

AN ANALYSIS OF LITHIC DEBITAGE FROM  
THE EARLY PERIOD AT NAMU

by

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AN ANALYSIS OF LITHIC DEBITAGE FROM THE EARLY PERIOD AT NAMU

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## Abstract

This focus of this thesis is on an analysis of lithic debitage from an Early Period (ca. 10,000 - 5,000 b.p.) component at Namu (EISx 1), located on the central coast of British Columbia. The goals of this research are twofold; first to discern the types of reduction strategies as evident in the lithic debitage assemblage and second, to make some preliminary interpretations on the way in which the Namu inhabitants organized their technologies during the first five thousand years of occupation at this location.

The site of Namu exhibits a remarkable pre-contact occupation sequence which is roughly continuous, beginning at approximately 10,000 years ago and ending 400 years ago. A substantial portion of the site matrix consists of shell midden, which appears at about 6,000 b.p. The present lithic assemblage is derived largely from stratigraphic levels which predate the initial appearance of shellfish and other organic remains. This assemblage was recovered during the Simon Fraser University excavations at Namu in 1978.

Three analytical methods are used to determine lithic reduction strategies; Magne's (1985) flake scar method, Sullivan and Rozen's (1985) flake completeness method as modified by Prentiss and Romanski (1989), and Ahler's (1989a) mass analysis method. These methods yield mixed results due to various confounding factors which are discussed in the text. Nevertheless each of these analytical methods reveal informative patterning on reduction strategies, trampling, and size class frequencies.

Based on results of the analysis, a working hypothesis is developed which proposes that Namu was the location of a sedentary or semi-sedentary

settlement as far back as the early Holocene. These findings indicate that the Early Period inhabitants of Namu practiced a low rate of residential mobility for at least some part of the year. This is evident in the raw material procurement strategy, diversity of lithic reduction at Namu, and the possible use of a designated "dump" area for lithic debitage. However these interpretations are preliminary, and suggestions for future research are also discussed.

## Acknowledgements

There are several individuals that contributed in many ways to the completion of this thesis. First, I thank my committee for guidance and support over the years. My senior supervisor Dr. Roy Carlson provided access to the assemblage, and the opportunity to participate in field research at Namu. He also disseminated knowledge and provided financial assistance. Prof. Phil Hobler has also been a source of knowledge and encouragement, and he let me briefly pilot the Sisiutl. I also thank Dr. Michael Roberts for serving as external examiner.

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There are probably very few graduate students that are not influenced in some way by their peers. During my tenure as a graduate student, some of my peers have been sources of inspiration and friendship, especially during the inevitable "low points". There are too many of these fellow students (graduate and undergraduate) to mention here, suffice to say I will buy each and every one of you a really cool gift sometime in the future.

My family deserves special mention, especially my parents who have

been unwavering in their support for my education, even though I have chosen a somewhat unorthodox field to pursue as a career. I can only claim that some day soon, I will hopefully be a "doctor", albeit not a medical one.

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## Chapter One: Introduction

### 1.1 General

The initial arrival(s) of peoples into the New World has been a long-standing topic of interest amongst academics and laypersons alike (indigenous accounts of creation notwithstanding). While some scholars have energetically participated in the ongoing debate on the timing and method of entry by populations from the Old World (Carlson 1991; Fladmark 1979; Meltzer 1989), others have focused on the lifeways of the first known settlers. Issues relating to technology (Ellis and Lothrop 1989; Goodyear 1989; Kelly 1988; Kelly and Todd 1988) and subsistence are now at the forefront of archaeological studies on early peoples on the continent.

This thesis focuses on an analysis of lithic debitage from an early component (ca. 10,000-5,000 b.p. \*) at the site of Namu (EISx 1), located on the central coast of British Columbia (Figure 1). In recent years there has been a revitalization in lithic archaeology, due to experimentation with new analytical techniques (see Amick and Mauldin 1989; Henry and Odell 1989), and to theoretical discourse which has led to new conceptual frameworks (Torrence 1989). Lithic cultural materials (especially debitage) can be used to infer the types of activities that took place at particular locations, and this information can then be used to reconstruct land-use patterns and other higher level interpretations. This type of research is referred to as the study of *technological organization* (Nelson 1991).

In such a study, Several criteria need to be considered, for example raw material availability, possible techniques for reducing these raw materials,

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\* Throughout this thesis, the b.p. nomenclature is used to indicate uncalibrated radiocarbon dates. Calibrated dates are denoted with the B.P. designation

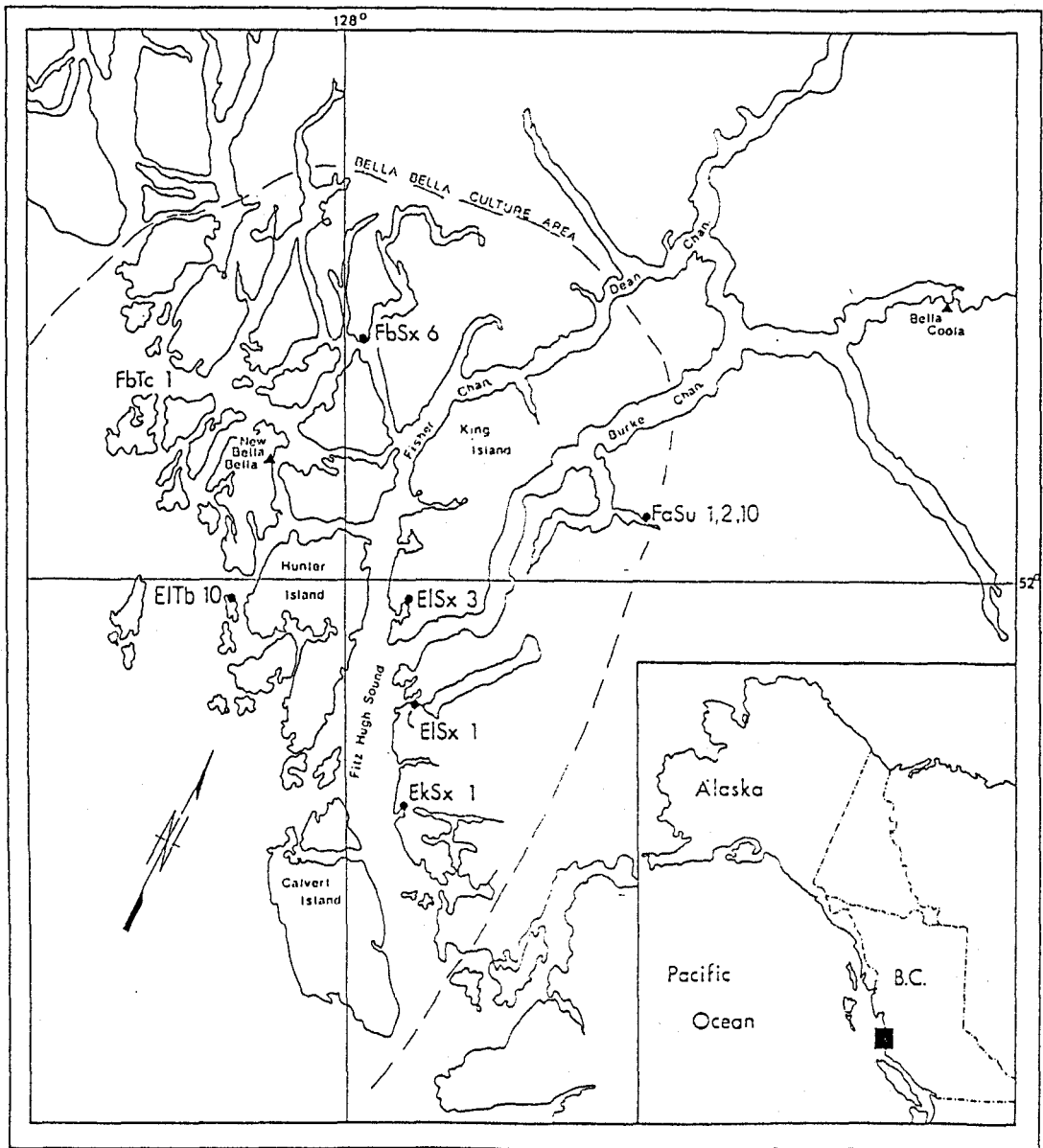


Figure 1. Location of Namu (EISx 1) on Central Coast (after Luebbers 1978)

specific uses of implements, method of use, and other criteria. Some of these variables are strongly connected to settlement patterns, for example raw material availability and reduction strategies can be constrained by the mobility patterns of the group in question. The present research endeavors to elucidate some of these variables through a technological study of the debitage from the early component at Namu, and by extension preliminary interpretations on technological organization will be provided.

Such research has previously never been attempted for the more ancient periods of Northwest Coast human occupation. The present study will shed some new light and augment the known ancient history of aboriginal peoples in this region.

## **1.2 Importance of Namu in Northwest Coast ancient history**

In British Columbia, coastal settlement was precluded by the presence of Late Pleistocene glacial events, although there is a strong possibility that ice-free refugia were present on the coast even during times of glacial advances (Fladmark 1979). Decay of the Late Wisconsinan Cordilleran Ice Sheet began at 14,000 b.p. in this area, some parts of the coast were free of ice by 13,000 b.p. and by ca. 10,000 b.p., most of the ice had disappeared (Clague 1989). Earliest human occupation on the coast probably occurred soon after glacial retreat (or earlier if the refugia hypothesis is supported). At present, relatively little is known about this early period of occupation on the coast, this is the result of several factors, the most conspicuous of which is the paucity of archaeological sites and data.

The most obvious reason as to why early sites are so rare on the coast is that they are difficult to locate, given modern day sea-levels. Starting in the Late Pleistocene and continuing on into the Holocene, eustatic and isostatic

processes have raised and/or lowered relative sea-levels dramatically on the coast. The actual history of relative sea levels in this region is highly varied depending on the particular locale (Clague *et al.* 1982), and this would have had the effect of changing shorelines through time, by either raising or lowering them. Consequently, archaeological sites located close to the paleo-shorelines are now either buried under water by higher present day relative sea levels, or located on terraces above present shorelines in the case of lower present day relative sea levels. Lateral movement of shore lines would accompany these vertical changes, therefore sites may also be laterally displaced in relation to the modern shoreline. The record of paleo-sea levels is very complex in this region, requiring much effort to decipher. Important new data have been the result of recent geophysical research in the Southern (Luternauer *et al.* 1989) and Northern (Fedje 1993; Josenhans *et al.* 1995) portions of the British Columbia coast, with implications for the Central Coast. The latter region is the central focus of the present research.

Even though there are now many recorded sites along the Central Coast (Apland 1977; Hobler 1970; Pomeroy 1980), relatively few have been excavated. A problem in locating and excavating sites along the coast involves logistics. Due to the nature of coastal research great amounts of time, equipment, and finances are needed. Most of these areas are very rugged and remote from modern conveniences such as roads, and transporting crews and supplies to some of these areas is no small feat. Therefore sea-going vessels are essential to this type of research, however the number of archaeological projects with access to these types of vessels is very low.

Given this situation, the inventory of excavated early archaeological sites on the coast is rather small. The site of Namu on the Central Coast of B.C. has yielded the earliest known evidence of human occupation on the



mainland provincial coast. Moreover, the site contains a relatively voluminous amount of archaeological material starting from roughly 9,700 to approximately 400 years ago (Carlson 1990). In view of the rarity of such data, the Namu findings play a pivotal role in our understanding of the ancient history of indigenous peoples in British Columbia.

### **1.3 Research goals**

The focus of this thesis then is on the analysis of a lithic debitage assemblage from Namu. The temporal focus is on the Early Period (ca. 10,000 - 5,000 b.p.) of occupation, during which lithic materials comprise the vast majority of the artifact inventory. The goals of this research are: to describe the strategies of lithic reduction as exhibited in the debitage during the first two archaeological periods of occupation Namu, and to make some preliminary inferences on the organization of technology in this period.

### **1.4 Description of chapters**

Chapter 2 provides the background for the present study, by discussing the context of research. Separate sections center on site location, general physiography, and history of relative sea-levels; environment; history of excavation; stratigraphy and chronology; and artifact recovery and culture history.

In Chapter 3 an overall summary is provided on theory and method. This is done by first summarizing the study of technological organization, and how this is relevant to the present study. Following this a review is provided on the history of lithic debitage research, followed by a discussion of recent studies on the subject. Methods of analysis for the present research are outlined, including advantages and disadvantages of each method.

Chapter 4 comprises the bulk of new data, the debitage assemblage is characterized with regard to raw material and other physical variables. Results are provided for each analytical method, along with possible biases that may distort the outcomes. Interpretations on reduction strategies are forwarded based on the analytical results, and this is used to make further interpretations on organization of technology in the Early Period at Namu. Critical discussion of these results is presented.

A summary and conclusion are presented in Chapter 5. The research is briefly outlined, and the resulting interpretations are assessed. General implications of these inferences are discussed within a context of Northwest Coast ancient history. Shortcomings in the present research are highlighted, along with suggested directions for future research.

## Chapter Two: Context of research

### 2.1 Site location, general physiography and history of relative sea-levels

The Central Coast of British Columbia has been defined as the geographic area extending from Douglas Channel to the north through Rivers Inlet to the south (Hobler 1990: 298). Namu is located in the Bella Bella region on the Central Coast, near the confluence of Fitzhugh Sound and the Burke Channel. Physiographically the site location falls roughly in the transition between the Coastal Trough and Coast Mountain Zones (Fladmark 1974). On the seaward side of Namu, the Coastal Trough is part of the continental shelf and is characterized by a number of offshore islands as are common in the famed "inside passage." These islands share some features with the mainland coast in this physiographic zone; both are dotted with "gently shelving" sandy beaches, but also more steeply graded rocky beaches (Fladmark 1974:32). Boulder laden beaches are not uncommon, as are locations with no beach area due to sharply rising landforms. Elevations in this area are not as dramatic as those of the Outer Mountain Zone to the west, nor of those in the Coast Mountain Zone to the east. Summits in the Coastal Trough tend to be rounded, and generally do not exceed 300 m (Fladmark 1974: 32), although around Namu they reach 900 - 1,200 m (Luebbers 1978:17).

To the east, the Coast Mountain Zone consists of deep water fjords and channels, flanked by steep walls cut into the landform. The Burke Channel just north of Namu is one such fjord, which eventually connects with the Bella Coola Valley through the North Bentinck Arm. In antiquity this may have provided a possible travel route between the two areas, although presently there are strong tides and currents in inland waters, which make travel difficult (Hilton 1990). The Coast Mountain Zone is rugged

mountainous terrain with peaks of up to 1800 m (Andrews and Retherford 1978:343), and is heavily forested, making intensive human occupation quite difficult. However lithic raw material and fauna may have been procured in this zone, along with other resources.

The exact site location is within Namu harbour, a small bay which forms the drainage for freshwater output from the Namu River. The bay itself consists of shallow sand and gravels, whereas the river bed consists of boulders and bedrock. The river itself is rather short at approximately 400 m, however the width is quite narrow and as a result there are numerous sections of rapids. The river is fed by Lake Namu which lies directly beyond the site, today the lake can be reached within ten minutes on foot from the site area. This is a freshwater body approximately 14-16 km in length and fed by runoff from the coastal mountains (Luebbers 1978).

The history of relative sea-levels in this area is quite complex to decipher, due to the combination of tectonic, eustatic and isostatic processes often working in concert. There has been a recent flurry of geomorphic research focusing on changes in relative sea-levels on the coast (Josenhans *et al.* 1995; Luternauer *et al.* 1989). Andrews and Retherford (1978) provide the most recent data on research conducted in the Bella Bella and Bella Coola Regions.

The Late Wisconsinan glaciation episode saw the Cordilleran Ice Sheet build-up to 2 km thick, encasing parts of the central coast. As a result of this build-up, isostatic loading depressed the crust to a greater degree than was compensated for by lower relative sea-levels. Because of this, relative sea-levels during and immediately after the last glaciation were up to 200 m higher than present in various parts of the coast (Andrews and Retherford 1978).

However following glacial retreat, isostatic rebound occurred in a very rapid fashion so that in this time period, relative sea-levels dropped with great speed over most of the coast except in the Queen Charlotte Islands, where the situation was reversed (Clague *et al.* 1982; Fedje 1993). In the latter area relative sea-levels were depressed through the glacial episode, and rose rapidly following glacial retreat.

Andrews and Retherford (1978) report that by 10,200 b.p. relative sea-levels in the Namu area had dropped to just over 17 m above present high tide. Initial occupational evidence at Namu is dated to 9,720 b.p., this point is roughly 11 m above the present tide line, so it is most likely that by the time of the initial occupation at Namu, relative sea-levels had dropped to no more than this level. Relative sea-level continued to drop after this time and reached the present level sometime between 7,000 and 9,000 years ago (Clague *et al.* 1982:603). Subsequent dropping led to lower than present relative sea-levels for much of the middle and late Holocene, and began to rise to present levels after 3,000 years ago. However this scheme is by no means uniform over the entire region, and there were periodic exceptions (Andrews and Retherford 1978).

More recently, there is evidence that a completely different sequence of events occurred to the west in the now submerged continental shelf that comprises Queen Charlotte Sound. Here deglaciation may have occurred some 3-4,000 years earlier than in the zone comprising the fjord heads, so that isostatic rebound should have been almost complete on the continental shelf by 10,500 b.p. Because eustatic relative sea-level was still low at that time, many of the shallow portions (< 100m depth) of Queen Charlotte Sound were exposed sub-aerially. Evidence for this is the recovery of *in situ* rooted plant remains dated at 10,500 b.p. at a depth of 95 m, from Cook Bank, off the north

coast of Vancouver Island (Luternauer *et al.* 1989). Subsequent to this, relative sea-levels fell dramatically in the fjords while rapid transgressions occurred simultaneously in the Sound. Luternauer *et al.* (1989) suggest that this is due to a forebulge process that likely resulted from the rapid uplift in the fjord lands. This notion of vast areas of the continental shelf being sub-aerially exposed is also supported by new data from the Queen Charlotte Islands (Josenhans *et al.* 1995). To the east of Graham Island at Dogfish Bank, present day marine environments were sub-aerially exposed between 13,200 and 10,000 b.p.

The implications of these new data are quite striking. The most obvious implication is that human occupation was possible in parts of the Northwest Coast long before 10,000 years ago. More importantly, if exposed areas of the shelf were relatively continuous from north to south, this would have provided a base for movement of human groups, as marine based economies would be possible in these areas. In view of this Fladmark's (1979) coastal migration hypothesis should be seriously reconsidered by workers involved in the debate on timing of initial human entry into the New World. This situation also underscores the need for a more intensive programme of underwater survey and recovery of archaeological material.

Moreover, these data suggest that at 10,500 years ago the present day area of Namu was submerged and could not have been occupied. However further west in what is now ocean, there may have been large tracts of terrain suitable for habitation by terrestrial fauna, including humans. If archaeological materials from such occupations indeed exist they are now under water, however at depths of less than 100m. It is interesting that initial archaeological deposits at Namu occur roughly at about the time when relative sea-levels in the area permitted human occupation. Although pure

speculation, one possible scenario is that the initial occupants of Namu migrated from the continental shelf area in order to escape rising relative sea-levels. In other words, Namu might have been an ideal location for habitation shortly after 10,000 b.p. as relative sea-levels were rising to the west and north, and dropping in the area around Namu and to the east. What is rather interesting, is that occupation at Namu seems relatively continuous in spite of fluctuating (but lower than present) relative sea-levels. The locations of archaeological deposits remain constant throughout the first few thousand years of occupation, even though the position of the shoreline would have changed over time in vertical and lateral location.

## 2.2 Environment

The present climate in the Coastal Trough Zone varies from south to north, however in this area annual precipitation ranges from 89 - 127 cm, which is lower than for the zones to the east and west. Much of this precipitation falls in the winter months. January temperatures average 1 - 3° C, while July temperatures average 16 - 18° C (Fladmark 1974:37). The Coast Mountain Zone has a much higher annual precipitation, along with greater temperature extremes.

Namu is in the Coast Forest Biotic Zone, the area around the site contains a floral suite that is characteristic of the region as a whole. Mature growth is evidenced by the presence of different hemlock species and also western red cedar, Sitka spruce and red alder. As in other Northwest Coast sites, salmonberry, elderberry, thimble berry and salal represent the immature growth (Luebbbers 1978:15).

Past and present day terrestrial fauna include blacktail deer, black bear, grizzly bear, wolf, beaver, river otter, raccoon, as well as several other

mustelids and rodents. Higher up in the sub-Alpine areas, mountain goats are also present (Cannon 1991; Fladmark 1974).

Avian fauna exploited in antiquity consisted largely of shoring and diving birds. This area falls within migration routes used by waterfowl, and their presence in the Namu faunal assemblage indicates that this scenario may also have great antiquity. Although crows and ravens are present and their eggs may have been eaten, these birds are not known to have been exploited for nutritional purposes (Hilton 1990). However their mythical status is well noted in Northwest Coast ideologies.

Marine nutritional resources are by far the most abundant type of food available, these are/were procured in a variety of manners depending on the particular habitats and habits of the species in question. Pelagic species require different techniques and equipment to procure compared to littoral and riverine species, which can be taken on the beaches and in rivers. Sea mammals such as harbour seal, fur seal, sea otter, and many Delphinids (dolphins and porpoises) and Cetaceans (whales) are present, although the last category does not seem to have played an important role in the ancient diet of central coast peoples (Cannon 1991).

As with other parts of the Northwest Coast, in the area around Namu fish are plentiful and formed the basis of subsistence for most of the occupation at Namu. The presence of coastal rivers and streams is an ideal situation for spawning cycles in anadromous fish. Several varieties of salmon utilize the rivers in and around Namu, as do steelhead. Non-anadromous species such as herring are also common to the area, as are rockfish, flatfish such as halibut, sablefish, several varieties of cod and others (Cannon 1991).

Crustaceans are represented by shrimp, a number of crab species, and barnacles. The shellfish component in the archaeological faunal assemblage is



dominated by the mollusks, these varieties are also available today and are relatively easily procured particularly in the littoral areas. Numerous species of clams are present, and also mussels, and whelks. Other available species include oyster, abalone, moon-snail, and more.

### **2.3 History of excavation**

The archaeological site is situated within the confines of a recent historical settlement built around a fish cannery. This cannery was established just before the turn of the century however the operation soon grew much larger, resulting in a thriving town by the 1940's (Lyons 1969). By the 1970's, the cannery was still operating, although at a much reduced output. Today the cannery is no longer active, although many of the structures and equipment are still present, albeit deteriorating rapidly. Since 1928 the cannery was owned by British Columbia Packers, who recently sold it to Namu Harbour Resorts Inc.

The site is also of recent historical relevance for aboriginal peoples in the area. This region falls into the territory claimed by the Heiltsuk peoples, whose language is classified in the Kwakiutlan Branch of the Wakashan Language Family (Thompson and Kinkade 1990). They are also referred to as the Bella Bella, however this term is more commonly applied to historic times when several tribes came together at the village namesake (Hilton 1990:321). At Namu, many Heiltsuk people were recruited as labour for cannery operations. Personal communication with several Heiltsuk individuals revealed that Namu had also been used as a seasonal (summer) village until fairly recently, a fact that Luebbers (1978:14) corroborates.

Initial archaeological survey in this region was conducted in 1938 by Drucker and Beardsley, who were able to document some 20 sites (Drucker

1943). Some excavation was done, however none of these sites nor their contents gave any indication of having great antiquity. Since this study was conducted before the inception of radiocarbon dating, chronology had to be established by means of stylistic criteria. The lack of early remains was not a large obstacle for Drucker and Beardsley, since one of their main aims was to use the direct historical approach in an archaeological situation. On the other hand the lack of evidence for early occupation in this study contributed to the situation in the following decades, where there was a feeling among many that the Central Coast was devoid of any notable human occupation previous to about 5,000 years ago (Carlson 1979:21).

Subsequent to Drucker and Beardsley's explorations, little archaeological work took place on the Central Coast until 1968, when research was rejuvenated with projects in the Bella Bella (Hester 1978a; Pomeroy 1980) and Bella Coola (Hobler 1970; 1982) regions. One of the main goals shared by these projects was to establish regional chronologies, something which had not been previously attempted in the period following the widespread use of radiocarbon dating. Since the mid-1970's field work has continued in these regions mainly under the direction of Carlson and Hobler of Simon Fraser University.

The site of Namu was first recorded by Hobler in June of 1968 (Hobler 1992: pers. comm.) Initial excavation began later that summer when a crew from the University of Colorado conducted test excavations under the direction of Jim Hester (1978a). This excavation was exploratory in nature, Namu was chosen partially because it exhibited evidence for the presence of a large shell midden. Expanded excavations continued at the site in the following summers of 1969, and 1970. In addition to several test pits, two main trenches were excavated, these were the Front and Rear/Main trenches

(Figure 2). Stratigraphic and chronological sequences were established, thousands of artifacts and a number of human burials were also recovered (Curtin 1984). The most salient information that came out of this research concerned chronology; radiocarbon dates indicated that Namu had an antiquity of at least 9,140 b.p., and that the occupation spanned a period encompassing several thousands of years, ending with European contact (Hester 1978b). This had the dual effect of: making Namu the earliest archaeological site on the mainland coast of British Columbia; and also extending the known aboriginal occupation on the Central Coast to the early part of the Holocene.

Renewed excavations began in 1977 and continued in 1978 when crews from Simon Fraser University worked under the direction of Roy Carlson. In these seasons, more test pits were sunk, and some of the previous Colorado excavations were laterally extended (Figure 2). Test pits in the River Mouth area indicated deeply stratified deposits here, as a result excavations were expanded and this turned out to be one of the most productive areas of the site. The total excavation area from which the present assemblage is derived is a 6m x 2m length and width, and approximately 4 m in depth (Figure 3). However the Early Period material is confined to the lower layers of this unit. A further season of excavation took place in 1994, where the Rivermouth Trench was extended a further 2 m along the northern edge. The materials and data from this most recent excavation are in process (Carlson 1995) and are not considered in this study, unless otherwise noted .

#### **2.4 Stratigraphy and chronology**

In addition to greatly expanding the archaeological inventory, the S.F.U. excavations extended the chronology of the site even further back, a

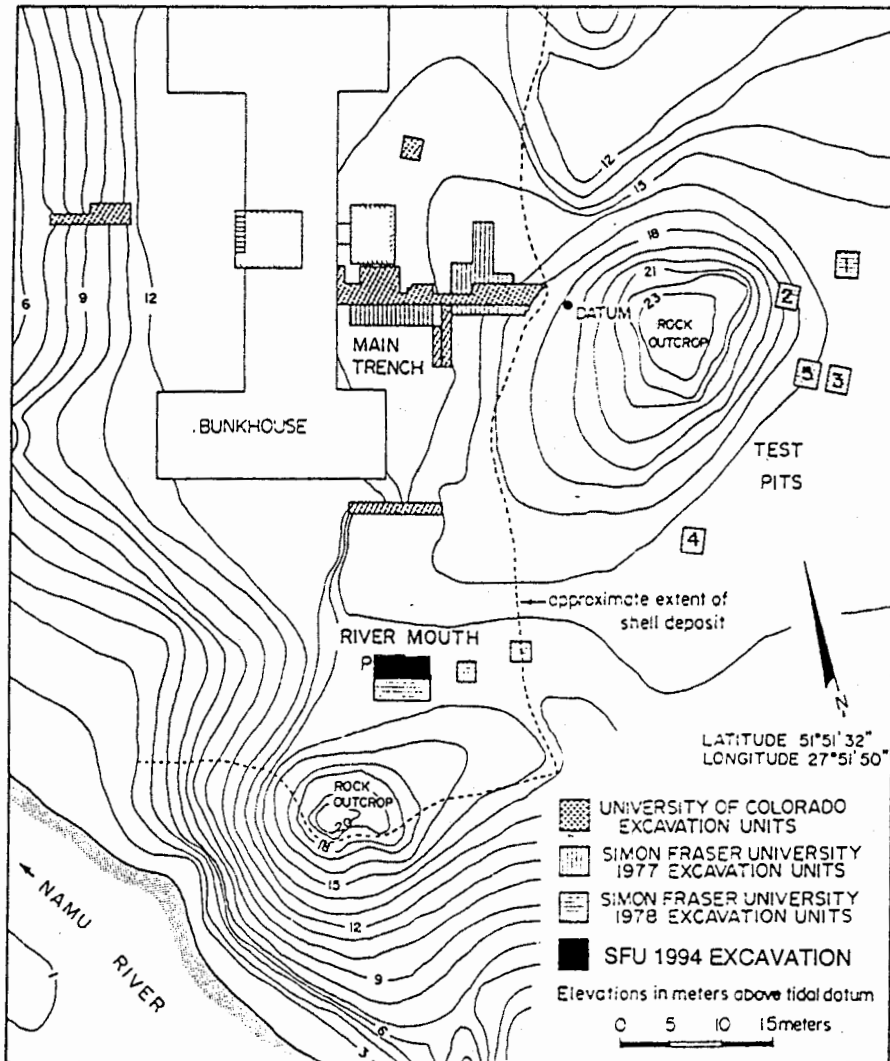


Figure 2. Namu site map (After Carlson 1991)

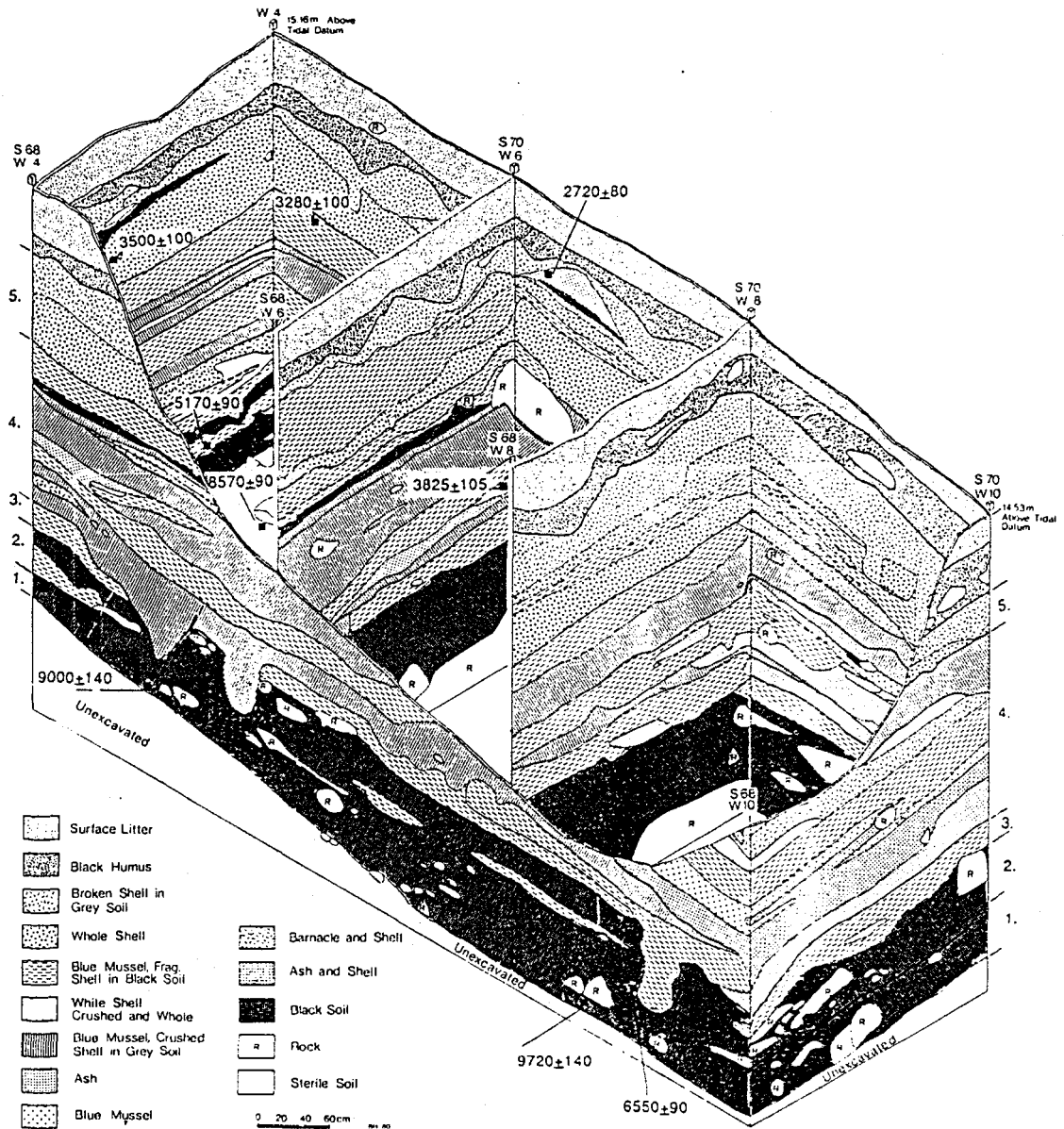
radiocarbon sample from the lowermost part of the Rivermouth Trench produced a date of  $9,720 \pm 140$  b.p. (Carlson 1991).

Characterization of Namu chronology and stratigraphy has been conducted by Carlson (1979, 1991, 1995), a distilled summary is presented here. A series of 38 radiocarbon dates has been compiled from all the excavations at Namu (Table 1), and from bone samples from skeletal remains (Carlson 1991). The sequence indicates that Namu was occupied (perhaps on and off) beginning at least 9,720 b.p. and up to European contact. This is one of the most impressive occupational sequences in the New World. Calibration of these dates pushes the initial occupation back to almost 11,000 years (Carlson 1991).

The stratigraphy at Namu has characteristics that are common in stratigraphic profiles exhibited at other shell middens of some antiquity (Figure 3). Carlson (1991, 1995) has divided the site chronology into six separate periods based on radiocarbon dates and stratigraphy. Seven strata are recognized, and some correspond roughly to these periods.

The basal level designated as Stratum I consists of glacial till which is sterile, save for a few surface artifacts. A brown-yellow tint characterizes the sand in this layer, but there are also boulders present. This till was found at the bases of both the Rivermouth (Carlson 1979) and Main (Luebbers 1978) Trenches.

Stratum II is divided into two sub-units, based largely on shell and faunal content. The bottom of these two sub-units is Stratum IIa, a dense, dark organic laden matrix, often referred to as the *black matrix*. This type of matrix has been noted in the basal sections of other shell middens, and is often described in the field as being "greasy", "wet", and "clay". The characteristic feature that separates this sub-unit from the next one is the lack of any faunal



Stratigraphy and C-14 dates in the Rivermouth Trench. Numbers 1 - 5 refer to the time periods to which the various strata have been assigned on the basis of associated C-14 dates and superposition. The lowermost part of the cultural deposit rests on sterile glacial till about 6 meters above present highest high tide.

Figure 3. Rivermouth Trench Stratigraphy (After Carlson 1991)

	Front Trench	Main Trench	Rivermouth	Test Plots
contact				
	480±80 (521) 680±90 (668) 980±100 (927)			
6	1470±80 (1361) 1840±80 (1769)	1405±120(FS 7) (1308)		
		1880±90(FS 8) (1850)		
2000 B.P.				
		2185±85(FS 6) (2226) 2440±100(FS 7) (2527) 2530±160(B78-1) (2650)		
			2540±80(FS 5d) (2672) 2720±80(FS 4b) (2818)	
5		2810±100(FS 5) (2922) 2880±100(FS 6a) (3013)		
			3280±100(FS 3d) (3516)	
		3330±90(FS 5c) (3608) 3400±100(FS 5b) (3660)		
			3500±100(FS 4a) (3774)	
4000 B.P.				
			3825±105(FS 3a) (4218)	
4		4290±120(FS 4b) (4862) 4300±125(B 212E1) (4864) 4390±160(B 4J1) (4928)		
5000 B.P.				
		4540±140(FS 4a) (5200) 4680±160(B 4G2B1) (5381) 4700±125(B 4G8) (5455) 4775±130(B 77-2) (5525)		
6000 B.P.				
			5170±90(FS 2b) (5940)	
2		5240±90(FS 2b) (5969) 5590±90(FS 2b) (6375) 5590±100(B 1.11B.1) (6375)		
			5700±360(FS 2b) (6480)	
		5740±100(FS 2b) (6506) 6060±100(FS 2b) (6921)		
7000 B.P.				
			6550±90(FS 2a) (7431)	
		7800±200(FS 2a) (8559)		
1			8570±90(FS 2a) (9462) 9000±140(FS 2a) (9920)	
		9140±200(FS 2a) (10067)		
			9720±140(FS 2a) (10676) 1	
1100 B.P.				

FS = Field Stratum B = Burial Number ( ) = Tree Ring Calibrated Date

Note: Calibrated dates are based on the computer program provided by the Quaternary Isotope Laboratory at the University of Washington (Stuiver and Reimer 1987). In those instances in which the computer program gave several possible calibrated dates, those dates have been averaged to give the single calibrated date listed (above). Since this program does not extend beyond the 7800±200 B.P. C-14 date, the four oldest dates (8570±90 through 9720±140) have been calibrated using the following calibration formula: Calibrated B.P. Age=(C-14 B.P. Age x 1.05)+470 years (Stuiver *et al.* 1986:969-979). Calibration of the oldest date (9729±140 B.P.) using uranium-thorium calibrations (Bard *et al.* 1990:Table 1) would actually make this date older than the 10,676 date obtained using the formula, and place it about 11,090 cal. years B.P. Hence, the beginning of Period 1 at 11,000 B.P. is not without justification (Carlson 1991:85).

Table 1. Namu radiocarbon chronology (After Carlson 1991)

remains in the lower layer. The earliest date came from the base of this layer, which also yielded numerous cultural lithic materials. This also forms the basis for Carlson's designation of Period 1, for which the earliest date given is  $9,720 \pm 140$  b.p., and the most recent  $6,550 \pm 90$  b.p. (~11,000 B.P. - 7,000 B.P.). A total of six dates are provided, two from the Main Trench and four from the Rivermouth Trench. Carlson (1995) has further divided Period 1 into three temporal periods based on artifact types. Stratum IIa begins at 390-395 cm below surface in the Rivermouth Trench and slightly higher in the Main Trench. Thickness of this sub-unit varies from 20-70 cm.

Period 2 coincides with Stratum IIb, and dates from  $6,060 \pm 100$  b.p. to  $5,170 \pm 90$  b.p. (~7,000 B.P. - 6,000 B.P.). There is no disconformity between substratums, Stratum IIb is texturally similar to the underlying one, but it also has the inclusion of shell and faunal bone remains. In the Main Trench lenses of mussel were associated with the more recent dates from this layer. Maximum thickness is 40 cm in the Rivermouth Trench, and 70 cm in the Main Trench. Lithic material continues to dominate artifact yields.

Period 3 deposits are poorly represented, three of the four dates from the Main Trench are from burials. Although Period 3 deposits were noted in the Rivermouth Trench, no dates have been obtained. This period is summarily dated between 6,000 B.P. and 5,000 B.P.

In the Rivermouth Trench, Period 4 makes up the bulk of archaeological deposits, yet this period is poorly represented in the Main Trench. Broken and crushed shell characterize this layer, along with ash and fire cracked rock. Maximum thickness in the Rivermouth Trench is 140 cm, at a minimum depth of 280-285 cm below surface. Dating for this period is from 5,000 B.P. to 4,000 B.P.

Strata V and VI make up Period 5, which consists of larger whole shell



fragments in a gray humic matrix. These are represented in both trenches, achieving maximum thicknesses of 120-140 cm. This period covers a span of 2,000 years, starting at 4,000 B.P. and ending at 2,000 B.P.

Period 6 is the final and most recent in this scheme, dates for this period were obtained from the Main and Front trenches. This period dates from 2,000 B.P. to European contact.

The focus of this thesis is the first five thousand years of occupation, namely Periods 1 and 2. Henceforth this entire time span will be referred to as the Early Period (Carlson 1979). Because fine grained differentiation of layers in Stratum II is quite difficult if not impossible to ascertain, finer temporal divisions within Periods 1 and 2 cannot be made.

Ordinarily this would present a problem, since the artifacts in these two 'layers' may reflect many *specific* types of behaviours and activities performed at different times. In other words, the vagaries of time averaging would coalesce these different activities into a larger block of time, which obscures our ability to differentiate *specific* activities and correlative temporal periods. However for the purposes of this research, the objective is to decipher overall lithic reduction strategies in the Early Period, or to ascertain *general* patterns of technological activity over large periods of time. With this in mind, the present assemblage is treated as a palimpsest accumulation, where some mixing over time is not a serious problem. The assemblage is broken down and analyzed by period, providing some temporal control, however minimal this may be.

The lithic debitage sub-assemblage under consideration in the present research is derived wholly from the S.F.U. excavations of the Rivermouth Trench during the 1977-78 seasons. This sub-assemblage is restricted to the Early Period, and is only a part of the total lithic inventory from this period.

All lithic debitage are under consideration, with the exception of the quartz and obsidian materials. The latter are being analyzed as part of a separate study (Hutchings 1995). The following is a general summary of lithic artifactual material recovered from Namu (a more detailed description of the present assemblage is provided in Chapter 4).

## **2.5 Artifact recovery and culture history**

The total inventory of recovered artifacts from Namu spans a wide range of raw materials, technological attributes and archaeological 'types'. However this thesis is mainly concerned with lithic debitage from the Early Period, and so the following summary focuses largely on lithic artifacts from this time period. More detailed descriptions and summaries are presented elsewhere (Carlson 1979, 1995; Luebbers 1978; Hester 1978b). In general, the artifact assemblages from the Early Period are comparable to other early lithic industries on the Northwest Coast and points further (see below). There are a wide range of raw materials represented, most of which are not fine grained, except for a few such as obsidian.

The Colorado excavations yielded a total of 398 lithic artifacts from three Central Coast sites including Namu. This number includes both chipped and ground stone implements (Luebbers 1978:36). The latter are not of concern here, since they generally appear after the Early Period, with a few anomalous exceptions.

The chipped stone component is varied, the largest category is the microlithic component, made largely on imported obsidian. Other implements are made on coarser material, namely basalt. Luebbers characterizes the Early Period lithics at Namu as "a lithic industry composed of obsidian microblades, crude bifacial projectile points, large cores and core

flakes, and possibly large pebble choppers....recovered with these tools was a small amount of basaltic and obsidian debitage" (1978:62). The debitage referred to was not reported otherwise in this paper. However, of import in this study was the fact that the microblade industry had an antiquity of at least 9,000 years on the Central Coast.

The S.F.U. excavations greatly expanded the lithic artifact inventory, particularly in the Rivermouth Trench. In the 1977-78 seasons over 13,500 lithic specimens were recovered from Stratum II in this part of the site (Table 2). Of this, some 12,000 pieces were recorded as being debitage and slightly more than half of this debitage assemblage is the subject of the present study. The non-debitage lithic materials have been analyzed for stylistic and possible functional categorization, but have not been subject to technological analysis (Carlson 1979; 1995).

Whereas the Colorado study showed a large preponderance of microblades in the sample, the S.F.U. rivermouth excavations also yielded microblades, but these form only a fraction of the total assemblage. Slightly over 300 obsidian pieces were recovered, these are currently being examined in a separate study (Hutchings 1995). There are also microblades made on other materials but these are relatively rare (Table 2). The quartz material listed in this category may be indicative of a specialized bipolar industry, further comment on this will have to await full analysis (Carlson 1979).

The assemblage as a whole is largely dominated by andesite and basalt raw materials, followed by a number of other locally available igneous rocks and a much smaller number of sedimentary and metamorphic rocks. The non-debitage lithic materials have been classified as pebble tools; various flake based tools such scrapers and notches; a variety of bifaces including knives, preforms and points, and a few microlithic items (Carlson 1979; 1995). Ground

5000 B.P.	PERIOD 2					PERIOD 1								Total
	Test Pits	meters					below	surface			1A			
		2.3- 2.9	2.9- 3.0	3.0- 3.1	3.1- 3.2	3.2- 3.3	3.3- 3.4	3.4- 3.5	3.5- 3.5	3.6- 3.7	3.7- 3.8	3.8- 3.9	3.9- 4.0	
							1C 8000 B.P.	1B 9000 B.P.			1A 10,000 B.P.			
<b>MACROLITHIC INDUSTRY</b>														
Large cores	4			2		1	9	6	11	14	3	1		31
Core Fragments	4	6	18	33	14	102	45	151	191	99	63	43	5	774
Flakes and fragments	19	17	120	285	555	1791	2576	2509	2086	736	549	170	17	11,430
Levalloisoid flakes	2				2	1	5	1	11	6	5			33
Billet flakes					1	4	2	2	4					13
Macroblade cores	1					1								2
Blades					2	1	1		2					6
Pebble choppers, unifacial	4					2	3	3				1		14
Large core scrapers			1			5	6	6	10	4	3	5		40
Pebble Rasp									1					1
Denticulate scrapers	1	1		1	1	1	7	9	10	11	3			45
Thin edge retouched flakes	1			1	1	1	2	1	4	6	3	3		23
Utilized flakes	1	1		1	1	1	7	4	5	2	4			26
Notches								1	1	1	1			4
Spurs/gravers					1		2		2	1	1			7
Uniface exotics						1								1
Points, leaf-shaped			1	2	3	3	9	8	6	7	1			40
Points, incipient stem						1	1	1	1					4
Biface preforms	1		1		1	2	2	4	6	9	2	1		29
Broad, flat knives						3	4	4	12	6	3			32
Limaces				1			1							2
Limace preforms							2		1					3
Stemmed ovoid									1					1
<b>MICROLITHIC INDUSTRY</b>														
Bipolar cores, andesite									3					3
Microcores, andesite						1		1						2
Microblade cores, andesite								1						1
Microblades, andesite					2	2	1			1				6
Quartz flakes and chunks	37	2	4	69	67	140	143	101	40	5	4			612
Obsidian nodules	1													1
Obsidian bipolar cores	3		2	7	5	5	14	15	4					55
Obsidian bipolar flakes				1	4	2	4	3	2					16
Obsidian microcores	2			3	2	4	6	7			1			25
Obsidian microflakes	23	1	4	9	7	12	27	21	5					109
Obsidian microblades	18	1	3	1	6	8	10	5	2					54
Obsidian flakes & frags	2		1	1	1	1	4		1			2		13
<b>GROUND AND PECKED STONE</b>														
Hammerstones	1	1				1	1	1	1		2			8
Ground pebble	1	1							1					3
Grooved sinkers/bolas										1	1			2
Abraders	2							1	1	1				5
Ground knife							1			1				2
Edge ground cobbles	3													3
<b>Totals</b>	<b>131</b>	<b>31</b>	<b>155</b>	<b>416</b>	<b>676</b>	<b>2097</b>	<b>2895</b>	<b>2866</b>	<b>2426</b>	<b>910</b>	<b>649</b>	<b>226</b>	<b>22</b>	<b>13,501</b>

Table 2. Namu lithic artifact inventory, 1977-78  
Test and Rivermouth Trenches (After Carlson 1995)

stone implements are present throughout the sequence, albeit in low numbers.

Based on comparisons with Early Period lithic industries on other parts of the Northwest Coast, Carlson (1979, 1983, 1990, 1995) has constructed a model for cultural historical affiliations in this time frame. Sampling bias aside, the earliest material at Namu consists of unifacially flaked cobbles, leaf shaped bifaces, and flake based tools. This is also referred to generally as the "Pebble Tool Tradition" There is a noticeable rarity of microblades until roughly 8,500 b.p., Carlson suggests that this may be due to a temporal separation in the introduction of the two technological traditions, based on two distinct migrations.

The Pebble Tool Tradition is widespread on the Northwest Coast, and is widely believed to be related to wood-working (Borden 1975; Carlson 1990; Haley 1987). The distribution of this tradition suggests a correlation with a marine based economy; the vast majority of sites with Pebble Tools are located on the coast or close to ancient river terraces (Haley 1987). Carlson proposes that this tradition was brought down the coast at an early date, by peoples who may have originated in Northeast Asia, specifically Kamchatka (1990:67). This proposal is based on similarities in tool types and economies.

The Microblade Tradition on the other hand, is seen as a later technological type on the coast, introduced by a second wave of peoples, possibly originating in Northern Asia, and coming through the Alaska Panhandle (Carlson 1990: 67). These people are also ascribed as being marine oriented. Evidence for this southward migration of microblade using peoples is twofold; first there are no microblades in the earliest assemblages in other parts of the Northwest Coast. Second, when microblades start showing up, there is a temporal gradient in that the earliest microblades are to the north,

and these assemblages become progressively younger as one moves south.

While this evidence is compelling, other variables also need to be taken into account in order to understand the bases for these technological traditions. As outlined previously, factors such as raw material availability and group mobility need to be taken into account in any study on the organization and design of lithic technologies. The mechanics of delineating this process are discussed in the next chapter.

## Chapter Three: Theory and Method

### 3.1 Theoretical Background

During the last two decades, there has been much discourse on theoretical considerations regarding lithics in archaeology (Binford 1977; Bleed 1986; Kelly 1988; Nelson 1991; Parry and Kelly 1987; Torrence 1983, 1989). Much of this discourse has centered on the interplay between lithic systems and settlement patterns, and collectively this has resulted in a new conceptual framework for lithic archaeology. Rather than viewing lithics as static forms created in simplistic technological schemes, the new approach seeks to integrate lithic technological systems within the larger framework of cultural organization over the landscape. As such, the *dynamics* of technological behaviour are emphasized (Nelson 1991, emphasis original). This approach has been referred to as the study of *Technological Organization* (Nelson 1991).

The impetus for this theoretical direction came from Lewis Binford (1973) through his research on assemblage variability in the celebrated Mousterian debate. Subsequently, Binford (1977, 1979) became specifically concerned with how different factors contribute to assemblage variability, for example variables such as raw material availability, location of manufacture versus location of use, tool maintenance, and discard. Among the salient general features that emerged in his works, two are of note. First, that *all* lithic materials should be viewed as products of reduction trajectories as opposed to schemes in which only some aspects of the lithic systems (such as formed tools) are emphasized. This was certainly not a new idea, others had previously adopted this stance (Collins 1975; Muto 1971, 1976). What was new and perhaps crucial for the development of the study of technological organization, was Binford's placing of this lithic system within a framework

of hunter-gatherer organization over the landscape.

It was in this context that Binford (1973, 1977, 1979) introduced the concepts of *curation* and *expediency*. These terms have since been defined in a number of ways by various researchers (Nelson 1991:62). In general curation involves maintenance and care for tools/toolkits, and can be manifest in several ways. Transport, resharpening, caching and advance manufacture are examples of this. The critical difference between curation and expediency involves a difference in time and place of manufacture of lithic implements; in curative strategies procurement and preparation of raw materials are done ahead of time of actual use of the implement. Therefore the individual or group anticipates the lack of "suitable conditions" at the time and place of use (Nelson 1991:63). Suitable conditions would include time and availability of materials.

For example, curation might involve preparing a core for future use in areas devoid of lithic raw materials. Bifaces are a good strategy in such situations since a well prepared biface functions adequately as a tool, but is also a reliable source of sharp flakes (Kelly 1988). Situations in which time is constrained would also predicate much curational behaviour. This can be illustrated in areas where certain nutritional sources are available for only a short time period during the year, but they are harvested with great intensity.

Such is the case in Binford's (1978a, 1978b) study of the Nunamiut, where the seasonal availability of caribou meant that these people only have access to this resource for brief periods in the year. When the caribou did arrive there was a brief but intensive harvesting, most of the meat was stored or cached for future use. Although modern weaponry were also in use, one can envisage a prehistoric scenario where more traditional implements were the sole types of technology. Because the Nunamiut depend largely on stored



meats for survival, success in these caribou harvests would have been crucial. Failure to procure the required amount of nutrition for future purposes would have been detrimental. In view of this, the technological system would have to operate with great reliability during the intensive harvest.

Moreover, time would be a great constraint during the harvest situation, there would be little time available to manufacture and maintain lithic tools. Therefore, these were prepared well before the hunt, in anticipation of a lack of suitable conditions at the time and place of use. This preparation would have been conducted in the months when little hunting was done, in periods of what Binford refers to as "down time" (Binford 1978a, 1978b). At this time the Nunamiut subsist largely on cached caribou meat, and other locally available resources. This allows for greater concentration time on pursuits that do not relate to immediate sustenance needs. A somewhat analogous situation may have occurred on the Northwest coast where a similar time constrained yet intensive resource was exploited, however this needs to be investigated further.

Expediency on the other hand involves a reduced level of care and maintenance of tools/toolkits, this is facilitated through knowledge or anticipation of sufficient time and materials at the place of use. Nelson (1991:64) summarizes at least three conditions which must be satisfied in expedient behavior:

- 1) locating activity areas close to sources of raw materials or stockpiling raw materials close to activity areas
- 2) substantial occupation or reuse of the area to take advantage of stockpile (cf. Parry and Kelly 1987)
- 3) reduced level of time stresses on tool making (cf. Torrence 1983).

Parry and Kelly (1987) surveyed data from a variety of North American prehistoric sites and found that in most cases, a trend towards greater sedentism after the mid-Holocene was accompanied by a shift towards greater technological expediency. This is attributed to the need to stockpile raw material in or near long-term occupation sites. The cost of curation in such a situation is deemed as unnecessarily high since a reliable source of material would be present, and would probably be replenished as needed. However this assumes that a raw material source is continually accessible, there are many factors which can dramatically reduce or deny access to raw material sources. Changes in regional physiography for example may cut off human access to sources, similarly changes in social relations between neighbouring groups could also affect access to raw materials. In temperate climates, seasonality may also be a factor in access to raw materials, for example in areas of high snow cover procurement would be constricted (Hayden *et al.* n.d.). Nevertheless, this general correlation between sedentism and expediency is an interesting pattern in the Parry and Kelly study.

Expediency and curation need not operate in a mutually exclusive fashion, both strategies can be employed simultaneously. Flakes removed, used and discarded near an area of stockpiling can be considered as expedient. However if the core from which these flakes were removed is then transported to another area for use, this would be curation. These systems can be quite complex behaviourally, and so concepts involving curation and expediency are constantly being refined.

More recently *design* of lithic systems has been emphasized as a focus of study. This term refers to "conceptual variables of utility that condition the forms of tools and the composition of toolkits" (Nelson 1991:66). Several related concepts have been proposed in the literature, including *reliability* and

*maintainability* (Bleed 1986), *flexibility* (Goodyear 1989; Parry and Kelly 1987; Shott 1986), *versatility* (Nelson 1986; Shott 1986), and *transportability* (Binford 1979; Kelly 1988; Nelson 1991; Shott 1986, cf. Nelson 1991). These concepts serve to identify various factors that might contribute to the design of lithic toolkits. There is some confusion regarding these categories, as many overlap. Moreover there has been a problem in operationalizing some of these concepts (Hayden *et al.*, n.d.). In any case, there are some general positive results that are emerging from these discussions, and there are recent attempts to apply these concepts to real archaeological data (Hayden *et al.*, n.d.; Torrence 1989).

This theoretical framework is based largely on principles derived from optimal theory in which some currency is used to measure relative costs (Foley 1985). For lithic archaeology there has been some debate as to the pertinent currency (Torrence 1989), although time and energy are the two most commonly used. The use of an optimal framework in any aspect of archaeology is not without controversy, there is no widespread agreement in the usage of these types of frameworks to interpret human behaviour (Hodder 1986).

However an argument can be made that some levels of human behaviour face greater environmental (used in the most general sense) constraint than others. Furthermore, these levels of behaviour are *more likely* to approximate optimal behaviour. Note that this is not necessarily a deterministic relationship, but rather a complex one which consists of a number of possible factors. Inherent in this way of thinking, is that many variables need to be considered before the exact mechanics of causality can be established.

The primary immediate goal of any organism is subsistence, without

which reproduction nor any other long term goal cannot be attained. Given that humans rely greatly on technology to procure and process nutrition, it follows that technology will be a high consideration in any human culture. However concerning the design and manufacture of traditional technologies, there would have been several environmental constraints present such as access to raw material, and the specific purpose or "tasks" of the technology. Access to raw materials can be constrained by physiographic and/or social factors as described previously, but also by the residential mobility of the group. Residential mobility would also affect the design of technology in other manners, a highly mobile group for example would likely travel with minimal material possessions, and the design of the technology may be expected to reflect this factor.

These constraints play a large role in the design of technological systems. As such, we can argue that availability of materials will play a seminal role in how those materials are used. In areas of high constraints, we may expect to see a more "cost-effective" technology. Although decipherment and quantification of these constraints is problematic, current research is making some progress in this direction. The point is that at this level of human behaviour where the stakes are very high, we can expect to see some level of optimal behavior as far as technology is concerned. A similar argument would be more difficult to apply in higher levels of behaviour, such as in social or ideological realms.

However there is one major problem within this type of framework in lithic studies. In previous conceptual frameworks, the focus has been placed on aspects of style to determine some measure of ethnicity. The basis for this thinking is that similarities and differences in perceived "styles" inherent in material culture may reflect relationships among groups in time and space.

These older frameworks have not considered other variables as have been outlined above, they are therefore limited in the behavioural information they can yield. With the new conceptual framework, the concept of style is not included, all variability is linked to adaptational principles (although Binford has discussed the concept of style within an adaptational framework, his arguments are unconvincing). The pendulum therefore has swung to the extreme opposite. At present our understanding of the role of style in lithic systems or in any aspect of archaeology is far from complete (Hegmon 1992), but this does not mean that we can simply ignore this factor. Future research in lithic archaeology would be fruitful if a more comprehensive exploration were undertaken into the role of style in the design of lithic systems.

Suffice to say, the study of any lithic system should incorporate all aspects of that system, including raw material availability, reduction strategies, implement use strategies, and mobility strategies. With the realization of this new conceptual framework came the realization of the importance of lithic debitage. This class of material has been largely ignored in the past, but is now at the forefront of studies on archaeological lithics.

### **3.2 The Study of Lithic Debitage**

The study of lithic debitage is a relatively recent phenomenon in archaeology. Historically most researches have focused on formal tools and implements, and have shunned studies of debitage. One reason for this situation is that in order to understand debitage, one must be well acquainted with lithic reduction sequences. This of course can only be fully understood through experimental flintknapping. In the past it was common for academics who studied archaeological lithics to have a limited background in flintknapping, this situation has changed in present times, most academics

involved in lithic research also practice flintknapping to varying degrees of proficiency.

Another reason for the previous lack of studies on lithic debitage is that the conceptual frameworks employed could not accommodate this class of material. This is particularly true in schemes where formal tools are emphasized in order to delineate spatio-temporal relationships between groups. Such frameworks often tend to visualize lithic artifacts as being the construct of a "mental template" embodied within the mind of the maker. Hence, formed tools are essentially the final products as visualized by the ancient knapper, and so the debitage from manufacture of these implements cannot yield any more useful information. More recent research (Dibble 1985; Flenniken 1985) has shown that a single artifact can pass through several stages, and can have very different morphologies and uses during its reduction cycle. In such cases, only the most recent morphological changes can be expected to be manifest on the implement itself, and following this, only the debitage can reveal any previous reduction operations and possible functions of the artifact.

The importance of debitage was realized as far back as 1890, by William Henry Holmes. Holmes was an astute observer of lithic technology, and was particularly fascinated by quarry sites. In describing one of the latter, he stated:

A careful study of every shade of form shows that more are broken than remain in the workshop entire, and I may add that had every entire flaked tool been taken from the spot the record would remain, and with a certainty that is absolute (Holmes 1890:12, cf. Muto 1976:139).

Holmes was aware that by examining debitage, reduction strategies could be discerned. More importantly, he realized that debitage could indicate the type of activity even in the absence of formed tools. This is a very important

potential of lithic debitage, considering that lithic materials are not prone to the vagaries of preservation as are other materials.

A salient feature of debitage is that it is not a transported class of archaeological material. Barring situational post-depositional processes then, we can expect to find debitage in the location of original discard. Because of this, debitage can be a good indicator of settlement patterns employed by past peoples (Binford and Quimby 1963; Magne 1985). Different types of reduction strategies over a landscape can be very revealing of land-use patterns, and this can potentially be discerned from debitage. Formal tools on the other hand are subject to transport, and can be discarded at locations other than where used and/or manufactured.

Examination of debitage at archaeological sites leads to interpretation of reduction strategies. This in turn can give clues as to the function(s) of the site. For example, imagine a hypothetical site in which only late stage biface reduction flakes, along with diagnostic finishing flakes (e.g. notching flakes) were found. The debitage would indicate a projectile point manufacturing site, and also that the bifaces were being reduced to an early/middle stage elsewhere before being brought to this location. Note that this interpretation could be made even in the complete absence of projectile points at the site. Furthermore, any analysis of material from this site which did not include lithic debitage would lead to incomplete or even erroneous interpretation.

In order to fully assess any behaviours reflected in archaeological materials though, all representative materials should be analyzed. In other words, at any site *all* components of a lithic assemblage should be analyzed if a more complete reconstruction is desired. This procedure is now widely pursued by lithic analysts all over the globe (Toth 1982, 1985; Peer 1994).

### 3.3 Methods for Analyzing Debitage

A number of strategies fordebitage analysis have been developed in the last two decades (Amick 1989; Amick and Mauldin 1989; Sullivan and Rozen 1985), these can be placed within two general approaches. The first approach advocates analysis of individual flakes, based on varying criteria. Within this approach there are several schools of thought with regard to methodology. Two will be focused on here, Magne's (1985) scar count method, and Sullivan and Rozen's (1985) flake completeness approach. The latter will not be used in its original form but rather in a slightly modified version.

The second general approach espouses analysis of flakes as aggregates, where the emphasis is shifted from examination of individual specimens to entire assemblages. The most widely known of these flake aggregate methods is mass analysis, as reported by Ahler (1989a, 1989b) and his associates. This method is also employed in the present research in conjunction with the individual flake analyses described above.

A key factor in all studies ofdebitage is the necessity of experimental work. Experimental samples have two purposes; they lead to an understanding of the variability involved in lithic reduction, and they serve as reference collections to interpret reduction strategies through archaeologicaldebitage. For the present research, there is no experimental analogue available for the Namu assemblage *per se*, but all of the researches described above include experimental data for comparison. The major problem with this is differences in raw material, no experimental studies have been conducted on raw materials similar to the ones found at Namu. Consequently, there are two available options; one is to build up an experimental sample based on the Namu raw materials, which would take more time than was available in the present research program. The other



option is to use the results of other experimental researches, with the awareness that differences in raw material add some factor of random variability.

### 3.3.1 Magne's scar count method

During the 1970's and 1980's some effort was directed at investigating variability in lithic debitage. One approach favoured a simple typology of flake reduction based largely on the amount of cortical cover on flakes (Francis 1983; Stafford and Stafford 1979). A tripartite classification is used, whereby *primary* flakes exhibit the greatest amount of cortex and are therefore assigned to early stages of reduction, *secondary* flakes exhibit some cortex and are therefore assigned to a middle stage, and *tertiary* flakes which exhibit no cortex and are therefore assigned to late stage reduction. Although this typology may be useful in certain situations, it is overly simplistic for most applications.

Many factors need to be considered when assessing the role of cortical variation in reductive operations. The initial form of the core needs to be considered, a blank obtained from a quarry source may not have any cortex to begin with (Dibble 1985), this would skew the flakes towards the tertiary category in the above scheme. On the other hand a reduction sequence performed on a small river rolled cobble will have a different cortical pattern.

The type of reductive strategy will also have bearing on amount of cortical cover. Research (Ahler 1989) has demonstrated that cortical cover can be present at any stage of reduction, including the later stages. This is taken to indicate that cortical cover in itself is not a useful variable in discerning reduction stages, and Mauldin and Amick (1989) argue that only early stage reduction can be identified with any confidence using this method.

A more comprehensive approach of stage reduction espoused a systemic approach in which lithic materials were plotted in flow streams beginning with raw material procurement, followed by reduction sequence, use and discard (Collins 1975; Newcomer 1971). In this sequence the reduction aspect is viewed as a linear operation beginning with initial core reduction, thinning, final shaping and discard (somewhat simplified). The initial stages are conducted with hard hammer percussors, including the rough shaping of the core or implement. This is followed by soft hammer operations where thinning and further shaping take place, and finally if applicable, pressure flaking is performed for final shaping and edge work to accommodate hafting etc. (see also Callahan 1979). These are based on experimental evaluations on wide ranges of knapping operations.

Even so, this is an admittedly arbitrary model of reduction that may not be applicable to all archaeological contexts of flintknapping. There have been valid criticisms leveled at this method, in that lithic reduction operations are not always linear, the knapper can pursue a different type of reductive method at any time during the sequence (Morrison 1994:20). On the other hand given that we know very little about the actual variation in reduction strategies in archaeological contexts, it is logical to begin with generalized models (Magne 1985). A valid point raised by Magne in this regard is that lithic experiments should be eventually designed to model *particular* archaeological assemblages, so that the reductive strategies can be understood in their own contexts. Variables such as the petrographic nature and availability of raw material, and function of the tool may have had great bearing on the actual reduction strategy employed by ancient flintknappers.

Regardless, researchers carried out experimental and archaeological assessments of debitage using generalized reduction models. A prime

directive in some of these researches was to determine which particular attributes of debitage are useful for determining reduction strategies. Some researchers had devised long lists of attributes for use with univariate and multivariate statistical techniques, for example Phagan's (1976) list of 28 variables. There are two inherent problems with this, first that long lists that are not based on experimental replication are difficult to assess in archaeological contexts (Magne 1985:108). Second, many of these variables are redundant, and given the time and energy needed to collect these data especially with large assemblages, this can be an unnecessarily wasteful endeavor. In view of this situation, Magne and Pokotylo (1981) and Magne (1985) strived to reduce the list to eight non-redundant variables in the former study and six in the latter, this was done through experimental observations. The latter research is adapted for the present study.

Magne's (1985) study was designed to analyze lithic assemblages from several archaeological sites in the southern Interior of British Columbia. This was done through a combination of experimental and archaeological observations. In general, Magne's experimental program was designed to model the lithic assemblages found in this region. Based on this analysis, he was able to make some interpretation on settlement and land-use in the archaeological context.

Essentially two types of debitage are envisioned by Magne (1985), those with a remnant striking platform (Platform Remnant Bearing - PRB), and those without a remnant platform (Shatter). Each of these categories subsumes a specialized flake type; Biface Reduction Flakes (BRF) are specialized Platform Remnant Bearing flakes that occur late in the reduction sequence. They are characteristically acute angled, and have multifaceted platforms, these attributes are recognizable in experimental biface reduction

assemblages. Bipolar (BIP) flakes on the other hand are a special type of Shatter, they are flakes produced through bipolar bashing where impactive force is evident from two opposite directions. Due to the nature of this strategy bipolar flakes rarely exhibit platforms, therefore they are a special class of Shatter. There is some subjectivity involved in the identification of the specialized flakes as Morrison (1994) points out, however Magne (1985:127) states unequivocally that the experience of the analyst plays a large role in the ability to identify these flakes. In other words, a background in flintknapping is probably essential if one wishes to use this method.

Six variables were initially chosen to analyze the debitage, with the intention of classifying the material into some stage reduction sequence. These are: weight of each flake, dorsal scar count, dorsal scar complexity (essentially the number of directions from which dorsal scars originate), platform scar count, platform angle, and cortex cover (Magne 1985:113). This list was narrowed down further in order to differentiate between block core reduction and tool production. For PRBs Magne argues that the platform scar count is the most important variable, likewise for BRFs, although by definition the latter would be expected to have more platform scars. For shatter, Magne argues that the dorsal scar count is the most important attribute.

Three stages of debitage are classified, *early*, *middle* and *late*, depending on when the flake was knocked off in the reduction sequence. In this scheme, early stage debitage is represented by PRBs with 0 or 1 platform scar, and shatter with 0 or 1 dorsal scar. Debitage classified into middle stage are PRBs with 2 platform scars, and shatter with 2 dorsal scars. Late debitage are PRBs with 3 or more platform scars, and shatter with 3 or more dorsal scars. By definition BRFs would fall into the late stage of reduction.

It should be noted that general patterning in assemblages is the goal, rather than assessing an entire assemblage based on one or a small number of flakes. Therefore, an assemblage with a large amount of *early* flakes is indicative of core or early stage reduction, whereas a predominantly *late* assemblage would indicate largely tool production. The *middle* category is more difficult to assess, but it could encompass some core reduction, and initial shaping and thinning. This patterning at the assemblage level is important since BRFs can be produced in low number during bipolar bashing (Magne 1985), similarly flakes with late stage attributes can be produced during initial core reduction (Ahler 1989a).

The advantages of this method are that once recognized, the attributes are fairly easy to identify on debitage. Magne (1985) had very positive results using this method, however others (Ingbar *et al.* 1989; Morrison 1994) have had less success. This may be partially due to the design of Magne's experimental aspect, that is his experimental research was designed to model assemblages from the southern Interior of B.C. This may not be fully applicable in all situations.

Disadvantages relate to training, this is not a method that can be easily carried out by individuals with no training in lithic technology or flintknapping. Many of the attributes (such as on BRFs) are more easily recognized as one becomes more experienced with knapping lithic materials. Odell (1989) notes that even a simple operation such as counting flake scars can yield different results between individuals. This factor can probably be ameliorated somewhat by a comprehensive knowledge of the raw material in question, in terms of natural properties and fracture mechanics. Another disadvantage is that this method is a bit more time consuming than the others, for extremely large collections this can be a problem.

### 3.3.2 The Sullivan and Rozen flake completeness method

Classic studies of debitage have favoured classification of waste flakes into preconceived type categories. These have been criticized as being subjective and unreliable (Sullivan and Rozen 1985). Others have espoused examination and quantification of certain attributes, such as edge angles, dorsal scar counts, etc. However there has been some debate as to which of these attributes are relevant in deciphering reduction strategies (Magne and Pokotylo 1981). There has also been a problem in discerning non-redundant variables, and this has led to studies of debitage variability, through experimental and archaeological samples (Magne 1985).

Because each flake has to be measured for attributes, this type of study can be very laborious and time consuming. For example Magne (1985) reports that it took 6 months of continuous work to measure a series of attributes on a sample of 1,000 experimental flakes. In analyzing large archaeological samples, this method would clearly be disadvantageous, particularly in situations of time constraint.

In view of these disadvantages, Sullivan and Rozen (1985) introduced a new method of individual flake analysis, with the aim of avoiding some of the ambiguities in the above approaches. At the same time they wished to cut down the amount of time required in data collection. Their method involves classification of debitage into a typology based on flake completeness, which they claim allows for sufficient differentiation between core and bifacial reduction strategies.

The primary criterion in this scheme is discerning a single interior surface (Fig. 4). Flakes without this attribute are classified as *debris*, while those that do exhibit the attribute move on to the next level. If a point of applied force is present (striking platform or fragment thereof) the flake

moves on to the next level, and those without this attribute are considered *flake fragments*. Flakes with a single interior surface and point of applied force are then examined for margins, those with intact margins are classified as *whole flakes*, while those without intact margins are *broken flakes*.

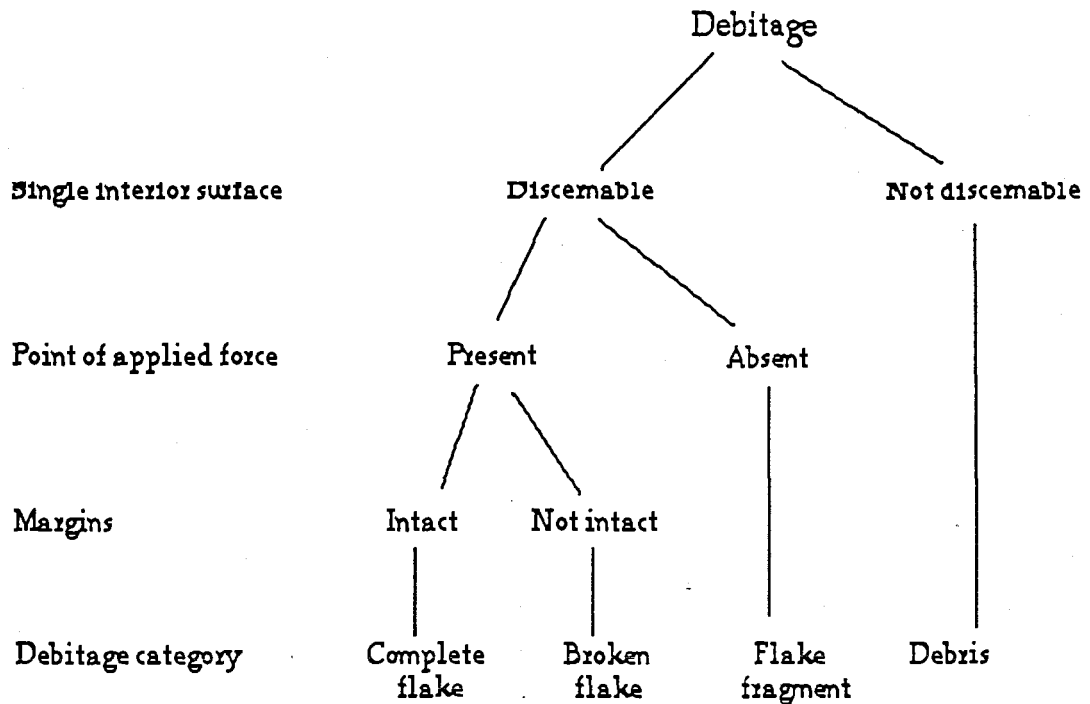


Figure 4. Flake completeness scheme (after Sullivan and Rozen 1985)

This scheme has caused much debate in the literature, and has been subject to criticism (Amick 1989; Baumler and Downum 1989; Ingbar *et al.* 1989; Prentiss 1993; Prentiss and Romanski 1989). The major point of contention is that the scheme is not based on any experimental analogues, rather Sullivan and Rozen developed their typology through examination of archaeological material. This would have the potential of circular reasoning. A second criticism is that trampling of lithic assemblages could have the

potential to distort type frequencies, resulting in incorrect interpretations (Prentiss and Romanski 1989). However, this criticism applies to all analyses of lithic debitage, particularly in contexts where living floors have been discerned. In any case, the Sullivan and Rozen scheme does seem to work in most examples, although apparently not for the reasons that the authors initially thought (Prentiss and Romanski 1989).

Prentiss and Romanski (1989) argue that this typology is incomplete, and add a further category. In their scheme five categories are employed; *complete flakes*, *proximal flakes* (equivalent to Sullivan and Rozen's "broken flakes"), *medial distal flakes* (equivalent to Sullivan and Rozen's "flake fragments"), *non-orientable* fragments (equivalent to Sullivan and Rozen's "debris"), and an extra category of *split flakes*. This last category comprises flakes which have a platform remnant, but the force of impact has split the flake longitudinally. Given these refinements, in the present study the Prentiss and Romanski modified version is employed rather than Sullivan and Rozen's original method. Moreover, Prentiss and Romanski provide experimental data for reference.

Advantages of this method include the rapidity with which it can be accomplished, even though each piece of debitage is being examined. Furthermore less training is required in recognizing attributes than in the Magne approach. The Sullivan and Rozen flake completeness attributes can be learned quickly by anyone with a basic grounding in lithic technology. It is therefore somewhat less subjective than Magne's scar count method, nevertheless there is room for interpretation in each category.

Disadvantages center on the fact that Sullivan and Rozen's initial paper was based on archaeological samples rather than on experimental assemblages. This has been rectified to a degree in other researches (Baumler



and Downum 1989; Prentiss and Romanski 1989), however more experimental work is needed in order to gain a better understanding on the validity of the method.

### 3.3.3 The mass analysis method

Over the last two decades, a group of researchers (Ahler, 1989a, 1989b; Patterson 1982; Stahle and Dunn 1982) have been developing a strategy for analyzing debitage through flake aggregates, rather than through individual flakes. Stanley Ahler has emerged as the staunchest recent proponent, with his particular approach, termed *mass analysis*.

The method revolves around a size sorting of debitage, into four size grade categories. This is usually done by employing a set of nested screens with varying mesh size. Through experimentation, Ahler has determined that the optimum set of screens would include 1", 1/2", 1/4", and 1/8" mesh sizes (Ahler 1989:100). These are termed G1, G2, G3, and G4 size grades, respectively. Once the debitage has been size sorted a small number of variables are recorded for each grade, namely number of flakes, weight of flakes, and number of flakes with cortex.

Based on years of experimental and archaeological research, Ahler (1989a; 1989b) has demonstrated the utility of this method. The basic premise is that different reduction strategies should have distinct patterns when sorted through size grades, especially when dimensions of weight and cortex are added. For example, an initial core reduction assemblage will likely show a heavy weight distribution in the larger size classes, along with a higher number of flakes with cortex. Likewise a tool manufacture assemblage is likely to show most of the flake weight towards the smaller size grades. The cortex cover in each size grade can be indicative of the initial size of the

nodule on which knapping operations were conducted. In some cases, it may be possible to differentiate between different percussor types.

These variables can then be quantified and compared with experimentally produced results. Ahler argues that it is possible to determine reduction strategy with this method, as each strategy will have a diagnostic pattern in the combination of the three variables. Ahler and his associates have been building up a large data base of results from experimental knapping operations (Ahler 1989b). However, most of these experiments have been done on a limited suite of raw materials, such as Knife River flint and Crescent chert.

Once these data are collected, they are compared to results from experimental collections. A variety of simple and complex statistical techniques can be applied at this stage, depending on the nature of the assemblage. In this manner the reductive operations are apparent, Ahler and associates (1989a) have had good success in applying this technique to archaeological sites in the northern Plains and elsewhere.

There are several advantages to this approach. All of the debitage are examined, as opposed to schemes where only whole or partial flakes are emphasized. The time required for analysis is shortened considerably, and there is less of a factor of subjectivity, as all results are replicable (Ahler 1989:89). The data collection is very simple and requires the least amount of training of all the methods used in the present study. These results are replicable and in a sense, are probably the least subjective of all methods as well. Moreover the time needed to analyze collections is reduced when compared to individual flake analyses, with large collections this can mean a drastic reduction in time needed for analysis. Because Ahler and his associates have been working in this vein for a number of years now, there is a large

experimental database accumulated which is far more comprehensive than for any other method.

The main disadvantage is the inability of mass analysis to deal with technologically mixed samples, although Ahler (1989:89) indicates that there is some promise towards resolution in this regard. Another disadvantage is that this method may not have the kind of resolution in tracking particular reduction strategies especially in technologically mixed assemblages (Morrison 1994). Ahler's experiments have been conducted on a limited suite of raw materials, which is a similar problem to the other experimental databases, and this is a disadvantage.

### **3.4 Discussion**

There is a problem encompassing all of the methods described above, in terms of relevance for the Namu assemblage. The flaking properties of the materials at Namu are obviously different than those utilized by Magne, Sullivan and Rozen, Prentiss and Romanski, and Ahler and associates. As mentioned previously there is no known comprehensive experimental data set that utilizes the coarse grained materials as found at Namu. This adds a quotient of uncontrolled variability for the present research, since patterning seen in the Namu debitage may differ from the above researches simply by virtue of raw material properties.

In view of this situation, all of the above analytical methods are used in the present research. To reiterate, these are Magne's (1985) scar count method, a modified Sullivan and Rozen (1985) flake completeness method, and the mass analysis method. All of the debitage in the assemblage have been subjected to these methods. By combining these different approaches it is hoped that any resulting interpretations will be more robust, especially in

view of the raw material problem.

**Chapter Four:  
Description of sample,  
results and discussion of analyses**

**4.1 The Assemblage**

The present assemblage is derived from Periods 1 and 2 in the Rivermouth Trench, from the S.F.U. excavations in 1978. The debitage is a part of a larger assemblage, which is described elsewhere by Carlson (1979, 1995). This material was excavated using a combination of natural layers and arbitrary levels. All Early Period matrix was water screened through 1/8" mesh.

Some 6,288 pieces of debitage have been analyzed, using the analytical approaches outlined in Chapter 3. The rest of the assemblage consists of various formed tools including bifaces, scrapers, prepared cores, retouched flakes and more. The entire collection has been viewed cursorily from a technological point of view, however formal analysis will have to await completion of this round of research.

In general, the raw material can be characterized as being very hard igneous rock and for the most part, not fine-grained. This is evident upon first glance of the assemblage, numerous tools and pieces of debitage exhibit multiple hinge and step fractures, which are largely due to the incipient fracture mechanics inherent in this material. Very few pieces display signs of pressure flaking, which would be extremely difficult if not impossible with some of this material. As such the raw materials posed limitations on biface thinning and very fine working. Nevertheless the inhabitants of Namu were able to fashion these raw materials into a variety of forms, and most likely these were used for a variety of tasks. This is rather impressive and attests to their skill and knowledge of flint knapping.

Classification of the raw material proved to be more difficult than

expected. When assessed on macroscopic visual attributes, many of the raw materials grade into one another, and only a few are diagnostic. In light of this, aid was sought from Professor Colin Crampton of the Department of Geography at Simon Fraser University. With his assistance, four general raw material categories were delineated; andesite, basalt, trachyte, and miscellaneous.

*Andesite* is the predominant material in the debitage collection. This igneous rock is fairly widespread in areas where there are coastal mountains, such as in British Columbia. It is softer than basalt on the Mohs scale, and somewhat easier to work. In general, andesite tends to be lighter in colour than basalt, although there are exceptions to this (Cox *et al.* 1973). In the present collection, colours range from grays to blues to greens. This material class comprised 49.8% of the total sample under consideration.

The second most prevalent material is *basalt*. Basalt is generally very hard, and quite dark in colour. There is some variation in this category, ranging from a small amount of fine grained basalt to medium and coarse grained. The latter two dominate the general basalt category. Some of this basalt is laminated and has very planar fracture patterns, as such it can be confused with slate. In the present sample, the colours range from dark grays to dark blues. Differentiation between basalt and andesite was not always easy, however in the final analysis, some overlap in identification between these two categories is not detrimental. Both materials are suspected as having similar procurement and reduction patterns. Approximately 31.3% of the materials were classed in this raw material category.

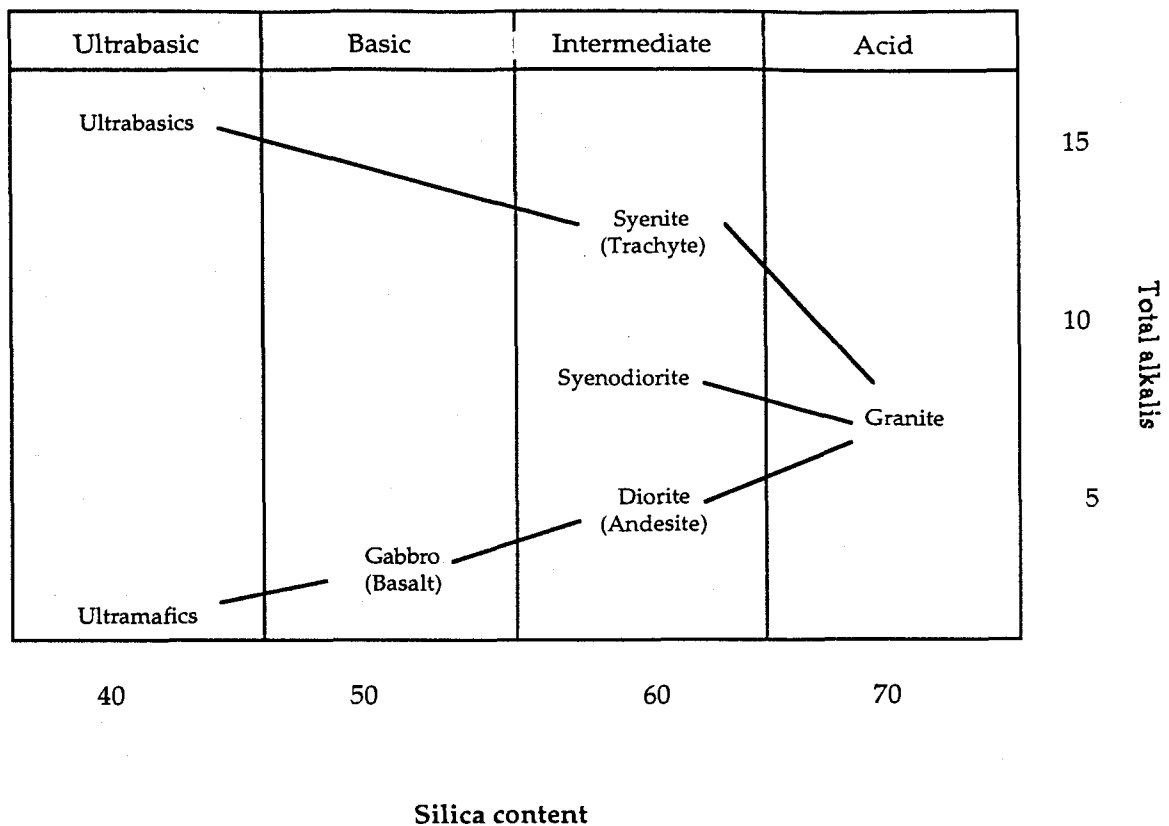


Figure 5. Alkali-silica diagram showing positions of igneous rock families (after Cox *et al.* 1973)

The third most predominant material at 6.6% is *trachyte*. This material and andesite are quite close in general characteristics. They differ in the amount of alkalis they contain (Fig. 5). To confuse matters further, their general textures as well as colours overlap. For the purposes of this study, most of the material used in pebble/cobble reduction has been classified as trachyte. Although undoubtedly, some of the materials classified as andesite probably belong in the trachyte category. The separation of the green trachyte was also necessary for functional reasons; this material was used quite differently than were the basalt, and andesite (which may include some non-green trachyte).

The fourth raw material category is termed *miscellaneous*. There are several types of raw material lumped into this category, since for the purposes of the analysis, none of these seem to occur in large enough numbers to warrant a separate category. Included in this material class are quartzite, microgranite, sandstone, limestone, and others, together this class consists of 12.3% of the research sample. This category is not useful in the analysis, due to the mixture of raw materials. However, analytical procedures treated this category as if it were a single raw material class, but results are used very cautiously in the final interpretations.

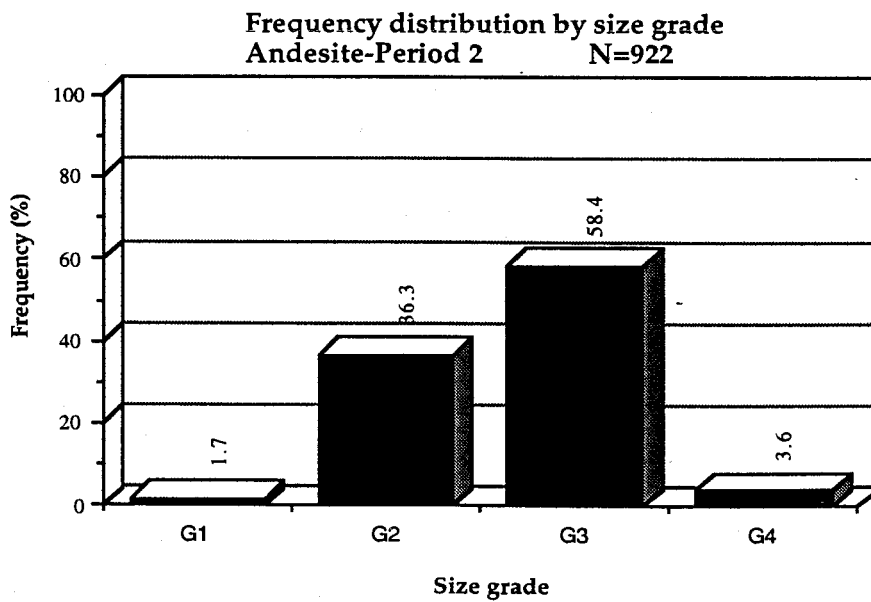
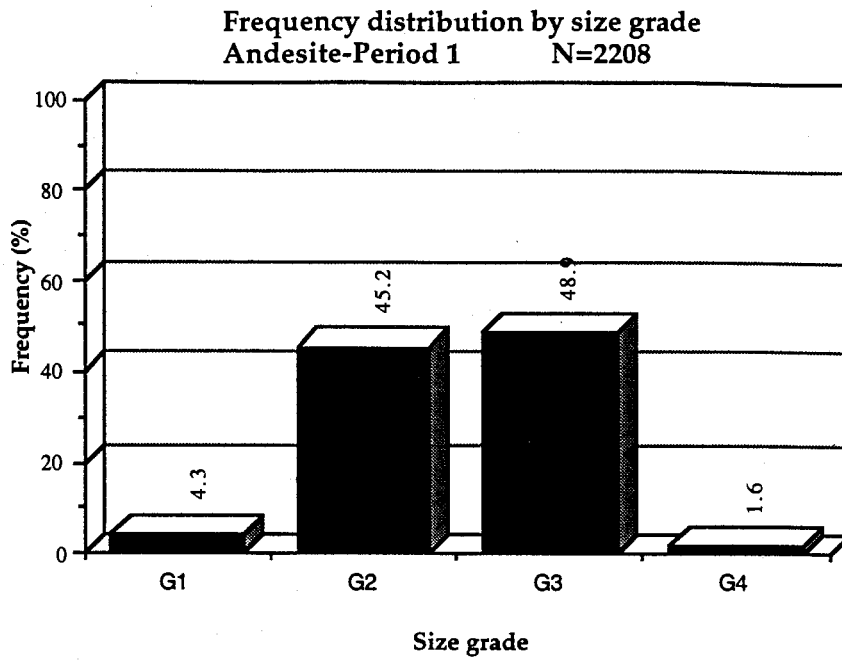
#### **4.2 Results of the Mass Analysis**

The principles of mass analysis predict that there should be patterning in numerical distribution, cortex, and flake weight per size grade, and that this patterning will be reflective of the reduction strategy. Distribution of flake size numerically is normally not a very useful variable in itself, the following charts are presented mainly to compare frequencies between Periods 1 and 2.

Figure 6 shows the distribution of andesite debitage in Periods 1 and 2. There is a general lack of specimens in the largest (G1) and smallest (G4) size categories. This pattern does not match any of Ahler's (1989a) experimental results with chert, the G2 and G3 values are anomalously high. This could be due to the absence of G4 flakes, which tend to numerically dominate all knapping operations (Patterson 1982). This absence would over-inflate the representations of other categories.

Many of the andesite G2 and G3 flakes exhibit diagnostic features of biface reduction flakes. Frequencies of flakes are slightly different between periods. In Period 2 there is a slight increase in the frequency of G3 flakes, at the expense of the G2 category. Intuitively, this indicates a slight shift toward





**Figure 6. Frequency distribution by size grade - Andesite**

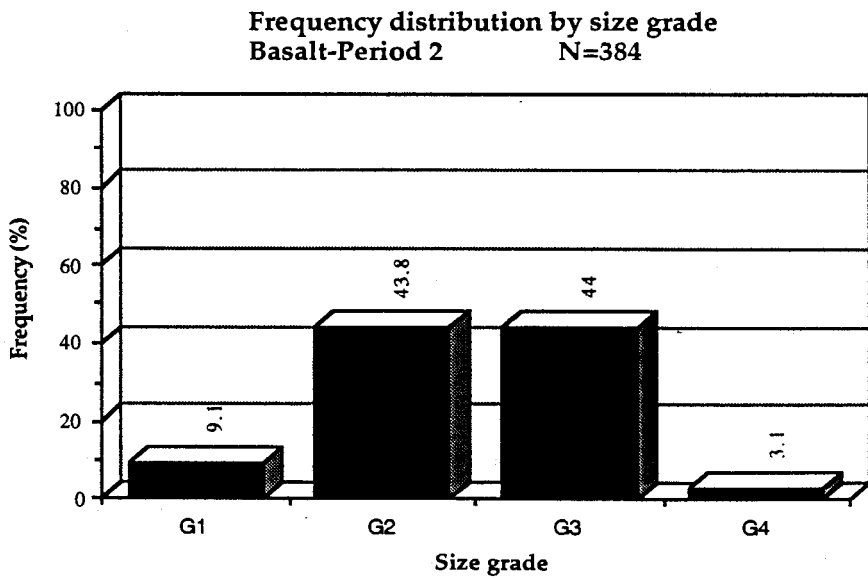
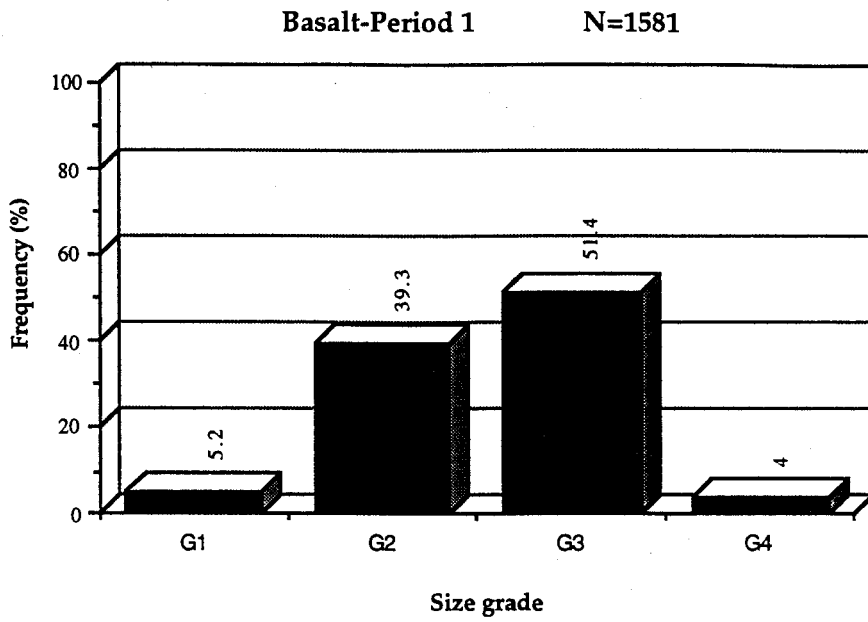
more later stage biface reduction, however this needs to be tested experimentally.

For the basalt (Fig. 7) there is general consistency in the frequency distribution between periods. The highest percentage occurs in the G3 category, followed by the G2 category. Once again, the lack of G4 debitage means that these values are over-inflated. The actual pattern is difficult to decipher, however it is broadly similar to that exhibited by the andesite. However, other comparisons (see below) indicate that the two materials may have had slightly different reduction patterns. Qualitatively, the basalt feels like it would be more difficult to work than the andesite.

The trachyte (Fig. 8) also displays good continuity across periods. This pattern however is quite different from those of the basalt and andesite. The G2 category dominates numerically here, with a substantially lower percentage of G3 flakes, followed by a somewhat lesser amount of G1 flakes. Note however that the G1 category is much higher here than it is in the andesite and basalt profiles. This accords well with a core reduction strategy. Further comparisons lend support to this contention.

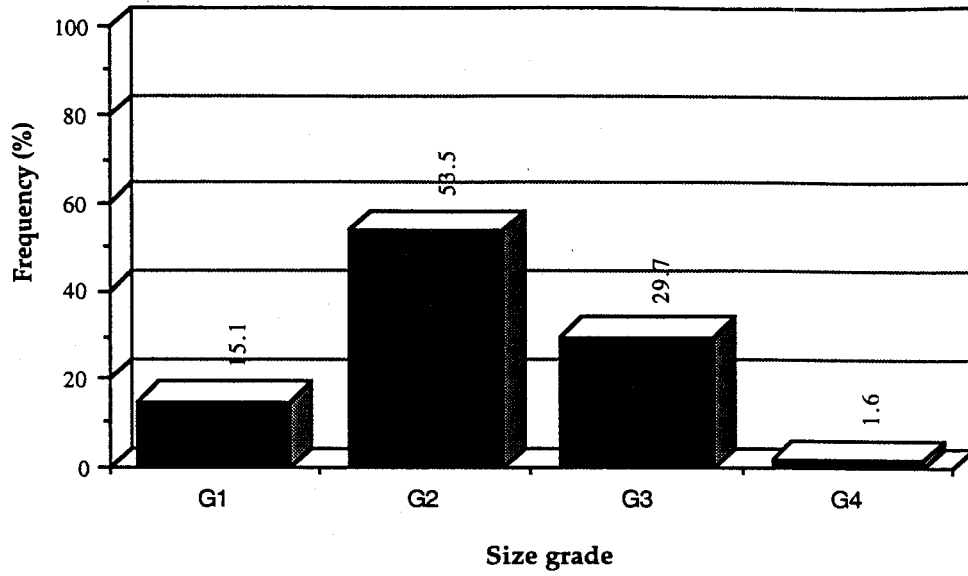
The miscellaneous frequency distribution (Fig. 9) shows relatively good continuity between periods. The increase in the G4 category at the expense of the G2 category in Period 2 may be due to the small sample size ( $n=159$ ) for that period. Because this category consists of a variety of raw materials, mass interpretations of the category as a whole would be misleading. It is therefore felt that interpretations in this category will have to rely mainly on results of the individual flake analysis.

What is very interesting about the frequency distributions of all the Namu material, is the lack of small sized debitage. In any knapping operations, small sized flakes tend to dominate numerically. The specific



**Figure 7. Frequency distribution by size grade - Basalt**

Frequency distribution by size grade  
Trachyte-Period 1 N=370



Frequency distribution by size grade  
Trachyte-Period 2 N=46

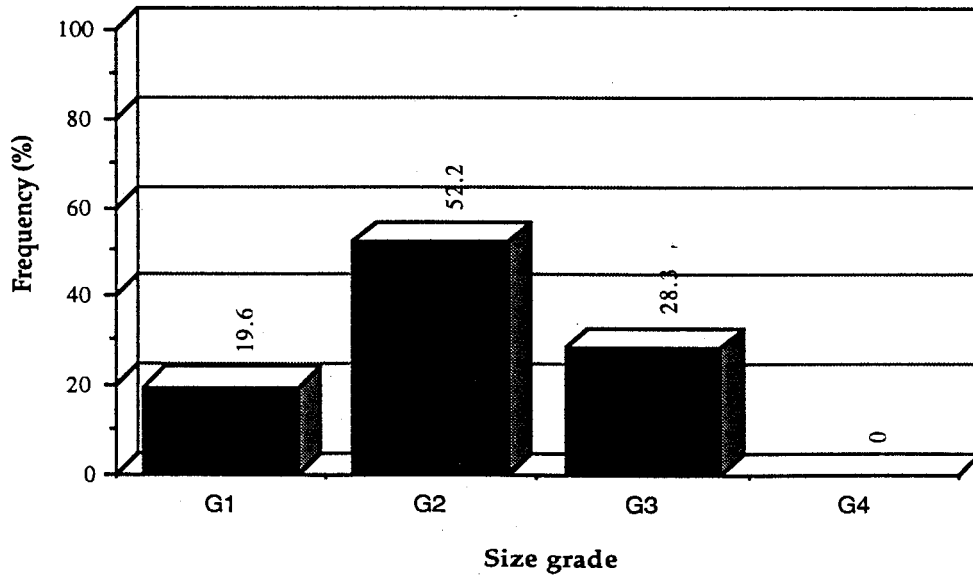
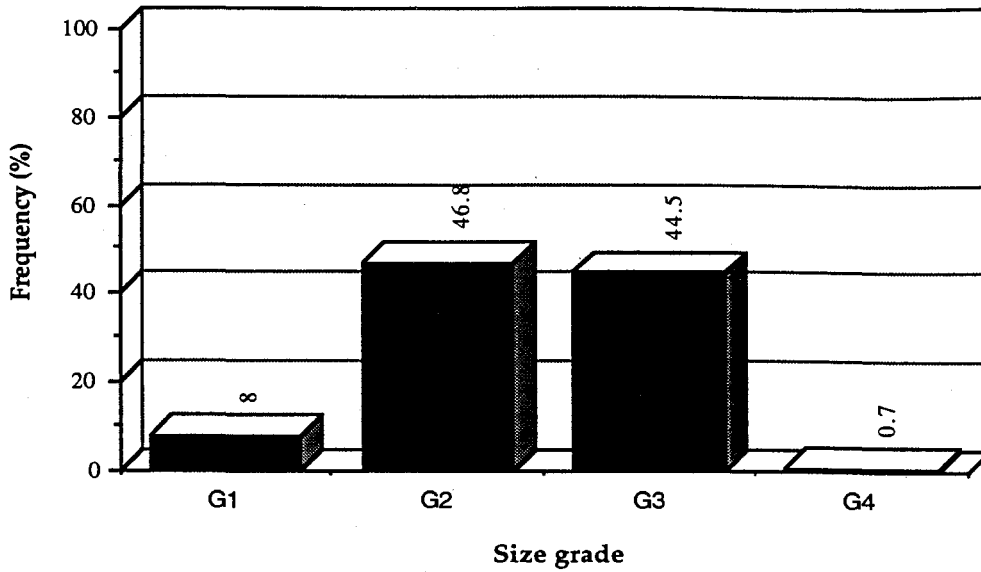


Figure 8. Frequency distribution by size grade - Trachyte

Frequency distribution by size grade  
Misc-Period 1 N=551



Frequency distribution by size grade  
Misc-Period 2 N=226

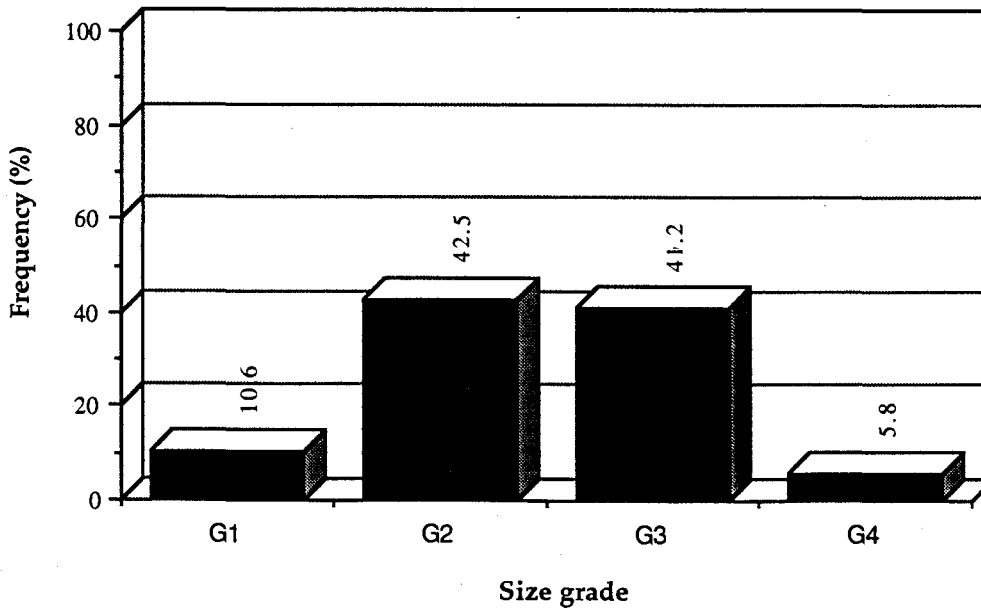


Figure 9. Frequency distribution by size grade - Miscellaneous

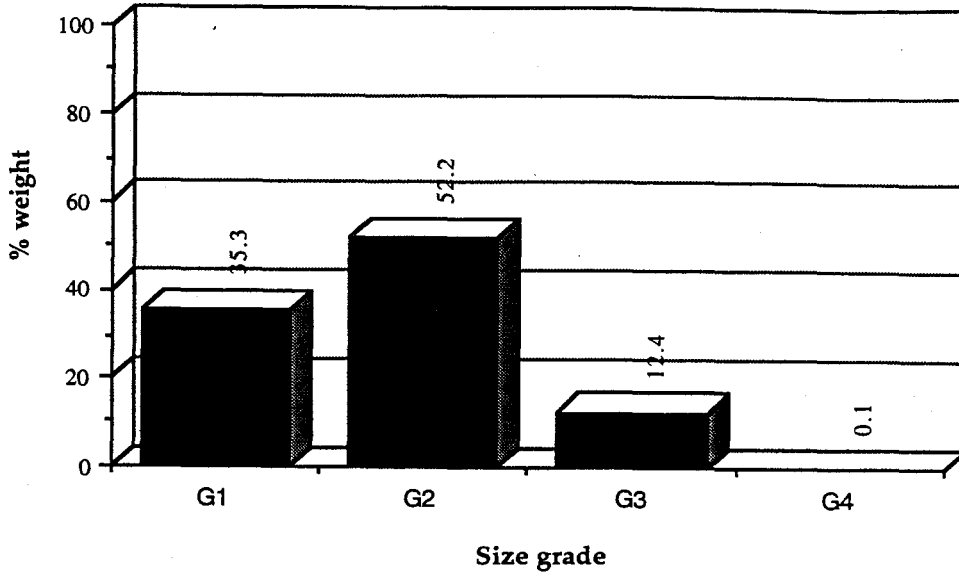
reasons for this phenomenon are unknown, however it has been demonstrated in several experimental studies (Ahler 1989a). The Namu profiles are highly anomalous in this regard since the G4 size frequency is extremely low for all raw material classes. The implications of this patterning are discussed further below.

Ahler (1989a, 1989b) has demonstrated that plotting the percentage of flake weight by size grade is more instructive than numerical frequencies alone. Figure 10 illustrates the percentage of flake weight by size grade for the andesite in Periods 1 and 2. There is a slight difference between the two periods, namely in the G1 and G2 categories, in the more recent period the G2 category shows an increase at the expense of the G1 category. Compared to Ahler's (1989:107) experimental values, the Period 1 profile most closely resembles a hard hammer flake production profile. On the other hand, the profile from Period 2 resembles the experimental profiles for small cobble bipolar flake production, and soft hammer biface production. The latter is much more likely, since very little diagnostic bipolar debitage was noted in the individual flake analysis for this raw material. It is difficult to assess whether this slight change in profiles between periods actually reflects a real change in reductive operations. This is due to the uncontrolled variables present in the research, two of which should be stressed at this point.

First, the raw material from Namu is completely different from Ahler's experimental raw material. Breakage patterns and tensile strengths of the Namu material are likely different from those used by Ahler. This could cause some differences in overall patterning, which may explain why these patterns do not exactly match Ahler's.

Second, the formed tools and examination of the individual flakes indicate that this is a technologically mixed assemblage. Andesite is used to

Percentage of weight by size grade  
Andesite-Period 1 N=5981.21



Percentage of weight by size grade  
Andesite-Period 2 N=1600.29g

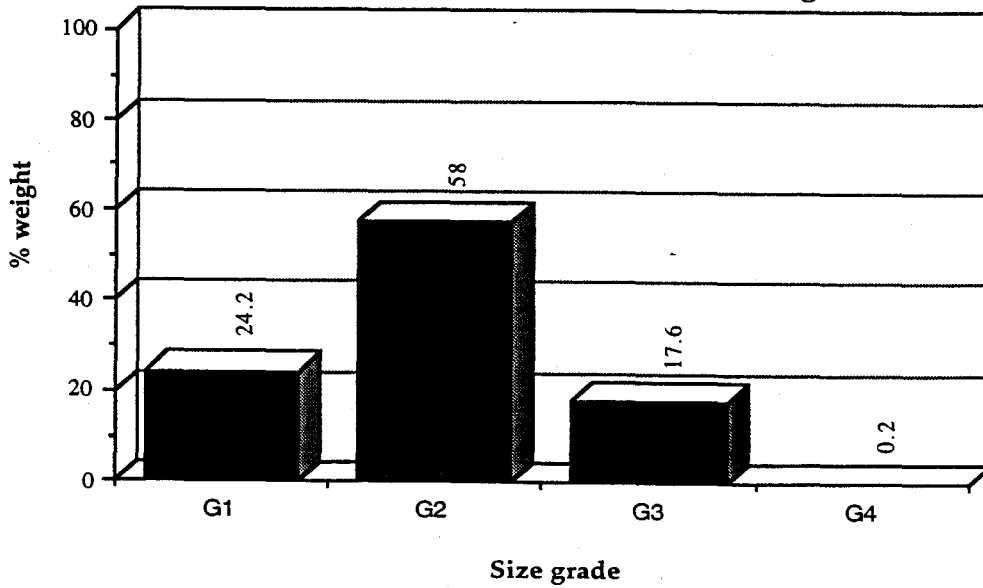


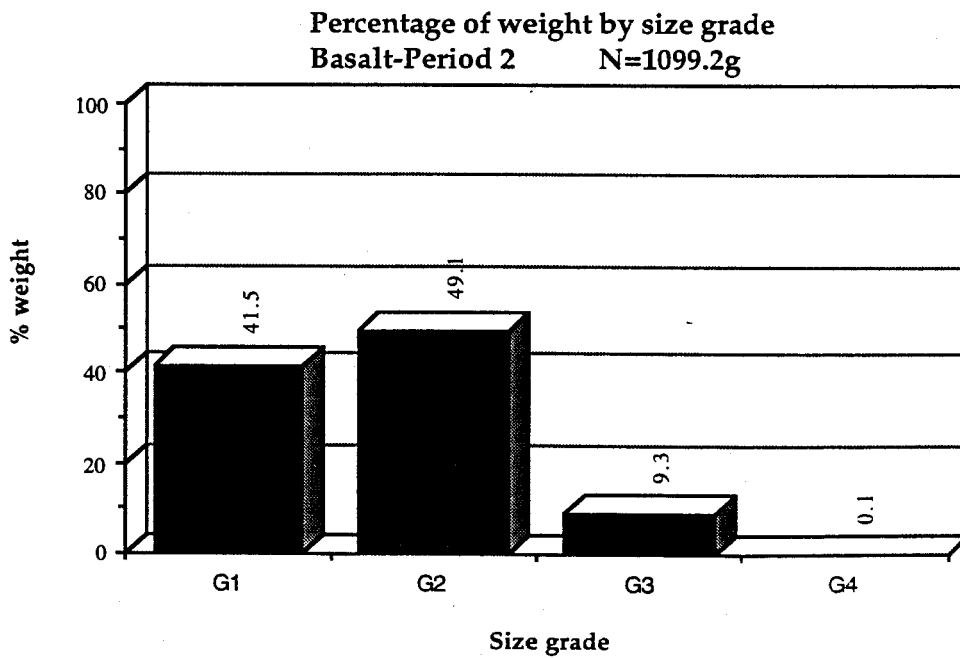
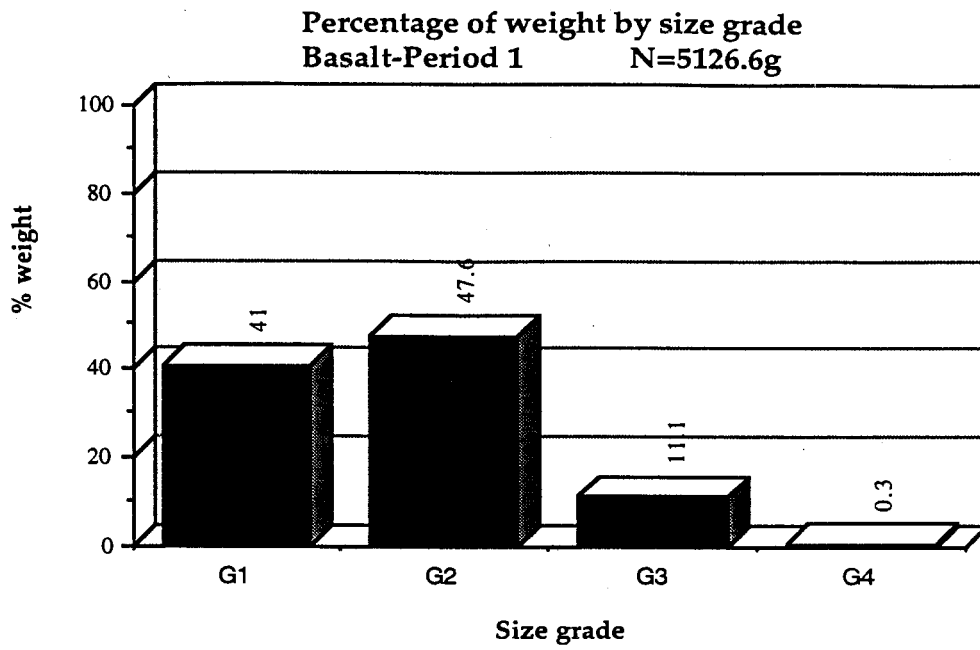
Figure 10. Percentage of weight by size grade - Andesite

manufacture bifaces, prepared cores, retouched flakes and other forms. As Ahler (1989: 106) has shown, separation of different reduction strategies in mixed assemblages can be quite complex in mass analysis. Multivariate analyses have been used with some success in interpreting mixed assemblages, however this has not been possible in the present sample, since these multivariate analyses are based on ratios of G4 to G1-G3 debitage. In view of this, such operations are precluded in the present research due to the lack of G4 material. Hence, the procedure involves straight comparisons with Ahler's experimental data, in order to decipher possible general patterns of reduction. Although there are diverse technical operations represented, some of the patterning here may be skewed towards dominant reductive strategies. The individual flake analyses shed some light on this problem.

The basalt percentage by weight distribution (Fig. 11) is more consistent between periods, however the profiles are slightly different than those of the andesite. These patterns match Ahler's experimental values for hard hammer thick biface production. This fits in nicely with other observations; many of the bifaces in the assemblage are made on basalt, and typically, these are relatively thick. This raw material precludes manufacture of very thin bifaces (such as those which can be made on finer grained materials). Moreover, as with the andesite, a number of biface reduction flakes were also noted in the basalt category during individual flake examination. However, this too is a mixed sample, since many core reduction flakes have also been noted in this raw material category.

In comparison to the andesite profiles, the basalt shows more weight distributed in the G1 size category, and less weight in the G2 category. This may reflect raw material differences, qualitatively the basalt seems to have more undesirable fracture planes than the andesite, however this is variable





**Figure 11. Percentage of weight by size grade - Basalt**

to an extent. There are a small number of basalt pieces that seem qualitatively superior for knapping purpose than the rest of the basalt sample. These specimens are macroscopically similar to the majority of the basalt pieces, however they do not exhibit the "layering" present in many of the pieces. This "higher quality" basalt indicates more predictable fracture patterns, and many of the pieces classified as BRF's and PRB's are of this type.

This leads to question as to whether there are different sources of basalt being exploited. It is more likely that this variation is natural within the main source of procurement. For one thing, if the "nicer" basalt is being obtained from a specialized source, we should expect to see more of it in the assemblage. The low frequency of this material would argue for a chance encounter type procurement. When it was found, it would have afforded more control in knapping, consequently it may have been used to manufacture thinner bifaces. It should be noted, that while there are some BRF's in the debitage which consist of this nicer basalt, there are not as many corresponding bifaces observed in the tool assemblage. This could be due to the fact that the nicer basalt is less susceptible to manufacturing failures, so that they may have been carried away for use elsewhere.

The trachyte percentage of flake weight by size grade profiles are dramatically different from the previous two samples (Fig. 12). An overwhelming percentage of the weight is centered in the G1 category. This resembles Ahler's experimental values for hard hammer flake production. This raw material is used largely for the pebble tools, so this find is not surprising. The profiles do show some variation between periods, with the G1 category showing an 11% increase in Period 2. However the overall patterning is still skewed towards core reduction. This pebble tool reduction is a puzzling phenomenon. Pebble tools have been known and described for several

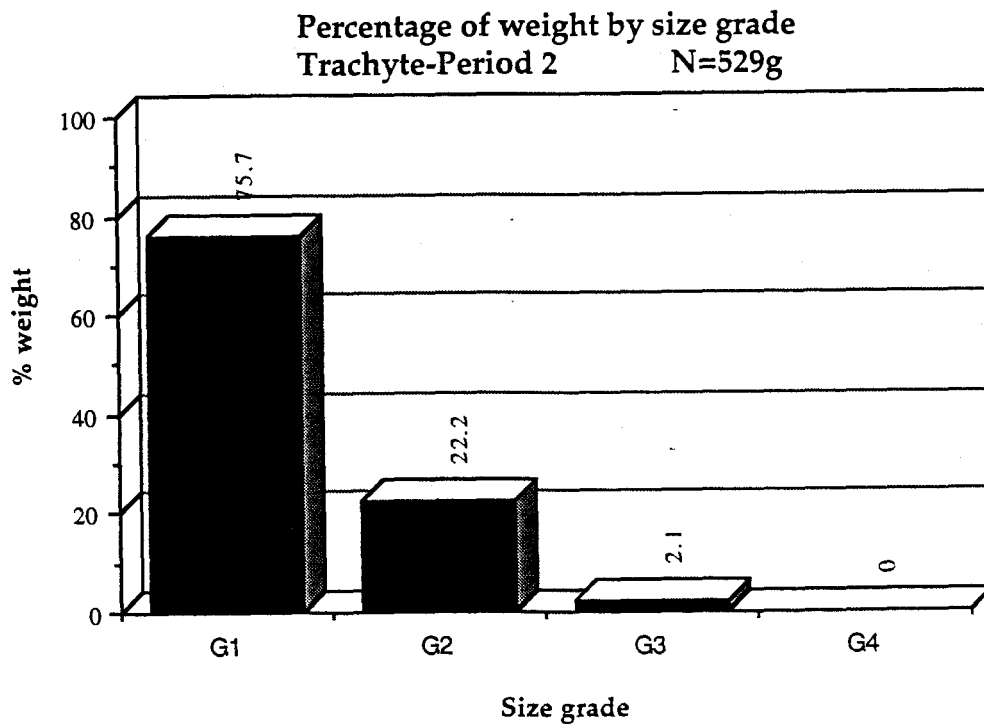
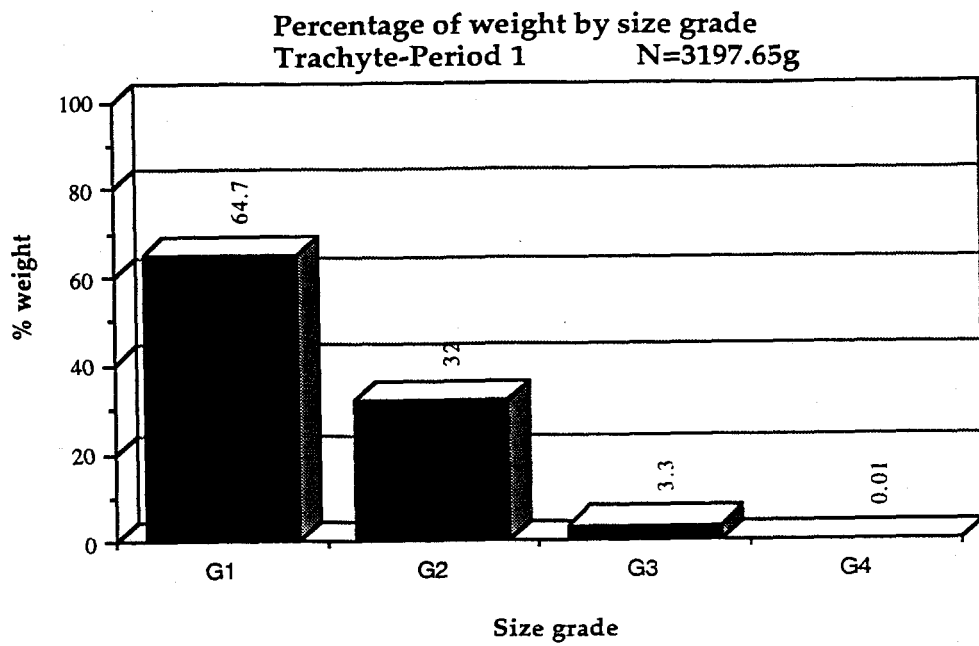


Figure 12. Percentage of weight by size grade - Trachyte

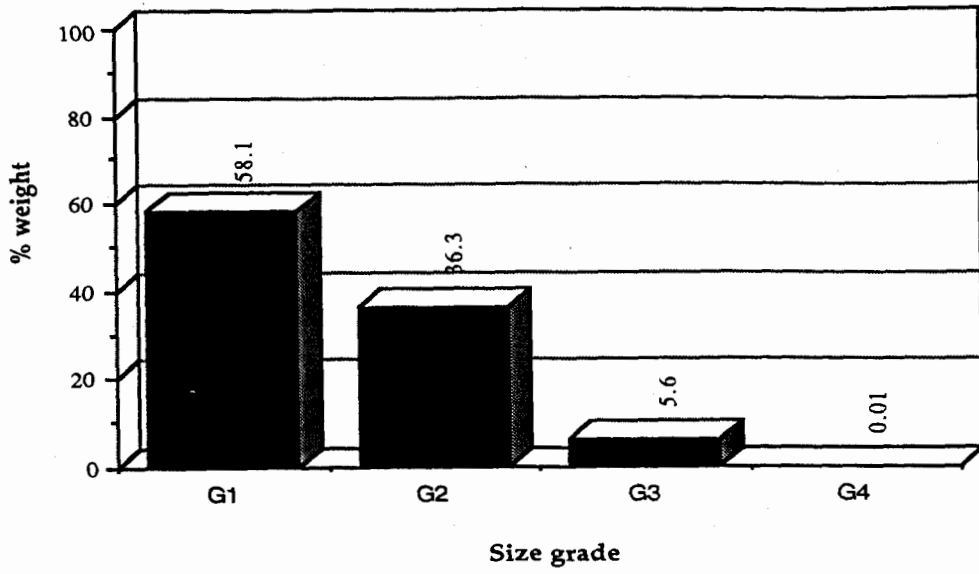
decades in Northwest Coast archaeology, however their possible technological function is still based on speculation. They are reduced mainly through unifacial flaking, which produces unique debitage patterns, as outlined in the individual flake analyses. It seems obvious that this is a more expedient technology. What is interesting is that river rolled trachyte was heavily favoured through time for this reductive technique. Elsewhere (Rahemtulla 1995) I have suggested that this industry is related to processing of marine resources for immediate consumption.

The miscellaneous profiles for percentage of flake weight by size grade also show consistency between periods (Fig. 13). However for reasons outlined above, interpretations on this class of materials will not be forwarded due to the heterogeneous nature of the sample.

Cortex profiles across size grades can be instructive with regard to the initial form of the raw material. Figures 14 through 17 illustrate the cortex profiles for all raw materials from Periods 1 and 2. The trachyte (Fig. 16) shows a very high amount of cortex in all size categories, this is to be expected from an operation that consists of core reduction on river rolled cobbles. Unifacial flaking of pebble tools would increase the amount of cortex on all flakes, since a high number of flakes would exhibit at least some cortex on the striking platform, and many spalls are entirely covered with cortex on their dorsal faces.

The cortex profiles for the andesite (Fig. 14) and basalt (Fig. 15) are more complex. Cortex was quite difficult to decipher on the basalt, and upon re-evaluating my abilities to recognize this cortex, I feel that the values indicated here may be too high. Ahler's experimental values do not show any similar patterns. Both the andesite and the basalt have values of 20% or less (except for the G1 basalt in Period 1 which may be unnecessarily high). Several

Percentage weight by size grade  
Misc-Period 1 N=3028.2g



Percentage weight by size grade  
Misc-Period 2 N=1102g

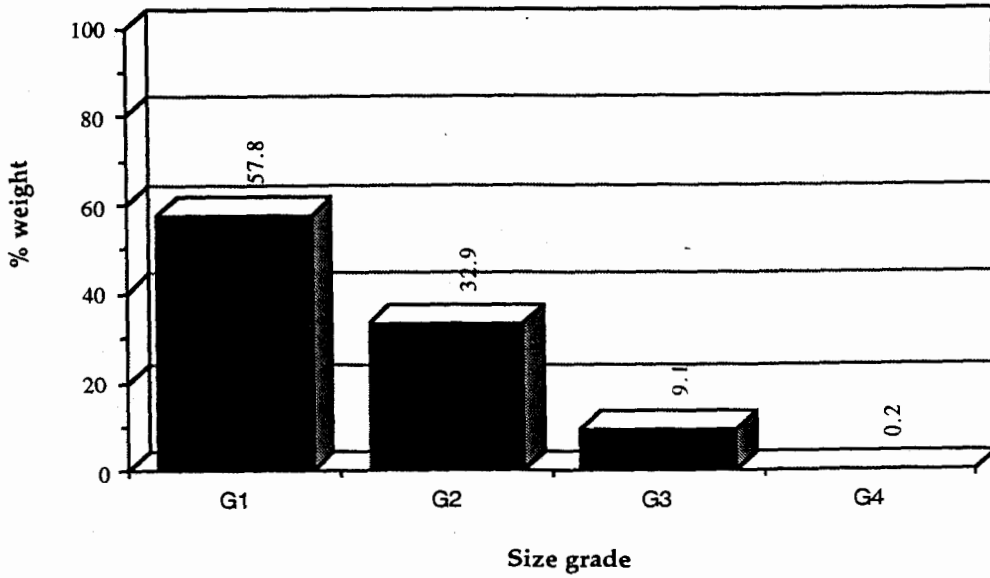
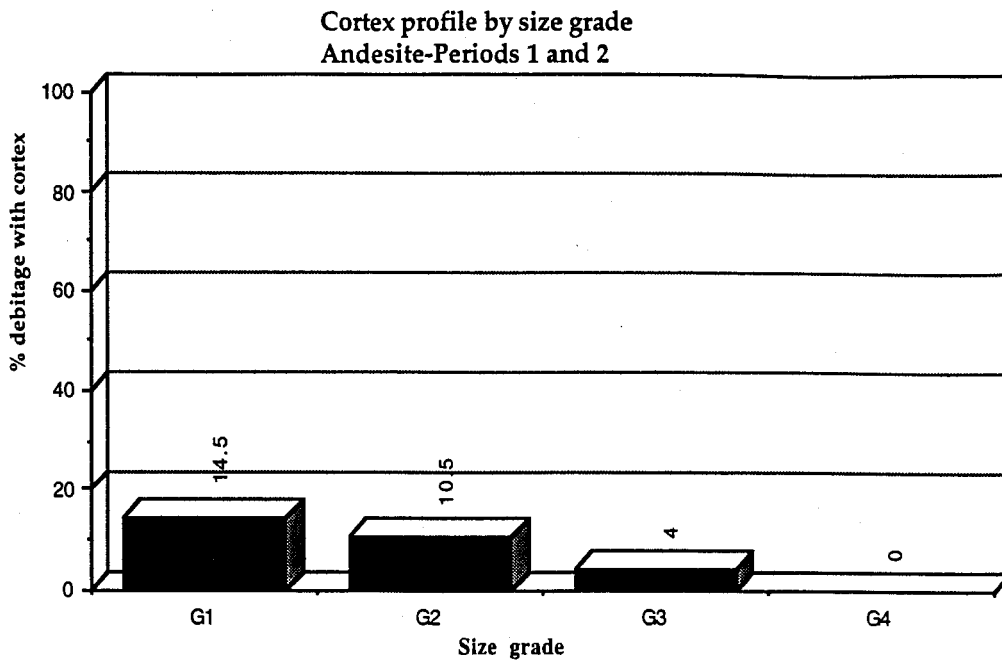
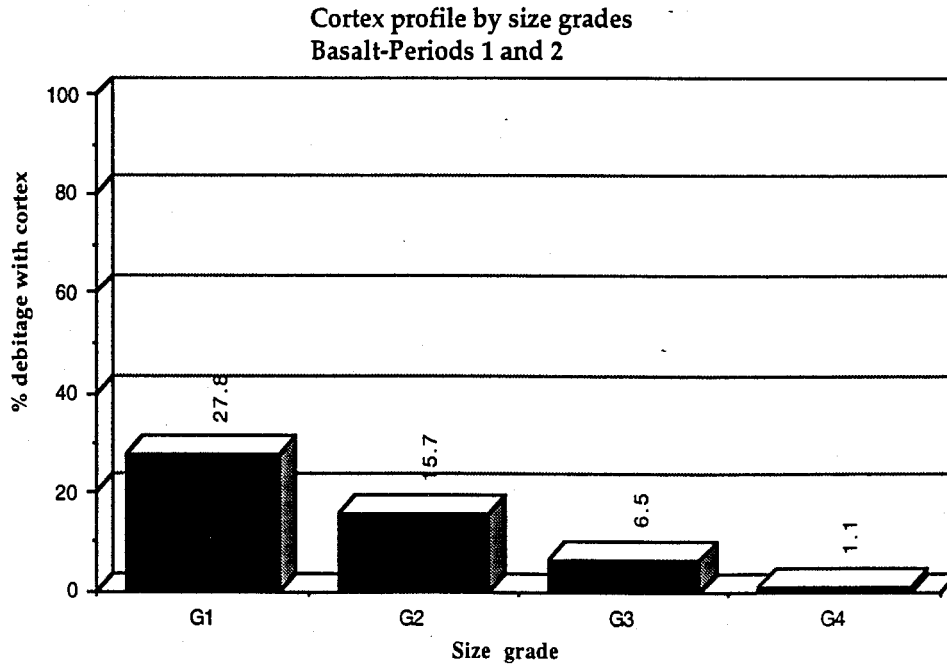


Figure 13. Percentage of weight by size grade - Miscellaneous



**Figure 14. Cortex profile - Andesite**



**Figure 15. Cortex profile - Basalt**

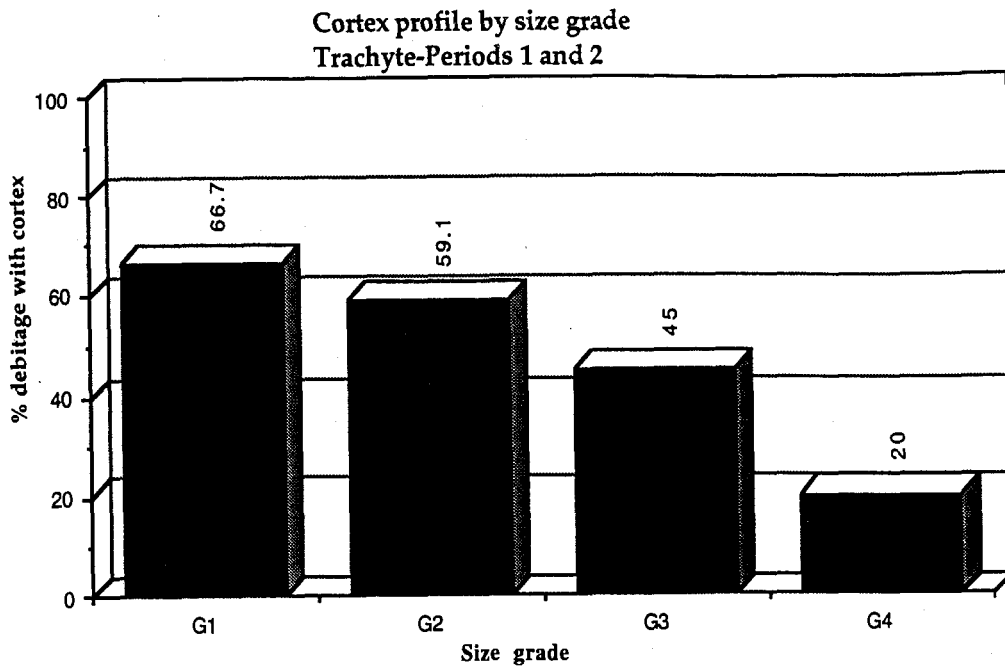


Figure 16. Cortex profile - Trachyte

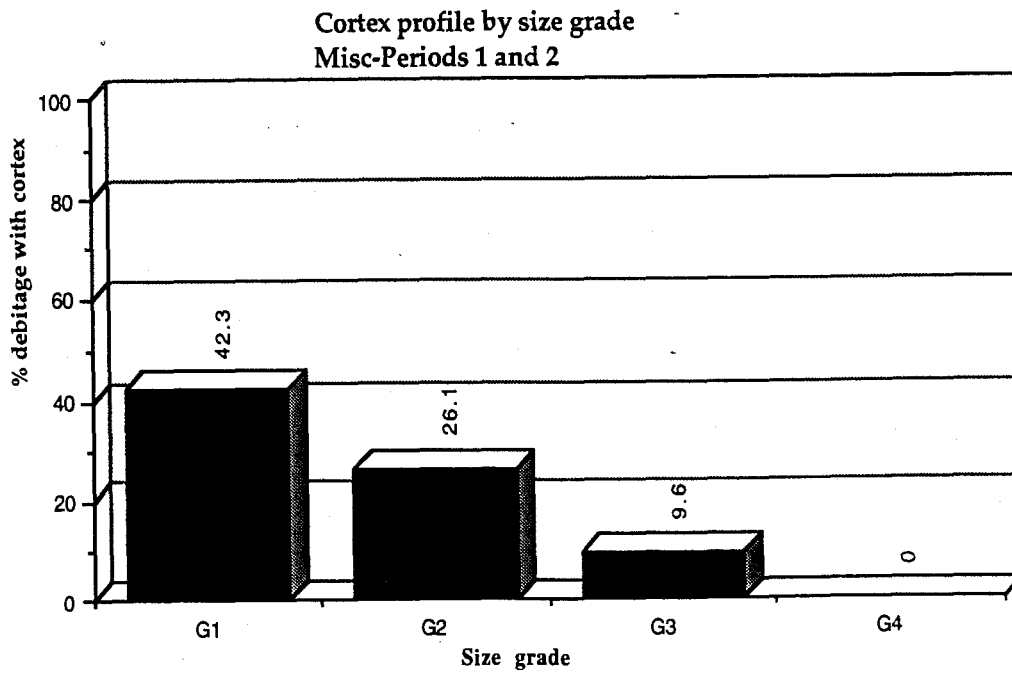


Figure 17. Cortex profile - Miscellaneous

alternate conclusions may be drawn from this. First, that these raw materials were not being reduced from river rolled cobbles, otherwise we would expect to see a much higher incidence of cortex (especially in the G1 category).

Second, that these raw materials have partial cortical cover throughout the sequence, except G4 category which has extremely low values, probably due to the lack of specimens in this size grade. This pattern would be expected if decortication was taking place elsewhere, for example at the location of procurement. Another possibility is that a combination of these two strategies were pursued.

If the initial core reduction was taking place elsewhere, the raw material could have been transported back to the site as large, partially decorticated cores, or as large flake blanks. As mentioned previously, a number of core reduction flakes have been noted in the andesite and basalt samples. This may indicate that the parent materials were in the form of large cores. The individual flake analyses provide some support to this notion.

### **4.3 Results of the Individual Flake Analyses**

The individual flake analyses were carried out after the mass analysis had been performed. As such, the material had been sorted into raw material and size grade categories. In the analysis, each flake was examined for a number of characteristics (Chapter 3). This was done with the aid of an incandescent lamp directly above the examination area, and with a 2X hand lens. Both of these greatly aided the visibility of certain features such as flake scars and platform preparation.

In most cases the debitage were catalogued as groups ranging from less than five to bags of a few hundred. This presented a problem, since if any of the debitage needed to be reexamined, it would be difficult to find the exact



same piece again. To overcome this a special white pencil was obtained with a lead that marks any material surface. This marking is water soluble, and actually comes off quite easily if rubbed with any vigour. Using this pencil, each flake was assigned a further identification number, within the larger catalogue number. This will facilitate any future reexamination of the debitage, without providing any adverse effects to the material.

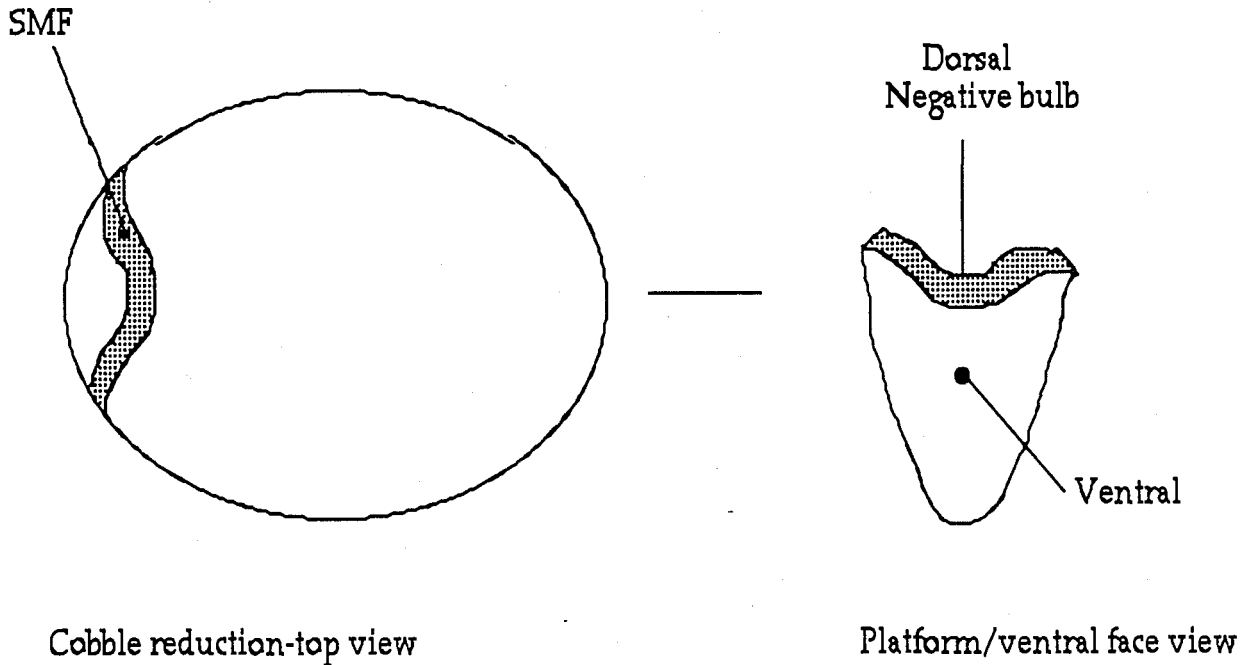
As the analysis proceeded, the information obtained from each piece was recorded directly onto a computer database. This procedure omitted recording of information on paper first, which saved considerable amounts of time, given the size of the database. In addition to variables pertinent to Sullivan and Rozen's flake completeness method, and Magne's scar count method, a number of other variables were recorded. These included the presence of secondary multiple flakes, and unifacial flakes.

#### 4.3.1 Secondary Multiple Flakes

A large number of secondary multiple flakes (Jelinek *et al.* 1971) have been identified in the assemblage. These are flakes with peculiar platform morphologies (see Figure 18) and have not been well described or discussed by archaeologists. When viewed directly onto the platform, they have morphologies that resemble birds in flight and are sometimes called "seagull flakes." This type of flake results from a percussive blow that removes two flakes simultaneously instead of one, the two flakes are nested within each other, and share the striking platform.

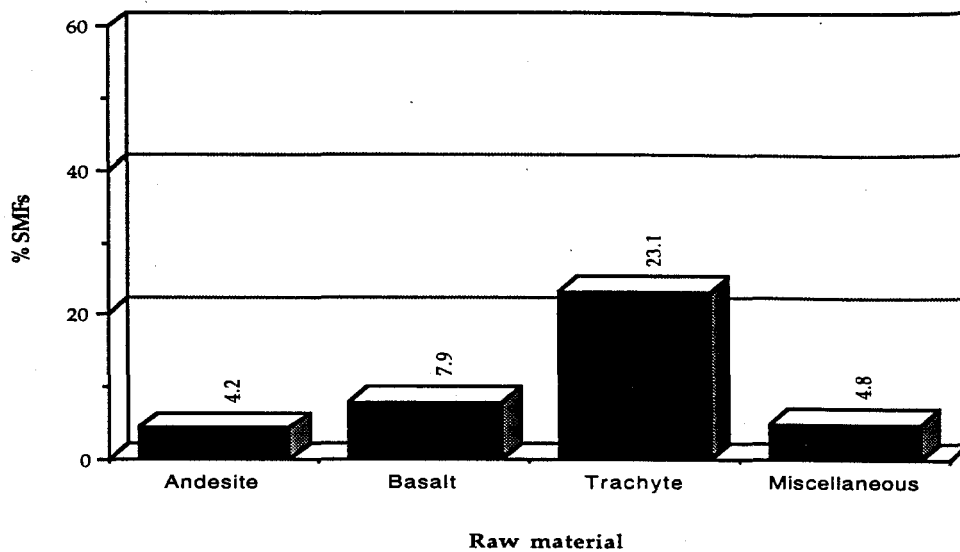
Salient features of these flakes are illustrated in Figure 18. The primary flake has a typical morphology, and would be difficult to separate from "normal" flakes. The secondary flake has a negative bulbar scar (concavity) on the dorsal face, caused by the removal of the primary flake, and a bulb of

percussion on the ventral face. This type of flake occurs when either the hammerstone has a large surface area, or when the surface being struck is either flat or convex (Jelinek *et al.* 1971). In the present sample, these flakes occur across all raw materials (Fig. 19), however they are most prominent in the trachyte category.



**Figure 18. Secondary multiple flakes**

This category comprises largely of cobble reduction and as such, this accords well with Jelinek *et al.* in that the river rolled cobbles would present large and flat or convex striking surfaces. The basalt and andesite do include some SMFs, this may be a result of the hardness of these materials. Initial reduction of these materials would require very hard hammerstones, these were most likely quite big, with large surface areas. Morrison (1994:105) found that a high number of these tend to occur during experimental block core reduction. On the other hand, there is a possibility that SMFs also result from large amounts



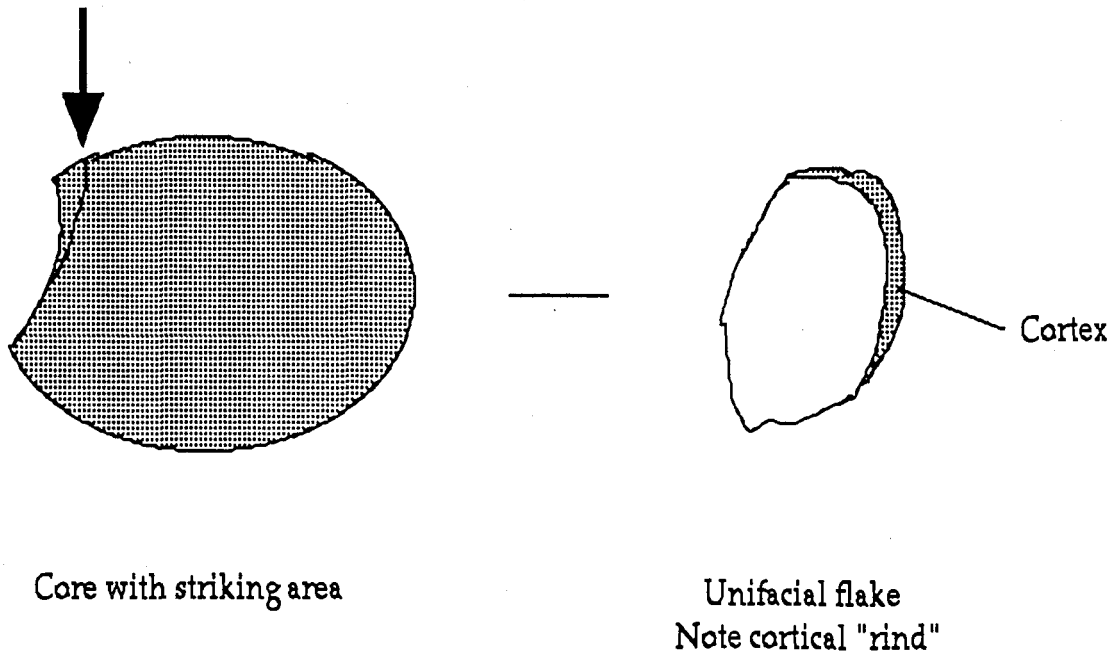
**Figure 19. Percentage of SMFs in all raw materials in Periods 1 and 2**

of force in percussive operations, in addition to the characteristics described by Jelinek *et al.* This is only an intuitive thesis that still needs to be tested.

#### **4.2.2 Unifacial reduction flakes**

These are specialized flakes that result from unifacial reduction of river-rolled cobbles. They have a unique morphology, their appearance often resembles "orange segments". Although this description has also been used to describe flakes from bipolar reduction (Breffitt 1993), the difference here is that the percussive blow is evident somewhere in the mid-segment of the cortical cover. In bipolar flaking, percussive force (or crushing) may be evident at both longitudinal ends of the flake.

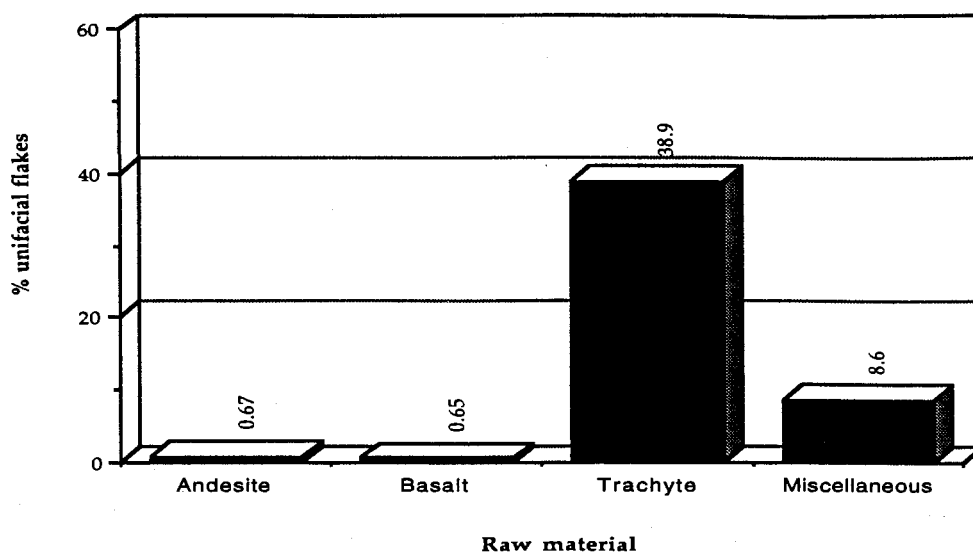
As to be expected, this type of flake occurs in especially high numbers in the trachyte category (Fig. 21). This raw material has values of almost 39% for unifacial flakes, as opposed to the less than 0.7% exhibited by the andesite and



**Figure 20. Unifacial reduction flakes**

basalt categories respectively. The miscellaneous category at 8.6% is much higher than andesite and basalt, but not nearly as high as trachyte.

Once again, these patterns indicate that the trachyte was reduced in a very different manner than the andesite and basalt. Most studies of pebble tools have focused on the core-tools themselves, and have largely ignored debitage from this reduction technique. Although this may be partially due to lack of debitage at sites where pebble tools have been found. Nevertheless, it is useful to ponder the potential functionality of unifacial flakes for certain types of tasks. Ideally the morphology of these flakes (Fig. 20) is such that they may function well as cutting implements. Unifacial flaking would ensure that a large number of flakes would retain a cortical cover around the thick edge, this would serve as natural blunt "backing." The sharp edge would serve as a cutting edge, and due to the toughness of this material, the edge would be



**Figure 21. Percentage of unifacial flakes in all raw materials in Periods 1 and 2.**

quite durable. Experiments have been conducted to test the viability of using unifacial reduction flakes as knives for cutting fish, and these experiments have been quite successful (Rahemtulla 1995).

#### **4.3.3 Results from Magne's scar count method**

Through experimental and archaeological evaluations, Magne (1985) has provided a scheme for debitage analysis, which aims to identify general stages of reduction. This is done through quantification of flake scars on different classes of debitage. Two distinct categories of debitage are visualized, those bearing a striking platform (PRB) and those without a striking platform (Shatter). Within these categories, specialized flake types are denoted. Biface reduction flakes (BRF) are a special type of PRB, these are characterized by narrow angled platforms which are "extensively faceted", and also exhibit "lipping" (Magne 1985:100, after Crabtree 1972). Bipolar flakes are a special type

of shatter, "having evidence of simultaneous percussion from opposite directions, often with crushing" (Magne 1985:100).

In addition, Magne's classification theoretically provides a template for differentiation of stage of reduction. This is done by counting flake scars: on platforms of BRFs and PRBs; and on dorsal faces of shatter. The underlying thesis is that the greater the amount of reduction, the greater the number of scars on the debitage. Through experimental research, Magne found that PRBs and shatter with 0-1 scars fall into *early* stage reduction, 2 scars indicate *middle* stage reduction, and 3 or more scars indicate *late* stage reduction. These stages are based loosely on Callahan's (1979) model for biface reduction.

In the present research, the debitage were sorted into the four main categories (shatter, BRF, PRB, bipolar). Dorsal scars were quantified on shatter, as were platform scars on BRFs and PRBs. In addition, edge angles were measured on all pieces with intact platforms. Other recorded attributes include presence or absence of: lipping, platform preparation, dorsal perimeter scarring, and amount of cortex on platforms (BRFs and PRBs) and dorsal faces (shatter) (Appendix A). It should be noted that the frequency graphs do not always add up to 100%. Frequencies reported here are based on specimens on which these attributes were visible. On many pieces, it was not possible to observe the variables because they were obscured by the natural properties of the raw materials. Even in cases where the variables were observable, they were not classified with any ease.

Figure 22 shows the frequency for numbers of dorsal scars for all shatter, in Periods 1 and 2. For Period 1, the andesite shows just under 20% of shatter with one scar, over 40% with two scars, and greater than 10% with three scars. The basalt shows only a slightly different pattern, which is not significant. This difference is in the 1 scar count category, where the basalt

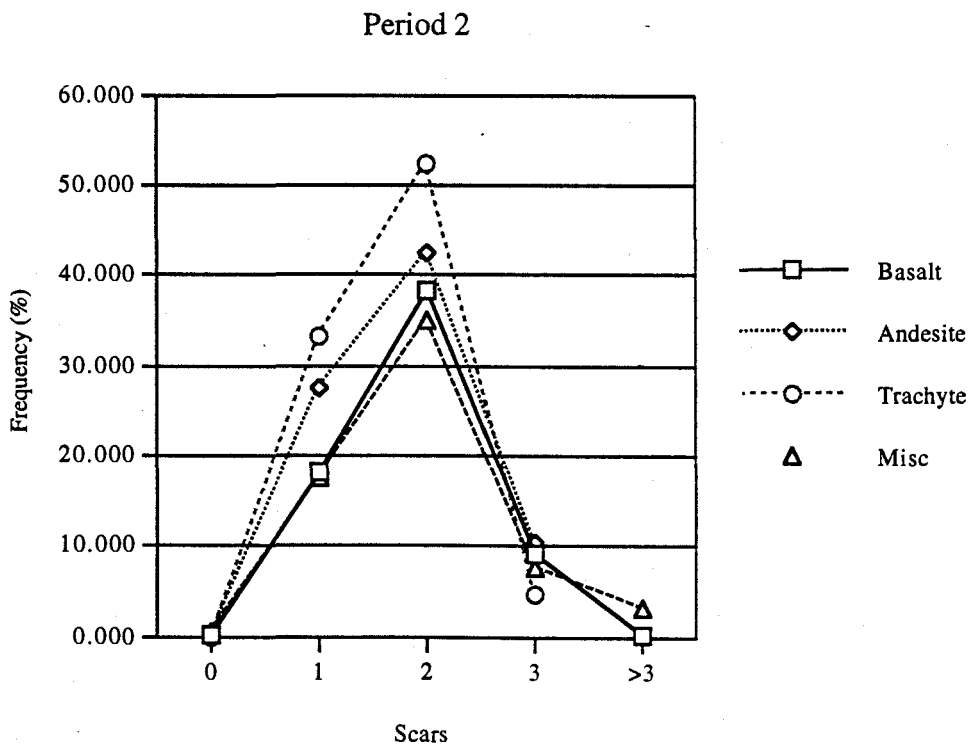
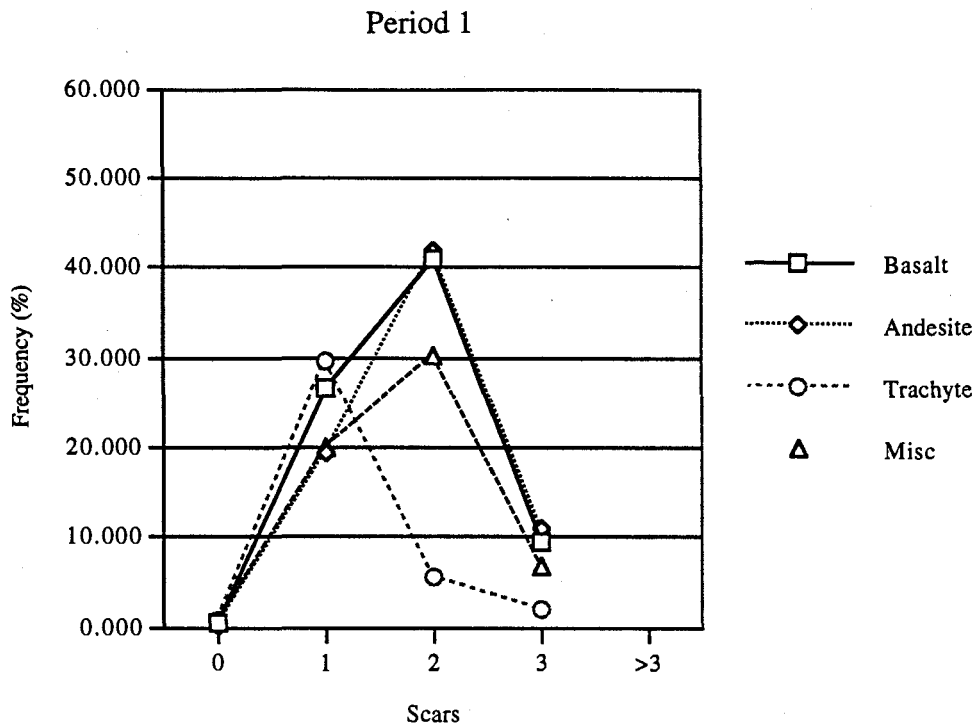


Figure 22. Frequency of dorsal scars on shatter

frequency is about 8% higher than it is for andesite. According to the tenets of Magne's model, a sample which is primarily core reduction should be skewed towards the early category, while tool manufacture and/or resharpening should be skewed the other way. The Namu sample does not fit directly into either one of these modes, rather there is a peak at the *middle* category, with a large number of *early* debitage. The frequencies drop in the *late* category, nevertheless they are present. This pattern could be taken to mean that a range of reductive operations were taking place, which again supports the contention of this being a technologically mixed sample. Most of the patterning suggests a core reduction to thinning operations, and some tool manufacture.

In Period 2 the frequencies for andesite and basalt are similar to Period 1 with one exception, the andesite displays a greater frequency of early debitage than in Period 1, while the basalt shows less of the same type of debitage. Generally, these differences are not significant, the patterning still argues for multi-stage reduction of these raw materials.

As expected, the trachyte shows quite a different pattern, with the vast majority of debitage occurring in the early category. Because this material was reduced in a very specialized manner, the scar count method may not be useful for measuring reduction strategy. Magne did not conduct any experiments emphasizing unifacial reduction of river cobbles. Nevertheless the pattern for Period 1 does support the notion of a primarily core reduction technique. The same cannot be said for the Period 2 pattern, which indicates a majority of debitage with 2 scars. This may be anomalous for the following reason.

The unifacial reduction of trachyte cobbles sometimes results in fracture planes that resemble 2 dorsal scars when there is actually only one.



This was noted throughout the sample. However, the trachyte sample for Period 2 is quite small (n=46), so the presence of a number of "pseudo-2 scar" flakes may be artificially high. Alternatively, unifacial reduction of river cobbles can produce flakes with more than one dorsal scar, even though a middle stage of reduction is not being performed.

The miscellaneous profiles are not much different from the andesite and basalt in Period 1, except for the lower frequency of middle stage debitage. In Period 2, the miscellaneous profile almost mirrors that of basalt, however there are a small number of flakes with more than 3 scars. Once again though, interpretation on this raw material class is difficult, given the mixture of materials.

Figure 23 shows the frequency profiles for platform scars on BRFs. Technically, BRFs are considered late debitage, and as such, they should exhibit 3 or more platform scars. The Period 1 profile indicates that andesite and basalt have between 30% and 50% of BRFs with one platform scar, and approximately 50% with two scars. Pieces with three or more scars are scarce. This lack of late debitage in a category which is defined as being late stage by nature is contradictory. It is felt that this is due to the nature of the raw material, rather than a fault in technique. Observing flake scars on platforms was very difficult for the most part. The main difficulty was in assessing the number of scars, as the coarse grained nature of the materials frequently obscures any diagnostic attributes which indicate previous flake removal. Morrison (1994) had the same problem in trying to quantify scars on experimental quartzite flakes. The nature of these materials is such that ridges and depressions that characterize flake scars are not always obvious. This situation is exacerbated on the small area that consists of the platform.

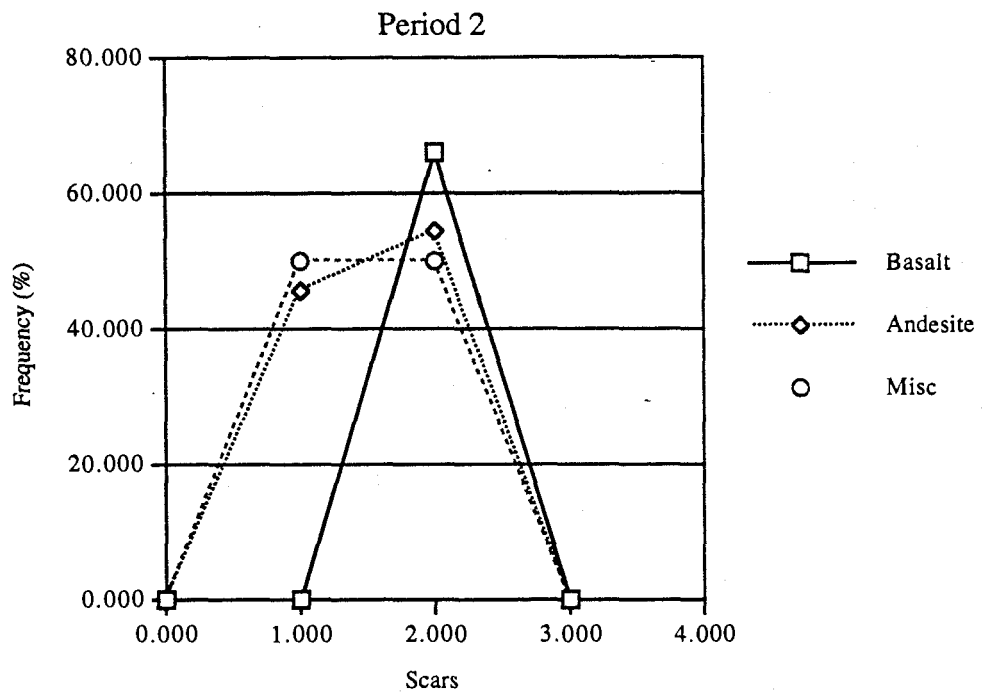
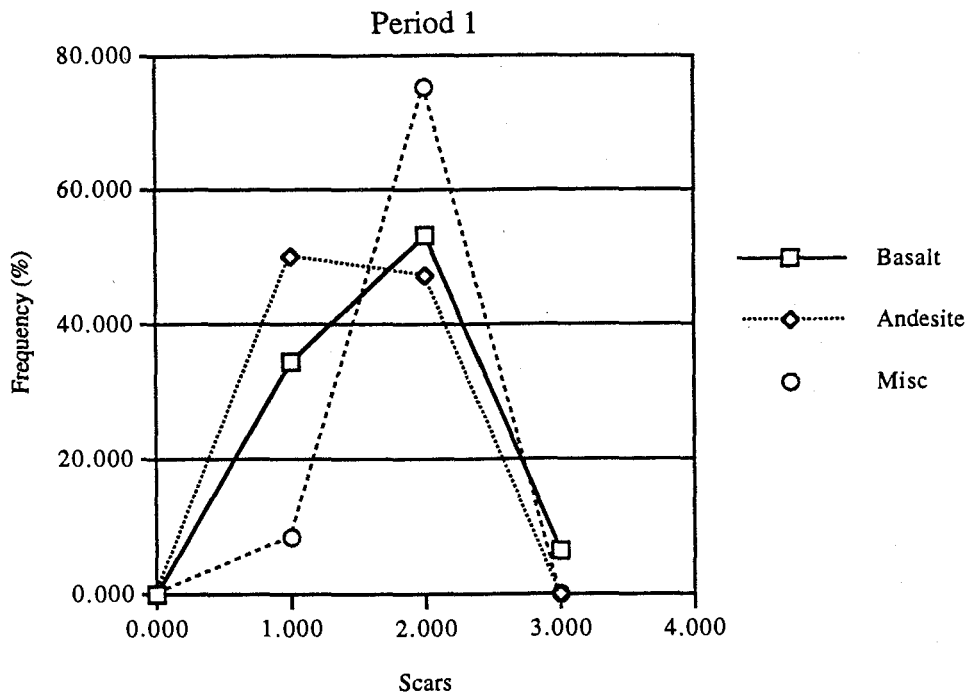


Figure 23. Frequency of platform scars on BRFs

In view of this, these specimens were classified as BRFs due to other attributes. The general morphology of these flakes closely resembled BRFs noted in experimental knapping conducted on other materials by the author. Most notably, the platform to interior surface angle is acute, generally less than 35°. Moreover, the platforms are generally narrow, and exhibit lipping. Of all the flakes classified as BRFs, 94% indicated presence of lipping. In addition, dorsal perimeter scarring has been argued to represent late stage reduction, specifically biface manufacture (Odell 1989). This consists of tiny fracture marks along the dorsal face, at the intersection with the platform. This preparation serves to stabilize the edge of a biface, and is necessary during biface reduction. Of the flakes classified as BRFs, 87% show dorsal perimeter scarring. It should be noted that this was a difficult feature to observe on these raw materials, however an incandescent lamp directly above the viewing area was of great aid.

Perhaps another factor involved in the lack of more than 2 platform scars on BRFs, is that the raw material does not lend itself to being reduced to the same levels as finer grained materials would. In essence, this would result in bifaces that are relatively thick, and exhibit fewer scars than finer bifaces made on other materials. This is borne out once again by the bifaces in the tool assemblage, they tend to be quite thick in cross section.

In Period 2 the andesite profile is not much different, except for a slight decrease of 1 *scar* BRFs and a slight increase in 2 *scar* BRFs. The basalt category shows an increase in the 2 *scar* category, and this is the only category represented in this period. However the sample size is only 2 for this category, which is not significant.

The miscellaneous profile for Period 1 indicates a large prevalence of flakes with 2 platform scars. BRFs with 1 platform scar are low in number,

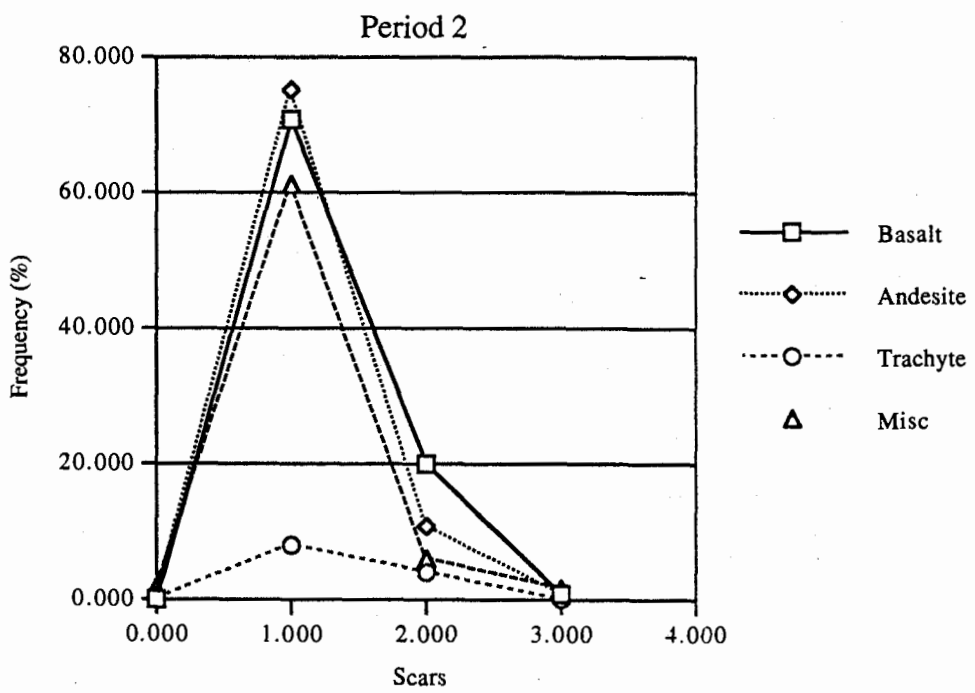
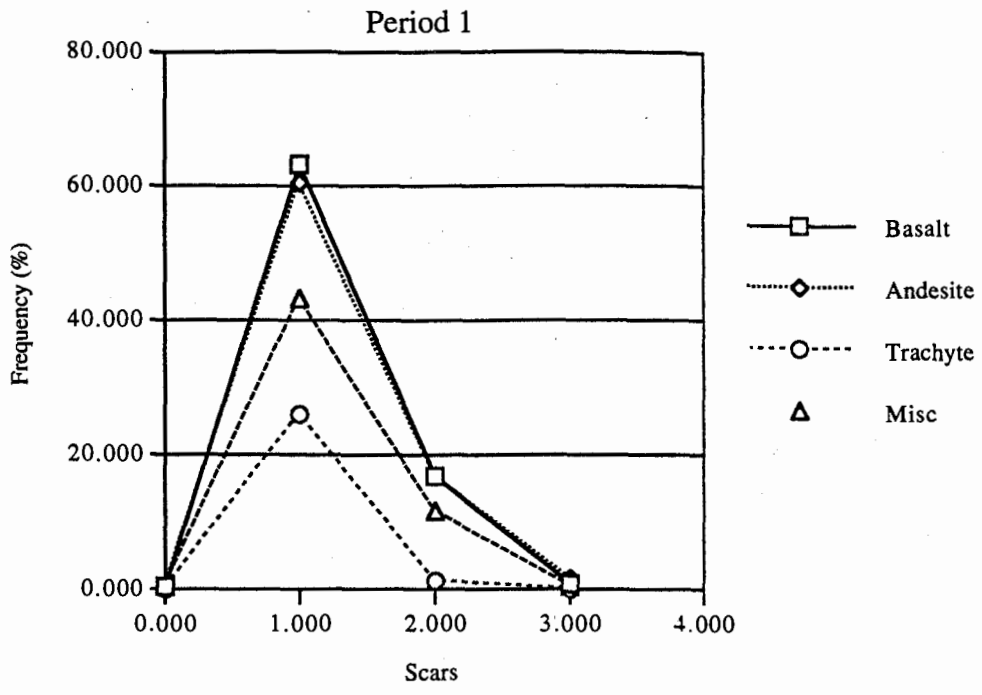
and there are no flakes with greater than two scars. In Period 2, there are an equivalent number of BRFs with 1 and 2 scars respectively.

The PRB platform scar frequencies are illustrated in Figure 24. In Period 1 the andesite and basalt profiles are very similar. Both indicate a high frequency of PRBs with one platform scar (about 60%), and below 20% of PRBs with two scars. This pattern is generally repeated in Period 2, with a greater frequency of PRBs with one scar. The patterning for the miscellaneous category is similar for both periods, but there is a reduction of overall frequencies. The trachyte patterns stand out, they do not follow the others. This can be explained by virtue of the unifacial core reduction strategy, which would include a high number of flakes with cortical platforms. This would account for the low number of platform scars for this raw material class.

The andesite and basalt profiles are skewed towards the early stage, indicating a heavy representation of core reduction. This patterning contradicts the dorsal scar frequencies on the shatter from the same raw materials, which indicate a mixture of core reduction and tool thinning operations. If the patterns were to match, we would expect a greater frequency of middle stage debitage in the PRBs, or less middle stage debitage in the shatter. It is felt that the shatter frequencies are more reliable than the PRB data in this study, due to the following factors.

As discussed previously, quantification of flake scars is very difficult with these raw materials. However, I felt that dorsal scar identification was slightly less difficult than platform scar identification, due to the larger viewing area. Hence, the confidence with which these assessments were made was variable, qualitatively the dorsal scar identification was in general done with a greater degree of confidence.

A further factor which seems to support the notion of greater reliability



**Figure 24. Frequency of platform scars on PRBs**

in dorsal scar patterning is that there are a wide variety of forms in the tool assemblage. These reflect a number of reduction stages, which is indicated in the dorsal scar frequencies on the shatter.

In order to test this notion, the number of dorsal scars on andesite and basalt PRBs was tabulated (Figure 25). The overall results contradict the PRB platform scar values, and support the trends seen in the dorsal scar frequencies on shatter. Values across periods are very similar for both raw materials, the graph for each material is virtually identical between the time frames.

These graphs indicate a frequency distribution of dorsal scars which is varied, but peaks at 2 scars. For andesite, PRBs with one dorsal scar are represented at between 19 and 24%, while for basalt the range is 29 to 31.5%. Again the higher values for basalt may reflect its generally more coarse grained nature, which would constrain further reduction in some cases. In the two scar category, andesite frequencies range from 56 to 60%, while basalt ranges from 52 to 55%. These are closer to the dorsal scar frequency values for shatter, which range from 42 to 55% for both materials, reflecting a predominance of middle stage reduction strategies.

In the three dorsal scar count category, the andesite PRBs range from 12 to 20% and basalt from 10 to 12%, once more probably reflecting the differences in raw material properties. Note that in the platform scar counts on PRBs, the three scar count category values do not even reach 5%. In the dorsal scar count, a number of PRBs exhibited counts of greater than three scars, this category is non-existent in the platform scar count. For andesite, PRBs with greater than three dorsal scars range from 3 to 4%, and for basalt from 2 to 3%.

These results are quite different from the platform scar counts on PRBs.

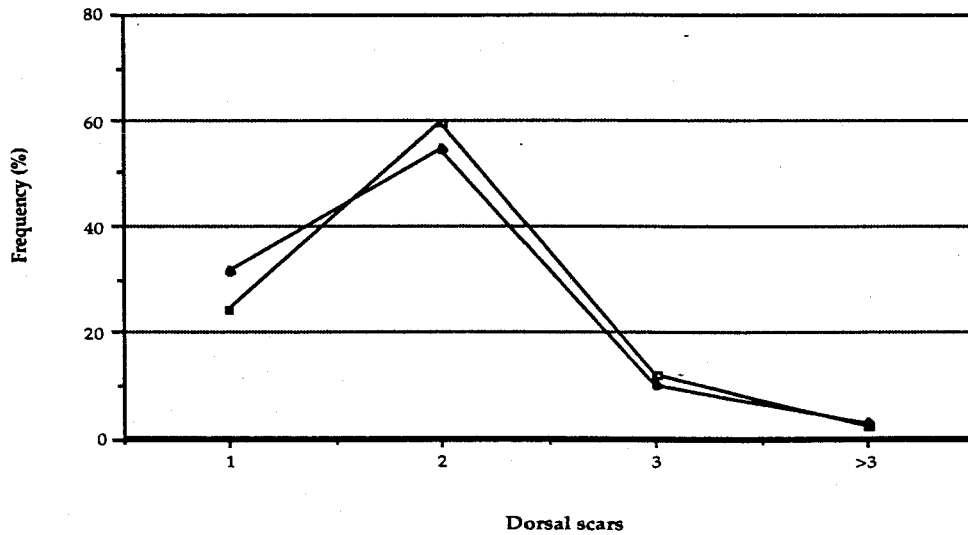
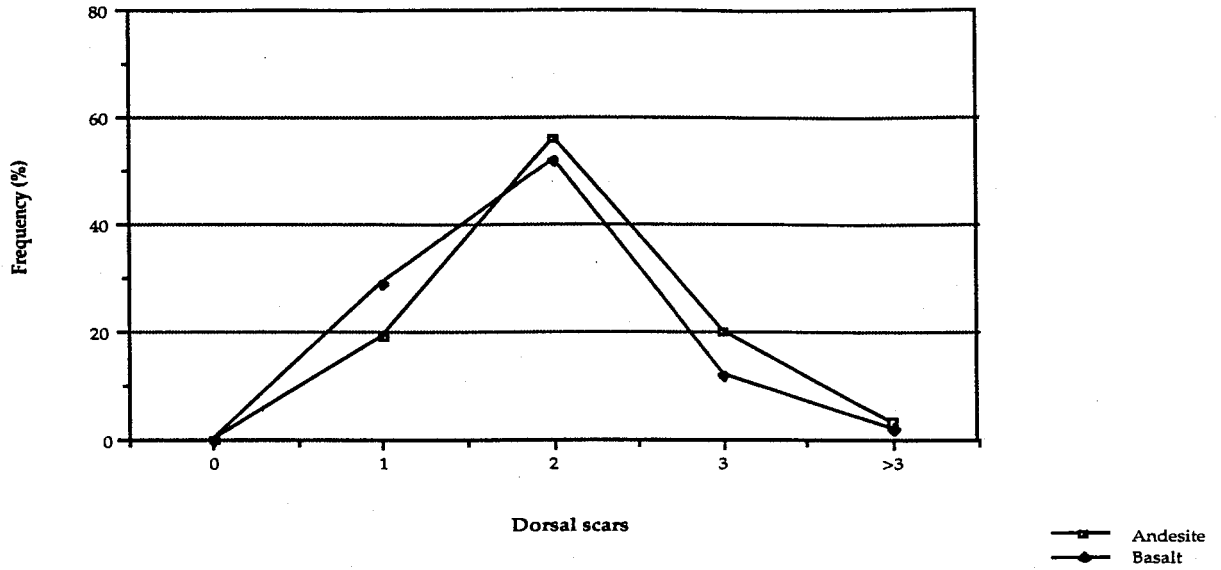


Figure 25. Frequencies of dorsal scar counts on PRBs.  
 (Period 1 - top, Period 2 - bottom)

Since they more closely match the patterning on shatter, it seems that for these raw materials, contrary to Magne (1985) platform scar counts are unreliable as an indicator of reduction stage. However this has more to do with visibility of scars on the platforms, rather than shortcomings in the technique. Still, we must be fully aware that Magne's research was based on a much more fine grained raw material.

Overall, these PRB values indicate that the reduction strategies are varied and consistent between periods. Initial reduction is represented by roughly one quarter to one third, middle stage reduction by more than half, and late stage reduction by about one sixth of andesite and basalt PRBs. This is instructive, it indicates as does the shatter and presence of BRFs, that the inhabitants of Namu were pursuing a range of reduction strategies. With respect to inferring technological activity based on these data, this is a very generalized pattern indicative of a multi-activity site. That is, a more technologically specialized site would be expected to show a specific pattern, perhaps skewed towards one reduction stage (Magne 1985). The formed tools at Namu also support the contention of a multi-activity occupation.

#### **4.3.4 Sullivan and Rozen flake completeness analysis**

Sullivan and Rozen's flake completeness approach to debitage analysis has been tested and critiqued by others (see Chapter 3), in the present analysis comparative data are obtained from experimental analyses, rather than from Sullivan and Rozen's (1985) original publication. This type of analysis aims to discern patterning based on two general technological strategies, core reduction versus tool production. In their original paper Sullivan and Rozen argued that core reduction would result in a higher amount of complete flakes, and that proximal flake fragment values would be higher in tool



manufacture. Other studies based on experimental assessment of this technique have contradicted these predictions.

Baumler and Downum (1989) and Prentiss and Romanski (1989) have shown that complete flakes occur in higher frequencies in tool production. The former study indicates values of 7.4 - 18.9% complete flakes in core reduction, while the latter work gives figures ranging from 16.3 - 25.4% complete flakes for the same reduction strategy. On the other hand, tool production values range from 30.4 - 88% and 30.1 - 34.1% respectively.

Prentiss and Romanski (1989) also found that proximal flakes do not really occur in higher numbers in tool production. Values for proximal flakes ranged from 22.2 - 22.5% for tool production, and 15.9 - 18.6% in core reduction. While there is a slight difference indicated, Prentiss and Romanski consider this to be insignificant. Split flakes also show no significant differences between reduction techniques, all values are all below 10%. This contradicts Sullivan's (1987) and Rozen's (1984) claims that split flakes are not represented in tool production assemblages (cf. Prentiss and Romanski 1989:93).

Values for medial/distal fragments are reported as ranging from 35 - 35.7% in tool production, and 22.2 - 25.6% for core reduction (Prentiss and Romanski 1989:91). Therefore tool production is expected to show a high frequency of medial/distal fragments, while core reduction a moderate amount of the same debitage class.

Non-orientable fragments also exhibit distinctive patterns based on reductive technique. Prentiss and Romanski (1989:91-92) show values of 4 - 10% in tool production, and 31.7 - 32.6% for core reduction. Baumler and Downum (1989:107) indicate value ranges of 1.3 - 10.8% for tool production and 29.1 - 37% for core reduction. These are significant differences between the

two techniques, and could be considered a hallmark for distinguishing between the two, however there are important other considerations.

The issue of trampling of lithic assemblages seems like an intuitively important one (Magne 1985), however few researchers seem to have conducted systematic studies to try and measure the effects of trampling on lithic assemblages. In this vein, Prentiss and Romanski (1989) and Prentiss (1993) have argued convincingly against Sullivan and Rozen's (1985:763) thesis which proclaims that trampling of lithic assemblages should not affect flake completeness patterns, in cases where assemblages occur in soft sand matrices. The basis of Sullivan and Rozen's argument is that trampling would have transposed all lithic material into the soft mantle, and that flake breakage would not be a serious problem.

Prentiss and Romanski for instance found that experimentally trampled assemblages are quite distorted relative to pristine ones, even when this takes place in soft sand. In trampled tool production and core reduction assemblages, values for complete flakes average about 15% and 25% respectively. Proximal flakes average 25 and 15%, medial/distal flakes 50% and 40%, split flakes 5% and 4%, and non-orientable fragments 5% and 19% respectively.

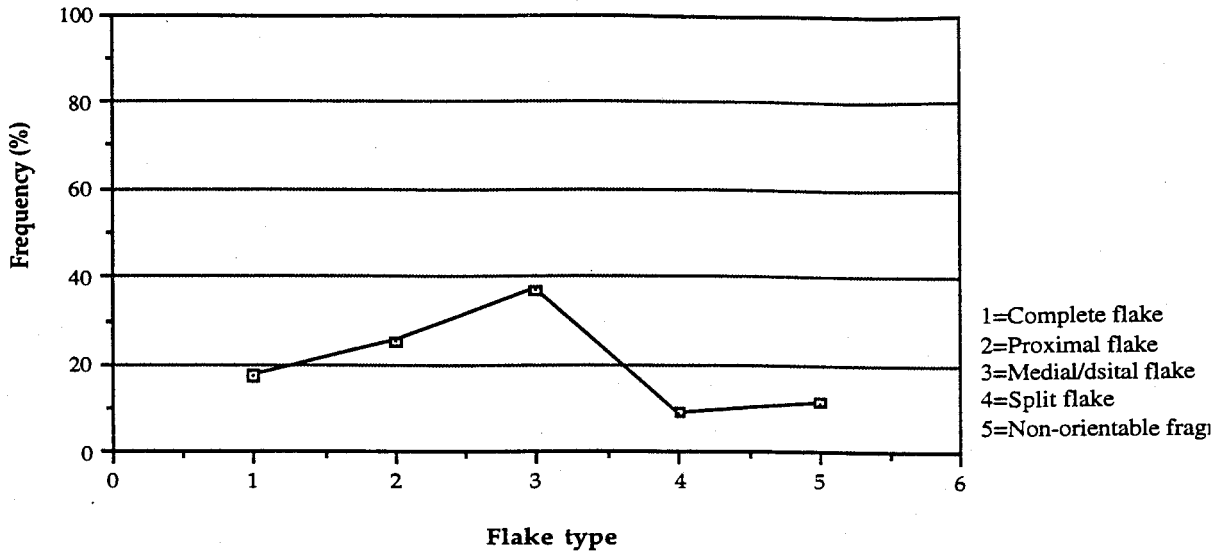
The most dramatic change in the flake profile is the reduction of complete flakes, particularly in the tool production category. This would be expected, since flakes from tool manufacture tend to be thinner and more fragile than flakes from core reduction. As a result, complete flakes from tool production would be more susceptible to breakage from trampling. However, a reduction in complete flakes is also seen in core reduction, although in a less dramatic fashion. Proximal flake values are relatively the same after trampling, although there is a slight increase in frequency. Conversely, the

medial/distal category is drastically altered after trampling. Values in tool production jump to 50%, and in core reduction to 40%. It would seem that trampling increases the frequency of medial/distal fragments, at the expense of complete flakes.

Split flakes show a very slight decrease in frequency after trampling in both types of assemblage. Non-orientable fragments remain unchanged after trampling of tool production assemblages, but show a significant drop in trampled core reduction assemblages. It is difficult to account for this drop in the frequency of non-orientable fragments, it may be due simply to the over inflation of the medial/distal category. In other words, the real numbers of non-orientable fragments do not change much after trampling, however their relative numbers would decrease with the rise in relative numbers of medial/distal fragments.

The Namu Period 1 andesite profile for the Sullivan and Rozen method (Fig. 26) indicates conflicting values. The value for complete flakes resembles the experimental values for the untrampled core category. On the other hand, the proximal flake value resembles trampled or untrampled tool production, medial/distal category fits with a trampled core assemblage, split flakes could be placed in any category, and the non-orientable fragments resemble an untrampled tool production assemblage. In Period 2, the complete flakes resemble an untrampled or trampled core reduction, the proximal flakes are unassignable due to low values, the medial/distal category could be either trampled core reduction or tool production, the split flakes are unassignable, and the non-orientable flakes again fit in with an untrampled tool production assemblage. Interestingly there is a difference in the profiles between Periods 1 and 2. The most significant difference is in the proximal flake category, which shows values of 25% in Period 1, and less than 10% in

Data from "Andesite 1S&R"



Data from "Andesite 2S&R"

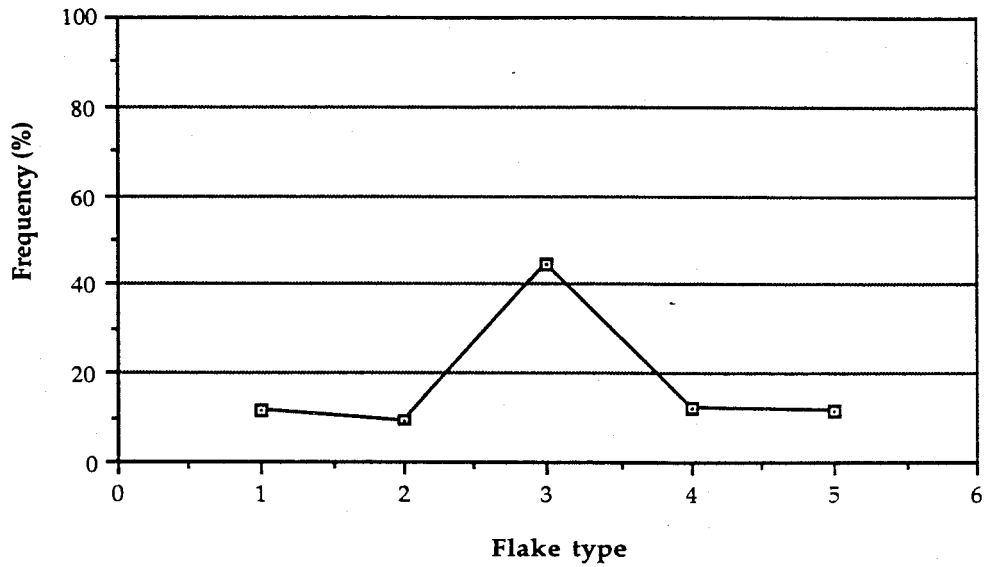


Figure 26. Flake completeness profiles - Andesite

Period 2. This may be the result of differential breakage due to variability in trampling. Certain parts of the assemblage may have been subjected to greater amounts of trampling or other processes. The lack of fine grained temporal resolution precludes testing this hypothesis at the present time, however future experimental work may be of benefit in this regard.

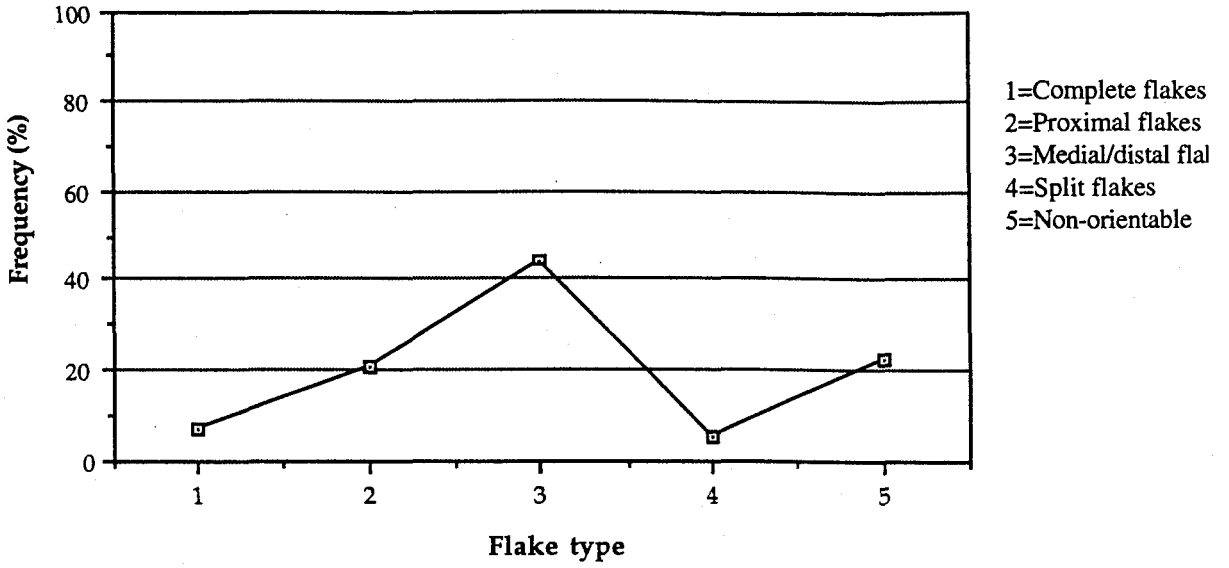
The basalt profiles (Fig. 27) for the two periods is quite similar. Both indicate: a complete flake frequency resembling an untrampled core assemblage, proximal flakes also indicating untrampled core, high medial/distal values indicating trampled core, and non-orientable frequencies indicating trampled core. In any case, the basalt frequencies seem to point largely to core reduction with a variable amount of trampling.

The trachyte profiles (Fig. 28) in general show a core reduction profile, with the exception of the non-orientable fragment category. This may be the result of the specialized type of core reduction, with an emphasis on unifacial flaking. Reduction of cores in this manner would not be expected to produce significant amounts of non-orientable fragments. What is notable is the slight change in frequencies between periods. In Period 2 there is a drop in the frequency of proximal flakes, and an increase in the number of medial/distal fragments. While it is tempting to attribute this to factors of trampling, the sample size should be considered. The total number of trachyte specimens from Period 2 is only 46, therefore this pattern may not be a representative sample.

The miscellaneous profiles (Fig. 29) will not be elaborated upon, except to point out that the medial/distal category frequencies are quite high. This may be a further indication of trampling.

An important factor to consider, the profiles when taken as a whole do not match any of the experimental results. What is interesting however is

### Data from "Basalt 1S&R"



### Data from "Basalt 2S&R"

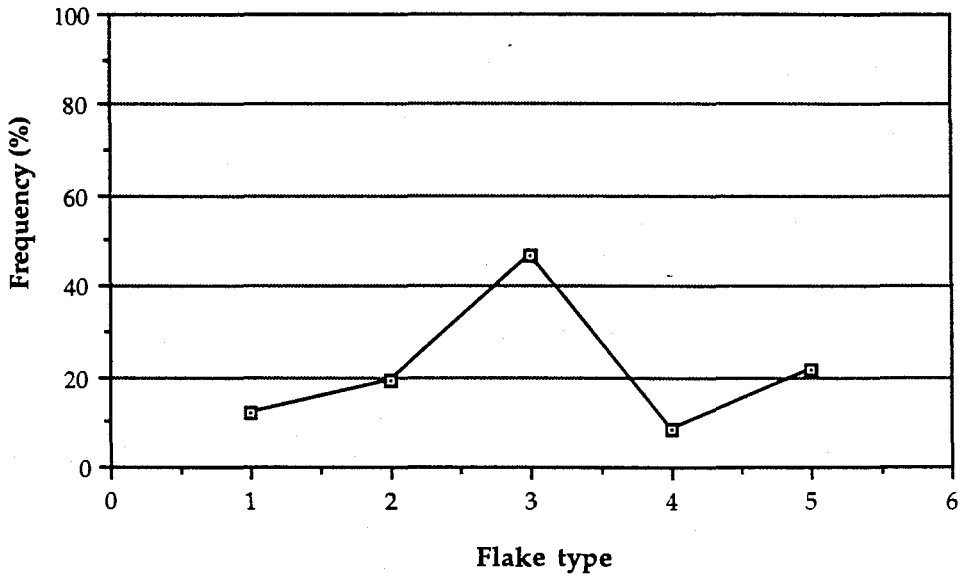
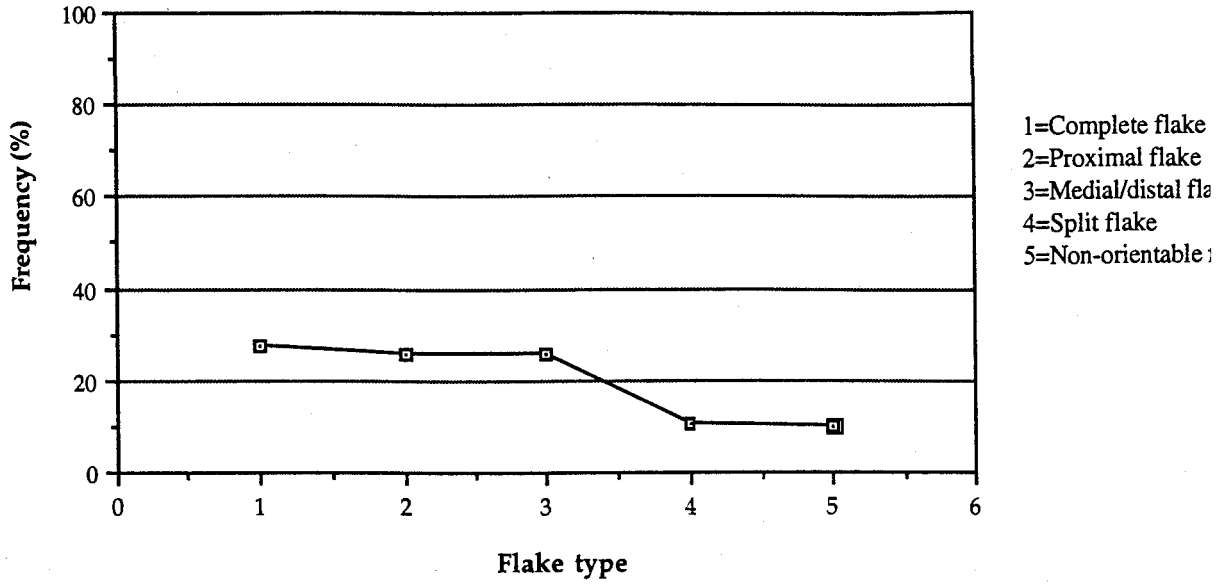


Figure 27. Flake completeness profiles - Basalt

### Data from "Trachyte 1S&R"



### Data from "Trachyte 2S&R"

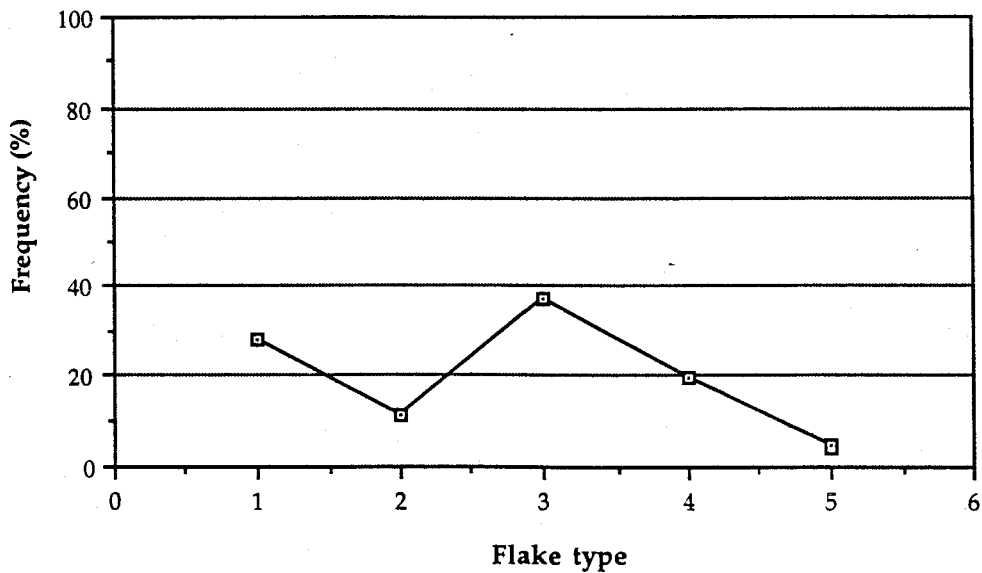
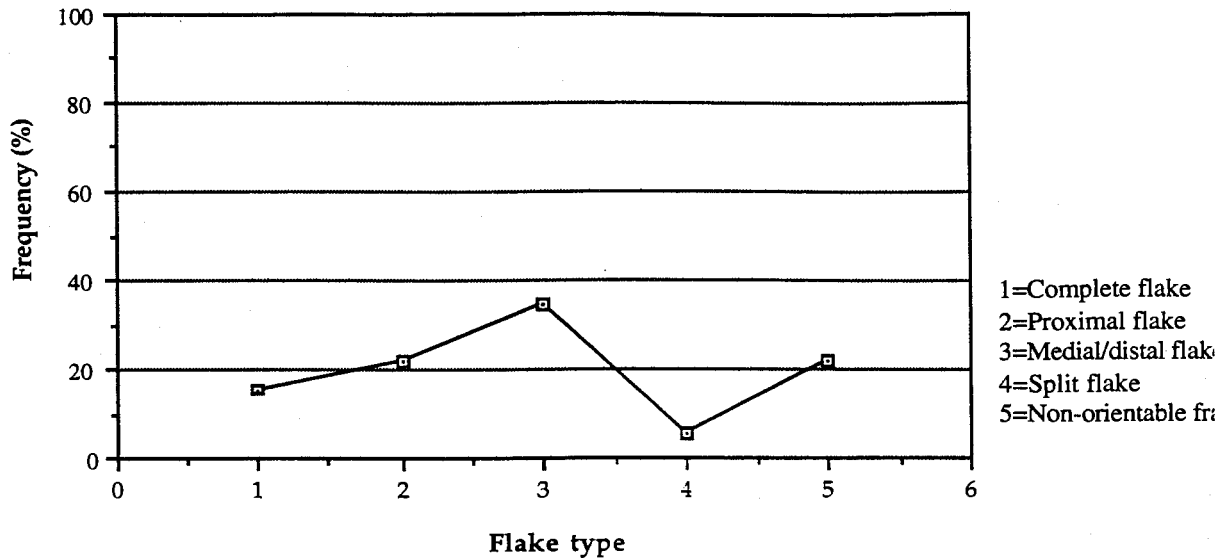


Figure 28. Flake completeness profiles - Trachyte

Data from "Misc 1S&R"



Data from "Misc 2S&R"

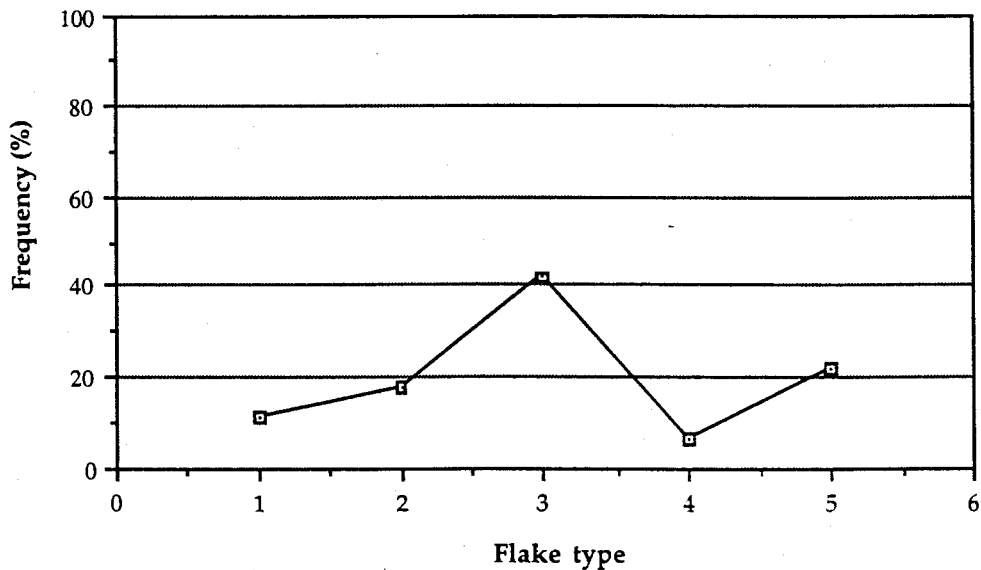


Figure 29. Flake completeness profiles - Miscellaneous



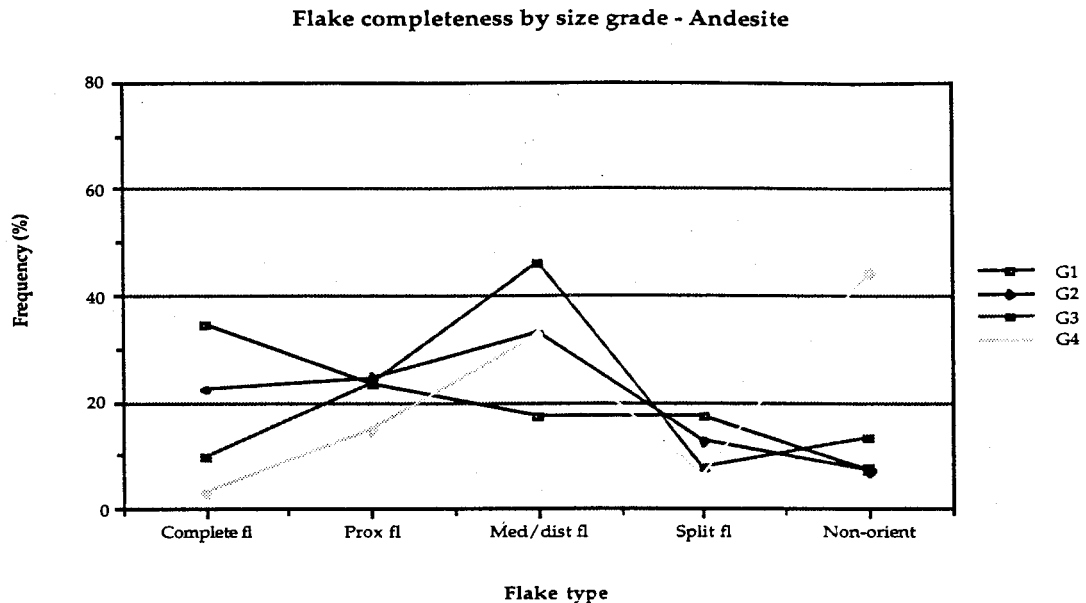
that the profiles could support an untrampled assemblage, except for the medial/distal categories, whose values exceed the untrampled assemblages. One reason for this lack of match in profiles may be the technological mixing. All the experimental samples consist of single reduction techniques, it is unclear as to what sort of effects technological mixing would have on the profiles.

Another variable that is uncontrolled in the present study is the differences in raw material, as pointed out previously. Prentiss and Romanski's work is based on experimental reduction of Morrison chert (1989:90), while Baumler and Downum (1989:102) used Wreford chert, Alibates chert, and Government Mountain obsidian. All of these materials are finer grained than materials in the Namu sample, therefore fracture patterns may be different. This has the potential to produce different flake completeness profiles, for example the Namu material is harder on the Mohs scale than the materials used in these experiments. As a result, flake completeness may be partially measuring the ability of the raw material to withstand impact during knapping operations, and also during episodes of trampling.

To investigate this line of thinking further, flake completeness frequencies were plotted against size grades for each raw material. Prentiss(1993) modified the Sullivan and Rozen (1985) scheme to include a size grade aspect, however his size grades were quite different than the ones used here, which were chosen to support the mass analysis. Prentiss (1993) argued that by adding size grades to the flake completeness analysis, the results were more valid and reliable.

Figure 30 shows the distribution of flake completeness by size grades for andesite in Periods 1 and 2. This is an interesting pattern that does not

compare favourably to any of the experimental data. In the G1 curve the highest frequency is the complete flake category, followed by proximal flakes,

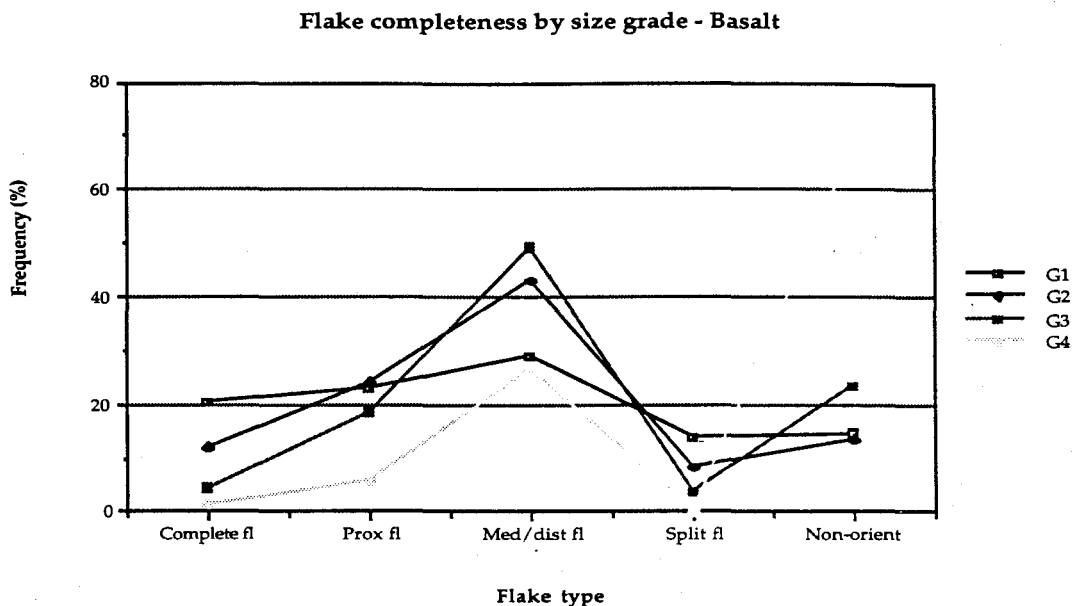


**Figure 30. Flake completeness by size grade for Periods 1 and 2 - Andesite**

medial/distal and split flakes, and non-orientable flakes. In the G2 curve the frequency of complete flakes drops by 12%, proximal flakes remain constant, medial/distal flakes rise dramatically, split flakes drop slightly and non-orientable fragments remain steady. This pattern continues in the G3 curve; complete flakes drop to below 10%, proximal flakes show no difference, medial/distal flake frequency rises even more, split flakes drop slightly, and non-orientable fragments rise slightly. In the G4 curve complete, proximal, medial/distal, and split flakes all drop, at the expense of a rise in non-orientable fragments. The G4 curve should be viewed with some caution, since the sample size is quite small.

The same patterning is seen in the basalt and miscellaneous graphs

(Figures 31 and 32), although the exact values are slightly different for various materials. However, the largest size grades once again have the highest frequencies of complete flakes and the lowest frequencies of medial/distal fragments, while the opposite is true for the G3 size grades. Moreover, there are only slight changes in frequencies of proximal and split flakes, and non-orientable fragments in the three larger size classes.



**Figure 31. Flake completeness by size grades for Periods 1 and 2 - Basalt**

Interestingly, the above pattern is exactly the same described by Prentiss and Romanski (1989) for trampled assemblages. That is in trampled assemblages, the frequency of complete flakes drops, and the medial/distal category rises, while other flake frequencies remain roughly the same. This patterning is seen to various degrees in both experimental core reduction and tool production assemblages. In the present case, it is difficult to sort out if a

### Flake completeness by size grade - Miscellaneous

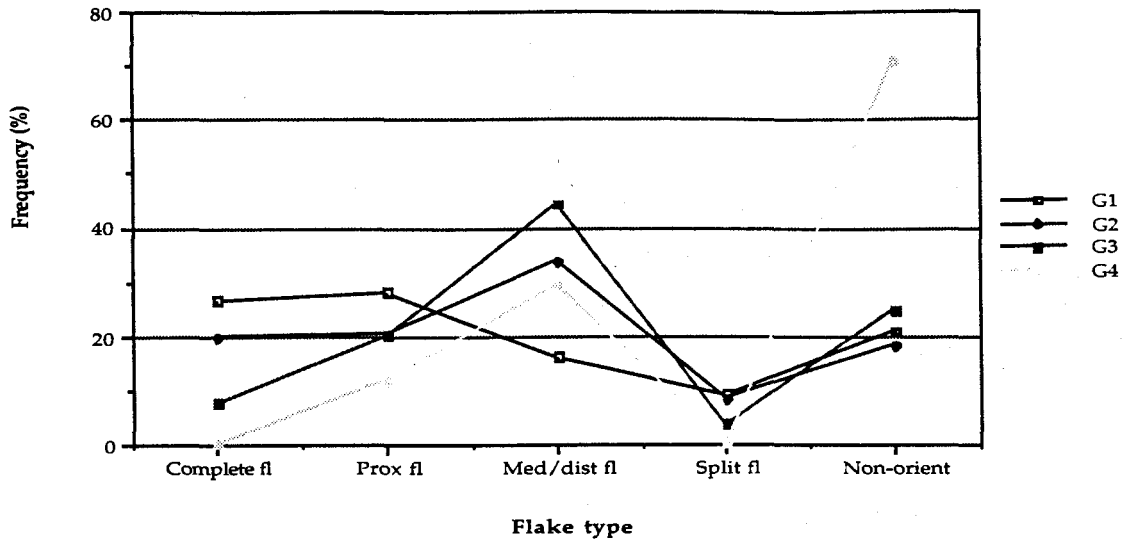


Figure 32. Flake completeness by size grade for Periods 1 and 2 - Miscellaneous

particular reduction strategy is indeed emphasized, the general pattern seems to support a technologically mixed assemblage. However, it is obvious that the frequencies of flake completeness are strongly tied with flake size, at least for complete and medial/distal flakes.

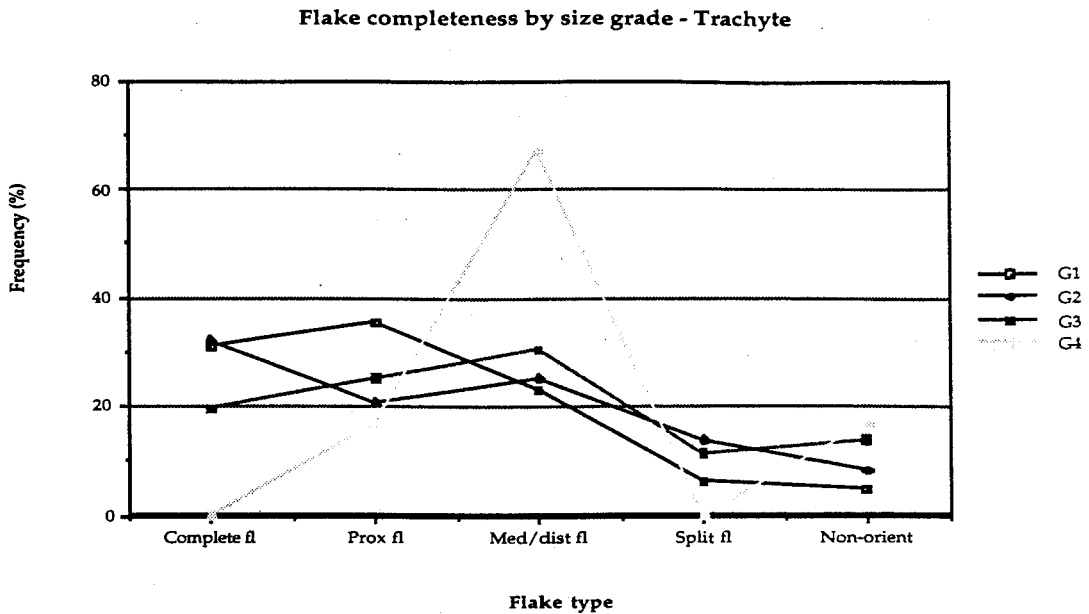
This may indeed represent some measure of trampling. The largest, thickest flakes would be expected to be the least resistant to trampling, and thus the largest size grade indicates a high number of complete flakes. As the flakes become thinner and smaller, they would have greater susceptibility to breakage due to trampling. However there are additional variables, the actual reduction strategy also determines survivorship of complete flakes after trampling (Prentiss and Romanski 1989). Tool production produces thinner flakes in general than does core reduction. These types of flakes then would be expected to break more easily than core reduction flakes, however there is some room for variation.

Given this situation, it is easy to decipher what the patterning actually means in the present research. If we were to accept that this is a technologically mixed assemblage, then we can hold the reduction technique as a constant. Trampling on such an assemblage would be expected to show the kind of patterning exhibited in this assemblage, where the smaller flakes exhibit more breakage than the larger ones. Having said that, we can infer that this assemblage has been subjected to some degree of trampling. Although as with other aspects of this research, experimental trampling on andesite and coarse basalt assemblages would be of great benefit.

Once again, the trachyte graph does not follow this trend (Figure 33). Here the G1 size grade shows a slightly higher frequency of proximal flakes than complete flakes. In the G2 curve the number of complete flakes rises slightly, as does the number of medial/distal flakes and split flakes, while proximal flake and non-orientable fragment values decline. In the G3 curve the frequency of complete flakes drops, while proximal flakes rise slightly as do medial/distal flakes, split flakes drop slightly and non-orientable fragments drop slightly. The G4 curve is unreliable due to the very small number of debitage in this size class.

This again may be due to the nature of the reduction strategy selected for this particular raw material. In all categories where frequencies change by size grade, the change is not very large, and the basic pattern is maintained. The only exception to this is the proximal flake frequency in the G2 curve. In any case, the flakes produced by unifacial reduction of cores are generally quite thick and sturdy, which may explain why the effects of trampling are less visible with this material.

Hence, the flake completeness approach is not too successful with this assemblage, due to raw material differences and technological mixing. Like



**Figure 33. Flake completeness by size grade for Periods 1 and 2 - Trachyte**

the other methods, this one works best on a single-technology assemblage, made on a fine-grained lithic raw material. What has been useful in this regard is the combination of flake completeness and size grades. When used in this manner, the patterns seem to indicate some degree of trampling.

#### 4.4 Discussion

The analysis has yielded mixed results. Technologically mixed samples have hampered absolute identifications of reduction strategies for the andesite and basalt. This has been compounded by the coarse grained nature of these raw materials. However, the examination does support the notion that the Namu inhabitants performed a diversity of reduction strategies with the andesite and basalt, ranging from core to early and middle stage biface reduction, tool production and some prepared core reduction. This is also

indicated in the formed tools, which include bifaces, scrapers, retouched flakes and a variety of other forms (Carlson 1995).

Another problem in the interpretation of the andesite and basalt results is that they do not precisely match any published experimental results. Two factors may be invoked here. First, the raw materials are obviously very different, the Namu andesite and basalt are more coarse and difficult to work than flints, cherts, obsidian, and vitreous basalt. This underscores the need for the building up of an experimental sample consisting of more coarse grained materials. Furthermore, this experimental sample should try to approximate the types of strategies and tools that are overtly and intuitively visible in the archaeological sample. In this sense, a more closer fit may be obtained between experimental and archaeological observations. This is one reason why Magne's (1985) research was deemed successful, in that he strived to experimentally replicate his archaeological sample, using similar raw materials.

What does seem apparent though with regard to the andesite and basalt is that initial decortication was taking place elsewhere. The cortex profiles indicate that these materials were being brought into the site after being initially tested and reduced, perhaps at the quarry site. The initial form from which they were worked is yet to be determined, but the core reduction flakes examined do not seem to point towards tabular cores. The initial cores then may have been large nodules brought into the site.

From these, initial flakes were struck, and a variety of reduction strategies followed after. This is most apparent in the scar count method as advocated by Magne (1985). In the present research, the andesite and basalt both indicate dorsal scars that represent early and middle stage reduction. However a number of Biface Reduction Flakes were also noted. Although late

stage reduction was not heavily represented in this sample, this may be related to the raw material. The coarse-grained structure of these raw materials preclude any real fine work, although there is some degree of variability in this regard. The formal tools support this contention, very few of the recovered bifaces are "thinned" to the degree of those found in temporally comparable assemblages elsewhere.

Problems associated with this method in the present analysis include the visibility and quantification of flake scars, this problem was particularly acute when counting platform scars. In this regard, the quantification of platform scars on platform remnant bearing flakes (PRBs) as advocated by Magne (1985) was deemed unreliable in the present assemblage. Instead dorsal scars on PRBs were used to infer reduction stage. This resulted in similar patterns for dorsal scar counts on shatter and on PRBs, indicating greater reliability of results.

The flake completeness method has also yielded mixed results. Identification of absolute reduction strategies was not possible due to the technological mixing and the raw material differences. What was instructive in this analysis however is that it indicates some degree of trampling, this is most notably seen in the andesite and basalt patterns.

On the other hand the trachyte results accord well with the general observations on the formed tools made on that material. In all analytical methods the trachyte stands out as being different, with regard to reduction stage and strategy. This material is utilized largely in the "Pebble Tool" Industry. The resulting flake weight and cortex profiles in the mass analysis reflect a core reduction strategy, especially one in which unifacial flaking was the primary method of reduction. This is also borne out by the high frequencies of secondary multiple flakes, and especially unifacial reduction



flakes in the trachyte sample.

One very important factor that has become apparent in the mass analysis is the lack of G4 debitage. In *all* knapping operations of siliceous materials, small size flakes should dominate numerically (Ahler 1989a; Patterson and Sollberger 1978). For example, Ahler (1989a) and his associates report numerical frequencies of G4 flakes ranging from 59.7% to 100%, depending on reduction strategy. At Namu, the numerical frequencies for G4 material do not even reach 10% at their maximum values. This cannot be explained by raw material, both the andesite and the basalt would be expected to produce much shatter upon being struck. Two hypotheses can be forwarded to explain this situation; the first involves consideration of post-depositional processes, and the other centers on differences in areas of activity versus areas of discard.

Some researchers (e.g. Stein 1992) feel that dark shell-free basal deposits in shell middens originally consisted of shell and other organics, which have since weathered away by chemical processes. Results of the Namu matrix analysis (Sullivan 1993) are inconclusive, and do not provide support to this theory. In any case, if we follow the assumption that there was a shell midden matrix here, then we may explain the lack of G4 debitage as being the result of some post-depositional process, that led to percolation of the smaller size lithics through the deposits. However if this is the case, then we would also expect to find an accumulation of these smaller size lithics somewhere in the lower levels of the deposits. These were not recovered during the course of the excavation. Therefore, they were simply not there in the first place, so the first hypothesis must be rejected.

In the second hypothesis, the lack of small size lithic debitage is attributed to differential functional areas. That is, the area of discard does not

coincide with the area of manufacture. Ethnoarchaeological studies (Gallagher 1977) among the Gurage, Arussi-Galla, and Sudama of south-central Ethiopia provide a convincing analogue. These peoples manufacture and use stone tools (namely obsidian scrapers) to process hides. The tools are manufactured and resharpened in the living area of the village, however any debitage is caught in a pre-positioned container (basket, pot, etc.), which is then subsequently emptied in an area designated as a dump. The reasoning behind this is obvious; in areas of high use, lithic debitage would present a potential hazard, particularly with angular and sharp edges.

Behm (1983) took this a bit further through experimental recreation. He conducted a series of knapping operations on a plain earth floor, and left the material outside for a period of two weeks. Next, he picked and swept up the lithic materials, and subjected them to size sorting using Ahler's categories. He found that the smaller sized flake frequency suffered great attrition in this process. The G4 grade frequencies were far below what they should have been, in terms of numerical frequency and percentage of flake weight (Behm 1983:13). Obviously, the cleaning of the knapping area was incomplete, many of the G4 size and smaller flakes being left behind. These would pose less of a threat to human flesh, and would probably be more easily compacted into the earth floor over time.

If the second hypothesis is correct, then the present assemblage may be derived from a prehistoric dump area. The actual knapping may have taken place elsewhere. The presence of biface production failures and other broken implements lends some support to this hypothesis. Furthermore, there are overlying deposits of shell and ash in the same location, but from more recent time periods (Carlson 1991). If this hypothesis can be further substantiated, it would mean that this particular area of the site was used as a dump for an

enormously long period of time. There is virtually no G4 debitage throughout periods 1 and 2 in this location. It would also mean that during this same time period, the actual knapping area(s) was being cleaned. This would only be expected in activity areas which were used (on and off) continuously.

A further hypothesis which is untestable at present, is that the G4 debitage was present but not picked up by individuals who were screening at the site. Even though this material was water screened with 1/8" mesh, the nature of these basal deposits are such that the heavy matrix can obscure smaller items in the screen, especially when the screened material is still wet. In the 1994 excavations, a new procedure was followed, whereby screened tailings were dried and examined further for lithic debitage and other cultural material. This assemblage is still being processed and will be analyzed at a later date, particularly for the G4 content. However for now it is assumed that they are not present.

In any case, the trampling patterns exhibited in the flake completeness analysis do not contradict this lithic dump hypothesis. The flakes may have been trampled previous to being swept up and carried to the dump. Alternatively, over the course of time, the dump area would have been subject to a substantial amount of pedestrian traffic which could cause the patterns of trampling.

A number of salient features can be summarized from the overall analysis:

- 1) There is impressive continuity exhibited at the site, in terms of choice of raw materials, and in reduction strategies.
- 2) None of the raw material with the exception of the obsidian,

can be classified as high quality material. The vast majority of the assemblage consists of andesite and basalt. This is followed by trachyte, and a number of other coarse-grained materials.

3) The andesite and basalt seem to be worked in a number of ways, with different reductive strategies indicating a mixture of curative and expedient components.

4) The andesite and basalt are probably being brought in from elsewhere, either as very large cores, or as large flakes. The presence of large expedient flakes indicates possible stockpiling.

5) The trachyte is local, and obtained in the form of river rolled cobbles. Reduction strategy is highly specialized in the form of unifacial core reduction. This is reflective of the "Pebble Tool Tradition" component.

6) The other (miscellaneous) raw materials are reduced in a variety of manners, ranging from early to late stage reduction.

7) A lithic dump area may have been established early in the site occupation history, and displays long continuity in usage.

8) There is some degree of trampling evident in the flake completeness by size grade patterns.

#### 4.4.1 Interpretations on technological organization

When all of these factors are viewed together, they seem to point to a pattern of reduced residential mobility. The continuity in choice of raw materials would be dictated by availability, and also by the amount of mobility practiced by the group. The types of reduction sequences could be constrained by these raw materials, and the tasks to be performed by the implements. One shortcoming in this research is the lack of any studies of use wear. Given the nature of this raw material, detection of signature patterns indicating use is very difficult. As a result, it is not known as to how much of the material analyzed was actually put to use by the inhabitants of Namu. If most of the material was being carried out of the area to be used elsewhere, then this would have some bearing on the design of the tools. Likewise, the design of tools would also be affected if their use was strictly local.

However, if a more mobile pattern was indicated, we may expect to see more exotic raw materials obtained from elsewhere during the annual round. Obsidian seems to be the only raw material coming from some distance, but this material occurs in very small numbers. This material is used largely for microblade production, after which the expended cores were bashed in a bipolar fashion (Hutchings 1992; personal comm.). This indicates the value and rarity of this raw material.

In general though the technological system was geared toward use of more local, qualitatively "less desirable" materials. Yet these materials are subject to a wide variety of strategies. This kind of pattern is usually not exhibited at activity-specific sites (Binford 1979; Kelly 1988; Parry and Kelly 1987). In other words, the pattern is more indicative of an area where a number of different activities were taking place, such as in a habitation site. This is also borne out by the formed tools, there are a variety of implements

being manufactured (and used?). In more activity specific sites, the diversity of reduction strategies and formed tools should be reduced (Magne 1985).

The transport of andesite and basalt from other areas would accord well with a sedentary/semi-sedentary residential pattern (Parry and Kelly 1987). These materials may have been stockpiled at Namu, and accessed during successive occupations. The raw materials here qualitatively look very similar to those found at FaSu 19 (Kwatna), which is approximately 12-15 km from Namu (P. Hobler 1994: pers. comm.) by water, along the Burke channel. Hobler also feels that FaSu 19 is a quarry site, large boulders and flakes have been recovered there. It is entirely possible that this was a source of material for the inhabitants at Namu. Periodic trips to Kwatna to obtain raw materials for transport back to Namu would be facilitated through the use of watercraft, such as dugout canoes. However, this relationship between Namu and FaSu 19 needs to be tested.

The possibility of a dump area for lithic waste strongly indicates an intensively used site. If this site were being used continually as a seasonal habitation for instance over long periods of time, it would make sense to keep the living areas relatively free from lithic debris. This would especially be true when a good source of raw material would be continuously available through stockpiling, reducing the need for extensive scavenging or "culling" (Prentiss 1993) of lithic resources.

The working hypothesis at present then, is that Namu is an intensively occupied site, and displays characteristics of reduced residential mobility starting at a very early time period. This may mean intensive seasonal occupation as occurred in ethnographic times, or it may indicate year-round residency. Cannon (1991) also leans towards this interpretation of intensive occupation in his assessment of the faunal material at Namu. Although,

whereas lithics are present from the earliest cultural occupation, faunal material is relatively absent until later occupations. The causes for this are still being debated (Cannon 1991; Carlson 1995). Nevertheless, this is only a working hypothesis which is fully testable, and like all forms of learning, this hypothesis may be altered or substantially changed as more knowledge is obtained.

## Chapter Five: Summary of findings, suggestions for future research, and conclusions

### 5.1 General

As stated in Chapter 1, the primary goals of this research are to examine a collection of lithic debitage from the Early Period (ca. 10,000 - 5,000 b.p.) at Namu, to determine the types of reduction strategies that were generally pursued in this time period and from this, to make some preliminary interpretation on technological organization. The following is a summary of the findings, including the shortcomings in this research. Suggestions are made for future research, and a conclusion is provided at the end.

### 5.2 Summary

Close to 6,300 pieces of lithic debitage were analyzed for this research, these were obtained from the S.F.U. excavations of the Rivermouth Trench in 1978. Studies of debitage are now at the forefront of lithic archaeology and offer several unique features; they are normally not a transported class of artifacts, so that barring natural post-depositional processes, they can be expected to be deposited at the place of manufacture, which is useful for identifying settlement patterns (Binford and Quimby 1963); they also act as a record of reduction strategies.

These reduction strategies can lead to higher level interpretations, when framed within a context of hunter-gatherer organization over the landscape. By delineating where raw materials are procured, and then where and how they are reduced and used, inferences can be deduced with regard to land use and mobility factors (Kelly 1988), this is referred to as the study of *technological organization*.



### 5.2.1 Raw materials

The lithic raw material in this assemblage is best described as medium to coarse grained igneous rocks, although there is a small number of fine grained material. The predominant material is *andesite*, followed by *basalt*. These two materials were used in the same manner, for a variety of reductive strategies. However, their nature precludes the fine work as seen in other archaeological assemblages with finer-grained materials. The bifaces here tend to be thicker, with larger finishing scars. The third most prevalent material is *trachyte*, this is the main raw material as used for the pebble tool component. This material is largely river rolled cobbles, which are reduced in a unifacial manner, the resulting debitage patterns are very unique in all analytical techniques. Following this, are a number of other raw materials ranging from fine to coarse grained, none of these occur in numbers large enough to warrant a separate category, so they are subsumed under the category *miscellaneous*.

### 5.2.2 Analytical methods

In the past decade, there has been much advance in analytical methods to deduce reduction sequences from lithic material, particularly debitage. In the present research three separate methods are employed, Magne's (1985) scar count method, Sullivan and Rozen's (1985) flake completeness approach as modified by Prentiss and Romanski (1989), and Ahler's (1989a, 1989b) mass analysis approach.

The results of the analyses are somewhat mixed, however some patterns are rather informative. With Magne's scar count method, it became apparent that this is a technologically mixed assemblage. The patterning indicates a variety of reduction stages, ranging from early to late, with a peak

in the middle stage. This indicates that there were several activities going on at Namu in this time period, at least from a technological point of view. In special activity lithic sites, we would expect to see only a small part of the spectrum of reduction stages, rather than the whole spectrum (Magne 1985). This notion is supported through cursory examination of the formal tools, which display a wide range of technological operations.

The only exception to this is the trachyte, in which the primary reduction strategy is unifacial core reduction. The trachyte also exhibits a high incidence of secondary multiple flakes and unifacial reduction flakes, which are characteristic of this technique. Some 40% of the trachyte debitage are unifacial reduction flakes, as opposed to values of less than 1% for both andesite and basalt.

The flake completeness method also yielded mixed results. While a distinct pattern could not be delineated (again due to technological mixing), there were some interesting results with regard to evidence for trampling. As part of their experimental testing of Sullivan and Rozen's method, Prentiss and Romanski (1989) also conducted tests on trampled assemblages. While the Namu flake completeness patterns in themselves may indicate trampling, the patterns were more apparent when combined with the size grade information. There are strong indications that the Namu material has been trampled.

The mass analysis also showed patterns that could be interpreted as technologically mixed assemblages, although the primary reduction seemed to be flake production and thick biface production for the andesite and basalt respectively. While this is not suspect in itself, the patterns did not exactly match Ahler's (1989a) experimental patterns. This may reflect the technological mixing in the Namu material.

The cortex patterns in the mass analysis were instructive. As expected the trachyte had the highest cortical values. For andesite and basalt, the results were also interesting. Neither of these raw materials indicated a large percentage of cortex in the largest size categories, which would be expected if the large cores were initially reduced at Namu. However, a limited amount of cortex was noted in all size grades, especially the largest one. This is interpreted to indicate that the primary reduction of the cores was taking place elsewhere, perhaps at the source. If this is the case, then the raw materials were being brought into Namu, with some of the initial reduction work already accomplished.

The most interesting result of the mass analysis concerns frequencies of debitage in the various size grades. It became apparent in the analysis that there was a very small amount of the smallest size class (G4) of debitage. This is highly anomalous, in all experimental knapping operations this size class should dominate by frequency (Ahler 1989a).

Ethnoarchaeological studies on village-dwelling stone tool manufacturing peoples produced one possible analogue, Gallagher's (1977) research in south-central Ethiopia with stone tool-using village peoples. Manufacturing waste from reduction operations is cleaned up and deposited into a lithic dump area. In this manner, the living area is kept clean and safe from potentially harmful lithic debris.

Behm's (1983) experimental study was designed to ascertain what patterns such behaviours would produce from an assemblage viewpoint. He found that when an area gets swept or cleaned by hand, the smallest lithic debitage tended to get left behind. Upon conducting a mass analysis of the materials in an experimental "lithic dump", Behm found that the smallest size grades tended to be under-represented. This same pattern is seen in the

Namu assemblage.

### 5.2.3 Technological organization

These findings seem to indicate that the Early Period inhabitants of Namu practiced a low rate of residential mobility. Several lines of evidence provide support to this contention. First, it would seem that the andesite and basalt materials were brought in as large cores from elsewhere (possibly Kwatna), and that some of the primary reduction had taken place before these materials were brought into Namu. Moreover, at Namu these materials were being reduced in a variety of manners, from early to late stage reduction. The formal tools also exhibit a wide variety of forms, ranging from unprepared and prepared cores, bifaces in various stages of manufacture, scrapers and other flake and core based tools. This indicates that Namu was not a special activity site.

The reduction and discard of these materials indicate that the Namu inhabitants were not overly concerned with curation of tool kits. It would be highly illogical for a group of people with a high rate of residential mobility to invest the time and energy to prepare large cores at the source, and then transport and dispose of them in a wanton manner. Alternatively if Namu was a sedentary occupation, it is possible that the raw material was being stockpiled at the habitation site. This is not an unusual strategy in post mid-Holocene sedentary settlements in the New World (Parry and Kelly 1987). Such a practice would ensure a continual supply of raw material at Namu, and also reduce the need for scavenging of lithics.

The trachyte seems to be local and was used largely in unifacial reduction on river-rolled cobbles. This indicates a highly specialized reduction strategy, and although the function of this technology is not known for

certain. There is good evidence to support the idea that unifacial reduction flakes are linked with cutting and processing of fish and other marine resources (Rahemtulla 1995). Waste materials from lithic reduction were disposed of in a designated area (area of the Rivermouth Trench). This dump area displays evidence of trampling, as seen in the flake completeness profiles. It should be noted that this area also serves as a shell midden after 6,000 b.p., when organic material shows up in the record at Namu.

When taken together, these factors allude to a pattern of reduced residential mobility at Namu. Perhaps this represents a semi-sedentary settlement, at least on and off during the first five thousand years of occupation. Alternatively, it could indicate a year round sedentary settlement, or a combination of the two. Given that we are dealing with a five thousand year time span, several combinations of residential patterns are possible through time. In any case, sedentary/semi-sedentary occupation would be expected to show some or all of: close source of raw material or stockpile, a variety of reduction strategies, and possibly a midden or lithic dump area. All of these are evident at Namu in the Early Period. Cannon (1991, 1994 pers. comm.) also independently arrived at this interpretation in his analysis of the faunal material from Namu.

### **5.3 Suggestions for future research**

The primary shortcoming in this research program has been the lack of a suitable experimental database conducted on raw materials similar to the ones found at Namu. This may be causing some of the differences in patterning seen in the various analytical approaches employed here. Morrison (1994) makes a good case for the use of similar raw materials when comparing archaeological to experimental lithic assemblages.

At present, plans are under way to begin the building up of a referential experimental sample based on medium to coarse grained lithic materials. This would also be of benefit in other areas where such materials are used. Very few research programs have bothered to include medium and coarse-grained materials in their experiments, even though these types of raw materials are not unusual in the archaeological record (Morrison 1994). Most studies have concentrated on fine grained materials such as flint, chert and obsidian.

A second confounding factor is that this is a technologically mixed assemblage, and while this has precluded identification of specific reduction strategies, it has also shown that there were a number of lithic reduction strategies pursued by the inhabitants of Namu. Ahler (1989a) has shown that multivariate techniques can be used to sort out technologically mixed assemblages, however this operation requires the presence of the smallest size flakes.

A third potential confounding factor regards the aforementioned G4 flakes. It is entirely possible that this size class was not picked up by screeners at the Namu excavations of 1978. In the 1994 excavations, collection techniques were modified so that screened tailings can be reexamined for small size lithic debitage. Once this is done, the question of G4 material presence can be answered. This will also be of benefit in the mass analysis, in terms of analysis of a technologically mixed component (above).

Fourth, the hypothesized relationship between Namu and FaSu 19 should be tested. Preliminary efforts have been made in this direction, samples of andesite and basalt from both areas will be submitted for possible analysis by x-ray diffraction. This may or may not be a useful exercise, since these materials have extensive flows, and are less useful as sourcing materials

than obsidian and other materials. Furthermore in the raw material vein, a preliminary survey at Namu in 1994 indicated that there are no knappable local basalt and andesite sources. At the least, a more comprehensive survey of raw materials around Namu would be of great benefit.

Fifth, and this may be unrealistic, is that if the current hypothesis regarding Namu as a sedentary settlement in the Early Period withstands further testing, then it would be paramount to discover where the actual living area was. However given the time and resources needed to conduct even small scale excavations in this area, this suggestion may be difficult to carry out.

#### **5.4 Conclusions**

The research goals of this project have been met with varying degrees of success. On a mechanical level, the analytical aspect of this research has some shortcomings, which have been pointed out. Nevertheless, at the least it is hoped that the potential of such methods for analyzing lithic assemblages has been made clear. There are other sites on the Northwest Coast and elsewhere that could benefit greatly from this type of analysis.

The overall objective was to forward some interpretation on the behaviour of the Namu inhabitants in the Early Period, based on lithic debitage remains. On this count the research has been successful by providing some rather interesting hypotheses with regard to Northwest Coast occupational history. The evidence gathered in the analysis seems to indicate that Namu was a sedentary/semi-sedentary occupation through most of the Early Period. This is a very early time period for such a settlement, it counters the widespread belief that villages did not arise in this region until after 5,000 b.p. (Fladmark 1974). This hypothesis is fully testable, and may change as new

data come to light.

Finally, it is interesting to speculate that sedentary settlement on the Northwest Coast may have a much greater antiquity at least in some areas, than is presently realized. This would have all manners of attendant consequences and questions, regarding the development of social complexity and related phenomena. That however, is another story.



**Appendix A: Attributes collected for Individual Flake Analysis**

1) Catalogue number: X

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2) Raw material: 1) andesite 2) basalt 3) trachyte 4) Misc

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3) Size category: 1) G1 2) G2 3) G3 4) G4

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4) Ave. flake weight per size category: Xg

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5) Flake completeness: 1) Complete 2) Proximal 3) Medial/distal  
4) Split flake 5) Non-orientable

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6) Magne Flake type: 1) Shatter 2) BRF 3) Bipolar 4) PRB

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7) Special flakes: 1) MSF 2) Unifacial

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8) Termination: 1) feather 2) step 3) hinge 4) reverse hinge

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9) Platform prep: 0) absent 1) present

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10) Platform cortex: 0) none 1) 0-30% 2) 30-60% 3) 60-100%

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11) Platform scars: 1) 1 2) 2 3) 3 4) >3

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12) Platform angle: X°

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13) Dorsal perim. scar: 0) none 2) <50% 3) >50% 4)100%

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14) Dorsal cortex: 0) none 1) 1-30% 2) 30-60% 3) 60-100%

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15) Dorsal scars (>5mm): X

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16) Dorsal hinge scars: 1) 1-2 2) 3-4 3) 5 or more

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17) Lipping: 0) absent 1) present

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