological practice as a total social fact, a medium through which social relationships are constructed and contested, archaeologists can seek out these processes in archaeological record, the static remains of technological practice. In the conclusion to this thesis, I elaborate on this perspective and its implications for the discipline.

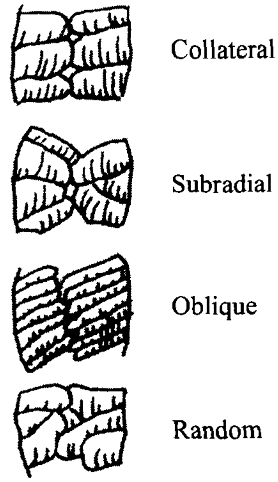
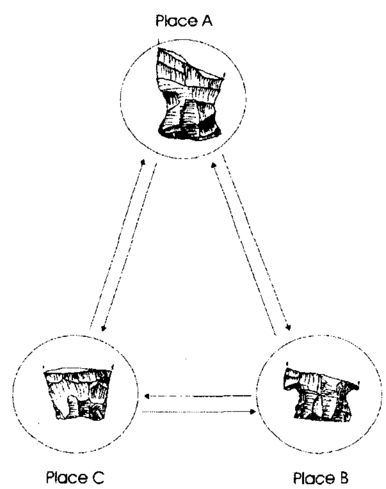


Figure 6.1. Diagram showing common flake scar orientation patterns (adapted from Gotthardt 1990:298-299).



Hunter	Place of Origin	Base Morphology	Raw Material
A	A	Side-notched	Coarse basalt
B	B	Corner-notched	Obsidian/gray chert
C	C	Lanceolate	Fine basalt

Figure 6.2. Social Interpretation of projectile point variability at the KdVo-5 site..

Chapter Seven: Conclusions

In his paper *Agency in (spite of) material culture*, Wobst (2000:41) argues that "even under the most severe constraints, when humans "act" they are informed by (and contribute to) context, history and social structure." This statement, I think, is particularly apt in the case of this thesis, for I have sought to show that context, history and social structure were important in the technological practice of prehistoric hunter-gatherers living in the subarctic, an environment often judged severe by subarctic archaeologists. This has required a definition of technology that goes beyond the domains of functional efficiency and economic rationality to one that includes the social shaping of technology. Sinclair (2000:198) offers a useful definition of technology in the following passage:

> It is a suite of technical gestures and knowledge that is learned and expressed by individuals in the course of social practices. Technology is one of the social processes by which individuals negotiate and define their identities, in terms of gender, age, belief, class, and so on. Sometimes these actions may be explicitly formulated; more often than not they are habitual and tacit. In its very essence, therefore, technical action parallels social action, and should be understood as social agency.

In the context of the KdVo-5 case study, I have argued that lithic technology can provide a window into prehistoric social processes. I have shown that the variability in artifacts found associated with the hearth feature cannot be explained solely in terms of functional requirements and that social and cultural influences were important considerations in their design.

A key point of my argument is that the KdVo-5 assemblage represents a single, short-term occupation of the site, and I offer several independent lines of spatial evidence that support this claim (Chapter Three). Yet, there is a contextual problem with the

KdVo-5 case study not fully refuted by this evidence. As is often the case in archaeological projects, the entire site has not been excavated, which opens the door to a host of interpretive problems. Most pressing is the possibility that the projectile point bases associated with the hearth were tossed there from other activity areas not contemporary with this feature (though testing of the site failed to locate any additional activity areas). This problem is exacerbated by the compact stratigraphy of the site, which presents the possibility that artifacts tossed there at different times could reside within the 'optimum de decapage' established for the hearth-associated assemblage (Chapter Three). This contingency is troublesome in view of the fact that the interpretation of artifact variability as social practice depends on the association of the projectile point bases with social actors in face-to-face interaction in the vicinity of the hearth feature. Thus, I think it appropriate to offer the qualification that further archaeological excavation at KdVo-5 could reveal that the co-association of these projectile point bases is suspect.

This association of projectile point bases has implications for the way that artifact typologies are conceptualized in standard archaeological discourse. Flenniken and Wilke (1989) argue that the widespread use of dart points as time-sensitive markers has led to the assumption that most forms succeeded one another in time. Dart point typologists maintain that "[d]art point forms can be described in terms of morphological series, types and subtypes that emerged, were common for a time, and then disappeared...[and that], in general, different forms (types) of dart points prevailed at different times" (Flenniken and Wilke 1989:150). At a broader level, Wobst (1999: 126) indicates that archaeologists tend to "pull from the archaeological record sets of form that are internally identical but maximally different from their respective logical neighbors [in time and space]." The result of these practices is to mask artifact variability by lumping similar forms into a typological category and dismissing outliers as noise or as intrusions from other levels of the site. Is this standard archaeological practice suspect? In his study of Solutrean lithics, Sinclair (2000) notes a large degree of variability in the size, shape and quality of retouch between artifacts otherwise considered typologically identical, and Flenniken and Wilke (1989) demonstrate that typologically distinct projectile point base morphologies are often the result of one form being reworked into another during the rejuvenation of broken points. I think that a main conclusion of this thesis is that dismissing a real archaeological association as typologically absurd can shut the door on interpretive avenues that have not yet been considered by subarctic archaeologists. Masking intrasite artifact variability masks the technical choices that people made as they engaged each other socially (Conkey 2000; Wobst 1999). The key to understanding technological practice as social practice is to apprehend variation in both the final forms of artifacts and in the *chaine operatoires* of their production.

Understanding technological practice as social practice provides a path for subarctic archaeologists to shed some light on the social processes that led to the unfolding of the unique and diverse historical trajectories of the prehistoric hunter-gatherer societies living in the northern boreal forest. As I pointed out at the conclusion of Chapter Six, my interpretation of the KdVo-5 case as a negotiation between kin and affines over marital residence is a hypothesis to be substantiated with further archaeological evidence. Regardless, the value of my assessment of the KdVo-5 assemblage is casting intrasite variability in technical choices in the light of social process, to recognize that the social constructions of age, gender, kinship, marriage, ethnicity, place, and so on are represented in technology, and that we can learn something of these constructions and their importance in culture change from an archaeological record composed primarily of lithic tools and debris. I suggest that the archaeological record of the subarctic does contain recoverable traces of daily social practice. For example, Esdale (2004) recently reported a site in northwest Alaska exhibiting an interesting association of technologies:

> Nim 51-3 is a buried single component archaeological site in northwestern Alaska with a toolkit composed of both microblade and bifacial projectile technologies. The assemblage contains 7 microblade cores, 14 core tablets, 12 Kayuk-style lanceolate points, 4 notched points, 19 bifaces, 9 unifaces, 12 expedient flake tools, 7 burins, and thousands of microblades and flakes. Site occupants repaired inset tools and projectiles with bifacial points, shaped microblade cores, and produced microblades. Bifacial projectile points and microblades were discarded in and around a hearth at the site which has, at present, produced one date of 4690+/-40 C^{14} years BP (Esdale 2004: Abstract).

Similarly, Gal and Wygal (2004) report an association of microblade technology and corner-notched projectile points from two sites in northwestern Alaska. Can these associations be explained solely by functional requirements posed by the activities undertaken at these sites, or is the association of lanceolate points, notched points and microblades, all of which can be used as effective hunting weapons, an indication of the social shaping of technology? Magne and Fedje (2004) argue that the spread of microblade technology matches quite closely the distribution of Athapaskan languages in northwestern North America: could there be a consideration of ethnicity in the choice of microblades over other implements? It is my position that design analysis of these associated lithic technologies, which take functional constraints, technological constraints, raw material constraints *and* cultural and historical influences into account, represents an effective tool for understanding this intrasite variability in technical choices, and that an understanding of these technical choices in the context of the spatial patterning of a site comprises an effective interpretive tool for inferring daily social practice from the archaeological record.

The *Nii'ii* site (KdVo-5) is typical of the small-scale, single component, and artifactually ephemeral sites often found in the subarctic. A key point of my thesis is that, though the *Nii'ii* hunting lookout is materially impoverished, it does not lack interpretive value. Indeed, I propose that this kind of site is ideal for the analysis of social practice at the microscale of face-to-face interactions, and suggest that the theoretical and methodological ideas demonstrated by the *Nii'ii* case study point towards a new direction for subarctic archaeology, wherein multifaceted spatial and technological analyses are used to infer how social relationships were created, maintained, contested and reproduced in the past. By highlighting this interpretive strength of the subarctic archaeological record, subarctic archaeologists can make a new and unique contribution to the wider context of archaeological method and theory, and leave behind narratives of subarctic prehistory in which the only plot elements are marginal environments, constant scarcity and techno-environmental determinism.

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Appendix: X-Ray Fluorescence Analysis of Obsidian Artifacts from KdVo-5

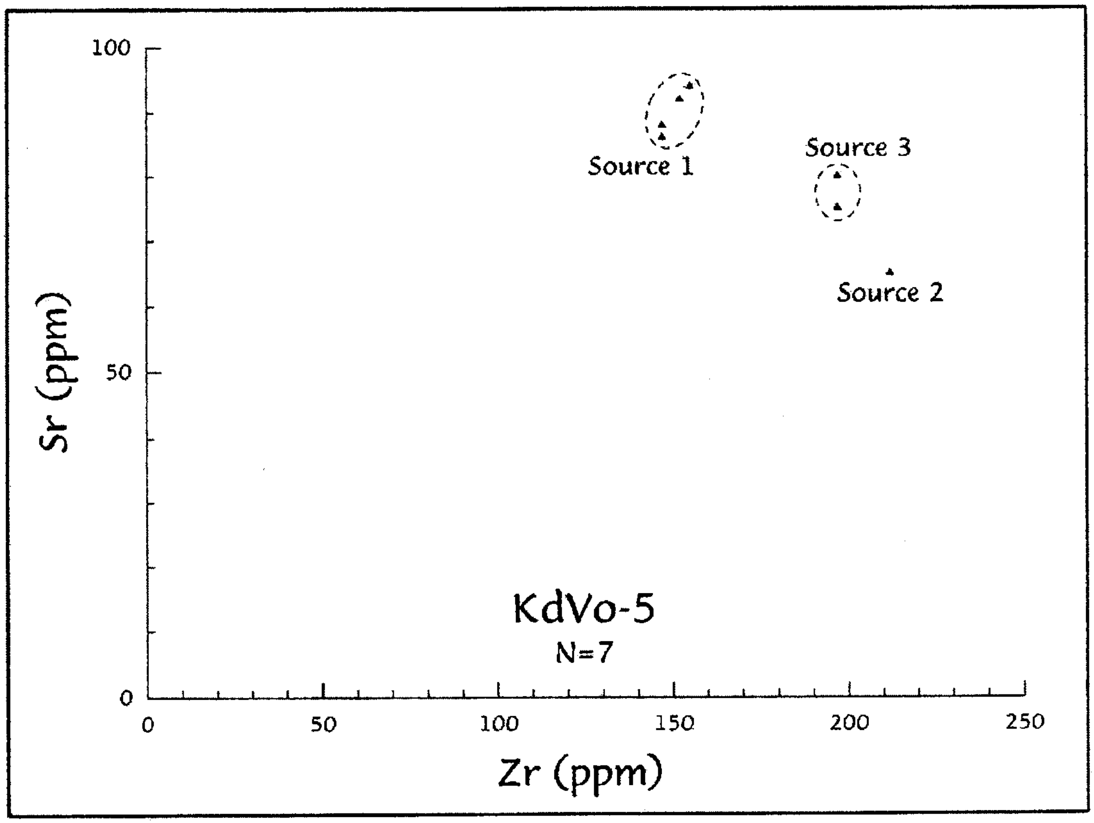
Northwest Research Obsidian Studies Laboratory

Table A-1. Results of XRF Studies: Site KdVo-5, Yukon, Canada

	Specimen		Trace Element Concentrations											Ratios		
Site	No.	Catalog No.	Zn	Pb	Rb	Sr	Y	Zr	Nb	Ti	Mn	Ba	$Fe2O3^T$	Fe:Mn	Fe:Ti	Geochemical Source
KdVo-5	1	143	82	20	161	75	25	197	20	NM	NM	NM	NM	33.8	85.8	Unknown 1 *
			± 8	5	4	9	3	7	1	NM	NM	NM	NM			
KdVo-5	2	217	88	27	179	80	31	197	15	NM	NM	NM	NM	35.8	87.9	Unknown 1 *
			± 10	5	4	9	3	7	2	NM	NM	NM	NM			
KdVo-5	3	325	72	17	150	65	31	212	14	NM	NM	NM	NM	38.9	102.3	Unknown 2 *
			± 7	4	4	9	3	7	1	NM	NM	NM	NM			
KdVo-5	4	190	36	12	117	92	20	152	15	1116	265	573	1.09	35.5	33.2	Unknown 3
			± 8	4	4	9	3	7	1	90	27	33	0.11			
KdVo-5	5	162	28	11	119	86	19	147	13	NM	NM	NM	NM	33.5	30.7	Unknown 3 *
			± 8	4	4	9	3	7	1	NM	NM	NM	NM			
KdVo-5	6	164	42	12	112	88	20	147	13	1156	273	615	1.12	35.4	33.0	Unknown 3
			± 7	4	4	9	3	7	1	90	27	32	0.11			
KdVo-5	7	157	33	13	109	94	18	155	11	1389	369	668	1.15	26.9	28.4	Unknown 3
			± 7	4	4	9	3	7	1	91	28	32	0.11			
NA	RGM-1	RGM-1	47	21	149	101	23	220	11	1726	363	820	1.98	45.7	38.4	RGM-1 Reference Standard
			± 7	4	4	9	3	7	1	92	28	32	0.11			

Note: gray obsidian (samples 1-3); black obsidian (samples 4-5); brown obsidian (sample 6); green obsidian (sample 7)

All trace element values reported in parts per million; ± = analytical uncertainty estimate (in ppm). Iron content reported as weight percent oxide.
NA = Not available; ND = Not detected; NM = Not measured.; * = Small sample.


100
50
0
Sr (ppm)
Source 1
Source 3
Source 2
KdVo-5
N=7
0
50
100
150
200
250
Zr (ppm)