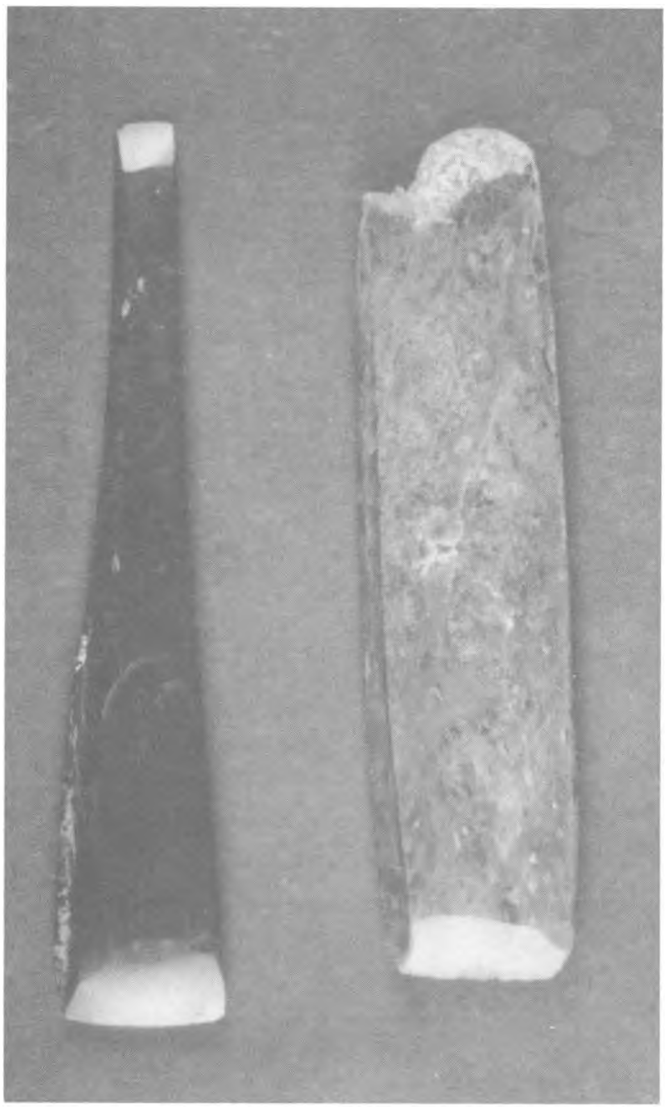
The Prehistoric Use of Nephrite on the British Columbia Plateau



John Darwent

Archaeology Press
Simon Fraser University
1998

The Prehistoric Use of Nephrite on the British Columbia Plateau

By

John Darwent

Archaeology Press
Simon Fraser University
1998

Printed and bound in Canada

ISBN 0-86491-189-0

Publication No. 25
Archaeology Press
Department of Archaeology
Simon Fraser University
Burnaby, B.C. V5A 1S6
(604) 291-3135
Fax: (604) 291-5666

Editor: Roy L. Carlson

Cover: Nephrite celts from near Lillooet, B.C.
SFU Museum of Archaeology and Ethnology
Cat. nos. 2750 and 2748

Table of Contents

Tables

Figures

Figures (Continued)

1 Introduction

This study is an examination of the prehistoric use of nephrite on the British Columbia Plateau. It was undertaken in order to determine whether nephrite was primarily used by Plateau societies to fulfill utilitarian woodworking requirements or as an item of status, property or wealth. To understand these issues, it will be necessary to evaluate the costs and benefits involved in manufacturing and using implements made of nephrite compared to those for other stone materials available for woodworking in the British Columbia interior. It will also be essential to determine how prehistoric plateau societies exchanged, utilized and disposed of nephrite objects. This study helps to establish how complex hunter-gatherer societies made use of commodities of potentially high value.

The physical characteristics of nephrite endow it with a toughness for woodworking tasks beyond any other stone material available in the interior of British Columbia. This strength, however, also makes nephrite one of the hardest materials to shape into useable implements. When polished, nephrite, being a form of jade[1], is a highly aesthetic gem stone that usually comes in various hues of green. Both the toughness and aesthetic qualities of nephrite, when combined with the amount of labor needed to shape it, made it a highly valued material in Plateau society.

The implicit assumption in Plateau archaeological literature is that nephrite artifacts were the primary heavy duty woodworking tools in the Interior and were part of a tool kit that every family unit possessed (e.g., Sanger 1968:128, 1970; Stryd 1973:65; Richards and Rousseau 1987:50). This view implies that the ownership of such artifacts would have been unrestricted to all members of Plateau society and that nephrite implements would have been used mainly for woodworking functions, as well as possibly being trade items for exchange with coastal groups (Fladmark 1982; Richards and Rousseau 1987:51). These assumptions probably derive from the belief that prehistoric societies on the Fraser and Columbia plateaux were egalitarian and not as complex as coastal groups (Ray 1939). Any cultural traits that suggested non-egalitarian behaviors (e.g., potlatches, totems or crests) are thought to have been the result of Plateau contact with the coast (see Cannon 1992).

Some work on the British Columbia Plateau has demonstrated that social inequities were present in the Interior ethnographic and archaeological records (Stryd 1973; Hayden et al. 1985; Hayden 1992; Hayden and Spafford 1993). These inequities are hypothesized to be the result of an in-situ development of a complex hunter-gatherer lifestyle on the plateau (Hayden et al. 1985; Hayden 1992). Under this model, nephrite use and ownership would have been restricted to wealthier individuals or families as a mechanism to display or retain wealth and to control labor by judicious loaning of costly-woodworking tools (Hayden et al. 1985).

To the present, no empirical evaluation of the significance of the occurrences and distributions of prehistoric nephrite artifacts on the British Columbia Plateau has been undertaken. It is not clear from the present literature whether nephrite artifacts were manufactured because they represented the most cost-effective or efficient tool for Plateau woodworking demands or whether their use went beyond utilitarian needs to fulfill prestige or wealth functions. In order to understand the value placed upon nephrite implements by prehistoric Interior societies, there must be an examination of the economic factors behind the use of nephrite (e.g., manufacturing effort and cost, relative efficiency, and curation) and an interpretation of the distribution of nephrite in the archaeological record.

The following aspects of nephrite technology on the British Columbia Plateau are investigated in this report:

1. What was the energy and time cost-efficiency of the use of nephrite? What were the time and effort factors needed to manufacture nephrite artifacts? Were alternate materials used in lieu of nephrite? What were the costs and benefits of those materials? Were some nephrite implements non-functional? Was there excess energy expenditure on nephrite artifacts when alternate raw materials

[1]. Unless otherwise stated, the term jade in this study refers only to nephrite. In other areas of the world it may also refer to jadeite.

would have fulfilled the task requirements?

2. Do certain types or sizes of nephrite artifacts occur in select contexts and locations on the British Columbia plateau? How did Interior societies dispose of nephrite implements? Does the distribution of nephrite artifacts suggest a particular exchange pattern? Are artifact contexts indicative of possession by certain individuals or groups in Plateau society? Did the value of nephrite artifacts vary in different regions of the Plateau?

Types of Data

The types of data that can be used to examine the prehistoric use and importance of nephrite in the British Columbia interior include: 1) ethnographic observation; 2) observations from experimental replications on the energy and time costs of prehistoric nephrite manufacturing; 3) archaeological contexts and distributions of different forms of nephrite artifacts; 4) observations of artifact material types, hardness, and manufacturing techniques; and, 5) analogs of nephrite (jade) use by other cultures in the world.

Ethnographic Observation

Optimally, direct historical evidence surrounding the use of nephrite would be the most ideal form of data. If direct observations of Interior nephrite manufacturing and the subsequent use and ownership of such artifacts were available, they would minimally form a starting point from which to interpret the archaeological record. Unfortunately, there is only a limited amount of ethnographic data available surrounding the use of nephrite in the Interior. The information that does exist (Dawson 1887; Teit 1900, 1906, 1909b, 1930; Emmons 1923) alludes mainly to manufacturing processes. There are also a few references to a special value placed on at least some types of nephrite artifacts (Emmons 1923).

In addition to the shortage of ethnographic data, there are problems with directly applying ethnographic analogy to the past. As Gould points out (Gould and Watson 1982:375), analogues based on resemblances, either from a direct historical or comparative origin, cannot always account for variability in the past and thus become self-fulfilling in nature. In building analogies for nephrite use in the Interior of British Columbia, a large problem exists due to the fact that nephrite artifacts ceased to be made at least a generation before serious ethnographical research was undertaken (see Emmons 1923:20-21). It is thus possible that the ethnographically recorded information about nephrite use may be biased due to European influences on Plateau society and due to both ethnographers and informants embellishing their descriptions of nephrite utilization to fill in details lost over time.

In this study, I review the ethnographic information surrounding the prehistoric use of nephrite to create a synopsis of Interior Plateau jade working. There will be an attempt to critically evaluate the ethnographic information to create a model from which to make interpretations on nephrite use.

Experimental Reconstruction

Most archaeological studies completed on ground stone tools have been stylistic or typological. For example, Roger Duff (1970) created a typology for ground stone axes in the South Pacific; Mackie (1992) attempted a classification of nephrite celts for the Northwest Coast; and many typologies have been completed for groundstone axes in Britain (e.g., Manby 1975; Wooley et al 1975). The other usual type of research on groundstone tools is petrological analysis. For instance, Leighton (1989, 1992) performed petrological analysis on jadeite from Sicily, Wolley et al. (1975) examined both typology and mineralogy of European jade implements, and attention has been paid in Mesoamerica to sourcing jade objects used in the region (Foshag 1957; Lange 1993). What have largely been ignored, however, are the manufacturing processes involved in producing ground stone tools. This is particularly the case with nephrite.

Most experimental work on ground stone tools has focused on factors of time and effort needed to shape pecked and ground implements (e.g.,, Beck 1970; Dickson 1981; Johnson 1975; M'Guire 1892; Olausson 1983; Pond 1930; Steensberg 1980). From the results of these experiments, it has been demonstrated that there is a great variation in the amounts of time needed to shape different rock types. The overall results of these tests, however, are not very extensive and, with a few exceptions

(Dickson 1981 and Olausson 1983), are not very rigorous in their data collection methods. Some experimental studies have been performed on nephrite (M'Guire 1892; Beck 1970; Johnson 1975), but the results are limited and do not really explore the full range of prehistoric methods likely to have been used to manufacture nephrite implements.

Considerable discussion in lithic technology has been devoted to issues surrounding technological efficiency (e.g., Bamforth 1986; Hayden 1987; Jeske 1992; Torrence 1983, 1989). Some attention has also been given to evaluating the cost-effectiveness of groundstone edges for various material types (Dickson 1981; Olausson 1983; Boydston 1989). Comparisons in these studies usually relate to the *speed* at which edges made of various raw materials will chop through wood, versus the time needed to make the tool. Very little attention, however, is given to the *endurance* of different material types, which is an important factor in tool curation and replacement time.

During this study, I use data from experiments designed to quantify the effort needed to cut nephrite, and estimate the life expectancy of nephrite tools. The results derived for nephrite are compared to other types of raw materials that have been ground in the same experimental regime. Of key importance in this study is the determination of whether the effort needed to manufacture nephrite implements was 'excessive' in comparison to the cost-efficiency of other material types.

Context and Distribution

The study of artifact distribution and context has long been part of the archaeological discipline. Through the observation of artifact distributions, one can address issues surrounding exchange or trade patterns in an area (e.g., Renfrew 1975; Cummins 1975; Sherratt 1976; Elliott et al. 1978; Hodder and Lane 1982; Chappell 1987). Contextual information is important to understanding questions surrounding artifact ownership, manufacturing locations, modes of disposal, utilization areas and artifact value (Hodder 1982).

The context and distribution studies that are most relevant for the issues at hand are those that have been undertaken in Europe for stone axes (i.e., Hodder and Lane 1982; Bradley 1990; Elliott et al. 1978; Sherratt 1976; Chappell 1987). These studies predominantly examine the distributional changes in size and functionality of stone axes over space (and time) in relation to their source. The derived correlations are used to interpret the types of exchange patterns that existed in Neolithic societies. Although good contextual data is lacking for many of the stone axes recovered in Britain (and therefore Hodder and Lane [1982] and others do not address it), it has been demonstrated that such information can strengthen the interpretations made about their use (see Bradley 1990:ch.2; Hodder and Lane 1982).

For the purposes of this investigation, I will analyze the distribution and contexts of nephrite artifacts from archaeological excavations and surveys done in the interior of British Columbia and, in some cases, from the Columbia Plateau of Washington. The research focuses on the type, form and size of nephrite artifacts recovered; the types of sites (i.e. burial, housepits, campsites, etc.) and features where nephrite implements are found; and the distance of nephrite items in relation to the source area. To compliment this data, attention is also paid to sites where nephrite does not occur and to artifacts of similar form not made of nephrite.

Artifact Observations

In order to fully understand manufacturing techniques and choices in raw material, it is vital to directly observe artifacts reported to be nephrite from the Interior. Nephrite is a very difficult mineral to identify (Leaming 1978:7) and it is probable that some mis-identification of the material has occurred in the archaeological literature. Other rock types, such as serpentine and vesuvianite, can mimic nephrite in appearance but are appreciably inferior in hardness or toughness (Holland 1962; Leaming 1978). Even nephrite itself ranges in quality (Leaming 1978:18). Since raw material influences the time and effort needed to make ground stone tools, it is thus critical to determine the types of materials used in the Interior.

In addition to raw material determination, observations on nephrite artifacts can be used to help clarify manufacturing techniques used to make nephrite implements. Ground stone technology, unlike chipped stone, does not leave a considerable amount of debitage. However, when remnant debris from the manufacturing process is found it is very useful for understanding groundstone reduction processes. Examination of nephrite products can also provide insight into the techniques and amount of care used to make the implement. Although much of the manufacturing evidence on a ground stone tool can be abraded away in the completion process, there often remains some evidence of the original blank, the number of cuts performed to make the implement, and the finesse with which it was finished.

In this thesis I provide a synopsis of the results from an examination of a number of ground stone artifacts from the interior of British Columbia. The analysis of these artifacts is focused on raw material identification, hardness determination and investigating manufacturing techniques or processes. This information is used to expand upon the results from the context and distribution analysis and to guide the experimental procedures.

Analog Information

Information about the use of nephrite (or jade) from other areas of the world can also be used as a means of understanding the use of nephrite in the Interior of British Columbia. Because of the lack of ethnographic data in British Columbia, jade use by other cultures, especially those of a similar cultural complexity, can be important to providing some possible alternative explanations. For example, there is good ethnographic information on how the New Zealand Maori manufactured a variety of greenstone (nephrite) implements (e.g., Chapman 1892). Besides this, archaeological sequences from other areas of the world, where jade manufacturing evolved, may also provide good analogs for the development of nephrite use in the British Columbia interior. The development of jade working in New Zealand is particularly relevant to this analysis (e.g., Best 1974; Duff 1950), along with information from other areas of the world, such as China (Huang 1992), Sicily (Leighton 1989), and Mesoamerica (Digby 1972).

The Study Area

The main geographical focus of this study is the Canadian Plateau cultural sub area. As defined by Richards and Rousseau (1987:3-4), this region extends from central British Colum bia to approximately the Canadian - USA border (Figure 1). The Coastal and Rocky Mountain Ranges comprise the western and eastern boundaries of the area. There will also be some examination of archaeological sites along the Columbia River in Washington where recovered nephrite artifacts have been attributed to British Columbia sources (e.g., Collier et al. 1942:70-2; Galm 1994; Grabert 1968; Nelson 1973:384). There will be no attempt to analyze nephrite utilization by coastal groups, including the lower Fraser River region around Hope. Any mention of the *Plateau*, the *Interior*, or the *Fraser Plateau*. throughout the study will be referring to the main study area, unless otherwise indicated.

Organization

There are six chapters in this report. The first chapter is the problem statement and the background introduction. The second chapter deals with the physical characteristics of nephrite and the sources of the material in the Pacific Northwest. The third chapter is an ethnographic and archaeological review of the introduction of nephrite into the British Columbia interior. This chapter summarizes the ethnographic pattern or model of nephrite utilization. The fourth chapter is concerned with establishing the cost-efficiency of nephrite implements in relation to other material types. In it there is a summary of the experimental procedures undertaken for this study and a discussion of what constitutes value in stone tool technology. The fifth chapter of the thesis deals with the context and distribution of nephrite artifacts on the Plateau. This chapter reviews theoretical aspects surrounding the deposition of artifacts and details several different explanatory models to interpret the patterning of nephrite distribution. The sixth and final chapter consists of a discussion of the experimental and archaeological results.

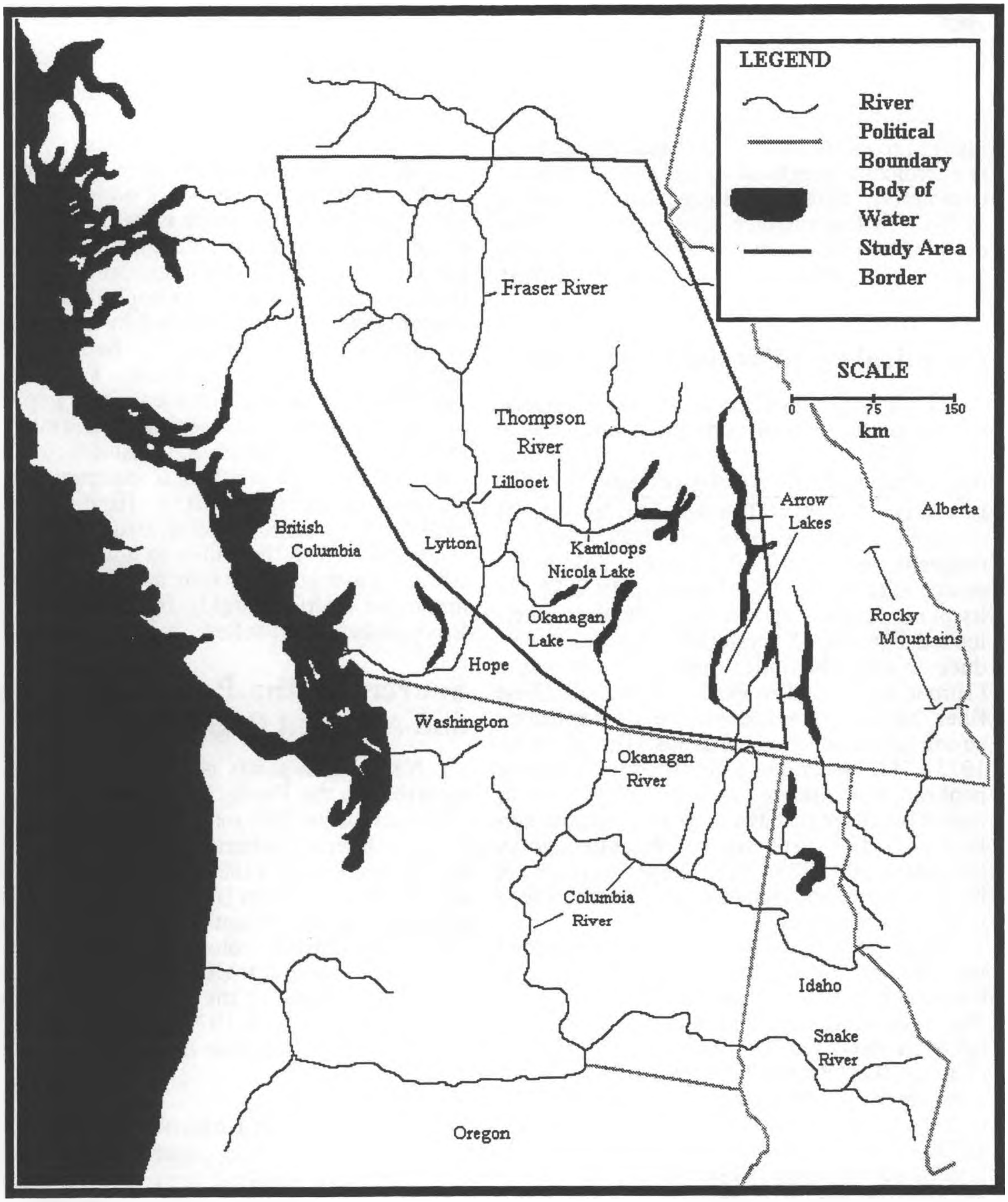


Figure 1.1. The Study Area.

2 Nephrite

Nephrite is one of two minerals commonly referred to as jade. The other material, jadeite, is chemically unrelated to nephrite and has a completely different petrogenesis (Leaming 1978). In this chapter there will be a brief description of the physical and chemical properties of nephrite and its sources in British Columbia.

Chemical and Physical Properties

Nephrite is classified as a dense, compact, micro-fibrous form of tremolite-actinolite with the following chemical formula: $(Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$ (Fraser 1972:21; Leaming 1978:8). The specific gravity of nephrite averages between 2.97-2.99 and ranges between 2.95 - 3.04, depending on the source (Fraser 1972:43; Leaming 1978:7). In its purer forms, nephrite has randomly interlocked bundles of crystalline fibers that produce a characteristic 'nephritic' structure (Turner 1935 cited in Fraser 1972:21). These fiber bundles are the source of nephrite's strong physical characteristics (Brandt et al. 1973:731). When applying force to a piece of nephrite, the interwoven fiber bundles act to hinder breakage through increased fracture surface area and dispersion of fracture energy (Brandt et al. 1973:731). Nephrite does not break in a concoidal manner and fractures tend to be very irregular.

Nephrite is probably one of the best natural materials to use for groundstone cutting tools because it is both a hard and tough mineral. The estimated hardness of nephrite ranges between 6-6.5 on the Mho hardness scale (Turner 1935; Brandt et al. 1973). On polished surfaces, however, a range of 6.5-7 was recorded on some nephrite specimens (Fraser 1972:46-51) whereas values as low as 5-6 were also listed (Hurlbut 1973). Again, the toughness of nephrite, or its resistance to breakage, is also high (Brandt et al. 1973:729). When compared to other materials, such as jadeite, corundum, quartzite and quartz (Table 2.1), nephrite is clearly the most resistant material. Furthermore, in terms of crushing strength, nephrite has values greater than those for steel (Kolesnik 1970 cited in Leaming 1978:7). These qualities make nephrite an excellent material for the creation of stone tools because of the durability of its working edges.

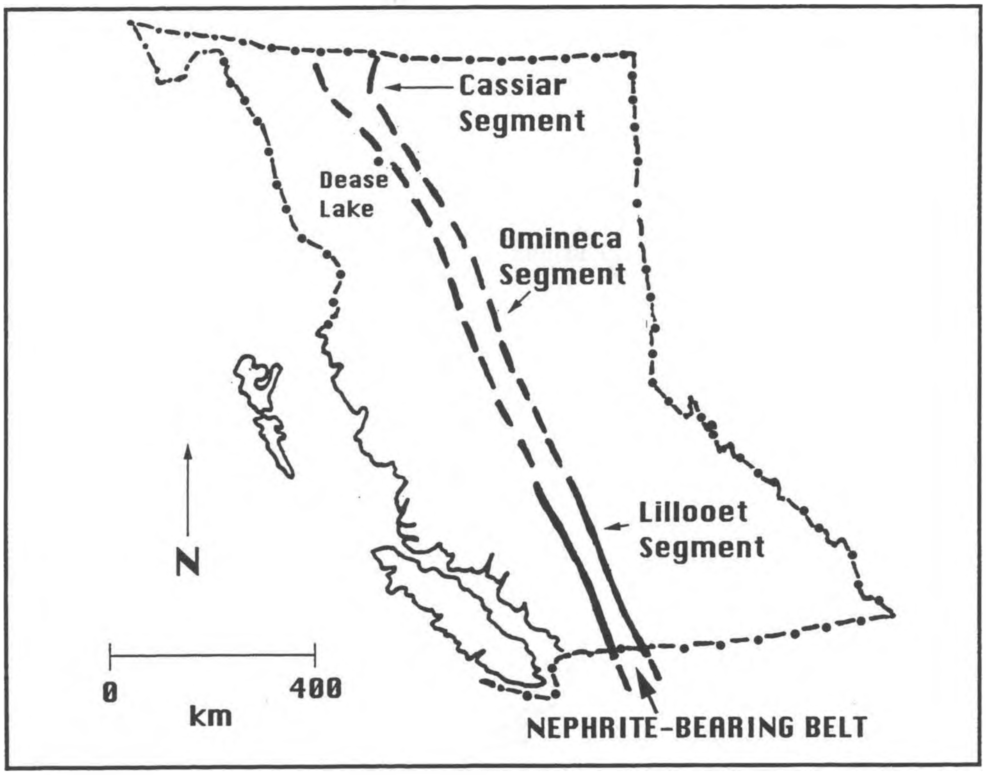
Nephrite is also a gem stone. In its higher grades, nephrite can be finely polished and is highly aesthetic. Nephrite is usually green in color but can take on black, white or purple hues (Fraser 1972:45-46; Leaming 1978:7). Impurities and variations in nephrite's mineral content often make it mottled in color. This variation can also affect the hardness and strength of nephrite specimens. For modern gemstone production and carving, nephrite appraisal involves assessing uniformity of color, structural soundness, translucency, hardness and the level to which a specimen can be polished (Leaming 1978:18). High grades of nephrite have uniform color, structural integrity, translucency, the ability to hold a high polish and have greater hardness. Lower grades are more mottled, highly fractured, opaque, less polishable and softer.

Sources in the Pacific Northwest and Adjacent Regions

Nephrite deposits occur in a number of locations in the Pacific Northwestern Region. The most accessible source of nephrite to prehistoric interior cultural groups occurs along the Fraser River in the area between Lillooet and Hope in southern British Columbia. Other nephrite bearing formations occur in Northern and Central British Columbia, Washington and Oregon. Peripheral to the Interior Culture area, nephrite appears in the Yukon, Alaska and Wyoming (Leaming 1978:55). Source locations of nephrite in these regions are described in this section..

Sources in British Columbia

The formation of nephrite deposits in British Columbia resulted from a metasomatic intrusion of serpentinites into Paleozoic deposits of greenstone, chert, pelite and limestone during tectonic events in the Mesozoic (Leaming 1978:18). In a band of ultra-mafic rock formations that begin in the Hope area, a belt of nephrite bearing rock stretches into the Yukon and Alaska (Figure 2.1; Fraser 1972:8; Leaming 1978:18-9). In British Columbia, three major segments of the belt contain sub-



stantial *in situ* deposits of nephrite: the Lillooet Segment, the Omineca Segment and the Cass iar segment.

The Lillooet Segment. The deposits in the Lillooet Segment (Figure 2.2) extend from Yakalom River, north of Lillooet, to the Coquihalla River near Hope (Leaming 1978:20). In the northern part of the segment, *in situ* deposits exist in the Shulap Mountain Range along Hell Creek, Hog Creek, Jim Creek and Blue Creek (Leaming 1978:25-27). In the Cadwallader range, Nephrite deposits are found along Noel Creek and Anderson Lake (Leaming 1978:27-8). Additionally, *in situ* nephrite formations out-crop along the "Horseshoe Bend" of the Bridge River and along the Ama and Applespring Creeks (Leaming 1978:21-2). In this area, large deposits of ultra-mafic rocks are present (Holland 1962; Fraser 1972; Leaming 1978:19-22). In the central part of the segment, *in situ* deposits appear along Texas Creek and in the Skihist area. In the south, *in situ* deposits occur near Harrison Lake on Cogburn Creek and the Coquihalla River.

Alluvial deposits of nephrite appear throughout the creeks and rivers of the Lillooet segment area (Holland 1962; Leaming 1978). These specimens range in size from small pebbles to 20 ton (18,200 kg) boulders (Holland 1962:121). Deposits of alluvial nephrite are particularly abundant in the area north of Lillooet because of the large number of *in situ* deposits in the Shulap and Cadwallader Ranges (Holland 1962:119). Alluvial pebbles also occur in the Hope area in the Fraser and the Coquihalla rivers, but are less extensive in quantity than in the north (Leaming 1978:19). Colluvial deposits of nephrite are also present in talus slopes in the Shulap Range (Leaming 1978:17).

Omineca Segment. The Omineca segment occurs in Central British Columbia (Figure 2.1). *In situ* deposits of nephrite are only found in a few locations in the Omineca segment and glacial action has transported some material considerable distances from any known source areas (Leaming 1978:29). The main nephrite bearing formations in the segment occur in the Mount Sidney Williams and Mount Ogden areas (Leaming 1978:28-29). Large deposits of alluvial and colluvial nephrite boulders are known in the Axegold Mountain Range.

Cassiar Segment. In the Cassiar Segment,

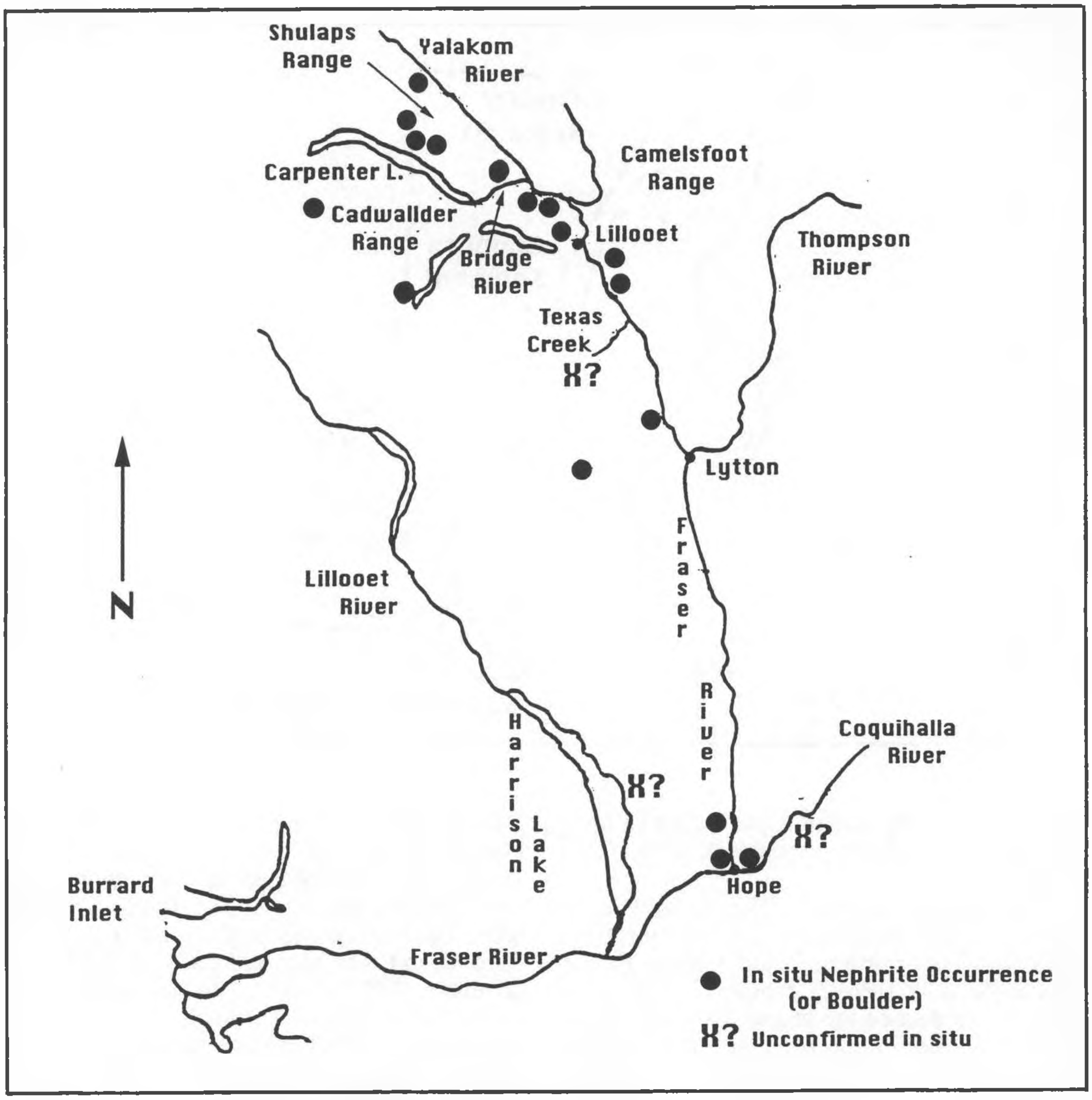


Figure 2.2. The Lillooet Segment (Modified from Leaming 1978:18).

extensive *in situ* nephrite deposits exist in the Cry Lake, Dease Lake, Wheaton Creek, King Mountain, Provencher Lake and McDame areas (Leaming 1978:33-5)

Yukon and Alaska Nephrite Sources

Nephrite deposits occur in several locations throughout the Yukon and Alaska. In the Yukon, deposits are principally in the Frances Lake area and may occur in other areas (Leaming 1978:39). In Alaska, nephrite occurs in the northwestern part of the state in the Upper Kobuk River area (Leaming 1978:55).

Washington and Oregon Sources

There are very limited nephrite deposits in Washington State including near Puget Sound in the Mount Higgins and Cultus Mountain areas (Leaming 1978:55). There is also a possibility of other sources of nephrite being in the Upper Skagit River drainage, because the British Columbia nephrite-bearing belt crosses into northern Washington (Leaming 1978:19). Other than these areas, there are no other locations in Washington State with known nephrite deposits (Galm 1994).

Nephrite deposits in Oregon are also very limited. Leaming (1978:35) cites only one example in the southeastern part of the state in Curry County and the possibility of other sources in additional areas.

Wyoming Sources

Wyoming is the only other location where nephrite could be obtained easily by interior groups. In south-central Wyoming alluvial deposits of metamorphic nephrite were abundant in early post-contact times (Leaming 1978:55).

Prehistoric Source Usage

The main type of nephrite source used prior to European contact was alluvial deposits of pebbles and cobbles. This is evident from artifacts and early records (Dawson 1887; Emmons 1923; Teit 1900). It is also quite possible that collection of suitable pieces also occurred on talus slopes and other colluvial deposits. Although important for modern commercial mining, the amount of effort needed to quarry *in situ* deposits probably deterred prehistoric use of such deposits. Modern mining of *in situ* jade deposits entails the use of explosives, large diamond saws, hydraulic wedges and heavy machinery (Fraser 1972:18; Leaming 1978:34). Most of the historic commercial nephrite mining in British Columbia, however, took place as part of the placer mining of alluvial gravels (Holland 1962; Fraser 1972).

For the purpose of this report, the alluvial deposits of nephrite in the northern and central Lillooet Segment will be considered to be the prime source of nephrite for prehistoric Interior Plateau groups. This is primarily based on the lack of any other centrally located source and the lack of ethnographic information relating to the import trade of nephrite from the Yukon or Wyoming. As will be discussed in Chapter 3, ethnographic informants reported that prehistoric nephrite gathering primarily occurred in the rivers and creeks of the Lillooet segment.

Although deposits of nephrite exist in Washington, their distant location and small size would probably preclude them from being utilized by Plateau occupants. The location of the deposits near Puget Sound makes them more accessible to coastal populations than to interior groups, and is unlikely to have been a significant source for British Columbia.

Although the Omineca and Cassiar segments are major focuses of the modern nephrite industry in British Columbia, their prehistoric exploitation is unknown. These areas were traditionally occupied by Athapaskan speakers and early ethnographic work among these groups does not indicate nephrite was used, processed, mined or traded historically (Morice 1897). The ultra-mafic deposits associated with the Omineca Segment border on the northern extent of the Canadian Plateau cultural sub-area (Richards and Rousseau 1987:3). It is thus possible that alluvial and glacial deposits of nephrite were available to northern Plateau groups. As will be discussed in a future section, however, very few nephrite artifacts have been recovered in archaeological excavations north of Kamloops. This probably indicates that use of Omineca nephrite was limited and it will be assumed that its contribution was negligible to the overall Plateau distribution of the material. The Cassiar segment, being farther north, is even more removed from contact with the plateau culture area. Northern Coastal groups probably utilized this segment for their nephrite requirements (Emmons 1923:18) but interior exploitation or distribution is unlikely.

It is almost impossible to determine the precise source areas within the Lillooet Segment from which prehistoric artifacts were derived because of the large number of possible *in situ* origins for alluvial nephrite deposits. The physical toughness of nephrite creates a problem for source identification. Thus, because of the distance cobbles of nephrite can be transported before disintegrating, boulders from a number of sources can accumulate in one placer deposit. To complicate this, specimens from any *in situ* location within the Lillooet segment usually appear virtually the same in color and structure -- including in thin sections (Holland 1962:123). The only practical method to finding the source of nephrite in the area would be to define chemical 'fingerprints' unique to particular *in situ* locations (Erle Nelson, 1994: personal communication). The value of this type of study, however, would be limited because it still would not identify the exact locations where alluvial cobbles could be collected. Geographically, the source of nephrite for the study will encompass the area along the Fraser River between the Big Dog Mountain on the Yalakom River to the end of the plateau culture area south of Lytton. Although nephrite deposits do occur in the Hope area, the historic and ethnographic associations of this region are more closely tied to

Table 2.1 Comparison of Hardness and Toughness Values for Various Stone Minerals.

	Hardness	Fracture Surface Energy (ergs/cm2)	Fracture Toughness Kc (dyne cm-3/2)	
Nephrite	6 - 6.5	226,000	77 x 107	Brandt et al. 1973
Jadeite	6.5 - 7	121,000	71 x 107	"
Hornblende	5-6	-	34 x 107	Wu et al. 1990
Glass	5.5	5,000	7 x 107	Wiederhorn 1969 *
Quartzite	7	4,320	7 x 107	Wiederhorn 1969 *
Quartz	7	1,030	5 x 107	Brace & Walsh 1962*
Corundum	9	600	7 x 107	Wiederhorn 1969 *

* Cited in Brandt et al. 1973

the coast (Richards and Rousseau 1987:21; Von Krogh 1980). It is more likely that nephrite from this locality would be distributed to the Coast rather than through the almost impassable Fraser Canyon.

Alternate Materials to Nephrite

Materials other than nephrite were also used for groundstone tools in the interior. The following section will briefly review some of the possible alternative materials that could have been used for groundstone celts.

Serpentine. Serpentine is often mistaken as a form of jade. As a related form of rock, serpentine frequently occurs in the same geological locations as nephrite and in greater quantity (Holland 1962:125). Due to its green color, serpentine is often brought home erroneously as jade by novice rock-hounds. Serpentine ranges between 2.5-4 on the Mho Hardness scale and has a specific gravity between 2.5 and 2.8 (Foshag 1957:32). It does not have a 'nephritic' texture and will not polish to the same degree as jade. Serpentine is a very common rock type and occurs in many different locations throughout the province of British Columbia (Holland 1962:125).

Greenstone. Greenstone is a "general field term for fine grained, chloritic, altered volcanic rocks." (Leaming 1978:54) On the Central Coast, greenstone is the predominate type of (Damkjar 1981; Philip Hobler 1994: personal communication) stone used for celt production where sources of the material exist in the Bella Coola Valley. Other sources of greenstone appear in the Shulap Ranges and are common in other areas of the Fraser Valley in the Carrier area of the plateau (Leaming 1978:22).

In New Zealand, the term greenstone describes a whole series of rock types that include both nephrite and serpentine (Beck 1970:20).

Jadeite. Jadeite is the other material referred to as jade. Jadeite originates in different geological contexts than nephrite and is "in general . . . a tough, hard, heavy, equigranular aggregate of prismatic pyroxene crystals" (Leaming 1978:4). As a material, jadeite is harder than nephrite but has less fracture toughness (i.e., it is more brittle (Brandt et al. 1973). It has long been used in other areas of the world for groundstone (see Digby 1972; Foshag 1957; Hansford 1968; Huang 1992; Leighton 1989,1992).

The chances of jadeite being used by prehistoric interior groups are negligible. In British Columbia, jadeite only occurs in the northwestern section of the province in the Pinchi Lake area (Patterson 1973 cited in Leaming 1978). Other locations in the Pacific Northwest where jadeite deposits exist include the Yukon and California (Leaming 1978:55).

Vesuvianite. Vesuvianite is a material that can be mistaken for jadeite because of a similar specific gravity, and it has some surficial and physical characteristics similar to jade (Holland 1962:121) It is often green in color and relatively hard (Foshag 1957). It also has a greater specific gravity than nephrite that ranges between 3.35-3.45. A source of the material is located on Kwoiek Creek in the Lillooet segment (Holland 1962:121). There is the possibility that some celts identified as being made of jade could be manufactured from this material.

3

Ethnographic and Archaeological Background of Nephrite Use

This chapter is a discussion of the ethnographical and archaeological background of the study area. The first section will be a review of the ethnolinguistic groups present in the study region, the Plateau lifestyle, and the ethnographically recorded use of nephrite. The second section will deal with the archaeological sequence of the British Columbia Plateau, the question of cultural complexity in the past, and the early development of nephrite technology in the Interior.

Ethnolinguistic Groups in the Study Area

At the time of European contact, the British Columbia Plateau cultural sub-area was occupied by Interior Salish and Athapaskan speaking groups (Figure 3.1). In the south, the ethno-linguistic groups were the Interior Salish speaking Lillooet (Slt'átl'imx), Okanagan, Shuswap (Secwepemc) and Thompson (Nlha7kápmx) (Teit 1900; 1906; 1909a;1930). To the north, the Athapaskan speaking Carrier and Chilcotin groups resided (Morice 1893; Teit 1909b). One group of Athapaskans lived in the Nicola Valley but became extinct shortly after contact (Bouchard and Kennedy 1978). The Sekani (Athapaskan) and Kutenai (isolate) occupied the border region to the north and east respectively. The Lower Fraser Valley was occupied at contact by the Stolo who speak a Salish dialect related to other coastal languages (Duff 1952). Across the internationa border, the Columbia Plateau was occupied by Interior Salishan and Sahaptian speakers (Hunn 1990).

Plateau Lifestyle

The lifestyle of the ethnographic groups in the British Columbia Plateau sub-area was focused around the exploitation of anadromous salmon and semi-sedentary use of pit house villages (Teit 1900, 1906, 1909a,b, 1930). Annual runs of anadromous salmon provided a reliable food source for most areas of the Plateau (Kew 1992), except for local areas where geographical features hindered annual spawning runs (e.g., the upper Similkameen River). Other major food resources utilized ethnographically included land mammals and plants. Mule deer comprised the most important terrestrial faunal resource (Romanoff 1992:471) and other animals such as bighorn sheep, white tailed deer, caribou, moose and bears were also hunted (Teit 1900:230, 1906:225, 1909:513). Plant resources that were gathered included an abundant array of roots and berries (Teit 1900:231, 1906:222-3, 1909a:514-5).

Cultural Complexity on the Plateau

Hayden et al. (1985) and Hayden (1992) have conjectured that many of the ethnographically recorded aboriginal groups of the British Columbia Plateau were probably non-egalitarian, complex hunter-gatherers. This is contrary to the traditionally held belief that Plateau societies were generally egalitarian, pacifistic societies (Ray 1939:21). Based on a review of Teit's (1900; 1906; 1909b) ethnographic work, Hayden (1992) and Hayden et al. (1985:186-7) point to indicators of social complexity:

1. the presence of several classes of individuals, including hereditary leadership positions: chiefs' descendants, freemen, and a slave class (Teit 1906:254, 1909:576);

2. the exclusive ownership by leaders of important economic resources such as salmon fishing locations (Teit 1900:293-294, 1906:255-256);

3. participation in warfare and the presence of palisaded villages (Fraser 1960:82, Teit 1906:326, 243). This level of conflict indicates a pronounced degree of competition usually associated with competitive, stratified societies;

4. the significant volume and importance of trade (Teit 1900:258-262, 1906:231-233, 1909:576,583);

5. clan economic organization, in which resources were often owned by the clan, with the clan head, or "chief," administering the resources. To emphasize their ownership, clans often erected carved crest poles at places

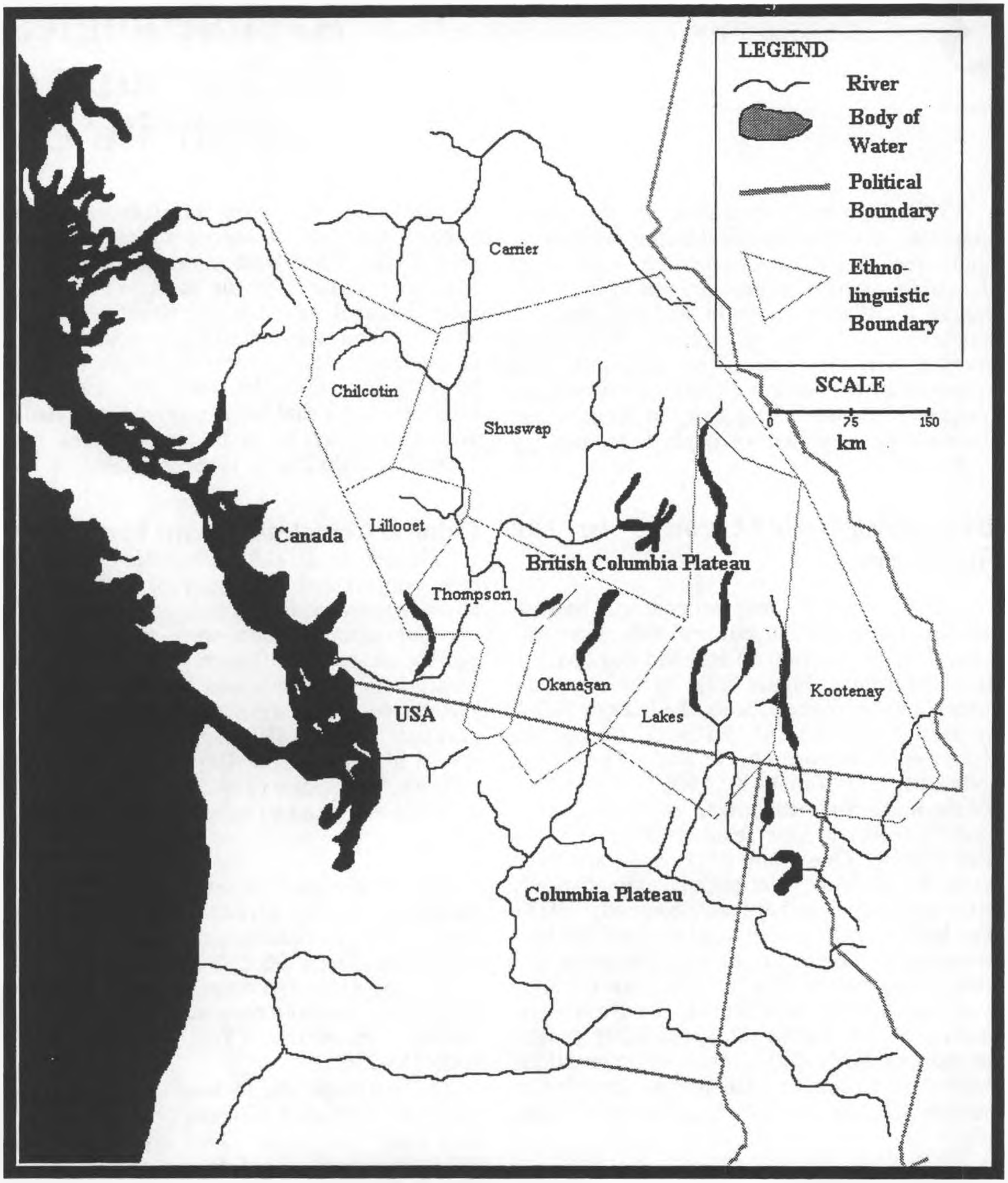


Figure 3.1. Ethnolinguistic Divisions on the British Columbia Plateau (after Richards and Rousseau 1987:2).

such as fishing stations (Teit 1906:255-256, 1909:576);

6. the presence of a competitive feasting complex resembling the potlatch (Teit 1900:297, 1906:255, 1909:583)

7. some specialization between hunters and fishermen (Teit 1900:295)

(Cited from Hayden et al. 1985:186-187)

In addition to these indicators, there were also high population densities and semi-sedentary communities typical of complex hunter-gatherers. Patterns of social complexity were predominately focused in areas where salmon resources were abundant and easily exploited and defended (Hayden et al. 1985:196; Hayden 1992). Within these areas the Lillooet, Thompson, Okanagan and Shuswap resided. It is apparent, however, that economic distinctions were present between different local bands in these groups. Among the Shuswap, local bands in certain areas were poorer than others because of limited access to trade routes and less abundant food resources (Teit 1909a:470-471; Hayden et al. 1985:168) conclude that the egalitarian labels assigned to Plateau societies were probably products of the diffusionist culture change model, and from changes in Plateau society related to European contact.

Ethnographic Use of Nephrite

The amount of ethnographic data bearing on the use of nephrite on the British Columbia Plateau is insubstantial when compared to the Maori in New Zealand (Chapman 1892; Beck 1970). Although Plateau informants from the turn of the century remembered earlier use of jade implements, no European ethnographers actually observed the nephrite manufacturing process in British Columbia (Dawson 1887; Emmons 1923; Hill-Tout 1905; Smith 1899, 1900; Teit 1900, 1906, 1909a,b). It has been speculated by Emmons (1923:20) that European trade goods, "particularly iron, . . . put an end to the laborious manufacture of edged tools made of jade." The unfortunate result of this technological loss is that there is only limited information on procurement and manufacturing procedures in the Northwest. This includes remembered details concerning ownership, trade and use.

The following section deals with the ethnographically recorded information surrounding the use of nephrite on the British Columbia Plateau. Topics to be discussed include the gathering of nephrite, the types of artifacts made out of nephrite, the aboriginal techniques used to grind nephrite and the utilization of nephrite implements. The section on the utilization of nephrite will specifically address the requirements of the Plateau woodworking industry, the trade of nephrite artifacts and the possible use of nephrite artifacts as wealth or prestige objects.

Nephrite Procurement

References to nephrite procurement in the ethnographic record are very general and only point to broad areas along the Fraser and Thompson rivers as sources for the material (Dawson 1887:2; Emmons 1923:14; Smith 1899:133). These inferences, however, were not based on information from informants and relate more to the recorders' personal observations and experiences. As Smith (1899:133) put it, "tons of green stones were seen along the Fraser and Thompson Rivers . . . ." Modern research on jade in the interior (Leaming 1978) does not point to any *in situ* deposits in the Thompson River drainage. The nephrite deposits alluded to by the ethnographers may possibly be serpentine. As will be discussed in a future section, the archaeological evidence points to most nephrite manufacturing occurring in the Fraser River area and not along the Thompson River.

It is obvious from the types of the nephrite artifacts found in the Interior that alluvial pebbles and cobbles were utilized as blanks or cores. This is attested to by the numerous partially sawn boulders that have been recovered along the Fraser (see Smith 1899; Emmons 1923). Although no direct ethnographic references exist, Alexander (1992:161) speculates that nephrite could have been gathered during slack times encountered during fishing activities in July and August. Coinciding with the time of fishing activities, water levels in the Fraser River were at their lowest during the season which would have facilitated gathering of alluvial cobbles of nephrite from gravel bars and river banks (Fladmark 1996:personal communication).

It has been suggested that ownership of certain fishing stations could have possibly transferred to other riverine resources like nephrite (Barbara Winter 1993:personal communication). Although an intriguing possibility, ownership may have been restricted to owned productive fishing rocks (Romanoff

1992:242). Such locations were favorable for the taking of spring salmon and were usually owned by 'rich men' in Lillooet society (Romanoff 1992:246). The lower ranking members of the community were not denied access to the larger runs of pink salmon. Public areas of the river were even open to members of different ethno-linguistic affiliation in some instances (Romanoff 1992:245; Kennedy and Bouchard 1992:314-316). In this situation anyone would have access to whatever nephrite resources existed in the area. Other fishing areas were, however, controlled by residence groups (Romanoff 1992:245; Kennedy and Bouchard 1992:308). It is possible that nephrite deposits would have been exclusive in such locations because of active efforts to limit the access of other groups. However, the value of nephrite does not lie solely in its unaltered form, and access to 'raw' nephrite, while important, was only a small part of the final value of finished jade artifacts.

Nephrite Manufacturing

The best account of how nephrite was shaped comes from Emmons (1923:22-24). As he describes:

> The cut bowlders [*sic*] are the most interesting, and the great number of sandstone saws found with these definitely show the process of working them. The heavier, thicker, more irregularly shaped bowlders were sawed longitudinally in parallel grooves, two or three inches deep, ... In one of the grooves a wedge was fitted in such a way that, when sharply struck the impact bore on the entire length of the surface with equal pressure, resulting in a lengthwise cleavage . . . .
>
> The initial cutting was accomplished by the means of a sharp silicious sandstone, and water. These saws were of varying length up to twelve or more inches, but being brittle they are generally found in smaller, broken pieces. They were three or four inches wide and from a quarter to half an inch in thickness. The cutting edge was sharpened, but it became rounded. Some saws were double-edged. The striation along the grooves of the cut bowlders is complementary with the gritty particles of the saws. It has been stated or suggested that the smooth surface to be cut was first scratched or roughened with a quartz crystal to give the saw a 'hold' This may be questioned, for, in an examination of several incipient grooves, they show the width of the saw and no fine scratches such as the point of a crystal would make . . . .
>
> Flat, thin bowlders were cut by scoring a deep groove in each face, and broken apart by a sharp blow or with a wedge driven in the groove. After separation, sections were shaped and worked with grindstones of sharp sandstone, and water; these stones, so far as could be determined, were finer in texture than the saws.

Although Emmon's (1923:22-24) synopsis cited above was partially constructed from his experience with artifactual remains, other descriptions support his claims. Teit (1900:183) reports in his Thompson ethnography that "Jade and serpentine bowlders [*sic*] were cut by means of gritstones and beaver teeth." In his subsequent Shuswap and Lillooet ethnographies, Teit (1906:203; 1909a:473) states that hard stones were cut using quartz and agate crystals and that "files for cutting and smoothing stone implements, [were made] of coarse-grained sandstone and also of a dark-colored stone. "(1906:203) Hill-Tout (1978:61) also records that quartz and agate crystals were used in conjunction with water to cut boulders of nephrite and emphasizes that he believes that they were the prime means by which jade was cut. From his informant Chief Michelle, Hill-Tout reports that a device consisting of two rigid, parallel strips of wood were mounted above a nephrite cobble to guide the crystal during the initial stages of reduction. Both Smith (1900:416) and Emmons (1923), as mentioned above, doubt that crystals and beaver teeth were used during nephrite manufacturing. Smith (1900:416) attributes the use of such crystals, and the beaver teeth that Teit(1900:183) reports, to the reduction of softer stones such as steatite (soapstone).

An alternate method for reducing nephrite was postulated by George Dawson (1887:5). He records that:

> A suitable fragment having been discovered, it has evidently been carefully sawn up into pieces of the required shape and size, the sawing having been effected either by means of a thong or a thin piece of wood, in conjunction with sharp sand (Dawson 1887:5).

One of Smith's (1900:416) informants, Michel of Lytton, gave a similar account by stating that horsetail rush was used to start grooves in boulders. Smith (1899:1900:416) ultimately discredited both Dawson and his informant by claiming that the 'character' of the concave grooves in the sawn boulders he observed would not support the use of a string or reed with sand. From my experience, however, there are instances where concave grooves exist in sawn boulders that would be unlikely to result from the use of a stone saw. It is probable that both techniques were used in situations where the need arose and perhaps where suitable materials (such as corundum or garnet bearing sands) were available, or where sandstone was scarce. It is also not beyond the realm of possibilities that quartz or agate crystals were used at some point during the cutting process as reported by Hill-Tout (1978:61-62).

There is relatively little information as to which members of Plateau society performed the task of making nephrite artifacts. There are no direct indications that nephrite manufacturing was a specialized craft among any Plateau group. It may be surmised that members of the community who worked more with wood may have used nephrite tools more than others. As will be discussed, however, not all nephrite implements may have been for woodworking purposes and the main users may not have been the manufacturers of the nephrite tools. By its very nature, jade working is a monotonous and laborious task that does not require the dexterity demanded by a chipped stone industry. Almost anyone, including children, could provide the locomotion necessary to cut jade. An underlying knowledge of the principles behind grinding rocks, however, would be needed in order for any effectual rates of reduction to be achieved. If specialization in nephrite cutting did exist, it would probably have been in the knowledge of the best types of sandstone and abrasives to use for saws and grit. Teit (1900:182) does record that some specialization did occur on an individual basis between different manufacturing tasks. It is thus very probable that some members of Plateau society had more knowledge of the principles of jade working than others.

It appears that ethnographically men were probably the primary jade workers in Plateau society. As Teit (1900:182) records for the Thompson, most of the stone manufacturing was performed by men. In addition, one of Emmons' (1923:20-21) informants stated that his father made a particular celt that he was selling. Although by no means conclusive, these are the only gender related references to nephrite manufacturing. Female activities were traditionally more clustered around basketry, hide preparation and matting, according to Teit (1900:182), and sexual divisions of labor were present in other areas of plateau lifestyle.

Neither the locations where nephrite artifacts were primarily manufactured, nor the time or times of year in which the activity took place are alluded to in the ethnographies. In terms of location, an area with access to water, sand, and grinding stones would be preferable. In New Zealand, for example, the Maori had specific workshop areas on beaches and river mouths that were permanently set up with grinding stones of varying coarseness (Chapman 1892:501; Beck 1970:70-77). Those locations were utilized at various times during the Maori seasonal round and all materials related to the greenstone industry were imported, sometimes from great distances, into the site. Although the nephrite industry in British Columbia never reached the same magnitude as the Maori greenstone trade, it is possible that similar preferred manufacturing areas were used on the Plateau. One such area could have been along the Fraser River where the nephrite was gathered. This, however, may not have been the case because of the intensive nature of critical subsistence activities during the seasonal round.

As Alexander (1992:161) speculates about summertime nephrite gathering, manufacturing could have taken place in the Fraser Canyon during mid-July to late August. When examining the subsistence activities occurring at the time, however, salmon procurement would have probably consumed the majority of available time. In addition, it was a time of social interaction and trade with other groups (Alexander 1992:168). When looking at the seasonal round as a whole, the most likely period when excess time would have been available from subsistence activities, was during the winter occupation of pithouse villages. At this time, people mainly subsisted on stored salmon supplies (Teit 1900, 1906, 1909; Alexander 1992:165) and the surplus time needed to cut or finish nephrite would have possibly been available if provisions were good. The winter village often served as a base camp for other seasonal resource storage and it is possible that the appropriate materials for nephrite working would have been brought into the camp. However, it may have been more practical to grind nephrite near the river due to the size of the boulders being cut. As one cubic foot of nephrite (0.255 m^3) weighs 186 pounds (83.7 kg) (Leaming 1978:7), it would possibly be more realistic to work nephrite down by the river rather than hauling the material up the river terrace. Because water would be available year round in such locations, nephrite manufacturing may still have been performed in the winter months. Emmons (1923) does report observing sawn boulders alongside the Fraser River.

Types of Artifacts made of Nephrite

The most common artifact type made of nephrite on the British Columbia Plateau is the celt. The term celt, as defined by Kapches (1979:65), "refers to a class of ground stone implements that includes the functional and morphological types of artifacts known variously as adzes, axes, gouges, chisels, etc. . . ." The term celt does not refer to ground stone implements used as obvious ritual items, or other forms of ground stone tools (knives, projectile points) (Kapches 1979:65).

Ethnographers report celts of all types to have been made by Interior groups, including adzes, chisels, skin smoothers/scrapers and axes (Emmons 1923:24-31; Teit 1900:183, 1906:203, 1909:473, 1930:217). Teit (cited in Emmons 1923:26) and Emmons (1923:24-31) point to three sizes of celts. The largest of these ranged from 15 to 45 centimeters in length, were straight or tapered slightly from bit to pole, and were finely crafted (Emmons 1923:24-25). At times they were double bitted and usually do not exhibit wear. The second type range in size from 10 to 12.5 cm, were proportionately broader, tapered slightly and could be rough in form (Emmons 1923:27). The third type was essentially a small chisel-sized celt. According to Teit (cited in Emmons 1923:24), Interior Salish in the Lytton area referred to any adze or celt as *xoisten* and if made of jade or greenstone, *sokalä'ist tek xoisten.* The large celts were referred to as *steúu sokalä'ist* and chisels were called *manāu* or *sokalä'ist tek manāu* if made of jade (Teit in Emmons 1923:31).

Other types of artifacts made of nephrite. include knives, drill-points, hammerstones, pestles, clubs and possibly war picks (Emmons 1923:31-36; Teit 1909a:473). It should be noted that there are no manufacturing references to any other artifact types except celts.

Interestingly, very few, if any ornamental objects were made out of nephrite on the British Columbia plateau. Ainsworth (1956:11) reports a dubious find of a human head carved from nephrite that was recovered by an individual panning for gold near Spuzzum. From artifacts I (or other authors) have observed, there is no evidence that interior jade items were created in any forms other than utilitarian shapes. Only one possible exception to this comes from the Keatley Creek site where a small polished fragment of nephrite was recovered. This fragment is not from a celt and may be a tip of a knife or possibly from some form of ornament. Utilitarian celt forms could be highly exaggerated in size and thus virtually non-functional. Clearly the larger celts do represent an elaboration of the nephrite industry. The levels to which this evolution proceeded, however, did not seem to extend to the ornamental objects seen in other jade working cultures like the Maori, Chinese, and Mesoamerican groups.

Use of Nephrite Implements

Nephrite is usually thought of synonymously with prehistoric woodworking on the British Columbia Coast and Plateau. While this assumption is not without merit, on the British Columbia Plateau there are ethnographic passages that indicate certain nephrite artifacts were specifically manufactured for alternate purposes. Therefore, the following section will be a discussion of Plateau woodworking and the other uses of nephrite artifacts.

Woodworking. The ethnographic woodworking kit on the British Columbia Plateau included a number of different types of adzes, chisels, hand mauls, bone and antler wedges, stone drills, beaver tooth knives and chisels, and chipped stone knives (Teit 1900:183, 1906:203-204, 1909a:474). Nephrite artifacts may have constituted an important part of this kit. As recorded by Teit (1900:183), "adzes and axes of jade and serpentine were in common use" for woodworking purposes. The types of hafts used for celts include elbow adze handles, D-Shaped handles (Teit 1900: 183, 1906:204), bone or wood straight handles (Emmons 1923:29; Teit 1906:204), and possibly axe type mounts (Emmons 1923:27). Along with the larger celts, chisels, and possibly knives of jade, were also used for woodworking (Teit 1900:183, 1906:204; Emmons 1923:28-31).

The pervasiveness of the woodworking industry in the ethnographic record for the Brit-

Table 3.1 Woodworking tasks on the Plateau as recorded in Teit (1900,1906, 1909a).

Utilitarian	Ceremonial
pithouse construction and associated structures (sweat lodges, women's huts) (1900:192-196)	totem/crest carving (1906:217,493)
mat lodge poles (1900:213)	grave pole/statue/marker carvings (1906:272, 1900:335-6)
household furnishings (ladders, bowls, beds) (1900:204, 1906:217)	grave boxes (1906:272; 1900:128-9)
fishing weirs and platforms (1900:254; 1906:227)	ladder carvings (1900:194; 1909:492-3)
drying and/or storage racks (1900:199; 1906:229)	interior post carving
deer fence construction(1900:247)	grave fences (1900:334)
canoe hollowing (1900:183)	
hunting equipment (bows, arrows, spears, nets, snowshoes, etc. . . .) (1900:239-43, 250-1, 257)	
firewood procurement (1909:709, 715)	

ish Columbia plateau is substantially less than that recorded for the Coast (e.g., Boas 1966; Drucker 1955). However, woodworking was still an important activity in Plateau culture. InTable 3.1 is a list of some of the woodworking tasks on the Plateau. The use of adzes are mentioned in several instances. During the construction of pithouses the timbers used in the structure were shaped using stone adzes, wedges, and hammers (Teit 1900:192). Stone adzes were also mounted in elbow handles and used for hollowing canoes. It is quite probable that adzes were used for other tasks but these uses were not explicitly stated. It is not clear, however, whether nephrite adzes or celts were the only heavy duty wood cutting tools. There are references to the use of alternate tool types to perform other kinds of heavy duty woodworking tasks. Those included antler wedges or chisels to split firewood (Teit 1909:709, 1917:29) and fall trees (Teit 1909:709,715). It is possible that most basic woodworking tasks could be performed without sharp stone edges - especially groundstone edges.

Property Items. As mentioned earlier in the artifact section, a long form of celt was manufactured on the British Columbia plateau. This type of celt was apparently non-utilitarian and was manufactured strictly for wealth purposes.

Teit recorded the following:

The long celt was not hafted as a common adze, and it seems that at least most of them were not used as tools at all. You will notice that many of them, at least, have no properly prepared end on which to strike, this end beingsometimes more or less convex, sometimes irregular in outline, and generally more or less narrow and thin; also some of these long celts were double-bitted. All this would seem to show these celts were not intended as a rule to be used as chisels, adzes, or wedges. According to the old Indians these long celts were "property", and good ones exchanged for considerable value. Some of them were occasionally used as chisels or wedges, in some cases being held, it seems, in the hand, and struck with hardwood mallets. The Indians aver, however, that generally speaking they were not made for any special use as tools. Occasionally they were also used in the hand for rubbing skins, but it seems their use for this was also rare. More often they were used as weapons, being hafted as tomahawks across the end of a wooden handle, in which they were inserted or set. It is said, however, that they were not made especially for this purpose, but were "property," or works of art, as it were, exchanging for high values (cited in Emmons 1923:26-7).

Other smaller sizes of nephrite celts did not have the same value and were definitely intended for woodworking purposes (Emmons 1928:28-31). It is not clear if other types of nephrite artifacts, such as knives, were valued in a similar manner as the large celts.

The exact 'value' that was placed upon long celts by Plateau groups is not explicitly stated by Teit or Emmons. However, in the northwestern British Columbia/ Alaska region, the Tlingit would trade one to three slaves for a jade adze blade merely two to three inches in size (Emmons 1923:18). Although obviously no direct contact between the Tlingit and Interior Plateau existed, the demand for jade on the southern coast was equally as high. Unfortunately, there is no further mention of what other types of items were exchanged for nephrite. Both the Lillooet (Teit 1906:231) and the Thompson (1900:259) had historic trade routes with coastal groups that probably included the exchange of nephrite in the past. Nephrite exchanged in this system would almost certainly generate a high return.

Warfare. Warfare was endemic in Plateau society and was possibly used as a mechanism to procure sufficient food in times of famine (Cannon 1992:509-511). Jade items are specifically mentioned as some of the artifacts used during conflict. As mentioned in Emmons (1923:26-7), some of the longer celts were possibly hafted as tomahawks and used in warfare by Plateau groups. This is also reiterated in Teit's (1906:234) Lillooet ethnography, where he records, "A kind of tomahawk was made by firmly lashing a jade or serpentine celt, . . . , to the end of a short wooden handle." These 'tomahawks' could also have been smaller celts with rounded bits (skin scrapers) instead of the large celts (Teit 1900:234; Emmons 1923:plt. VII). Besides this weapon, clubs and daggers made of nephrite were also possibly used (Teit 1909b:473, 1930:256; Emmons 1924:plt.VII).

Larger raids on the plateau were led by a war-chief (Teit 1900:267,1909:543). Such men usually achieved their position through their exploits and often were responsible for dividing 'booty' after raids. Such successful war chiefs could have possessed special weapons made of jade. This would be similar to high status Maori individuals who employed the *mere*, a jade club/short sword (Chapman 1892:505). Such weapons took months of labor to complete and were only possessed by Maori chiefs or head-men. A similar situation is also present for ethnographically recorded axe use in New Guinea (Phillips 1975). Here, nephrite celts were mounted in elaborate ceremonial fashions that would have precluded their use for utilitarian tools.

Ceremonial Usage. There are only two ethnographic passages that relate to the ceremonial use of jade objects and they are rather vague. One reference comes from the boy's puberty ceremony amongst the Thompson where Teit (1900:320) reports the use of a jade celt during the performance of ritualistic gymnastics. As he records:

> He made holes in rocks or bowlders [*sic*] with a jadeite adze, which was held in the hand. Every night he worked at these until the holes were two or three inches deep. When making them he prayed, "May I have strength of arm; may my arm never get tired - from thee, O Stone !" This was believed to make the arm tireless and the hand dextrous in making stone implements of any kind. (Teit 1900:320)

The second reference comes from Thompson mythology. In this passage, a number of mythological characters try to make Raven jealous by adorning her sister with a necklace and "a finely polished celt of green stone (jade) to hang at her belt" (Teit 1912:88).

It is obvious that direct correlations or meanings cannot be taken out of these two passages. One is based in mythology and the other is a rather unbelievable practice (i.e.., possible waste of a valuable implement). What can be brought out of these passages, however, is that probably some ceremonial or prestige value was given to some nephrite implements. This admiration derives from of the strength that jade possesses and the aesthetic or wealth value of jade.

Other Uses. Other uses of nephrite in the interior are reflected in the names of the artifacts. These include use as skin scrapers, pestles, and hammerstones (Emmons 1923:24-31; Teit 1900:183,1906:203,1909:473,1930:217). As Teit (cited in Emmons 1923:27) stated above, even the large celts may have been used for rubbing and processing skins. The usual artifact associated with this task, however, is a blunt form of celt that has a smooth, rounded bit (Emmons 1923:28; Teit 1906:203). The strength of nephrite makes it an excellent material for both pestles and hammerstones and this probably accounts for its use as such.

Trade of Nephrite Implements. Well-developed trade networks were present on the British Columbia plateau during the post-contact period (Teit 1900, 1906, 1909a,b, 1930). These trade routes connected the Lillooet, Thompson, Shuswap, Okanagan, and Chilcotin with Coastal groups, the Carrier to the north, the Kutenai and Lakes Salish to the east in the Rockies and to other Plateau groups in Washington. Items traded include dentalium shells, dried salmon, salmon oil, buckskin clothing, copper, slaves, skins, berries, bark, goat and dog hair, beads, mats, baskets, and other materials. At one time this trade may have included nephrite. There are no direct references to nephrite being exchanged, but one passage from Teit's (1930:253) Okanagan ethnography states that stone celts were obtained from the Thompson. The material that the celts were made of, however, was not listed. Teit (1930:256) also indicates that stone clubs, possibly of jade or serpentine, were obtained from southern groups in Washington. The merits of this claim, however, are unknown. As will be discussed in following sections, nephrite was traded from the Fraser Valley archaeologically.

Summary of Ethnographic Nephrite Use

Ethnographically recorded use of nephrite can be summarized as follows:

1. Nephrite used by prehistoric interior societies came from the Fraser Valley, but no specific areas were identified.

2. The manufacture of nephrite celts was performed by creating deep grooves in a boulder or cobble with either sandstone saws, reeds, wooden rods, or thongs of leather in conjunction with sand and water. Quartz crystals were possibly used to start these grooves. Abrading stones and files of sandstone were also used during the shaping process. Once the desired width of celt was roughed out, it was snapped out of the boulder either by the use of wedges or blows from a hammerstone.

3. The places of manufacture, or the times of year that nephrite artifacts were made, are not recorded. The nature of other activities during the seasonal round would suggest that the gathering of nephrite possibly occurred in the summer and that manufacturing or finishing perhaps ensued during the winter.

4. Artifacts made of nephrite include celts, chisels, knives, hammerstones, pestles, clubs and drills. No definite ornamental artifacts of nephrite were made. At least three different sizes or types of celts were manufactured.

5. Small and medium sized celts were used predominantly for woodworking.

6. An exaggerated elongated form of celt was produced specifically for non-utilitarian use as a "property" or wealth item and was highly valued. The extent of this value, however, is poorly defined.

7. Some nephrite artifacts were possibly used as weapons in warfare.

8. There are limited references to nephrite being used in ritual. Two references that do exist suggest the placement of high value upon nephrite celts.

9. There is some very limited ethnographic evidence that nephrite celts were traded. There are no direct references to actual exchange values.

What is really lacking from the ethnographic record are specific indications of which individuals or groups in Plateau society made, owned and used nephrite artifacts. The record does suggest that high ranking individuals had distinctions in their clothing and material possessions that set them apart from lower ranked members of the community (Teit 1900: 206-222). Nephrite, however, by the time that ethnographic studies were undertaken was not specifically mentioned as a possession of wealthy or high ranked individuals. On the other hand, it is also not an item that was overtly recorded to be owned by all members of society.

The reliability of some of those ethnographic impressions has to be questioned due to the prior loss of nephrite technology. A problem with the recorded ethnographic information is that it is partially an interpretation derived from of the archaeological record rather than a direct observation of living Interior cultures. Teit, Emmons, Dawson, Hill-Tout, and Smith all partially based their study of nephrite on artifacts they recovered from archaeological sites and did not observe any manufacturing. When posing questions to their informants, they would have had to refer to those archaeological specimens. Herein lies a problem because it is probable that those informants only had limited experience with nephrite in their childhood (if any at all), although at least one stated that his father had made a nephrite adze and presumably could have observed its manufacture and use. As with other humans, they would have naturally filled in gaps in their knowledge with their own interpretations

(Leone 1982). This is compounded by a similar situation pertaining to the ethnographers themselves who could also have interpreted those artifacts based on their knowledge of jade working in other areas of the world. Unfortunately, it is now difficult to determine what portion of the "ethnographic" record was reconstructed and what was actually remembered.

However, the ethnographers and their informants were both closer in time to the subject than we are currently. The informants, because of their direct cultural affinities and possible contact with the technology, had a more 'emic' position and were thus most likely to understand how their culture had used and made such items in the past. One cannot ignore the use of ethnographic analogy because it provides us a starting point from which to interpret the past. However, in using the ethnographic information on nephrite use from the interior of British Columbia, one must exercise caution to avoid constraining the data into an already biased model.

British Columbia Plateau Prehistory

Fladmark (1982:124-131) divided the prehistory of interior British Columbia into three periods: Early (>8000 BP), Middle (8000-3000 BP) and Late (3500/3000-present). No major published revisions of this sequence exist and only the Late Period has received modifications. Richards and Rousseau (1987) have revised the chronology of the Late Period by extending its initial dates to 4000/3500 BP.

The Early Period (>8000 BP)

Relatively little is known about cultural occupations of the early period and most information comes from scattered Early Prehistoric projectile point finds (Fladmark 1982:125). Only one excavated site from the time period exists in the Interior (the Gore Creek Burial) and it consists of one unfortunate individual who was mired in a flash-flood or mudflow at 8340 ± 115 BP (Cybulski et al. 1981). No artifacts were found in association. Other sites relating to the Early Period are only found in areas peripheral to the Plateau on the Coast, e.g., Namu (Hester and Nelson 1978); in the northern Interior e.g., Charlie Lake Cave (Fladmark et al. 1984) and in the Rocky Mountains e.g., the Vermillion Lakes Site (Fedje et al. 1995). The paucity of data available for the British Columbia Plateau area makes it difficult to make any evaluation of the Early Prehistoric in the Interior (Fladmark 1982:126).

The Middle Period (8000-3500 BP)

Substantially more is known about the Middle Period, although only a limited number of sites from the time period have been excavated. Those include the Oregon Jack Creek site (EdRi 6) (Rousseau and Richards 1988), the Lochnore-Nesikep sites (Sanger 1970), the Rattle Snake Hill site (Lawhead and Stryd 1986), the Terrace site (EeRl 171) (Richards 1978), and some of the sites in the Highland Valley (EcRg 1b, EdRg 2) (Lawhead and Stryd 1986). These sites suggest that Middle Period cultures were small, loosely organized groups that primarily exploited terrestrial animal populations (Sanger 1970; Kuijt 1989). There does not appear to be the same dependence on anadromous salmon resources as seen in the Late Prehistoric (Kuijt 1989:109-110), although the faunal evidence is very meager for such conclusions. The tool kits associated with the Middle Period were primarily of flaked stone and in many sites there was the presence of a developed microblade technology (Fladmark 1982:126-129). No manufacturing or use of nephrite is known to have occurred during this time period.

The Late Period (4000/3500 - 200BP)

The Late Period is marked by the development of the Plateau Pithouse tradition between 4000/3500 BP on the British Columbia plateau. As defined by Richards and Rousseau (1987:21):

> . . . the *Plateau Pithouse tradition*, [is] a cultural tradition characterized by semi-sedentary, pithouse dwelling, hunter-gatherer, logistically organized (Binford 1980), band-level societies that relied heavily on anadromous fish for subsistence.

Within the tradition, three cultural horizons exist: the Shuswap (4000/3500-2400 BP), the Plateau (2400-1200 BP) and the Kamloops (1200-200 BP) horizons. Although there are differences between the horizons, many similarities exist:

1. use of pithouses as winter dwellings;
2. use of earth cellars as food storage facilities and a hypothesized reliance on stored

food in winter;

3. hypothesized semi-sedentary settlement pattern involving permanent winter settlements, and short-term non-winter resource extraction and/or processing camps and stations;

4. reliance on anadromous salmon as the primary food, supplemented by large and small land mammals, fresh water fish and mussels, birds, and wild plant resources;

5. use of earth ovens at pithouse sites for baking and roasting;

6. use of a heavy-duty woodworking tool kit consisting of *nephrite adzes*, bone and antler wedges, and large hammerstones or hand mauls;

7. a sophisticated bone and antler fishing technology;

8. emphasis on chipped stone tools;

9. limited use of ground stone tools;

10. anthropomorphic and zoomorphic carving in stone;

11. hypothesized wood and plant fiber industry . . . ;

12. use of stone boiling technique for cooking . . . ;

13. exchange with Northwest Coast cultures involving *nephrite* and steatite going to the Coast, with marine shells being traded to the Interior. (Cited from Richards and Rousseau 1987:50-51, emphasis added)

The adoption of the Plateau Pithouse tradition on the British Columbia Plateau has been speculated to have occurred as an adaptive response to climatic change (Fladmark 1982:135; Kuijt 1989 105; Richards and Rousseau 1987:22-23,52). During this time annual salmon migrations stabilized due to hydrological changes (Fladmark 1975) and ungulate grazing areas diminished due to forest expansion (Richards and Rousseau 1987:23; Kuijt 1989:105). Although originally speculated to be a northern innovation (Nelson 1973; Stryd 1973), from radiocarbon evidence it appears that pithouse use spread up from the south (Ames and Marshall 1980:37). The earliest pithouses in the Pacific Northwest are found in northeastern California (O'Connell 1975:33 cited in Ames and Marshall 1980:35) and on the southeastern Columbia Plateau (Ames and Marshall 1980:35). Recent excavations in British Columbia reveal, however, that the housepit may have been on the British Columbia Plateau by ca. 4500 BP (Wilson 1991).

Complexity in the Past

The possibility of complex hunter-gatherer groups extending into the late prehistoric archaeological record needs to be considered (Hayden et al. 1985). Stryd (1973:76-89) supported this view based on the patterns of pithouse distribution he observed in the Lillooet area. In larger housepit villages, Stryd (1973:76-82) noted the presence of exceptionally large cultural depressions (15m+) that usually had preferential locations near fresh water. This pattern he attributed to differences in family size and rank, with wealthier and larger families inhabiting the larger housepits with better resource access. In addition, the settlement pattern in the Lillooet area exhibits a hierarchical structure with larger villages interspaced with smaller housepit sites (Stryd 1973:86).

Hayden et al. (1985:190) expanded upon Stryd's (1973) assertions by postulating that Plateau groups used "primitive valuables" (Dalton 1977) seen in use by other complex hunter-gatherer groups. They also indicate that Plateau society possibly had ascribed status that could be inferred from differential burial good distribution and that it had a food resource base ample enough to fuel socioeconomic differentiation. Some work has gone into verifying these presuppositions. Hayden and Spafford (1993) have conducted a preliminary examination of the distribution of certain types of artifacts (which suggest wealth) in various sized housepits at Keatley Creek (EeRl 7). With some exceptions, the distributions of apparent wealth items were more associated with large housepit occupations than with those of medium and small sizes. It is also surmised that poorer families may have been economically attached to the residents of the larger dwellings and were employed as servants by those households (Hayden and Spafford 1993:137). Schulting's (1995) work on burial assemblages on the Fraser-Columbia plateau supports Hayden et al.'s (1985) speculations on burial patterns. Based on statistical manipulations of artifact distributions in Plateau burials, Schulting (1995) makes a convincing case for some measure of inequity being present in Plateau society, as well as possible evidence for some ascribed status.

The actual level of complexity displayed by Plateau groups is difficult to quantify. As Schulting (1995:185) points out, the complexity that Plateau societies exhibit falls along a continuum between egalitarian groups and rigidly stratified societies. Hayden et al. (1985:187) assert that prehistoric Plateau groups in the first millennium AD show greater complexity than ethnographically recorded groups. They feel that prehistoric occupants of large housepits on the Plateau were organized into residential corporate groups that had control over resources and trade (Hayden et al. 1985:183). However, Richards and Rousseau (1987:53) caution that large pithouses may be an adaptational or behavioral response that is not related to corporate groups.

The Prehistoric Development of the Nephrite Industry

The initial introduction of nephrite artifacts onto the Canadian plateau occurred during the mid-Shuswap horizon (Richards and Rousseau 1987:30). The earliest date associated with nephrite artifacts on the British Columbia Plateau comes from the Arrow Lakes Region at DkQm 5 (Turnbull 1977). At this site a celt was found in an occupation associated with a carbon date of 3090±200 BP. In addition to this, nephrite has been found at EeRb 10, near Kamloops, dated at 2950±50 BP (Richards and Rousseau 1982), at EfQu 3 near Shuswap Lake at 2540 BP (Sendey 1971:13; Mohs 1980), DlQv 39 in the Okanagan Valley at 2370±80 (Rousseau 1984) and at DiQm 4, in the Arrow Lakes Region again, at 2580±220 BP (Turnbull 1977). One celt is also associated at the Lochnore site (EdRk 7) with a date of 3220±90 BP (Sanger 1970:103-4), but problems connected with the radiocarbon assay has raised questions about the accuracy of this date (Richards and Rousseau 1987:11).

From the dates associated with the nephrite in this period, it would appear that nephrite technology was adopted or developed shortly after the introduction of the pithouse complex. Artifacts made of nephrite have yet to be recovered from Middle Prehistoric sites on the British Columbia Plateau (e.g., EeRh 61 and EfQq 3, Arcas Associates 1985, 1986; EeRk 1, Bussey 1994: personal communication; FgSd 1, Donahue 1977; FiRs 1, Fladmark 1974; EdRi 2 and EdRi 11 Rousseau 1988 and Rousseau et al. 1991; EdRk 4, EdRk 7 and EdRk 8, Sanger 1970; EcRg 4J, Stryd and Lawhead 1983; EdQx 41 and EdQx 42, Wilson 1991). The earliest dates associated with the Plateau Pithouse tradition suggest that it first appeared between 4000 and 3500 BP (Richards and Rousseau 1987). The deposits at these sites (FaRm 23, FiRs1, FgSd 1, EeRb 10[earliest component]) did not provide evidence of nephrite working in the form of celts or manufacturing debris (Fladmark 1976; Donahue 1977; Richards and Rousseau 1982; Rousseau and Muir 1991).

The development of celt technology appears to have occurred virtually simultaneously along the Northwest Coast. The dates given for the initial occurrence of celts in coastal sites generally range from 4500 to 3000 BP, with 4000 BP being a rough mean (Figure 3.2). The earliest celts were either produced through pebble modification or flaked blank approaches (see Section 4.1.3) and no 'sawing' technology was used. The first instances of nephrite being used for celts occurred in the Lower Fraser River and possibly on Vancouver Island during the Charles Culture / Mayne phase. At the Pitt River site (DqRq 21), two nephrite celts were recovered in close association with two radiocarbon dates of 3750±100 BP and 4100 ±100 BP (Patenaude 1985:121). These celts are fairly crude, however, and were made on modified nephrite pebbles. Another site in the Duke Point area, DgRx 5, has nephrite celts potentially occurring between 4760±190 BP and 2600 BP (Murray 1982:128). There are, however, problems with the contexts from which the earlier carbon sample was obtained and other material culture recovered in association suggest a later affiliation (Murray 1982:128). This celt was made either on a pebble or flake of nephrite. The use of sawing techniques to manufacture celts did not occur on the Coast until the Locarno Beach Culture Type between 3200 and 2400 BP (Mitchell 1990). It is possible that the technique was the result of an evolution of ground slate technology that was present in the Charles Culture / Mayne phase (Borden 1975:95).

The start of ground stone celt technology can be linked to an increasing demand for efficient woodworking tools sparked by increasing social pressures and environmental change along the Northwest Coast. People usually evolved and developed lithic technologies based on cutting demands (Hayden 1987). With celt technology the ground edge, although requiring more effort to maintain, represents an improvement over the flaked edge because of its increased durability. Environmental conditions at the time celts appeared saw the stabilization of salmon fisheries (Fladmark 1975), the rise of mature cedar forests on the Coast

(Hebda and Mathews 1984) and the concurrent development of the Northwest Coast lifestyle pattern. An examination of the relative similarity between the dates of initial celt development from north to the south, seems to indicate that there was a very rapid dissemination of celt technology.

Based on the radiocarbon dates associated with nephrite artifacts in the Northwestern area, it is probable that nephrite celt technologymoved from the Southern Coast into the interior.

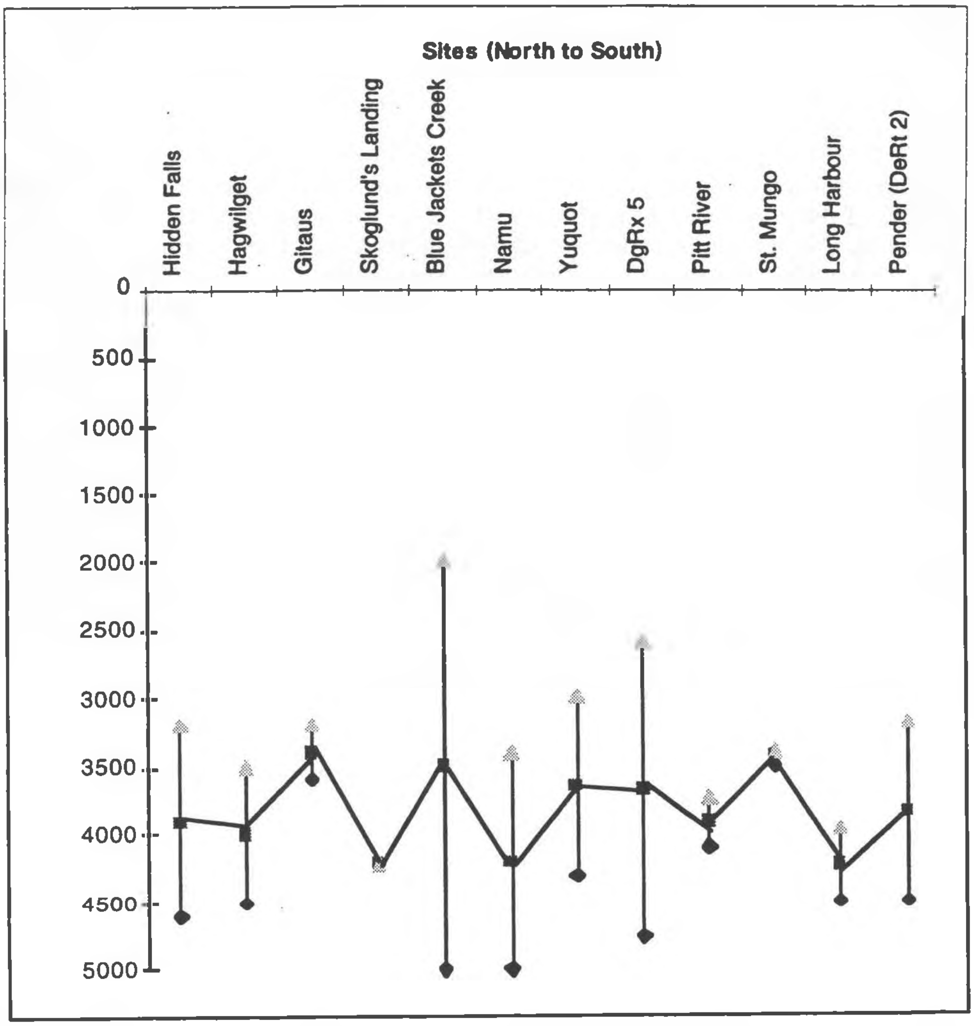


Figure 3.2. Early Celt Ocurrences in the Pacific Northwest, North to South.

References: Hidden Falls (Lightfoot 1989:228-9), Hagwilget (Ames 1979:198,201), Skoglund's Landing (Fladmark 1970:32-3), Blue Jackets Creek (Severs 1974:181,191) Namu (Luebbers 1978:48-50, 56, 58), Yuquot (Dewhirst 1980:94-121), Long Harbour (Johnstone 1991:58, 122, 132b), Pender Canal (Carlson and Hobler 1993; Carlson 1994:pers. comm.), Pitt River (Patenaude 1985:121), St. Mungo (Ham et al. 1984:46-7, 114), DgRx 5 (Murray 1982:127-9)

Both the use of nephrite and the sawing technique appear to have greater antiquity on the Southern Coast than any other area bordering the British Columbia Plateau. On the Columbia plateau, early dates associated with celt use are similar to the British Columbia plateau. Sites 45-OK-58 and 45-OK-78 in the Washington Okanagan have nephrite celts associated with dates of 3020±150 BP and 2730±160 BP (Grabert 1968). In addition, site 45-DO-214 has a celt placed between 4000 and 2000 BP (Miss et al. 1984a) and at site 45-OK-4 a celt was recovered in a floor deposit dated to 2097±132 BP (Miss et al. 1984b).

In the northern Interior there are relatively little amounts of data because of the paucity of excavated sites. Some of the most northerly sites associated with Plateau style pithouses, like FiRs 1 (Fladmark 1976) and FgSd 1 (Donahue 1977), show no evidence of nephrite use.

The adoption, rather than the development, of the nephrite industry is also suggested in the Interior by the lack of evidence for an *in situ* evolution of celt technology. There are no evolutionary proto-types of celts, as seen on the Coast, in the Interior. The first interior celts are made on sawn blanks, which on the Southern Coast were preceded by flaked and pebble forms. It would appear from this that celt technology was already partially developed before it was adopted by Interior groups.

The adoption of jade working technology in the interior during the Shuswap Horizon was possibly a response to increased woodworking demands brought on by shifts in settlement and subsistence, as seen on the Coast. The nature of the Middle Prehistoric occupation in the Interior suggests that most Plateau groups of the time were organized into small, highly mobile groups that had a general subsistence strategy relying heavily on terrestrial mammals (Kuijt 1989). There is some evidence from Monte Creek that some sedentary activity was beginning in the interior at the time (Wilson 1991). With the changes in settlement and subsistence patterns seen in the Shuswap Horizon, it is foreseeable that woodworking demands increased. For example, the woodworking requirements needed to construct a pithouse would probably far exceed those needed for a form of mobile residence like a mat lodge. Furthermore, a greater emphasis on anadromous salmon, as hypothesized for the Shuswap Horizon (Richards and Rousseau 1987; Kuijt 1989), would require the annual construction of fishing weirs and platforms which may not have been used during the Middle Prehistoric.

More attention will be directed in subsequent sections to the evolution of the nephrite industry during the Plateau Pithouse tradition and to the context of archaeological occurrences.

4 Groundstone Tool Technology

In its broadest sense, material culture encompasses any part of the physical world intentionally altered by humans (Deetz 1977:10). This definition not only incorporates obvious items made of ceramic, stone, bone, metal, earth and plastic. Underlying every act in the creation of material culture, whether it is the manufacture of an arrow point or a toy made by a child, is the expenditure of energy, which is best termed effort.

It can be argued that all material culture has value. Although the term 'value' in the modern sense has become inexorably tied to a monetary scale, it is still applicable to the past. Value can be defined as "that quality [or qualities] of a thing which makes it more or less desirable, useful, etc." (Guralnik 1983) People value objects based on qualities such as utilitarian functionality, cost of manufacture, endurance (Olausson 1983:7), as well as aesthetic appeal and rarity. When dealing with the worth that prehistoric peoples placed upon certain objects, archaeologists are very limited in which aspects of value they can reconstruct because value is predominantly an emic cultural property. Unless a written text or an oral tradition survives from a culture, recording the types of value placed on a particular kind of object, there are no direct forms of evidence that can be used to establish value. There are, however, indirect lines of evidence that lie in the artifacts themselves and the contexts from which they were recovered.

The characteristics of nephrite are static or uniform over time -- the amount of effort needed to alter nephrite today is the same as it was in the past. Modern use of nephrite is largely aesthetic, such as its use in jewelry or carvings because of the polish and luster it will hold. While these characteristics were widely admired by past cultures in various areas of the world, nephrite was also used for tools due to its strength and durability. It is the latter qualities of nephrite that are the easiest for the archaeologist to study.

In this chapter I will examine nephrite as a material for tool manufacture. The main emphasis of this chapter will be to establish the cost-effectiveness of nephrite in comparison to other types of stone material. The purpose of this investigation will be to examine the amount of time needed to shape stone tools of various materials compared with the effectiveness and durability of working edges. The first part of this chapter will summarize the principles of groundstone tool manufacture and use. The second section will focus on the results of experiments undertaken to replicate the manufacture of nephrite implements. Finally, I provide time efficiency models for the use of nephrite in comparison with other materials.

Flaked debitage, in many sites, is the largest artifact class represented. Most experimental lithic studies have, therefore, focused on the reconstruction of chipped stone assemblages. Experimental reconstruction of groundstone tool technologies, on the other hand, has largely been ignored. The research conducted on groundstone tools has been primarily petrological (e.g., Mesoamerican jade studies Foshag 1957; Lange 1993; Wooley et al. 1975) or typological in nature (e.g., Mackie 1992, Duff 1950). Some experimentation has been undertaken, but the overall quantity of this work compared to chipped stone is limited. This is probably due to the lack of evidence left behind from making groundstone tools and to the substantial amount of time and effort needed to simulate groundstone manufacturing processes.

In this section, I will review aspects of groundstone tool technology that relate to the manufacture of nephrite implements. This will include discussions of:the following: 1) principles of groundstone tool technology, 2) theoretical issues pertaining the use of groundstone versus chipped stone technology, 3) various techniques employed worldwide to manufacture jade objects, 4) techniques used to make stone celts, and 5) relevant experimental procedures previously undertaken on groundstone tool production.

Principles and Methods

Unlike chipped stone, groundstone technology is essentially the alteration of stone by techniques that do not utilize the conchoidal fracture pattern. The key mechanism of reduction in groundstone technology is abrasion.

Abrasion is the removal of one substance by friction from another substance and is a type of wear (Barwell 1979). Other forms of wear include adhesive, fatigue, and chemical processes. As a process, abrasion is influenced by material hardness, surface roughness, and the amount of pressure between two contacting materials (LeMoine 1994:320).

Hardness is probably the most important factor in groundstone tool technology. As a measure of a substance's strength (Szymanski and Szymanski 1989), it influences both the occurrence and the rate of abrasion. In order for one material to alter or scratch another, it must be equal to it or greater in hardness. Also, the greater the hardness of one material compared to another, the greater the amount or rate of abrasion that will occur.

Typically, hardness is expressed using the Moh's hardness scale in increments from 1 to 10. Each increment has a well-known associated mineral type: 1-talc, 2-gypsum, 3-calcite, 4-fluorite, 5-apatite, 6-feldspar or orthoclase, 7-quartz, 8-topaz, 9-corundum, 10-diamond. Additionally, fingernails rank around 2, a knife blade or window glass are about 5.5, and a steel file is approximately 6.5. The typical way measurements are taken using the Moh`s hardness scale is by finding which minerals will scratch the test specimen. If a mineral scratches a substance, it is at least equal to or greater in hardness. If a mineral does not scratch the specimen, then the mineral has a lesser hardness. Other more accurate hardness measures, such as the Vickers, Brinnell or Knopp methods, are also used in modern hardness testing (Szymanski and Szymanski 1989). The Moh's scale, however, is still relevant today because of its simplicity, and the proximity of the chosen minerals to the hardness increments in the Moh's system.

In groundstone tool technology, there are two primary reduction techniques: pecking and grinding. Both can be considered abrasive techniques but differ in the manner in which they remove material.

Pecking

Pecking, sometimes known as hammer-dressing (Beck 1970), is when a hammerstone is used to detach minute particles of material from a stone (Figure 4.1). Using a pecking technique, the amount of pressure or load exerted from the hammerstone is just as important as the hardness of the hammerstone. A soft hammerstone will remove material from a harder stone. However, as Dickson (1981) and M'Guire (1892:166-7) found, a hard hammerstone made of jasper or quartzite (hardness of 7) was more effective than one made of a softer material. In the same manner, when pecking different types of material, Dickson (1981) removed the most material per hour from softer rocks such as limestone than from harder rocks like basalt and quartzite.

Grinding

Grinding can be divided into four methods: simple grinding, sawing, drilling and polishing (Figure 4.2). Grinding is usually performed in conjunction with water, which acts as a lubricant/coolant, and as a mechanism to remove expended particles (Beck 1970:72; Callahan 1993:43). Sand/grit may also be used in the grinding process (Callahan 1993:43).

Simple Grinding - a grinding stone is employed to abrade. The grinding stone is usually made of some form of sandstone, but other stone types such as granite (Callahan 1993), siltstones or abrasive volcanic stones can also be used. As a rule, grinding stones tend to have very hard particles incorporated into their matrix.

Sawing - a specialized form of grinding where a saw is used to create a groove to cut through a piece of stone material. The saw can be made out of stone such as sandstone, siltstone, slate, greywacke or schist (Beck 1970), or constructed from thongs of leather, wood (Dawson 1899; Digby 1972:15), string (Digby 1972:15), or in some cases a metal wire (Hansford 1950; Chapman 1892). Generally the saw is used in conjunction with an abrasive and a lubricant, although this is not a necessity with stone saws. The abrasive could be as simple as sand, but may be a more refined sub stance such as crushed quartzite pebbles (Beck 1970), or harder prepared abrasives such as pulverized corundum or garnet (used ethnographically in China, [Hansford 1950:67-8]). The lubricant usually used during the sawing process is water, but oils or grease will also perform the same function (Johnson S. 1975; Hansford 1950).

Drilling - is another specialized form of grinding. In this instance, a drill is rotated to create a hole in a piece of stone material. Some drills, such as those used by the Maori (Beck 1970:75-77), have a hard stone tip, whereas others are untipped or hollow (Hansford 1950; Digby 1972:15). Again, as with sawing, usually an abrasive and a lubricant are used in conjunction with the drill bit. In the case of hollow drills, abrasives are poured into the drill to function as a bit (Hansford 1950).

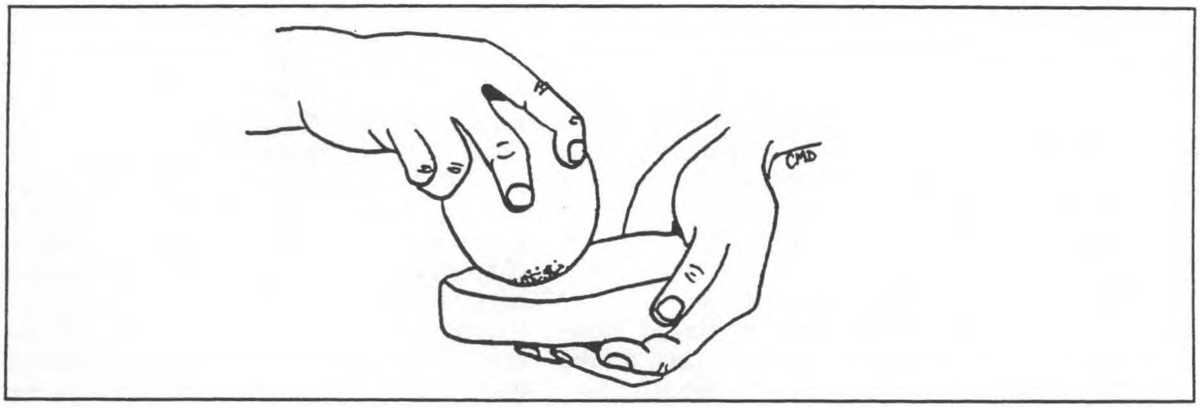


Figure 4.1. Methods Involved in Pecking.

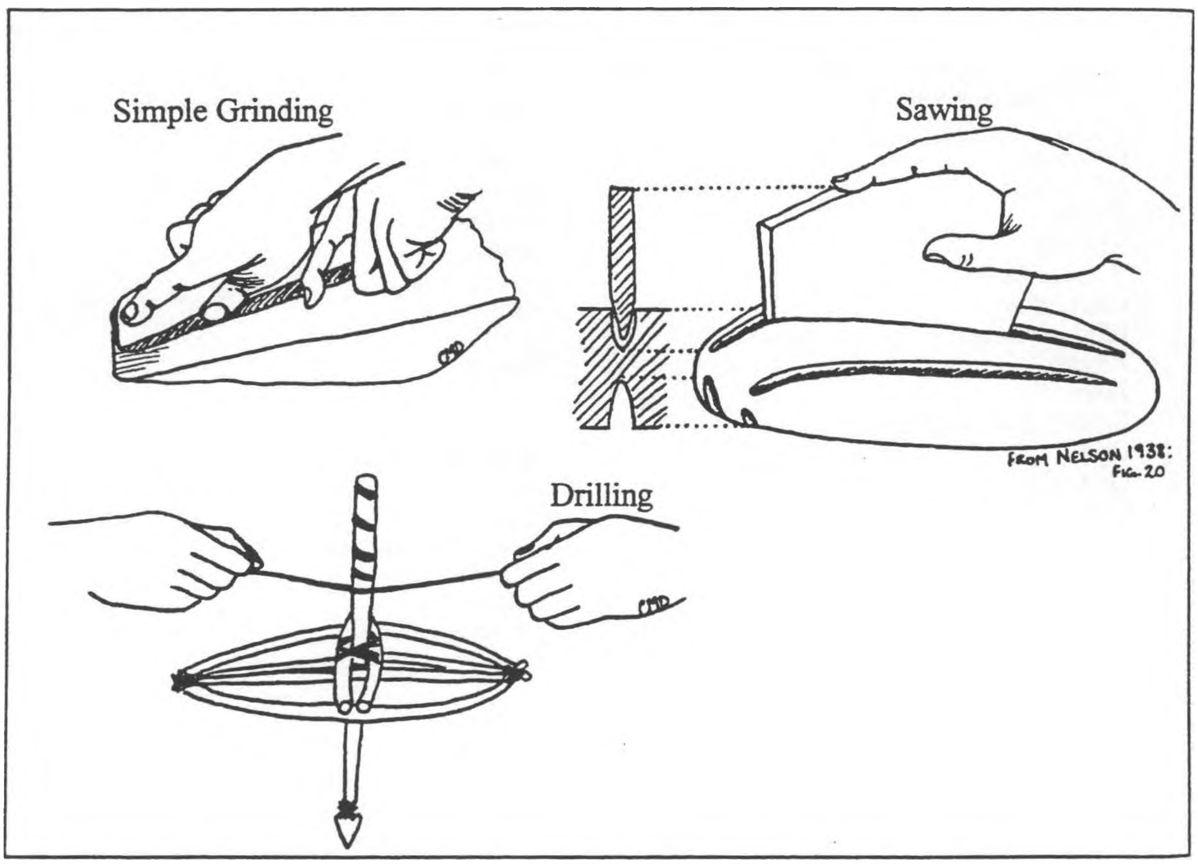


Figure 4.2. Methods involved in Grinding.

Polishing - is very similar to simple grinding, but the objective is not to remove material. Rather, it is to create a smooth surface. Many different techniques can be used to polish stone, ranging from using fine grained abrasive stones to repetitive dunking in a fine slurry of abrasive (Dickson 1981). Other polishing techniques include rubbing with leather or wood in conjunction with grease (Callahan 1993:43), or burnishing with hematite (Digby 1972:15).

Materials Used in Groundstone

Unlike the manufacture of flaked stone tools, almost any type of stone material can be exploited using groundstone techniques. Frequently, stones used in groundstone tools do not flake or break readily or predictably. This is not to say that stone types used for chipped stone cannot be modified using groundstone techniques. There are many instances where both methods are used to create a tool (e.g.., European flint axes and daggers, greenstone adzes on the Central Coast). However, most rock types used for groundstone tools do not break with a conchoidal fracture pattern. Table 4.1 lists the different stone types that are generally exploited by groundstone and flaked stone technology. As will be discussed later in the chapter, one advantage of groundstone technology is that it makes it possible to use very tough, fibrous materials that could not be effectively exploited with flaked stone techniques, and allows for continuous, long-term resharpening without significantly reducing the size.of the tool.

Table 4.1 - Materials Generally Exploited by Flaked Stone and Groundstone Techniques.

Materials Desirable for Flaked Stone Tools (after Crabtree 1982:9)	Groundstone Materials (after Kapches 1979; Callahan 1993)
Obsidian	Amphibole
Ignimbrite	Granite
Basalt	Basalt or Metabasalt
Rhyolite	Gniess
Welded Tuff	Greenstone
Chalcedony	Serpentine
Flint or Chert	Dorite
Agate	Pumice
Jasper	
Silicified Sediments	
Opal	Hornfels/Horneblend
Quartzite	Marble
Quartz	
	Soapstone/Steatite
	Nephrite
	Jadeite
	Greywacke
	Slate
	Sandstone
	Siltstone
	+ all of column one can be modified in using groundstone techniques

Optimization of Lithic Technologies

The types of lithic technologies used by people in the past were systems that operated not only in response to environmental needs, but in conjunction with other strategies which maintained social cohesion (Torrence 1989:2). Current discussions surrounding lithic technology (i.e., Torrence 1983, 1989; Boydston 1989; Bamforth 1986; Bousman 1993; Hayden 1987; Jeske 1992) have focused on applying optimization theory to the dynamics involved within lithic industries. Viewing tools as "optimal solutions" (Torrence 1989:2-3), these authors often attempt to explain stone tool systems in terms of a cost-efficiency or cost-benefit relationship of some form of 'currency'. 'Currency', in this situation, refers to the item of expenditure or value that is to be 'optimized' (Torrence 1989:3). Items such as energy, time, raw material, technical knowledge, stability, risk, uncertainty and security are all potential currencies in stone tool systems (Torrence 1989:3). The underlying principle behind optimizing theory is that past cultures always attempted to maximize returns while minimizing the expenditure of currency.

While all the currencies listed above interact with respect to any lithic system, it can be argued that both time and raw material constraints are the most basic factors to consider within a stone tool industry. Many forms of currency are subsumed under the term effort. Effort, as discussed, as an encompassing concept is difficult to measure (Boydston 1989:71). Some studies use caloric energy as currency (e.g., Jeske 1989, 1992; Morrow and Jeffries 1989; Camilli 1989; Henry 1989) which assume that past cultures had energy budgets or constraints (Torrence 1989:3). Use of this currency, however, can be criticized because it is not clear whether caloric energy is scarce enough in environments to be a selective behavior (ibid.). As Boydston (1989:71) points out, even if an individual spent a whole day flaking and grinding a stone tool, the energy expended would be insufficient to interrupt "biophysical homeostasis". More important than the energy expended for the day is the time lost grinding.

Torrence (1983:11-14) initially explored the concept of time currency and stressed the importance of time budgeting in hunter-gatherer societies. She argues that the scheduling of resource related activities within hunter-gatherer societies was vital to fully exploit a subsistence base. Because the timing involved in harvesting different resources varies, tool designs have to be specific to the risks and needs at hand. Torrence (1983:13-14) argues that scheduling or time budgeting needs affect the composition, diversity and complexity of tool assemblages. As all humans operate under finite time constraints, tool designs reflect the necessity to conserve time. Often logistical hunter-gathering lifestyles associated with high latitudes necessitate large, diverse tool kits that take relatively more time to create and maintain than those affiliated with more residential hunter-gatherers at lower latitudes (Torrence 1983:18-20).

Boydston (1989) has similarly suggested, through the study of functionally comparable tool types, that prehistoric peoples chose tool manufacturing processes based upon time expenditure in relation to perceived or expected benefits. When examining a cost-benefit function for time consumption (Figure 4.3), Boydston (1989:71) hypothesizes four possible cases: 1) high cost, low benefit, 2) low cost, low benefit, 3) high cost, high benefit, and 4) low cost, high benefit. When using the concept of efficiency (benefit divided by cost), the cases can be ranked, except for instances 2 and 3 which are equivalent, as follows:

$$4 > 3;\ 2 > 1$$

Under an optimizing paradigm, the cost benefit function predicts that a tool with a Case 4 efficiency level would supersede a tool with a Case 3,2 or 1 level (ibid.). The costs involved in tool production are procurement time, production time, and maintenance time. The benefits derived from a tool type are measured in terms of operational life and effectiveness (Boydston 1971:71).

The other relevant form of currency, raw material factors, has been explored by Hayden (1987). In reviewing the development of different cutting edges through prehistory, Hayden (1987:41) argues that raw material conservation was a key factor influencing the development of cutting edges. In a progression from hard hammer percussion reduction techniques to the development of metal tools, the amount of effort required to maintain cutting edges increase while there was greater conservation of raw materials. Under this model, the

		COST	
		Low	High
BENEFIT	Low	Case 2	Case 1 - Potential Prestige Function
	High	Case 4 - Optimal Tool	Case 3 - Potential Prestige Function

Figure 4.3. The Cost Benefit Function (after Boydston 1989:71)

need to conserve raw material is important because of the amount of time spent on resharpening/retooling detracts from the primary activity. Hayden (1987:40-41) uses for an example the inefficiency of using chipped stone edges instead of slate knives on the Northwest Coast. Because of the relative weakness of chipped stone edges compared to groundstone edges, the constant need to resharpen or replace chipped edges would have greatly detracted from the number of salmon that could be processed in a day when time was of the essence and therefore waste energy.

Similarly, Bamforth (1986) after examining the stone material used by the !Kung San and two archaeological examples, concluded that raw material availability directly influences the choices of reduction technologies. Looking at the distribution of lithic resources from these examples, he (ibid:41-49) demonstrated that a shortage or restriction of lithic material increases the level of tool maintenance and recycling. He also identified instances where only specific types of material were used for certain tool forms. This distinction was related to the advantage of using particular stone types for certain technologies.

While there is some disagreement concerning the relevance of raw material as a currency (see Torrence 1989:3), I believe that the selection of raw material is generally related to time availability and cost. Different stone materials take varying amounts of time to be reduced. For example, as noted previously, there are great differences between the manufacturing times for stones that can be reduced by flaking compared with those that can only be reduced using groundstone techniques. Thus, the time needed to remove equivalent amounts by chipping chert, as opposed to grinding nephrite, differs greatly.

As with the development of cutting edges, there must be benefits that favor a change from one resharpening method to the next (Hayden 1987). Boydston (1989:71) predicts, using cost benefit (Figure 4.3) function as an evolutionary model, that in any instance where a high benefit/ low cost technology is present, it will be chosen over other alternatives for practical technological purposes. In situations of high cost/high benefit or low cost/low benefit, there may be no incentive to change technology. It is assumed that high cost/low benefit technology will be replaced in the face of other alternatives. The advantages vary -- what may be needed by a mobile residential hunter-gatherer group is not necessarily beneficial for a more sedentary logistical group (Boydston 1989:75). For some lifestyles, the advantages of using crude chert choppers that may take half an hour to make and a short time to expend are greater than spending days creating a groundstone adze that will last considerably longer. In this situation, the time needed to make a groundstone adze would detract from other more important activities. If chert was hypothetically abundant in the area, there would be little need to conserve material. Hayden (1987) also suggests that heightened sedentism in the past increased woodworking demands, requiring the use of materials that were more advantageous for these tasks due to lower replacement rates. In this case, the use of expedient choppers not only would waste chert resources but also would detract from the time spent on woodworking. Use of tougher groundstone edges would allow for greater efficiency in woodworking tasks due to lower replacement rates. In both of these instances, raw material and time, interchange with each other as the currency being optimized.

Surplus and Non-Utilitarian Functionality

While optimizing theory in many ways is a powerful tool for explaining lithic use in prehistoric cultures, there is the simple problem that not all human behavior in the past was optimized. As demonstrated by a paradox illustrated by Olausson (1983:7), a tool's value can be dependent on "two opposing factors". A tool can be valued on its ability to perform its practical functions with high benefits and low costs, or it may be a factor of its inability to effectively perform its intended utilitarian function. There are many instances in prehistory where an item has evolved away from its original intended use,

> [to] serve some [other] purpose in society -- to mark status, religious affiliation, etc. The value of such an object *increases* the *less* it is able to fulfill a practical function. The amount of time or effort spent on the manufacture of such an object represents an investment *beyond* what is required for subsistence -- a surplus. Therefore the more time spent in the manufacture of such an object, the more valuable it is as a symbol of wealth (Olausson 1983:3).

A major criticism of optimizing theory is that it is incapable of explaining behavior beyond a subsistence level. As cultural complexity increases the most optimal decision on an economic level may not be the best choice on a social level.

Olausson (1983), in the above passage, brings up two important concepts that cannot be explained by optimizing theory: surplus and non-utilitarian functionality. Surplus is the result of excess effort used to create a stone tool. For example, grinding/polishing a celt beyond the working edge may be considered surplus because of the limited benefits that the effort imparts to the practical function of the tool. Non-utilitarian functionality is the process where a practical tool is elaborated or modified to the degree where the modification hinders the performance of the implement. With celts, the typical elaboration is to increase the size to unwieldy or easily breakable proportions. In both cases, these concepts are not apparently wise economic choices. If an exorbitant amount of effort is spent in making a practical tool (i.e.., enhancing the aesthetic appeal), it may have high benefits, but it would also have high costs. If the same amount of effort is spent on a non-utilitarian tool or item, it would have high costs and low practical benefits. Both of these, especially the latter, are non-desirable in terms of optimizing behavior.

In her study of flaked versus groundstone axes, Olausson (1983:7-8) felt that the best approach to identifying surplus energy expenditure was to derive minimal criteria for the effort/time needed to make strictly functional woodworking tools. To do this, she examined three aspects of groundstone flint axe use versus greenstone axe use in Scandinavia: 1) differential access to raw material, 2) ease of manufacture, and 3) differential use of material types for specific tasks. The results of her investigations demonstrated that groundstone axes made of greenstone were easier to manufacture and resharpen than those made of flint. Despite this, the greenstone axes were equivalent, if not superior, to those made of flint in performing woodworking tasks (Olausson 1983:60-1). Olausson concluded that the additional effort expended upon the flint axes was an "'extra' touch not required for function; i.e., value." (1983:60) The incentives behind making flint axes were associated more with the desire to display or confer status rather than any utilitarian need.

Although not addressed by Olausson (1983), there are many prehistoric instances where stone tools have been elaborated to the point where they are essentially not practical for utilitarian functional (e.g., Mesoamerican, Mississippian, Northwestern Plateau obsidian eccentrics and stone bowls). Usually in these situations, the energy and time needed to manufacture an implement is beyond that needed to make a utilitarian counterpart. The point at which items cross over between utilitarian and non-utilitarian function is not always apparent and sometimes investigators arbitrarily set limits. For instance, in New Guinea ceremonial axes are distinguished by their size, which are generally over 25 cm, from the working axes that are usually under 15 cm in length (Sherratt 1976:567). Similarly, thin-butted flint axes in Scandinavia and northern Germany are at times more than 40 centimeters in length and weigh around 4 kg. This, as Sherratt states, "[is] clearly in excess of ergonomic requirement." (1976:567) While it appears that the most exaggerated forms are probably non-utilitarian, I am not aware of any studies that have determined the point where the size of a celt becomes a hindrance to performance.

One of the major risks in using such exaggerated implements is breakage. As has been found during experimentation with adzes, even normal sized celts are susceptible to bending/compressive (Olausson 1983), or side-slap (Kinsella 1993:41) fractures. This weakness is amplified by the extended body length of an exaggerated celt which makes it even more prone to damage. Risking a celt of this type to breakage could result in the loss of a large amount of time and effort. Therefore, with European axes, the symbolic function of an exaggerated implement form must override its utilitarian function (Sherratt 1976:567).

Another component of non-utilitarian function is mimicry. If an object is being made specifically for non-practical purposes, alternate materials that lower manufacturing costs but imitate the final appearance of the functional original may be utilized. Thus the value of the object is gained with a lower time investment. In Mesoamerica, for example, serpentine is often used in forgeries of artistic pieces made from jadeite because of the relative speed in which it can be worked (Foshag 1957:32). Conversely, if the lower quality item was ever used for practical purposes, its performance would be substandard.

Summary

To understand the nature of nephrite use on the British Columbia Plateau it will be necessary to establish the cost benefits of nephrite use in comparison to other available material types. A strong emphasis will be placed upon establishing manufacturing costs in terms of time needed to reduce various material types. Some attention will be also devoted to the use life of various tool forms. By examining these aspects, it may be possible to determine whether surplus or excess effort was expended manufacturing nephrite implements, compared to their advantages as working tools

Examining all the issues of non-practical functionality is beyond the scope of this thesis. There will be no attempt to define at which point a nephrite implement becomes too large to be functionally effective as an adze or celt. There will be some investigation into the possibility of substituting serpentine for nephrite in Chapter 5.

Celt Manufacture

Because celts are the main type of nephrite artifact manufactured on the British Columbia Plateau, I will focus my discussion on the cost-efficiency of nephrite for celt technology. Other types of artifacts, such as knives, are exceedingly rare.

There are three basic reduction strategies used to manufacture celts: 1) pebble modification, 2) flaked blank reduction, and 3) sawn blank reduction (Hanson 1973; Mackie 1992). The following discussion is based on Hanson (1973:228-230), Mackie (1992:127-140) and Kapches (1979).

Pebble Modification

The simplest celt reduction technique is pebble modification. With this method, a pebble that is roughly celt shaped is either pecked or ground. Depending on the proximity of the stone to its final shape, this can be the fastest method of producing a celt. When completed, the cross-sections of such celts are usually oval and they may or may not have some of the original pebble shape or cortex. Pebble celts can be manufactured on virtually any stone type.

Flaked Blank Modification

Using this celt reduction technique, the blank is initially shaped using flaking reduction. Any combination of hard hammer or soft hammer techniques may be used to form the blank, including the bit. The blank is subsequently finished by either pecking or grinding, although the celt may be functional without further modification. When completed, such celts typically have a bi-convex cross-section and may have remnants of flake scars depending on the degree of grinding. The types of materials exploited using this technique at least marginally break in a conchoidal pattern (e.g., chert or flint, basalt, greenstone, jasper, tuff, etc..). Although not used with great effectiveness, it is also used to reduce tougher rock types such as nephrite, serpentine, granite, hornblende, slate, etc. The results of such breakages are often unpredictable and waste a large amount of material. The time needed to manufacture a celt with this method varies depending on the raw material and amount of abrasion used after the initial flaking -- it can be the fastest method if no further grinding is performed after the blank is flaked, but it is generally slower than pebble modification.

Sawn Blank Modification

This celt reduction technique is the most specialized and is usually only performed on a limited number of non-brittle rock types. The blank is sawn out of a larger rock with a groove and snap approach. The bit may be formed during the sawing process or done through pecking and grinding. Sawn blank celts usually have a rectangular cross-section and may have manufacturing grooves present on the margins or faces. The sawn blank modification is by far the most time consuming method of celt production and is usually only utilized on materials where flaking is ineffective (e.g., nephrite, jadeite, serpentine, hornblende, soapstone, slate).

Previous Observations and Experiments on Nephrite Manufacturing Time

Only a limited amount of ethnographic observation and experimentation has been published on the amount of time needed to work nephrite but it does indicate that a considerable amount of time is required to cut that material. In this section I will review the ethnographic and experimental literature relating to the time needed to manufacture nephrite implements.

Ethnographic Information on Nephrite Manufacturing Times

The closest parallels to Plateau nephrite manufacturing come from Maori jade working in New Zealand. Here a range of nephrite artifacts, including adzes, knives, weapons, fish hooks and ornaments (Beck 1970), were made using methods similar to those in British Columbia.

During the 1800's, several explorers made observations on Maori greenstone working methods (Chapman 1892). Two of these explorers, Heaphy and Brunner, reported (Chapman 1892:498-499) their observations on the manufacture of a *mere* or stone short sword out of *pounamu* or nephrite:

> The Arahura natives [Maoris] lay in a large stock of thin pieces of sharp quartose slate, with the edges of which, worked saw-fashion, and with plenty of water, they contrive to cut a furrow in the stone, first on one side, then on the other, until the piece may be broken at the thin place. . . . With pretty constant work -- that is, when not talking, eating, doing nothing, or sleeping -- a man will get a slab into rough triangular shape, and about 12 in. thick, in a month, and, with the aid of some blocks of sharp, sandy-gritted limestone, will work down the faces and edges of into proper shape in six weeks more (Major Heaphy to Chapman 1892:498).

Beck (1970:74) estimates that initial sawing of this *mere* would have involved minimally 50 square inches (325 cm^2) of sawn area based on the average *mere* size of 15 inches (450 mm) long and 4 inches (100 mm) wide. In other words the total distance sawn, based on the circumference of the cross-section of a *mere* blank, was 225 millimeters. Assuming that 160 hours were minimally spent during the month the *mere* was manufactured, the craftsperson was sawing at a rate of approximately 1.4 mm/hr.

Jade working in China has been undertaken since the early Neolithic (Huang 1992). The craft, in its long development, has produced some of the best artistic carvings. The tools and abrasives used in Chinese jade carving are considerably more sophisticated than those used on the British Columbia Plateau. The lapidaries in China used a variety of metal (usually iron) tools in conjunction with numerous hard abrasives including corundum (hardness of 9) (Hansford 1950:67, 81). Diamonds were also used but usually just for drill points.

Despite the advanced nature of the tools and abrasives in Chinese jade working, cutting speeds were still slow. In describing the bisection of a jade cobble (I estimate to be 20 to 30 centimeters in diameter) using a metal wire, abrasive, and water, Hansford (1950:79) stated that the operation would require several weeks to complete. Other processes, such as hollowing bowls and jars, inscribing writing, creating relief, are described as being laborious, but Hansford offers no further time estimations.

Experimental Data on Jade Manufacturing

One of the earliest investigators to study aboriginal lapidary was M'Guire (1892). During his research, M'Guire attempted to reconstruct prehistoric technology by simulating reduction techniques. In one experiment, he (1892:166-167) manufactured a grooved axe of nephrite. Beginning with an irregular shaped fragment of a nephrite boulder, he repetitively pecked and ground the piece into a grooved nephrite axe in a total of 66 hours. Most time was spent on pecking the axe into shape (55 hours). During this experiment M'Guire estimated that he delivered approximately 140 blows per minute for a total of over 460,000 strikes for the whole procedure. Also during the process he destroyed 40+ hammerstones until he found one tough enough to withstand the pounding. After pecking (which was curtailed after breaking a section of the celt), the axe was ground for 5 hours and polished for 6 hours. M'Guire considered the amount of time needed to complete the axe to be excessive. With tougher hammerstones (e.g., one made of nephrite) he felt that he could have cut the amount of work needed to complete the axe in half. Likewise, he believed that aboriginal craftspeople would have chosen pebbles to reduce that were closer to the desired form.

M'Guire (1892:175) also attempted to measure the rate at which nephrite could be sawed. He first attempted to saw nephrite with a sheet of native copper, sand and water. Subsequently, he tried both chert and jasper in conjunction with sand and water. With all three saws M'Guire reported that "great difficulty was experienced in making satisfactory progress." (1892:175) Only when using a saw made of "jadite" was a greater rate achieved. When using "jadite", with or without sand, in association with water, he recorded "cutting a groove one-fourth of an inch deep in about an hour." (1892:175)

Johnson S. (1975), in a study of Mesoamerican jade working, investigated the rate at which jadeite can be sawn. In her experiments, Johnson S. (1975:6) achieved a cutting speed of 1 millimeter per hour using a blade or sheet of wood in conjunction with crushed granite and water. In a similar experiment she found that sawing rates could be increased to 2 mm per hour using grease or fat, instead of water, as a lubricant.

In his studies of Maori jade working, Beck (1970:70-72) performed some experiments on nephrite. In these investigations he tested the efficiency of saws made of different materials in creating cutting grooves and their effectiveness after the groove was established. Beck (1970:72) determined that sandstone saws are superior in both circumstances compared to those made of quartzose schist, greywacke spalls, and slate. Unfortunately, he does not record the rates achieved with the different materials.

Finally, Barrow (1962:254) observed the manufacture of a nephrite *hei tiki* using semi-aboriginal techniques by a jade worker known as Mr. Hansson. For the most part, modern tools and abrasives were used to create a *hei tiki* that measured 6.5cm x 3.3 cm x 8 cm. Some aboriginal drilling and grinding techniques were used, however, to shape and finish the pendant. Despite the use of synthetic carborundum abrasives and an emery wheel, the *hei tiki* still took 350 hours to complete. Barrow concluded that this would probably be the minimum amount of time a skilled Maori craftsperson would need to complete the same item using only traditional methods.

Manufacturing Experiments

This section deals with a series of grinding experiments that were undertaken to establish the effort needed to make nephrite tools compared to other material types. As discussed earlier in the chapter, I believe time and raw material are the most important factors involved in making and using stone tools. The following experimental procedures were designed to gauge the relative time needed to cut nephrite, serpentine, greenstone, chert, and steatite using similar techniques to those utilized prehistorically on the Plateau.

Experimental Procedures

The experimental approach undertaken in this thesis to emulate Plateau jade working technology was to cut grooves in various specimens of rock with a sandstone saw in conjunction with sand and water. Following the ethnographic information recorded by Emmons (1923) and Teit (1900), and my observations of nephrite artifacts, I believe that this method, as opposed to the use of a thong or reed, was probably the primary means of reduction.

I decided to use a sandstone saw partly from Emmons' (1923) descriptions of Plateau nephrite working and from Beck's (1970) endorsement of sandstone saws over other material types for effectiveness in cutting. The saws used in the experiments were approximately 20 cm x 10 cm x 1.5 cm in size and were made from a pink sandstone tile. Although saws were sought from natural sources in British Columbia, commercially obtained sandstone tiles were used because of their uniform thickness. The composition of the particles in the sandstone is largely unknown. I had hoped that a large number of the particles were pink quartzite (hardness of 7) but many may have been feldspar (hardness of 6). The particles were approximately 0.25 millimeters in size and had a partially rounded shape.

Two types of sand were utilized during the procedure. Due to the location of my experiments, both came from the Missouri area and were a mixture of different particle types. Again the types of materials in the sand were not identified, but quartz crystals were present in both. The first kind of sand had particles approximately 0.5 to 0.25 millimeters in size and was not as coarse as the second type with particles up to a 1.0 millimeter in diameter.

The tests were carried out on specimens of nephrite, serpentine, greenstone, chert, and steatite, which are all available in the interior of British Columbia (Leaming 1978). Three samples of nephrite were tested -- two from the Dease Lake area (Specimen #1 and # 2) on the Cassiar segment and one from the Skihist area on the Fraser River (Specimen # 3). The serpentine (Specimen #4) and steatite (Specimen #7) were purchased in a Vancouver lapidary and probably came from the interior of British Columbia, although this is uncertain. One sample of greenstone (Specimen #5) was tested and it was collected from the Bella Coola valley (Breffitt 1993: personal communication). The chert sample (Specimen #6) used was Burlington chert from Missouri and served as a replacement for a broken piece collected in British Columbia. For three of the material types (nephrite, serpentine, and greenstone), samples of various sizes were cut to determine what factors the length of the groove played in cutting time.

The following procedures were followed for every test:

1. An initial cutting groove was established in each specimen before the start of the experiments. This was to facilitate direction of the saw and effective dispersion of sand and water.

2. The depth of both ends of the cutting groove were measured to the nearest 1/10 th of a millimeter and recorded before each test.

3. All specimens were held in place with the use of a large vice ("Black and Decker Workmate").

4. Only one saw was used for each test.

5. The saw was moved repetitively through the groove at a rate of approximately 150-170 strokes per minute. Some downward pressure was exerted while moving the saw but not an excessive amount.

6. Sand and water were liberally added when needed. Only one type of sand was used per test. In some situations, sand was recycled after being used once.

7. All sawing was timed -- usually in 1 or 2 hour increments. Any time sawing was halted the timer was stopped.

8. After the grinding was completed, the depth of each groove end was again measured to the nearest 1/10th of a millimeter. Rates were calculated by averaging the distance cut on each end of the groove.

Results

Of the samples tested, the lowest cutting rate was achieved on the chert specimen. After spending a large amount of time trying to establish a groove and additionally sawing one timed hour, only a minimal amount of headway was made (0.15 mm/hr). Sawing was curtailed after 1 hour because of the lack of progress. The reasons behind the slow rate directly correlate with the hardness of the material (Table 4.2).

The second slowest sawing rate was associated with the nephrite specimens, which had an average cutting speed of 1.455 mm/hr. A number of groove lengths were tested during the experiments. It was found that groove length had only a minor influence on cutting speed. The longest groove (402 millimeters) did have the slowest cutting rate (1.31 mm/hr). When comparing it, however, to grooves half the size, the difference only amounts to between 0.20 mm/hr and 0.365 mm/hr. The second lowest cutting speed was on Specimen #3 which had the shortest groove length, at 1.375 mm/hr. This variation between specimens can likely be attributed to slight differences in hardness.

The greenstone sample followed nephrite in cutting speed with an average of 2.52 mm/hr. Rates achieved for the serpentine specimens were over double those for nephrite and averaged 3.15 mm/hr. This is not unexpected due to the fact that the serpentine is approximately half as hard as nephrite. The differences in groove length for both the greenstone and serpentine samples reflect the same trends seen in the nephrite specimens. Only minimal differences (if any in the case of greenstone) were found between different groove lengths. Not surprisingly, the fastest sawing rate was recorded for the steatite specimen. At 20.95 mm/hr, the sample was nearly bisected before an hour

Table 4.2. Results of Experimental Sawing.

Specimen	Trial Number	Sand Type	Groove Length	Side A	Side B	Time Elapsed	Increase in Groove Depth
No 1 Nephrite	1	1	202 mm	4.05 mm	2.65 mm	2 hrs	1.675 mm/hr
	2	2	202 mm	4.1 mm	1.95 mm	2 hrs	1.51 mm/hr
	3	2	402 mm	2.85 mm	2.4 mm	2 hrs	1.31 mm/hr
No 2. Nephrite	1	2	114 mm	2.5 mm	3.2 mm	2 hrs	1.43 mm/hr
No 3. Nephrite	1	2	94 mm	1.6 mm	1.15 mm	1 hr	1.375 mm/hr
Hardness: 6-6.5							Ave - 1.455 mm/hr
No.4 Serpentine	1	1	170 mm	6.55 mm	6.3 mm	2 hrs	3.21 mm/hr
Hardness : 4-5	2	2	170 mm	6.05 mm	5.8 mm	2 hrs	2.96 mm/hr
	3	2	101 mm	4.0 mm	2.7 mm	1 hr	3.35 mm/hr
							Ave - 3.17 mm/hr
No. 5 Greenstone	1	1	160 mm	5.3 mm	4.85 mm	2 hrs	2.54 mm/hr
Hardness : ~5	2	2	160 mm	7.9 mm	3.95 mm	2 hrs	2.96 mm/hr
	3	2	106 mm	2 mm	2.05 mm	1 hr	2.05 mm/hr
							Ave - 2.52 mm/hr
No. 6 Chert	1	2	94 mm	0	0.3 mm	1 hr	0.15 mm/hr
Hardness : 6.5-7							Ave < 1 mm/hr
No.7 Steatite	1	1	111 mm	20.3 mm	21.6 mm	1 hr	20.95 mm/hr
Hardness : ~2							Ave -20.95 mm/hr

of sawing was completed.

Several other observations were made during the experiments. There was, at times, a considerable amount of attrition noted on the sandstone saws - particularly when sawing nephrite. During one test, the saw decreased 6.3 mm in size whereas the nephrite's groove depth only increased by 3.35 millimeters. Also, the working edges of the saws tended to become concave or bowed as the experiments proceeded. This was also reflected in the grooves which tended to be shallower in the middle. The only exception to this was the nephrite specimen with a groove length of 402 millimeters where the opposite conditions were observed; the groove was deeper in the center.

During the experiments, I discovered that water and sand needed to be added continually. Although I never precisely measured the quantities of either material, it was not uncommon to use at least 4 litres of water and 1 litre of sand over a 2 hour test period. Increased pressure placed on the saw during the grinding process resulted in greater loss of sand and water. These were literally 'pushed out' of the groove.

Only a minor amount of physical exertion was needed to operate the saw. Never was the procedure physically rigorous and the overall caloric expenditure was likely quite low. In no way could this procedure have upset "biophysical homeostasis" (Boydston 1989:71) by its caloric consumption (unless carried on for excessive periods of time).

I also noted that the serpentine sample would not have been suitable for strictly functional tools. It is doubtful that a celt could even be successfully made out of this specimen of the material. During the experiments, I observed that the serpentine subject became pervaded with cracks and pieces of the material simply fell off. If this piece is indicative of serpentine in general (although this is probably not the case), then this material would not even be suitable for mimicking nephrite.

Critique of the Experimental Results

The results gained from the experiments should only be taken as an approximation of cutting rates achieved by prehistoric stone workers. This is especially the case when looking at the variables involved in the sawing process. These include:

1. Hardness of the material being sawed
2. Hardness of the saw
3. Hardness of the abrasive
4. The amount of pressure exerted downward on the saw
5. The shape and size of the particles in the saw
6. The shape of particles in the abrasives
7. Rate of sawing strokes

Hardness of the material being sawed can only be varied to a limited extent (e.g., nephrite can only be between 6-6.5 in hardness; one can choose pieces in the lower part of the range), whereas other factors also can be controlled to some degree. Throughout the experiments, I did not try to maximize the effects of the other factors. This would have entailed finding harder, more angular abrasives (e.g., pure quartz sand); saws with harder particles such as garnet; applying more downward thrust; and possibly increasing the number of sawing repetitions per minute. If prehistoric Plateau stone workers maximized these factors, they may have been able to saw at an increased rate. There are indications that the Maori tried to maximize the hardness of their abrasives and saws (Beck 1970) and in China a whole industry arose to supply lapidaries with effective abrasives (Hansford 1950:67-69). Nevertheless, despite some limitations of the experiments, they do provide valuable information.

Comparison of Reduction Techniques and Materials

Table 4.3 is a summary of the manufacturing times recorded by other researchers for making celts using different blank types. The figures for sawing nephrite were derived from the experiments conducted for this thesis, using probable reduction sequences inferred from nephrite artifacts from the plateau and ethnographic references discussed in Chapter 5. When comparing the times needed to make celts with different techniques, the flaked blank approach has the fastest mean time of 5.2 hours. This is followed by the pebble modification technique at 29.8 hours and sawn blank at 82 hours (using average times calculated using maximum speeds). The reason for this large variation is that the materials modified by the pebble and sawing techniques cannot be effectively reduced by flaking. It should be noted that the excessive time needed to reduce nephrite and greywacke siltstone inflates the average rate for the pebble modification and sawing techniques. If these two materials are

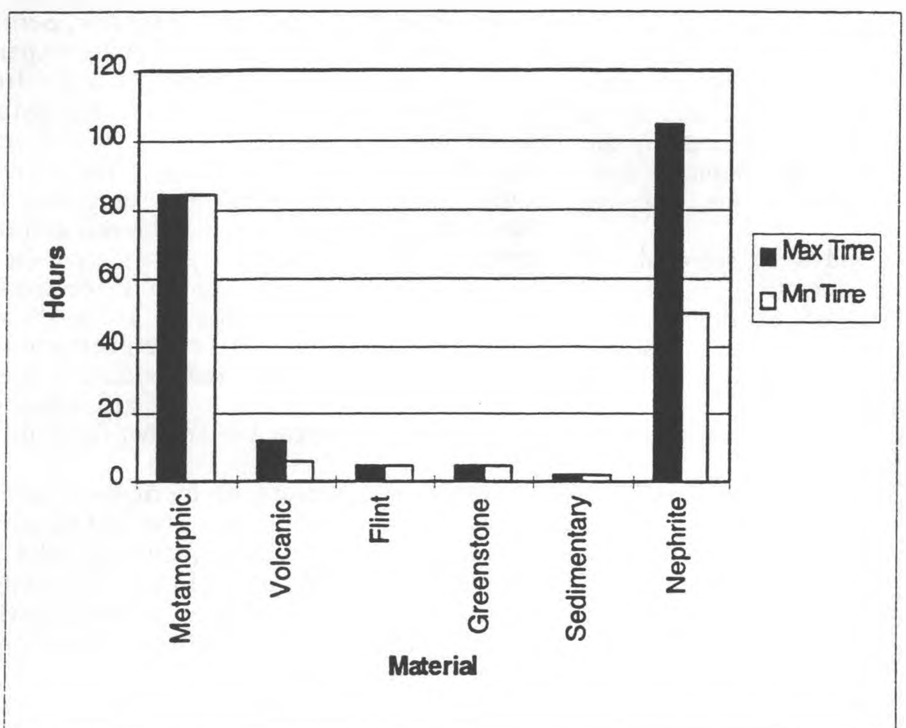


Figure 4.4. Time Needed to Manufacture Celts from Different Material Types.

removed from the sample, the average time decreases to 3.3 hours.

It is quite apparent that celts made of different raw materials have varying manufacturing times (Figure 4.4). Some of the materials have been grouped by similar geologic origin. Metamorphic rocks (greywacke, siltstone, and slate) and nephrite clearly have the greatest manufacturing times. This is particularly the case with the total for nephrite which underrepresents the actual time required.

Cost-Benefits

Since the cost of manufacturing nephrite adze bnlades is so high, there should in theory be very high benefits, unless those objects were created for non-utilitarian or prestige purposes. One potential benefit that nephrite tools may have bestowed upon their users was increased speed in cutting or chopping wood. To evaluate this aspect of nephrite celt use, a series of chopping experiments was undertaken using a nephrite celt to gauge the cutting efficienncy of the tool compared to celts of other materials.

Wood cutting experiments were conducted using a nephrite celt mounted in an axe haft. Nephrite from the Dease Lake region of northern British Columbia was cut into a celt using a diamond saw. The celt measured 270 mm x 60 mm x 20 mm and had a bifacial working edge to 38°. Because of its size and weight, the implement tended to readily induce fatigue. Its use, unfortunately, was necessary due to the inadequacy of two smaller celts also manufactured for experimention. Due to flaws in the material, that were probably inhanced by the heat and vibrations from the diamond saw, those two celts fractured before the chopping experiments could begin.

Three types of wood were selected and gathered for the experiments -- sycamore, poplar, and a form of juniper. Sections of these tree types were held in a large vice (Black & Decker workmate) in a horizontal position for cutting. Both the sycamore and juniper trees are considered hardwoods, whereas the poplar specimen was softwood.

Each wood specimen was chopped at a rate of between 45 to 50 blows per minute. The amount of force exerted on each swing was less than would be used with an iron or steel axe blade because of the brittleness of stone edges (Olausson [1983] forewarns of this problem). Each experiment was timed using a stop watch. When chopping ceased (usually to adjust the position of the log), the timer was stopped. After each procedure, the distance proceeded into the specimen and the volume chopped were recorded. Volumes were obtained in a similar manner used by Olausson (1983:41) by measuring the amount of wet sand needed to fill the cut area.

The results obtained during the chopping experiments were mixed (Table 4.4). Most of the cutting speeds obtained are relatively slow when compared to the results obtained by Olausson (1983) in her experimental proce dures and by ethnographic observations listed by Boydston (1989:73) using groundstone implements. In Figure 4.5, the cm2/minute of wood chopped (based on the diameter of the tree being cut) for my experiments are compared to those listed by Boydston (1989:74) for ethnographic observations for other groundstone edges. As can be seen, the rates achieved in this study are far below Boydston's average figures for general groundstone axes for both hardwood and softwood. However, these rates fall within the standard deviations that Boydston (1989:73) listed for both his hardwood (12.6 cm2/min) and softwood (22.5 cm2/min) averages.

Few conclusions can be drawn from these experiments. Nephrite edges appear to be neither superior nor inferior to other forms of groundstone edges for cutting efficiency. Although all the chopping results obtained in the experiments in this study were low, Semenov (1964) also conducted chopping experiments using a nephrite adze on a fir tree (considered to be softwood by Boydston [1989:73-4]) and achieved higher rates of cutting efficiency (See Figure 4.6). The slower cutting speeds achieved in this study may be due to the oversized nature of the celt and the horizontal position of the logs being cut (it is difficult to gauge when exactly a tree would fall and the values presented in Table 4.6 are only estimates). Until more experimentation is completed under standardized conditions, there can be no conclusions as to the efficiency of one material as opposed to another for cutting edges.

Three observations of merit were noted during the experimentation. The first of these is the importance of manufacturing celts of nephrite with very few or no flaws. In the case of the two smaller celts that were used briefly, both implements broke immediately along previously existing flaw lines. The celt that was used also sustained some minor damage along a previously existing crack while being used on a hardwood sycamore specimen.

The second observation was that the cutting edge of the nephrite celt, except for a minor break on one end of the blade, essentially retained its sharpness throughout the chopping experiments. Although the experiments could hardly be considered an arduous test of the strength of nephrite edges, this observation does suggest that nephrite edges are enduring.

Table 4.3. Time Involved in Celt Manufacturing Techniques for Different Materials.

Manufacturing Technique	Material	Time Expended	Reference
Pebble Blank (pecked and ground)	Nephrite	66.16 hrs	M'Guire 1892
	Kersantite	2 hrs	M'Guire 1892
	Sandstone	3.75 hrs	Treganze & Valdiva 1955
	Greywacke Siltstone	~ 126 hrs *	Chapell 1966
	Metabasaltic Pebble	1.8 hrs	Dickson 1981
	Porphyry	5 hrs	M'Guire 1891
	Gabbro	4.16 hrs	Evans 1897
	Method Average	29.8 hrs	
	without nephrite & greywacke	3.3 hrs	
Flaked Blank (flaked,pecked,ground)	Catoctin Greenstone	3.16 hrs	Callahan 1993
	Amphibolite	3.55 hrs	Olausson 1983
	Catoctin Greenstone	4.5 hrs	Olausson 1983
	Catoctin Greenstone	5.1 hrs	Olausson 1983
	Catoctin Greenstone	5.87 hrs	Olausson 1983
	Flint	4.25 hrs	Olausson 1983
	Flint	5.1 hrs (6.03 hrs)	Olausson 1983 est.
	Flint	5.63 hrs (6.36 hrs)	Olausson 1983 est.
	Diorite	~18-24 hrs* †	Bordaz 1970
	Granite	4 hrs †	Pond 1930
	Rhyolite	5 hrs	Dickson 1981
	Limestone	0.5 hrs	Dickson 1981
	Basaltic Pebble	2 hrs	Dickson 1981
	Flint (just flaked)	0.25 hrs	Coles 1973
	Method Average	5.2 hrs	
Sawn Blank	Fine Grained Slate	43 hrs	Roberts 1975
	Nephrite	~ 34 to 145 hrs	this thesis - see Figure 5.2
	Serpentine	~16 to 60 hrs	this thesis - see Figure 5.2
	Method Average	max - 82 min - 31	

~ means estimated * estimated by Kapches (1979) † estimated by Boydston (1989)

The third observation was that the large size of the celt probably decreased its efficiency as a chopping tool. This was mainly due to unwieldly weight of the implement that tended to fatigue the chopper reducing the number of swings per minute and weakening the force behind them. Further experimentation will be needed in the future to determine what size of celt is more manageable.

In a project to reconstruct prehistoric structures at Cahokia, celts similar to those found in the area prehistorically were used to perform some of the woodworking tasks. Callahan (1993:38) recorded the life history of one celt made of Catocin greenstone. In total it was used for 29.39 hours to fall and trim cedar trees before it was broken. In total it underwent 14 resharpenings and only was abandoned when damage from an accidental drop on a large stone was too severe to warrant a major resharpening. If the celt had not been broken prematurely, it may have had a much longer life. One could expect even longer duration from nephrite celts.

The two measures of a stone's strength are hardness and toughness (Brandt et al. 1973). Hardness is the measure of its resistance to scratching or abrasion, while toughness is its resistance to fracture. Both attributes figure heavily in the use-life of a stone tool. Harder substances are more resistant to abrasion (noted in my sawing experiments). In theory, a chert celt should remain sharp longer than a nephrite celt because of its greater hardness. However, chert is a brittle substance and this seriously affects its performance. Returning to the surface fracture energy and the fracture toughness measures in Table 2.1, chert has similar toughness values to glass and quartzite. The values for nephrite are 52 times higher for fracture surface energy and 11 times higher for fracture toughness. In practical terms, a nephrite celt should be able to absorb the impact of a blow 11 times stronger than a chert adze.

When modeling the cost-efficiency of different material types, it becomes apparent that nephrite is a 'high cost-high benefit' material for manufacturing celts. In Figure 4.6, the estimated time for manufacturing celts of different materials is compared to the resistance of the material to breakage. The costs and potential benefits of nephrite far exceed any other material. Theoretically, a nephrite celt will withstand seven times the amount of fracture energy than chert. However, the major manufacturing costs would demand either the need for a strong tool, or the *luxury* of having an enduring implement.

Table 4.4. Results of Chopping Experiments.

Specimen	Extent of Cut	Cutting Time	Distance Cut	Volume of Wood Removed	Estimated Tree Falling Time†
Poplar (softwood) 10 cm diameter	cut through	13.68 minutes	10 cm	450 ml after 10 minutes	~ 8.8 minutes
Poplar (softwood) 10 cm diameter	cut through	9.5 minutes	10 cm	500ml	~ 7.7 minutes
Sycamore (hardwood) 11 cm diameter	groove only	10 minutes	4 cm	200 ml	~ 27 minutes
Sycamore (hardwood) 11 cm diameter	groove only	6.3 minutes *	3 cm	200 ml	~ 17 minutes
Juniper (hardwood) 8 cm diameter	groove only	5 minutes	3cm	150 ml	~ 10 minutes

* Experiment stopped due to edge damage

† Based on removing two wedges of wood that would leave a 2 cm rib - based on personal experience, the tree should fall at this point. These estimates may be slow.

The practical functional benefits of nephrite are not equal, however, for all celt sizes. This is demonstrated by the model in Figure 4.7. At some point, an optimal size of celt exists which has maximum functional utilitarian benefits, while at the same time it is large enough to endure multiple resharpenings. Simply put, if one makes a short celt, it will have a limited use life. However, there is a maximum length for optimal benefits. After this juncture, an excessive celt length becomes a liability for bending/compressive fracture. This decreases the practical benefits because of the potential to lose the time invested in manufacture. Since this does not represent optimal behavior in a strictly utilitarian sense, the motivation behind making such an artifact probably resides in either symbolic or social value. At present, it is not clear where the optimal length for nephrite celts is located. New Guinea axes (some of which are nephrite) can be divided, based on metric attributes, into ceremonial and utilitarian implements (Phillips 1975:110). This division is approximately between 15 and 25 centimeters in length (Sherratt 1976:567). Using this analogy, nephrite celts greater than 15 to 25 centimeters may not have functioned as effectively as smaller implements

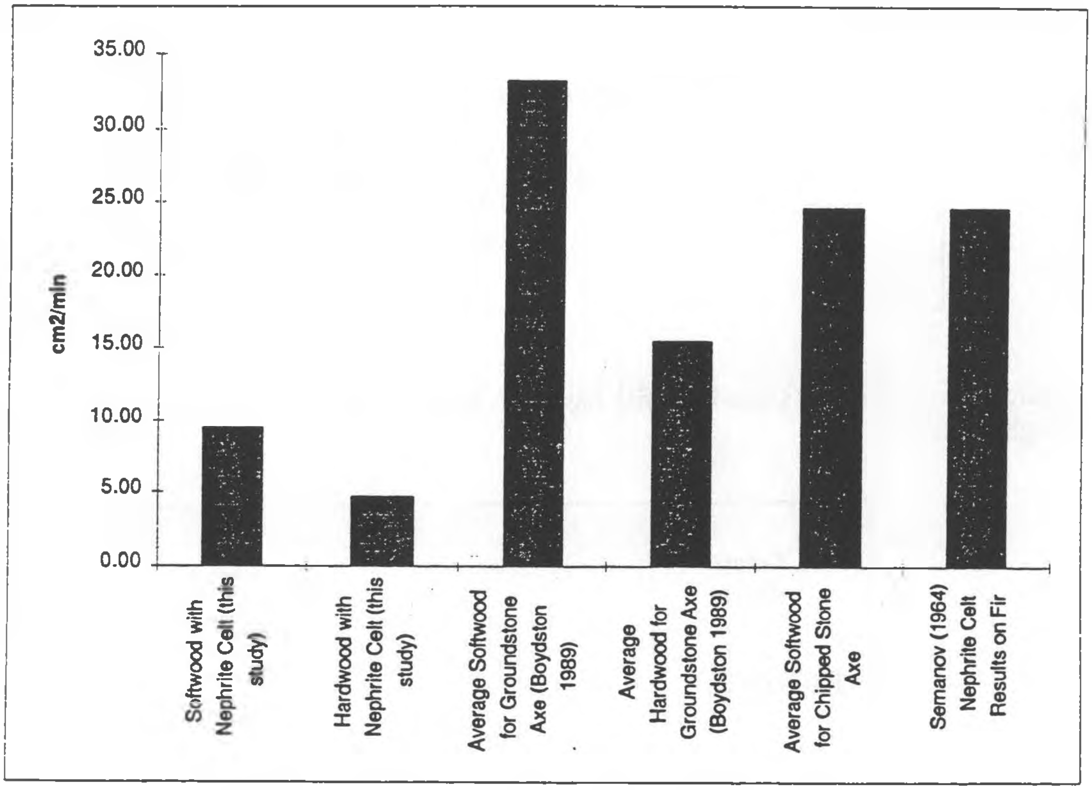


Figure 4.5. Comparison of Areas Chopped to Averages Presented by Boydston (1989).

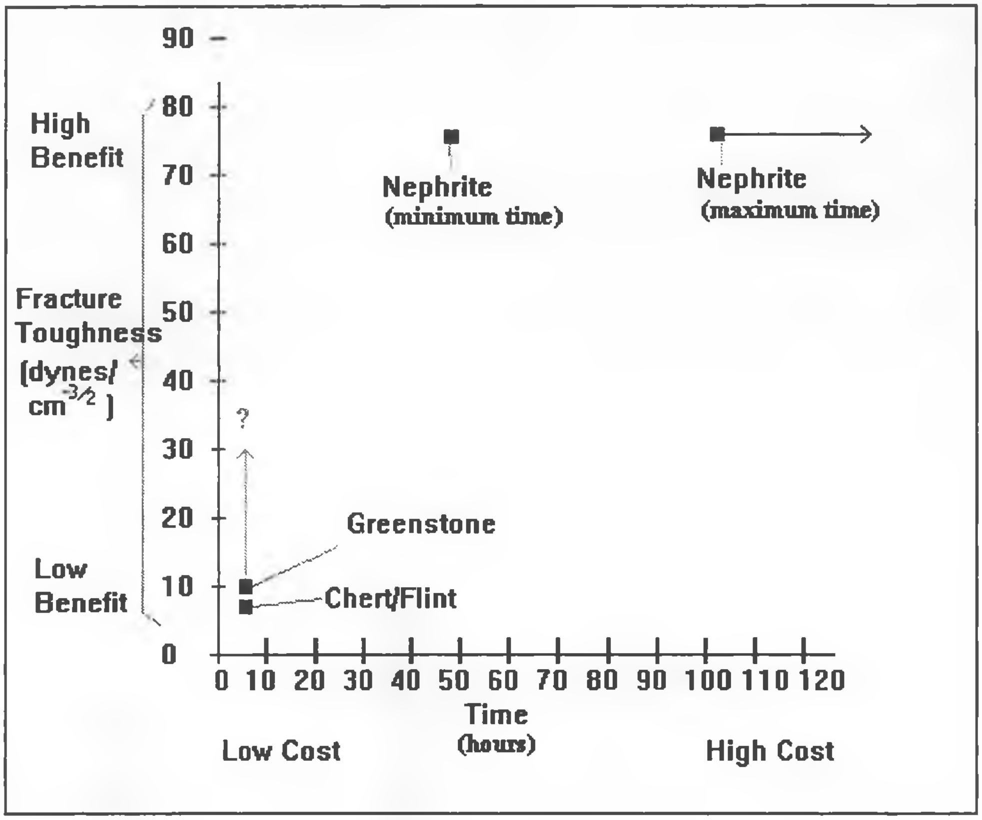


Figure 4.6. Estimated Cost-Benefits based on Manufacturing Time and Fracture Toughness.

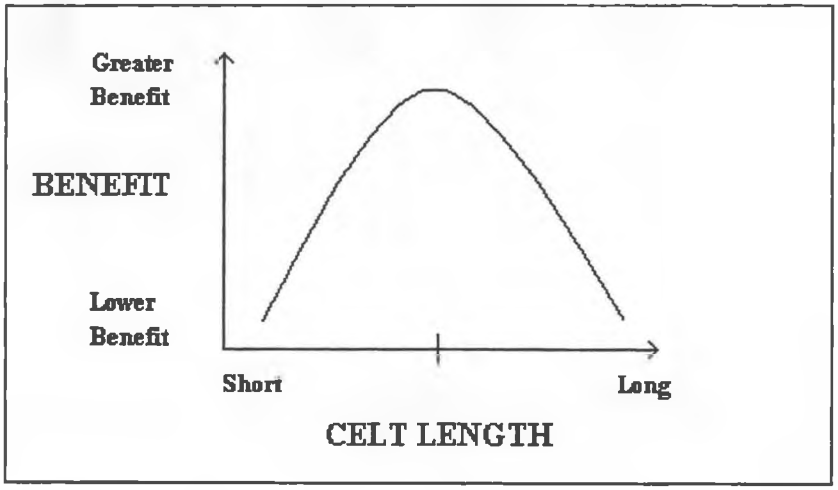


Figure 4.7. Model of Benefits for Nephrite Celts based on Length.

5

Celt Manufacture, Context, and Distribution

This chapter will examine the use of nephrite on the British Columbia Plateau through the analysis of nephrite artifact attributes and a review of the contexts in which nephrite artifacts have been recovered. The first section focuses on the choices that prehistoric Interior groups made concerning the materials and manufacturing methods used in celt technology. The second section is an analysis of the context and distribution of nephrite on the British Columbia and Columbia Plateaus.

Prehistoric Celt Manufacture on the British Columbia Plateau

Observations were made on 84 different groundstone artifacts from the Interior of British Columbia, as well as several from the Lower Fraser area and the Coast. The sample of artifacts was taken from collections stored at the Museum of Ethnology and Archaeology at Simon Fraser University and the Department of Anthropology and Sociology at the University of British Columbia. When selecting the artifacts for study, my aim was to explore the manufacturing aspects of celt technology, regardless of material type. Along with this, I also undertook an examination of various types of artifacts (beyond celts) that appeared to be made out of nephrite. There was no attempt to examine other groundstone artifact types (i.e., mauls, sculptures, pipes) where nephrite did not appear to have been used. An explanation of the types of measurements and attributes recorded, as well as the data collected, are found in Appendix 1. No effort was made to classify the objects beyond a functional level.

Most of the artifacts examined were celts (Table 5.1). Other types of artifacts included celt blanks, chisels, knives, manufacturing debris, sawn boulders, and miscellaneous ground fragments. In addition, a gouge and a celt rejuvenation fragment were examined.

In total, 55 celts were analyzed. Most were complete, followed by distal, medial and proximal fragments (Table 5.2). The average dimensions for all the celts are listed in Table 5.1. Looking only at the complete celts, the largest specimen was 290 millimeters long and the smallest 40.1 mm long. As seen in Figure 5.1, most of the celt lengths are below the mean of 121.2 millimeters.

The majority of the sample came from private collections that were donated to the museums. Some of the artifacts have a specific site provenience, but others can only be attributed to a general area within the Interior of British Columbia (Table 5.3).

Celt Blank Manufacture

From the attributes present on the celts, and the accompanying manufacturing debris from the British Columbia Plateau, it is evident that flaked blank, sawn blank and possibly pebble modification were utilized. Of the methods noted, clearly the majority of celts were made using sawing techniques, followed distantly by flaking. No positive identification of modified pebble celts were made, but several of the indeterminate celts had characteristics could possibly be ascribed to this type of celt (i.e., oval cross-section, cortex).

Most of the flaked blank celts were crude in their appearance. Some celts were little more than a bit ground on some fortuitously detached flakes of nephrite. Only a limited amount of attention was given to shaping their overall form (i.e., SFU 93-1-993, 93-1-113, 4519). Others, however, were well shaped by flaking and grinding procedures (i.e., SFU ElRn 13:3; UBC EfRl 258-428).

The sawn blank approach to manufacturing celts was the dominant reduction method used in the sample. Based on the manufacturing evidence left behind on the celts, sawn boulders and other manufacturing debris, it is possible to determine four methods used to make celts by sawing. These methods are as follows:

Method 1. The simplest form of the sawn blank celt. As illustrated in Figure 5.2, this method involves only one saw cut near the exterior of a cobble/boulder. If the stone is of correct size and shape, it is possible to create a fully functional celt with a minimal amount of additional grinding after the initial sawing.

Using this method there is no necessity to snap the blank out of the boulder if the cut is made through the entire thickness of the cobble. The celt produced typically has a cortical

Table 5.1. Numbers and Average Dimensions of Observed Artifact Types.

Artifact Type	Number		Length	Width	Thickness
Celts	55	Mean(All):	103.2	44.2	13.4
		Complete - mean:	121.2	47.5	14.1
		- σ	68.6	9.8	4.4
Unfinished Celts(Celt Blanks)	6	Mean (All):	137.0	42.0	19.4
		Complete - mean:	126.2	47.1	16.4
		- σ	37.8	14.5	8.7
Chisels	2	Mean (All): - mean	41.9	17.0	3.7
		- σ	3.3	3.8	1.2
Celt Rejuvenation Fragment	1		34.3	29.3	8.1
Gouge	1		46.0	20.1	4.6
Knives	2	Mean (All):	65.3	29.7	5.4
		Complete - mean:	72.2	32.8	4.9
		- σ	7.9	20.9	0.14
Manufacturing Debris	9		120.2	43.4	20.0
Miscellaneous Fragment	3		84.3	36.6	11
Sawn Boulders	5	All -	233.9	97.6	62.2
		Complete - mean:	321.5	130.8	77.7
		- σ	99.2	45.8	14.7

Table 5.2. Celt Portions Analyzed.

Portion	Number	Percent
Complete	31	56 %
Distal (pole missing)	13	24 %
Medial (pole and bit missing)	5	9 %
Proximal (bit missing)	4	7 %
Bit Fragment	2	4 %
Total	84	100%

Table 5.3. Artifact Provenience.

Provenience	Number	Provenience	Number
Bostok Ranch, Tranquil	1	EfQv 1	2
Cache Creek	1	EfQv 2, Little River	3
East Lillooet	2	EfQv 9	1
EbRj 1 (Lytton)	2	EfRl 253	1
EbRj 92 (Lytton)	1	Egmont *	1
Lytton	17	ElRn 14	2
Lytton ?	1	FaRn (Williams Lake area)	1
EdRk 3 (Lochnore Locality)	2	Interior	1
EeQl 3	1	Interior ?	1
EeQs 1	1	Lillooet	15
EeQw 1 (Chase)	3	Nicola	2
EeQw 3, S. Thompson River	3	Nicola Valley	1
EeQw 5 ?, Little River	2	North Lytton	3
EeQw 6, S. Thompson R	2	North Lytton, Burial 2	1
EeRl (Lillooet Area)	4	Pitt Meadows *	1
EeRl 19, Fountain Site	1	South Thompson (EpSi1?)	1
EeRl 7 (Lillooet)	3	Tsawwassen *	1
EeRm (Seton Lake)	1	Unknown (probably Interior)	1

*Not from the Interior

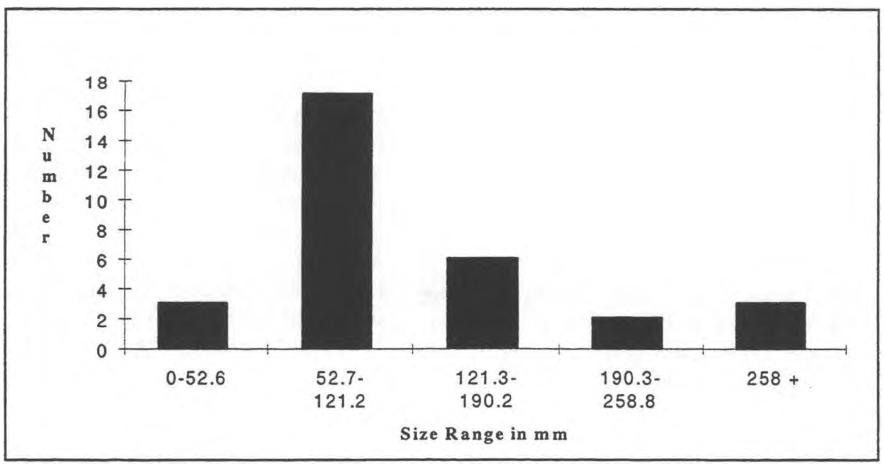


Figure 5.1. Size Ranges for Complete Celts.

Table 5.4 - Celt Blank Types (including unfinished celts and chisels)

Blank Type	Number	Percent
Sawn Blank	44	72%
Flaked Blank	8	13%
Indeterminate	9	15%
Total	61	

rind over one face and evidence for sawing on the other. An example of this type of celt was found at Keatley Creek (SFU #5534&5524). Several other examples, including an abandoned sawn boulder, were also observed in the assemblage from the Flood site in the Lower Fraser Valley.

It should be noted that multiple celts can be removed from an appropriately shaped cobble/boulder. However, the advantage of the method is lost with secondary celt removal because of the need to grind bits onto the ensuing blanks.

Method 2. This second method of sawing was described by Emmons (1923:22-23) for large, irregular boulders. In this procedure (Figure 5.3), two parallel grooves are sawn into a boulder, with the depth of each groove depending on the desired thickness of the celt. At this point, Emmons (1923:22) records that wedges were placed into the groove. With equal pressure, these wedges were driven into the grooves in order to snap out the celt. The results varied and at times Emmons (1923:22) documents that there were failures. (i.e., the celt was only partially freed from the boulder). There is one instance on a sawn boulder now at UBC (EeRl-x:12) where a partial celt fragment is still present between two grooves. However, there appears to have been variation in the method to minimize the risk involved in removing celt blanks. In some instances, there appears to have been a third groove placed perpendicular to the other two grooves. This was created to decrease the distance to be snapped (see Figure 5.3) and therefore minimize the chance of breakage. It is probable that this method was used to produce some of the longest celts because of the lowered risk. Celts manufactured in this fashion often have the remnants of the snap area remaining on one margin, unless it has been ground away.

Once the initial celt has been removed from a boulder using this method, subsequent celt removals can be accomplished with less effort. On one of the sawn boulders I examined there is evidence for the removal of multiple celts (SFU 2815). It is conceivable that such a sawn boulder could have had considerable value.

Method 3. This method is used to reduce flat boulders/cobbles of nephrite. It too was described by Emmons (1923:22-3) and is quite similar to the Maori method for sawing nephrite (Best 1974:73). In this approach, a nephrite boulder/cobble is cut by sawing grooves in each face of the rock (Figure 5.4). After sawing was completed, the central rib is broken and the blank removed. Celts made from this blank form usually have a distinctive snap scar on at least one face, instead of the margins, unless it is ground away. Depending on its size, a number of celts can be removed from this type of boulder.

Method 4. This is an alternative method used to reduce flat boulders/cobbles. As demonstrated in Figure 5.5, this technique involves sawing three grooves to create a blank -- two parallel grooves on one face and a centrally cut groove on the other face of the rock. If the central groove is wide enough, there may not have been the need to break the celt from the boulder. Some celts have deep grooves in their margins (e.g., UBC EeQw 1:41) which suggests this type of removal. Similar to the other methods, after one celt has been removed from a boulder, others can be removed more easily.

Celt Blank Modification

After a blank has been sawed from a boulder/cobble, usually further modification has to be performed to make the celt functional, including grinding the bit and shaping the margins. There is a possibility that the bit may be ground on a blank before its removal by altering the shape of the cutting grooves. If the bit is not added in this fashion, it must be installed by either pecking or grinding. There is some evidence that the bit may be ground before the margins are finished. Some celt blanks were noted to be too wide to be functional for woodworking, yet a partial bit was present.

Shaping the margins of a celt could take up to two additional saw cuts. The margins of the celt can be shaped by removing the cortical area on the external side of the celt and the

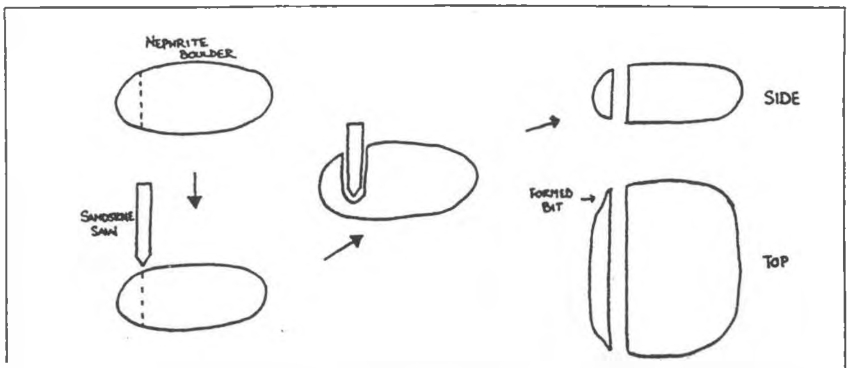


Figure 5.2.
Method 1.

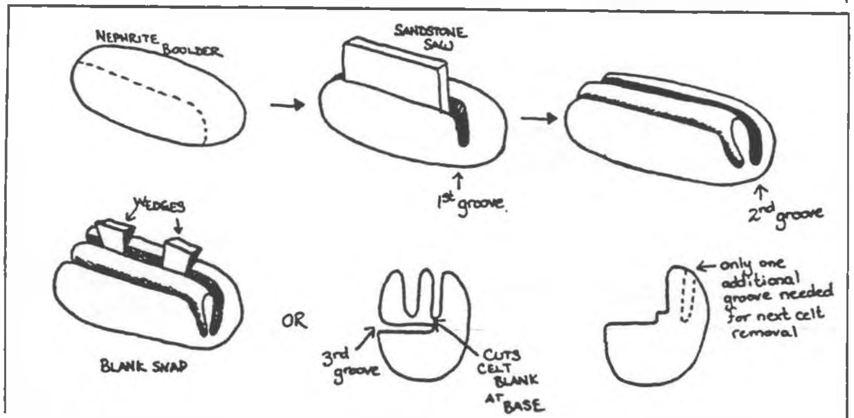


Figure 5.3.
Method 2.

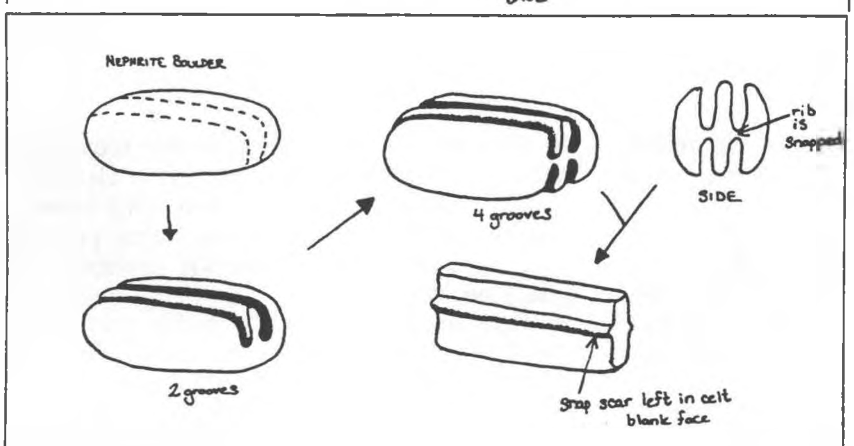


Figure 5.4.
Method 3.

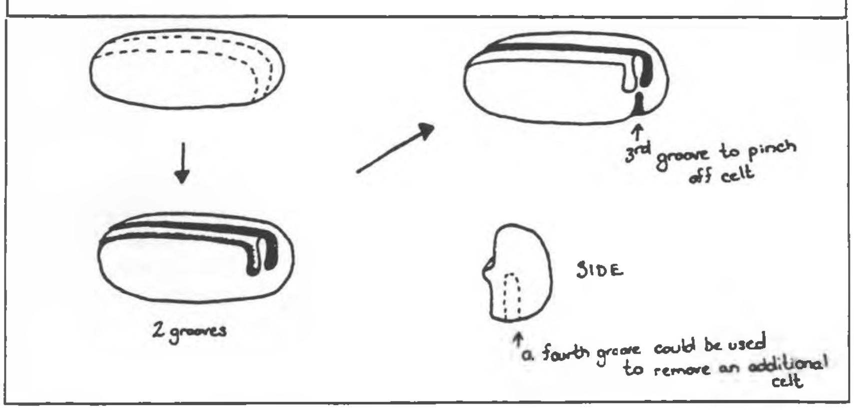


Figure 5.5.
Method 4.

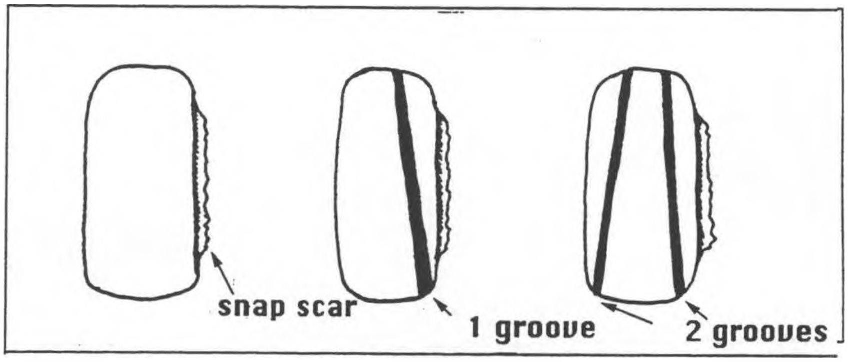


Figure 5.6. Celt Blank Modification.

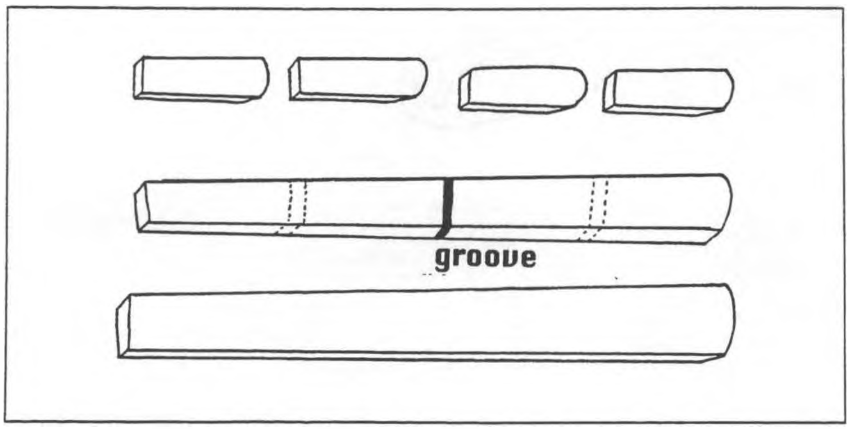


Figure 5.7. Larger Celt Sectioning.

snap area from the internal margin (Figure 5.6). Further modification was typically undertaken on thecortical surface of the celt. Depending on its intended function, the celt was either tapered from the bit to the pole, or given a rectangular shape. Similar approaches were taken during the construction of some Maori celts (Brailsford 1984:27) and for British Columbia Coastal celts (Smith 1909:370).

Other modifications to celts could include squaring or rounding the pole and grinding the margins flat. Of the finished celts examined 27 % displayed some form of manufacturing evidence (e.g., a groove or a snap scar in the margin or face). Many of the remaining 73% of the celts appear to have had most of this type of evidence ground away. Some of the different variations in the modifications undertaken on celt blanks probably related to the intended function of the celt. This, however, was not investigated.

Interestingly, I did not observe any evidence for reduction through pecking. No artifacts displayed dimpled or pocked surfaces indicative of the technique. It is possible that the evidence for this method was removed by subsequent grinding. However, it is also possible that the technique was too risky to warrant its use during the manufacturing process (e.g., M'Guire [1892] broke his nephrite celt during pecking).

One last modification possibly performed was the sectioning of a larger sawn blank into several smaller celts. Evidence for this comes from a celt from EeQw 1-50 (UBC) where a saw cut is present on the proximal end of a celt, suggesting it was likely sectioned from a larger blade (Figure 5.7). This might be a time saving option. My sawing experiments (Chapter 4), indicated that a long groove can be sawn nearly as fast as a short one. In a cost-benefit analysis, this would be a desired option because two or possibly three usable celts could be partially manufactured at one time. If each of these celts were individually cut, the process could take 2 or 3 times as long to produce the same results. I could not determine the frequency with which this sectioning method was used from the present sample. It is possible that any evidence would be ground away.

Material Type Identification

Ultimately, the best way to determine the exact mineralogical nature of any rock is to perform both chemical and microscopic petrological tests. Nephrite cannot be positively identified without the use of thin sectioning to confirm the presence of tremolite (Leaming 1978:7). As this technique (along with chemical testing) is destructive, alternate methods should be used to conserve artifacts when possible. There are procedures that will allow tentative identification of mineral specimens, through the determination of physical properties, that cause only minimal impact to an artifact. The primary attributes of nephrite determination are color, hardness, specific gravity and resistance to breakage (Leaming 1978:7).

A key part of my analysis was an attempt to determine the hardness and specific gravity for each artifact. Color was also recorded. Hardness determinations were made using scratch tests with minerals for each increment of the Mho hardness scale. Using this method, usually only a range could be determined (e.g., 4 to 5 on the scale). With permission from the SFU Museum, hardness tests were performed on a number of artifacts. Because hardness determination is destructive, scratch tests were only performed on artifacts in areas that were exposed by breakage or covered in cortex. Artifacts that did not have these types of areas were not tested. No artifacts from UBC were scratch tested. The hardness values determined on the artifacts may be under estimated because of the locations in which they were taken. Cortical areas tend to be softer due to weathering, and broken areas tend to give lower hardness ratings than polished surfaces (Leaming 1978:7). The hardness of nephrite is usually listed between 6 to 6.5 (Turner 1935; Brandt et al. 1973).

Specific gravity was determined for most of the artifacts from the SFU Museum by obtaining weights of artifacts in and out of water and calculating the following formula:

$$\text{Specific Gravity} = \frac{1}{1 - \frac{\text{Weight in water}}{\text{Weight in air}}}$$

Specific gravity was not measured for the UBC artifacts. I found during my analysis that small objects could not be reliably measured because of problems in suspending them in water, and insufficient accuracy of the scale beyond 0.05 of a gram. As reviewed in chapter 2, the specific gravity of nephrite usually varies between 2.95 and 3.04 (Fraser 1972:43; Leaming 1978:7).

Colors were recorded for all the artifacts. I made an effort to record general colors for each specimen, but no chroma chips were used. Nephrites are usually green in color and fall in the yellow-green hues of the Munsell color chart (Leaming 1978:7). With many nephrite specimens, there were variations in the hues of green present and difficulty would have been encountered when trying to assign a Munsell code. As color is often an unreliable criterion for identification of minerals, its use was not stressed.

Table 5.5 presents the results of specific gravity, hardness, and color identifications. Artifacts for which specific gravity was not determined are not included. Using these criteria, 62.3 % of the sample is tentatively identified as nephrite. Another 15 % is also likely nephrite but the recorded attributes are not conclusive. Twenty-two percent of the sample is probably not nephrite -- based on low specific gravity in some instances and the occurrence of flake scars indicative of a conchoidal breakage pattern in others.

Several of the non-nephrite samples may have been serpentine or greenstone. The specimens with lower specific gravity fall into the serpentine range (2.5 to 2.8), but the hardness values are high for this mineral (see Foshag 1957). Two celts in particular, with specific gravities of 2.98, and hardnesses of 6-6.5, were either a green metamorphosed silicified siltstone or a volcanic greenstone. They did not have a nephritic texture and displayed a conchoidal fracture pattern.

Time Estimates for Manufacturing Celts

Using rates for sawing nephrite derived from experiments in Chapter 4, it is possible to make estimations of the time needed to manufacture different types of nephrite celts. In Table 5.6 there are estimations for the time needed to make celts using the methods discussed in Section 5.1.2. None of these estimations include the time for the additional grinding or polishing that undoubtedly was performed. Because of this, all the time calculations are probably under estimated, and more time would realistically be needed to complete the celts. Despite this, there is still a considerable amount of variation in the estimated time between the reduction methods.

Table 5.5. Nephrite Determination.

Artifact Type	Specific Gravity	Hardness	Material Color	Tentative Nephrite Identification
Celt	2.59	5-6	spinach green	No
Celt	2.6	6-6.5	medium green	No
Celt	2.64	n/a	greenish beige	No
Celt	2.85	n/a	black with brown striations	No
Celt	2.86	5-6	spinach green	No
Celt	2.86	4-5	mottled gray brown	No
Celt	2.87	5-6	medium green & white mottles	No
Manufact. Debris	2.9	6.5-7	spinach green	Possible
Celt	2.91	6	black/spinach green	Possible
Celt	2.91	n/a	dull reddish brown	Indeterminate
Celt	2.92	n/a	off-white (chicken bone white)	Possible
Celt	2.92	6-6.5	lawn green	Possible
Celt	2.92	5-6	black to dark spinach green	Possible
Celt	2.94	6-6.5	spinach green	Yes
Celt	2.94	6-6.5	emerald green	Yes
Celt/Chisel	2.94	6-6.5	emerald green	Yes
Celt	2.94	6-6.5	light green	Yes
Celt Blank	2.94	6	medium green	Yes
Celt	2.94	6-6.5	emerald green	Yes
Celt	2.95	6-6.5	emerald to medium green	Yes
Manufact. Debris	2.95	5-6	emerald green	Yes
Celt	2.95	6-6.5	emerald green	Yes
Celt	2.95	6-6.5	spinach green	Yes
Manufact. Debris	2.95	5-6	emerald to spinach green	Possible
Celt	2.95	6-6.5	medium green	Yes
Celt	2.96	6-6.5	emerald green	Yes
Celt	2.96	6-6.5	spinach green	Yes
Knife	2.96	n/a	emerald to spinach green	Possible
Celt	2.96	6-6.5	black and beige	Indeterminate
Celt	2.96	6-6.5	spinach green	Yes
Celt	2.97	6-6.5	emerald green	Yes
Knife	2.97	n/a	emerald green	Possible
Celt	2.97	5-6 *	emerald to light green	Yes
Celt	2.97	6-6.5	emerald green	Yes
Manufact. Debris	2.97	6-6.5	lawn green	Yes
Celt	2.98	6-6.5	emerald green	Yes
Celt	2.98	6-6.5	mottled emerald green	Yes
Celt	2.98	6-6.5	spinach green	Yes
Sawn Boulder	2.99	6	light green	Yes
Celt	2.99	6-6.5	emerald green	Yes
Celt Blank	2.99	6-6.5	spinach green	Yes
Manufact. Debris	2.99	6-6.5	mottled medium green	Yes
Celt	2.99	5-6	medium green	No
Sawn Boulder	2.99	6-6.5	emerald green	Yes
Manufact. Debris	3.00	6-6.5	emerald green	Yes
Celt	3.00	6-6.5	emerald to lawn green	Yes
Celt	3.00	n/a	spinach green	Yes
Sawn Boulder	3.00	6-6.5	spinach green	Yes
Celt	3.01	6-6.5	medium green	No (Fractures Conchoidally)
Celt Blank	3.02	6	spinach green	Yes
Celt	3.03	6-6.5	dark spinach green	Yes
Celt	3.05	6-6.5	dull dark green	No (Fractures Conchoidally)
		* On Cortex	YES Possible Indeterminate No	33 62.3% 8 15.1% 2 3.8% 10 18.8%

Using the fastest sawing method to manufacture a practically functional celt (Method 1), one must spend 34.4 hours just to produce the blank. A celt of this type without further modification would have irregular margins. On the other extreme, the manufacturing of a large well-formed celt blank using Method 2, would take between 130.0 and 145 0 hours. The time needed to cut such a blank may be reduced using Method 3, but a large amount of time would subsequently be needed to grind the snap scar from the faces of the celt.

For Methods 2, 3, and 4, the primary celt sawn from the boulder is the most costly in terms of time. When removing a secondary celt at least one side of the celt is already sawn.

Table 5.6. Time Estimates for Manufacturing Nephrite Celts.

	Hypothetical Celt Size	Amount of Sawing Distance	Rate mm per hour	Estimated time *
Method 1 without additional celt blank modification	Length 10 cm Width 5 cm Thickness 1.5 cm	1 cut 50 x 1 50 mm	1.455	34.4 hours
Method 2 without additional celt blank modification	Length 40 cm Width 5 cm Thickness 1.5 cm	3 cuts 65 x 2 30 x 1 160 mm	1.455 or 1.31	110.0 hours 122.1 hours
Method 2 with additional celt blank modification	Length 40 cm Width 5 cm Thickness 1.5 cm	5 cuts 65 x 2 30 x 1 1.5 x 2 190 mm	1.455 or 1.31	130.6 hours 145.0 hours
Method 3 without additional celt blank modification	Length 30 cm Width 5 cm Thickness 1.5 cm	4 cuts 22.5 x 4 90 mm	1.455	61.8 hours
Method 4 with additional celt blank modification	Length 20 cm Width 5 cm Thickness 1.5 cm	5 cuts 55 x 2 30 x 1 15 x 2 170 mm	1.455	116.8 hours

This eliminates approximately 34 hours of sawing time in the case of a celt 50 mm wide. Using either Method 3 or 4, if there has been sufficient pre-planning in the arrangement of the grooves, only one major saw cut is necessary to remove a secondary celt.

According to my estimates and experiments, about half the amount of time would be needed to manufacture the same celts out of serpentine. For example, making a long celt out of serpentine using Method 2, would take approximately 59.9 hours. This is as opposed to the 130 to 145 hours needed to make a nephrite celt. About 75.4 hours would be needed to create the same celt out of greenstone. This, however, is drastically over inflated because greenstone blanks can be effectively produced by flaking (e.g., Damkjar 1981).

It was not possible to determine which sawing method was used more frequently from the present sample. Due to the grinding and re-grinding that was carried out on the celts after their initial removal. Abrasion, unlike flaking, leaves little in the way of recognizable evidence. Mackie (1992) experienced similar problems when he attempted to create a typology of celts for the British Columbia Coast because the original form is usually ground away.

Celt Use Wear

Another attribute I investigated was any indications of use. No microscopic studies were undertaken, but some forms of use wear were visible to the naked eye. I did not attempt to determine what was responsible for the use wear patterns observed, although microscopic use wear analysis would be very informative on this aspect of nephrite use. However, the issues surrounding use wear analysis of nephrite artifacts in themselves are beyond the scope of this thesis and time could not be spent on this aspect of the technology. For this study, only macroscopic indications of use were recorded.

Of the 46 celts that retained bits, 83 % exhibited possible signs of use -- mainly in the form of striations and damage to working edges. The striations, that may be from use were oriented perpendicular to the cutting edge. The use wear was broken down by severity and is presented in Table 5.7. The relative frequency of specimens with heavy, medium, and light use wear levels were fairly similar. Interestingly, 17.0% of the celts displayed no macroscopic evidence of use.

Thirty-one of the complete celts were examined to determine whether certain sizes of nephrite artifacts were used more frequently. There appears to be slight differences in the utilization of various celt sizes (Table 5.8). Even though the largest celts have the second lowest ratio of utilized to non-utilized bits, the sample is too small to make strong conclusions.

Summary

From the examination of the sample, there are several conclusions that can be made concerning the manufacturing use of groundstone tools in the Interior:

1. The most laborious method of celt manufacture, the sawn blank approach, was predominantly used on the British Columbia plateau. Both the flaked blank and pebble modification approaches were used much less frequently. Furthermore, the materials reduced using the sawn blank technique tended to be harder types of stones. As seen in Table 5.9, over 65 % of the sample was equal to, or harder than a 6, on the Moh Hardness scale.

2. Concurring with the use of the sawn blank approach and the hardness data, the dominant type of material used was nephrite. Both hardness and specific gravity tests indicate that serpentine was not used in the sample group as a replacement for nephrite. Furthermore, most of the sawn blank celts (70%) can be tentatively identified as nephrite (Table 5.10). This is also the case for the 4 sawn boulders that were analyzed, which all had hardness and specific gravity readings within the nephrite range.

3. The different methods used to saw blanks vary substantially in the amount of time needed to produce a usable celt. The effort needed to make a strictly functional celt is considerably less than that needed to manufacture a well-formed celt. It appears that the majority of celts were significantly altered after being snapped from their original boulders because 72% had most of their manufacturing evidence ground away. Even celts that had remnants of manufacturing features (snap scars and grooves) usually had those marks at least partially smoothed. Unfortunately, this makes it difficult to determine the predominant method of boulder reduction.

There are indications that some shortcuts were taken to produce strictly utilitarian celts.

In a number of instances, celts were expediently manufactured on flakes of nephrite - not much effort was expended to create a regular form. In several instances the celt was little more than a bit ground on a semi-polished flake.

4. Most celts display some possible evidence of utilization and this is not restricted to any one size of celt. Even the largest celts in the sample have some evidence of use in the form of striations or edge battering. The origin of use wear was not determined.

Context and Distribution

The following section examines the context and distribution of nephrite artifacts on the British Columbia and Columbia Plateaus, as described in published and unpublished archaeological reports in and around the study area. My discussion will focus on: 1) theoretical issues behind exchange studies; 2) the nature of the sample and the types of data collected; 3) changes in nephrite technology throughout time; 4) the distribution of nephrite within the study areas and; 5) context of nephrite artifacts in the study area.

Table 5.7. Observable Use Wear Damage on Celt Bits.

Type of Wear	Number	Percent	
Heavy			
Heavy Striations on Bit	4	8.7	
Heavy Striations + Edge Damage	4	8.7	
Severe Edge Damage	4	8.7	
	Total Heavy Wear		25.5%
Medium			
Medium Striations on Bit	6	10.9	
Medium Striations + Edge Damage	6	13.0	
Dulled or Rounded Bit	1	2.2	
	Total Medium Wear		27.6 %
Light			
Minor Striations on Bit	4	8.7	
Minor Striations + Edge Damage	1	2.2	
Minor Edge Damage	9	19.6	
	Total Light Wear		29.8 %
None			
None Observable	8		17.0 %
Total	47		100 %

Table 5.8. Possible Use Wear on Complete Celts.

Length	H eavy Wear	Medium Wear	Light Wear	Total with Use Wear	No Use Wear
0-50 mm	1	-	-	1	2
51-100 mm	3	5	2	10	2
101-150 mm	1	3	3	7	1
151-200 mm	1	3	1	4	-
201-250 mm	-	2	-	2	-
251-	1	1	-	2	1
Totals	7	12	6	26	6

Background to Exchange Studies

From her study of historical accounts of the stone axe trade in New Guinea, Phillips (1975:109) concluded that the most useful way to analyze axe exchange was to examine the contexts of production, acquisition, and consumption. Figure 5.8 demonstrates possible factors for celt exchange on the British Columbia Plateau. Unfortunately, many of these cannot be seen in the archaeological record. Within the context of production, we can only interpret the results of manufacturing. We can recover evidence on burial practices, resource processing, woodworking, accidental loss and possibly potlatch behavior pertaining to context of production. It is not possible, however, to directly examine the consumption of celts in ceremonial exchange, puberty ceremonies, and warfare. Virtually no archaeological evidence is available to determine any of the contexts of acquisition.

An artifact, from the time it was originally manufactured until the time in which it was finally deposited, can go through an almost infinite number of exchanges -- all of which are invisible to the modern investigator (Elliott et al. 1978). This is especially the case with artifacts that have long use-lives, that can undergo a series of transformations through their lives that obscures their original form (see Mackie 1992 for coastal celts). The way in which an artifact moves across the landscape from its manufacturing point to its final deposition is known as the 'random walk' (Sherratt 1976:558; Elliott et al. 1978:81). Artifacts, of course, do not move themselves and dispersion of material over an area is not a random process. An artifact's final location of deposition does reflect the system in which it was exchanged (Sherratt 1976:558).

Table 5.9. Hardness of Tested Specimens

Moh Hardness	Number of Instances	PerCent
4 - 5	1	3.4%
5 - 6	7	17.9%
6	2	6.9%
6 - 6.5	19	65.5%

A dynamic trade network was present on the British Columbia and Columbia Plateaux at the time of contact (Hayden et al. 1985; Galm 1994). Although housepit villages were largely self-sufficient, there is ethnographic evidence that trade was necessary at times to provide food supplies in years of shortage (Hayden and Spafford 1993; Cannon 1992). This necessity was also present in the past as natural salmon run fluctuations could have resulted in poor harvests (Kew 1992). In conjunction with needs extending to other localized products (e.g., stone resources), the trade in salmon likely created an inter-village exchange system that operated to reduce the vulnerability of local groups to short term disaster (Cannon 1992). Along with material trade relations, village interactions probably also included the exchange of people -- mainly as marital partners (Teit 1900:322-5, 1906:590-1, 1909:269), but also as slaves (Teit 1906:221).

Table 5.10. Tentative Nephrite Identification for Sawn Blanks.

Tentatively Nephrite	Number	Percentage
No	6	18.2 %
Possible	4	12.1 %
Yes	23	69.7 %
Total	33	100 %

In describing exchange networks in the European Neolithic, Sherratt (1976:558) suggests that, for the manufacture of every type of product there, is a distribution channel comprised of a source, production zone, direct contact zone and an indirect supply zone. The source is where the raw material for the product is found. The production zone is the area where local settlements around the source are involved in the exploitation of the material. The area surrounding the production zone, where face to face contact occurs between supplier and consumer, is the direct contact zone. In this case, "effective supply" of the product is the "result of close kinship links" (Sherratt 1976:558). The indirect contact zone are where settlements do not have direct access to production zones.

Typically, most villages in such a system can produce a similar range of subsistence products. Unless catastrophe or famine befalls a local group, there is no major impetus to maintain a production of goods strictly for trade. However, communities in the indirect supply zone, which require an essential product from a distant production zone, could experience shortages because of supply problems (Sherratt 1976:559). Rarely in stateless economies are there direct supply and demand situations. Rappaport (1968:106) found in the New Guinea highlands that the production of commodities is more a factor of needs in the direct contact zone than those of the indirect contact area. If there is no necessity for a product in the direct contact zone, it may not be manufactured for indirect contact groups. To avoid economic

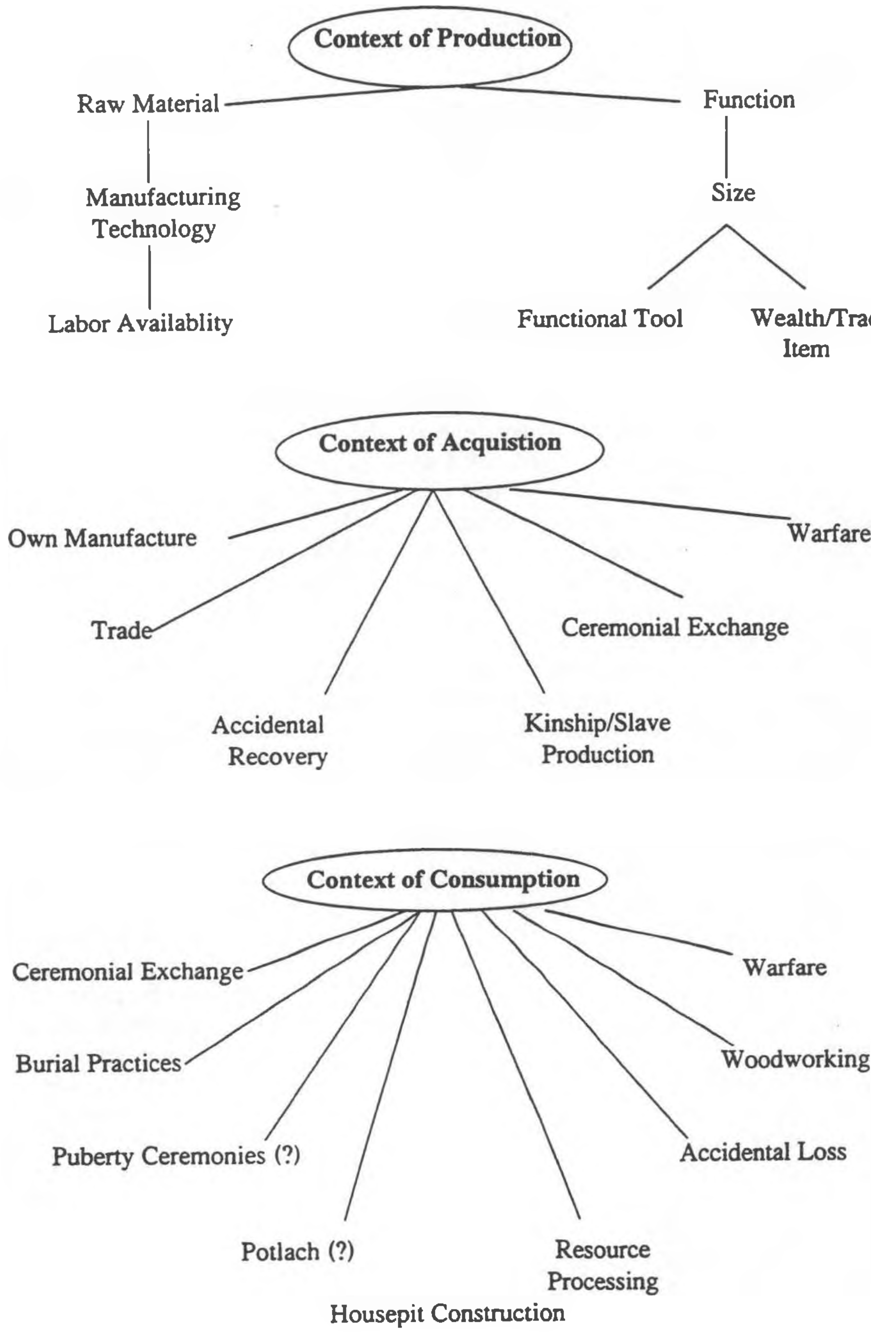


Figure 5.8. Contexts of Celt Production, Acquisition, and Consumption for the British Columbia Plateau (after Phillips 1975).

stagnation, Sherratt (1976:559) hypothesizes that usually an exchange network of non-utilitarian objects will develop that act as a "fly-wheel" to keep the system operating. These non-utilitarian objects are produced in times of surplus and traded to ensure continuity in the exchange system, and have been referred to as 'primitive valuables' (Dalton 1975; 1977).

The concept of primitive valuables refers to the use of certain objects by lineage or clan leaders, or "big men", to underwrite social and political transactions. Those include "death compensation, payments to allies, bridewealth, and, occasionally, for 'emergency conversion'" (Dalton 1977:198). They are not 'primitive money' and do not operate in the same way that currency acts in western society. Rather than a mechanism of material gain, primitive valuables are spent and valued in terms of social and/or political action (Dalton 1977:198). Although they are not equivalent to cash, this does not mean that they are any less valuable. Dalton (1977:198) explains how the Trobrianders in New Guinea risked their lives by crossing open seas in canoes to acquire primitive valuables such as kula shells. Similar risks were taken by Northwest Coast groups to acquire dentalia shells (e.g., Barton 1994).

It is possible that a trade system like the one described above was present to some extent in British Columbia. Although this system may not have been as elaborate as those in those Neolithic Europe or New Guinea, Hayden et al. (1985) and Hayden and Schulting (1997) have speculated that primitive valuables were exchanged amongst Plateau groups in British Columbia. Artifacts they record as potentially being primitive valuables include:

> shell beads; copper artifacts; elaborately carved stone bowls, pestles, and bone ornaments and other bone tools (Stryd 1981); *nephrite adzes*; hard to obtain animal and bird parts (claws and wings); finely flaked obsidian objects; molybdenum and other metallic ochres; steatite pipes; stone spindle whorls; whalebone clubs; mauls; quartz crystals; turquoise (Grabert 1974); and numerous other perishable items. (Hayden et al. 1985:190, emphasis mine)

Nephrite celts, particularly large specimens, may be classified as primitive valuables for a number of reasons. First, they take a large amount of time to manufacture. This in itself does not make a nephrite celt a primitive valuable. However, one must take into account the time manufacturing such an implement draws away from subsistence activities. This is where the risk lies. Thus, it is possible that nephrite manufacturing occurred in times of surplus food supply rather than in situations of shortage. Second, ethnographic accounts (Teit cited in Emmons 1923) suggest that large celts were made specifically for wealth or trade purposes. Third, large nephrite celts can be cut into smaller utilitarian celts. An example of this was found during my celt analysis (see section 5.1), where a celt (UBC EeQw-50) displays a groove that suggests that it was cut from a larger blade.

Anthropologists can see many facets of an exchange system in a living cultural context. Archaeologists, on the other hand, can only glean some of the contexts of production and consumption (e.g., Phillips 1975). Many different methods have been used to examine exchange systems in the archaeological record and good reviews can be found in Hodder (1982) and Chappell (1987). The approach taken in this thesis to examine nephrite exchange on the Plateau may be labeled a contextual approach in Hodder's (1982) terminology. It is based partly on the work of Hodder and Lane (1982) who investigated stone axe exchange in Neolithic Britain.

In their investigations, Hodder and Lane (1982:217-219) compare the distribution of different sizes of stone axes to four hypothesized models of axe exchange:

Model 1. Larger axes should be found at greater distances from the production area than smaller axes because of their high non-utilitarian value as prestige items. Based on Sherratt's (1976:567) observations of large axes in northern Europe, this model predicts smaller axes being replaced at greater distances from their source by other material types because of their lesser value.

Model 2. This model draws on the earlier work of Elliott et al. (1978) and predicts that all axes will decrease in size from their source because of use, curation and breakage. As the celts pass through more hands, the more likely they are to decrease in size. Large axe blades in this situation, will be pulled out of circulation at the source and reserved for display purposes in the area of production.

Model 3. Hodder and Lane (1982) predict that there will be a lack of size changes in axes over the landscape. In this situation, bulk exchanges and middleman traders would have transported a multitude of axe sizes at one time. In this model some small scale contact may have occurred even for groups at a distance. However, "direct contact [with the source] would not result in the chain of axe reduction and retention becoming associated with a gradual decrease in size with distance. The chain of reduction would occur equally in all locations" (1982:218).

Model 4. Hodder and Lane (1982:218) anticipate that direct contact access to the source by all groups would be associated with a decrease in size of axes over distance from the source. The decrease in size is attributed to greater curation because of the increased value of the material the further away from its source.

Hodder and Lane (1982:218) also note that models 2 and 4 have the same expectation in size differences of axes over a landscape.

In undertaking their analysis, Hodder and Lane (1982) designed their investigations to work around the poorly known contexts of celts in Britain. Most of their axes were chance finds. In British Columbia, however, there is much more contextual information available for nephrite artifacts. This opens up an opportunity to expand interpretations of nephrite exchange beyond those that Hodder and Lane could undertake with their sample.

There are numerous ways an artifact can become deposited in the archaeological record. It can be accidentally lost, broken or exhausted and then discarded, placed in burials, placed in storage and then forgotten, or ritually deposited in some feature. The manner and location in which an artifact enters the archaeological record reflects some information about the people who deposited it. Barring accidental loss, all other forms of deposition have some form of *intention* behind them. Although not directly observable and often disturbed because of site formation processes (Schiffer 1976:12), the location of artifact deposition does reflect the intentions behind the act. For instance, the intention behind depositing a celt in a burial context is different from the intention behind discarding an exhausted celt in a midden. The division here is between ritual and non-ritual space. Levy (1982:ch. 3), in an ethnographic cross-cultural study of hoarding behavior, found that most groups draw divisions between ritual and ordinary space and the types of objects that are usually placed in them. As the reasons behind ritual acts are often connected with legitimization of power or wealth in society, the value of artifacts used in such affairs is usually greater than those used for non-ritual purposes (Hodder 1982:207; Levy 1982). For hoarding behavior, Levy (1982:22) found that special objects (such as ornaments, weapons, cosmologically significant items) were usually placed in ritual hoards. The content of non-ritual hordes tended to be more utilitarian tools, raw material and usable fragments of tools (Levy 1982:24).

Burial sites represent some of the more productive areas for information concerning social systems. Investigation of mortuary practices in the interior is beyond the scope of this thesis, and has been recently undertaken by Schulting (1995). What is important to this study is defining what the placement of objects in ritual contexts reflects about their value on the Plateau. Schulting (1995:28-9) chose to define his values for objects based on preconceived notions of the value of artifacts on the Plateau following guidelines proposed by McGuire (1992). While these notions of artifact value may have some legitimacy, this sort of weighting scheme is premature, because the contexts of most ranked items have not yet been thoroughly investigated in Plateau sites. For instance, how many chipped eccentrics are found in burial/ritual contexts in comparison to non-ritual contexts? What are the differences between the artifacts found in burials versus those in housepits?

When dealing with artifacts like nephrite celts, which have an incredible amount of manufacturing labor invested in them, differences in size, condition, and context can reflect differences in the values originally attached to them. For instance, placing a large nephrite celt into a burial context represents the consumption or expenditure of a large amount of effort in terms of manufacturing costs. This is also true for smaller celts that are still practically functional. On the opposite end of the spectrum, the deposition of exhausted, damaged, or fragmented celts into burial contexts does not represent the same expenditure because of the limited utility of such items. Inversely, if large nephrite celts are found more frequently in non-ritual space, it is probable that such items were not valued as greatly as in ritual contexts. The relationships between context and celt attributes are demonstrated in Figure 5.9.

Based on the theoretical considerations discussed above, the following parameters will be investigated to determine the nature of nephrite exchange and the range of economic and social roles nephrite celts may have played on the British Columbia Plateau:

1. The distribution of nephrite artifacts only related to manufacturing will be identified. In doing this, it should be possible to distinguish the production zone (Sherratt 1976). Artifacts such as sawn boulders should theoretically be found near sources.

2. The distribution of nephrite celts in relation to the source of the material will be determined in order to establish the density of nephrite artifacts away from the source. This should indicate where the majority of nephrite exchange occurred.

3. The size of nephrite celts in relation to the distance away from the production areas will be calculated. Following the four models reviewed by Hodder and Lane (1982), it should be possible to determine the nature of the types of nephrite celts being exchanged.

4. The types of sites in which nephrite is found will be identified, to ascertain the contexts of deposition for such artifacts. Following Levy (1984) and Hodder (1982), attention will be directed at calculating the number of artifacts found in ritual versus non-ritual areas. To fully investigate this, it will be necessary to include an examination of sites where nephrite has not been recovered. This analysis may also indicate where nephrite artifacts were primary used.

5. The types of nephrite artifacts found within different site contexts will also be analyzed. Again following Levy's (1984) division, often artifacts found in ritual contexts are different from those found in utilitarian areas. If differences in the types of nephrite artifacts can be observed for ritual versus non-ritual areas, it should be possible to make conclusions on the values attached to the different forms.

6. The changes in nephrite use through time will also be discussed. It is important to trace the chronological development of nephrite exchange patterns to differentiate any changes in function or value that may have occurred.

The Data Set

The sample was gathered from the British Columbia Heritage Sites (BCHS) files and library resources. The BCHS files were systematically searched for all excavations undertaken in the interior of British Columbia. As the BCHS files are constantly growing, reports were reviewed up to the latest available dates (ca. 1993 to 1994). In addition to the excavation information, some review of survey reports occurred in cases where sizable artifact collections were made. The only reports not generally examined were those for non-permit excavation, which were not available on microfiche. The material from the Columbia plateau came from published sources only.

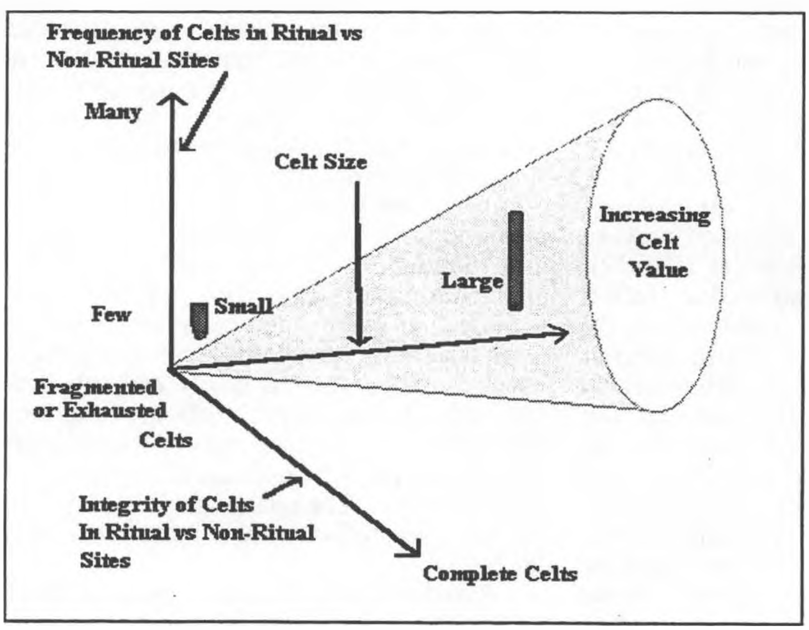


Figure 5.9. Parameters of Celt Value in Ritual versus Non-Ritual Sites.

Celt Manufacture, Context, and Distribution

My research focused on recording any artifact made out of nephrite and all celts (regardless of material) recovered in archaeological investigations on the Plateau. When I found such artifacts, I attempted to record the following information:

1. Site Designation
2. Artifact Type.
3. Material Type
4. Artifact Length
5. Artifact Width
6. Artifact Thickness
7. Celt Shape.
8. Celt Blank Type
9. Bit Shape
10. Side Shape
11. Artifact Condition
12. Manufacturing Evidence
13. Artifact Context
14. Site Type
15. Feature Type
16. Time Period
17. Associated C14 dates
18. Environmental Zone
19. Number of Meters2 Excavated
20. Investigation Level
21. Number of Associated Formed Tools

The data for these categories are found in Appendix 2 and 3.

I found during my investigations that it was not possible to collect data on some of the attributes. This was typically due to the quality of excavation and survey reports. In many instances, celts or other artifacts would be listed as being present but virtually no information concerning dimensions, material types, contexts, or time periods would be included. Unfortunately, this left gaps in an already small database. In situations where specific data were unavailable for an artifact, they were left out of any calculations.

The emphasis of this research was to record each artifact in terms of: 1) where it was found, 2) the type of site and feature in which it was recovered, 3) the time period with which it was associated, and 4) the amount of excavation associated with its recovery.

The site types used in the investigation are roughly based on Mohs (1980a,b). The following are definitions used to classify each site:

Housepit. any site where semi-subterranean house depressions are present. Examples of this type of site are the Keatley Creek and Bell Sites (Hayden and Spafford 1993; Stryd 1973) where multiple housepits are present.

Burial. any site where the primary features are associated with the deposition of human remains.

Campsite. any site where no permanent dwelling structures are present. Artifacts found at the site relate at least partially to domestic activities (e.g., hearths, fire broken rock, and faunal remains.

Lithic Scatter. any site where only lithic artifacts are found. No evidence for domestic activities is identified.

Resource. any site that is associated with the exploitation of resources. This may include fishing stations, plant processing camps (usually with roasting pits), quarry sites, hide processing sites, and storage sites (with cache pits).

In addition, some sites had to be listed as being 'unknown' because of a lack of reported information.

It is important to note that a site would only be designated as a burial site when most of the features of the site were associated with human interment. Examples of this are the Chase Burial Site (EeQw 1) and the Texas Creek Burial Site (EdRk 8) (Sanger 1968a,b). In situations where human remains were associated with other types of features (like housepits), the site would be designated by the major feature type rather than by the burial. Examples of this are the Bell Site (Stryd 1972) or EdRk 9 (Sanger 1970) where burials were associated with housepits.

Temporal data corresponded with the horizon designations made by Richards and Rousseau (1987) for the Plateau Pithouse tradition. Although not descriptive of cultural occupations on the Columbia Plateau, the same system was used for the area to standardize the data set. If an artifact could not be associated with any time period (as was often the case) it was listed as unknown.

An attempt was made to calculate the amount of excavation performed at each site. This was undertaken in order to quantify the rate per square meter at which nephrite artifacts occur at different types of sites. Ultimately, the volume of excavation would have been the most ideal form of data because some cultural occupations are deeper than others. It was found, however, that even determining the number of square meters excavated (let alone volume) from the reports was one of the most

Map #	Site	Reference
1	DgQo 1	Barlee 1969
2	DgQo 2	Freisinger 1979
3	DgQo 3	Freisinger 1979
4	DhPt 1	Bussey 1981
5	DhQv 34	Copp 1979
6	DhQv 48	Copp 1979
7	DhQx 10	Copp 1979
8	DiQm 4	Turnbull 1977
9	DkQm 3	Turnbull 1977
10	DkQm 5	Turnbull 1977, Mohs 1977
11	DlRi 6	Arcas Associates 1985
12	EbRc 6	Wyatt 1972
13	EbRi 7	Skinner and Copp 1988
14	EbRj 1	Rousseau et al. 1993
15	EbRj 92	Muir et al. 1992
16	EcQk 3	Turnbull 1977
17	EdQs 32	Arcas Associates 1985
18	EdQx 20	Blake 1976
19	EdRk 1	Sanger 1968b
20	EdRk 3	Sanger 1970
21	EdRk 4	Sanger 1970
22	EdRk 5	Sanger 1970
23	EdRk 7	Sanger 1970
24	EeQl 3	Mohs 1977
25	EeQw 1	Sanger 1968a
26	EeQw 3	Fladmark 1969
27	EeQw 5	Fladmark 1969
28	EeQw 6	Fladmark 1969
29	EeRb 10	Richards and Rousseau 1982, Wilson 1980
30	EcRg 4b	Stryd and Lawhead 1983
31	EeRh3	Whitlam 1980
32	EeRk 4	Stryd 1973
33	EeRl 19	Stryd and Hills 1972
34	EeRl 192	Wigen 1984
35	EeRl 22	Stryd 1970
36	EeRl 30	Stryd and Hills 1972
37	EeRl 7	Hayden and Spafford 1993
38	EeRn 11	Wales 1974
39	EfQs 1	Fladmark 1969
40	EfQu 3	Sendey 1971
41	EfQv 1	Fredlund and Tucker 1971
42	EfQv 2	Fladmark 1969
43	EhRn 17	Wilson 1983
44	Kamloops	Smith 1900
45	Lytton Burial	Smith 1899
46	Nicola Lake	Smith 1900
47	Nicola Valley	Smith 1900
48	CO 47	Caldwell 1954
49	CO 93	Caldwell 1954
50	GbSk 1	Borden in Sanger 1968a
51	45-DO-214	Miss et al. 1984a
52	45-OK-250	Miss et al. 1984b
53	45-OK-4	Miss et al. 1984b
54	45-OK-58	Grabert 1968
55	45-OK-78	Grabert 1968
56	UC43	Collier et al. 1942
57	Little Dalles	Collier et al. 1942
58	45-FR-42	Combes 1968
59	45-BN-15	Crabtree 1957
60	45-DO-176	Galm et al. 1985
61	45-KT-28	Nelson 1969
62	45-LI-6	Rice 1969
63	Crab Creek	Sprague 1967
64	DlQv 39	Rousseau 1984
65	Lytton	Emmons 1923
66	10 miles N of Lytton	Emmons 1923
67	Mouth of Thompson	Emmons 1923
68	6 miles S of Lytton	Emmons 1923
69	5 miles S of Lytton	Emmons 1923
70	7 miles N of Lytton	Emmons 1923
71	Captain John Creek	Spinden 1915
72	Kouse Creek	Spinden 1915
73	Dalles:Maybe II	Butler 1959
74	Indian Well	Butler 1959
75	Wahluke	Krieger 1928
76	45-GR-131	Crabtree 1957

Figure 5.10. Sites with Nephrite on the British Columbia and Columbia Plateaus.

Table 5.11. Site Types Reviewed from British Columbia Plateau.

Area	Burial	Campsite†	Housepit	Lithic Scatter	Resource *	Campsite/ Burial	Unknown	Total
British Columbia	29	68	101	23	26	3	8	258
Columbia Plateau	13	6	6					25
Total	42	74	107	23	26	3	8	283

* Includes Roasting Pits, Cache Pits, Fishing Stations, and Quarry Sites
† Includes 2 rock shelters in British Columbia

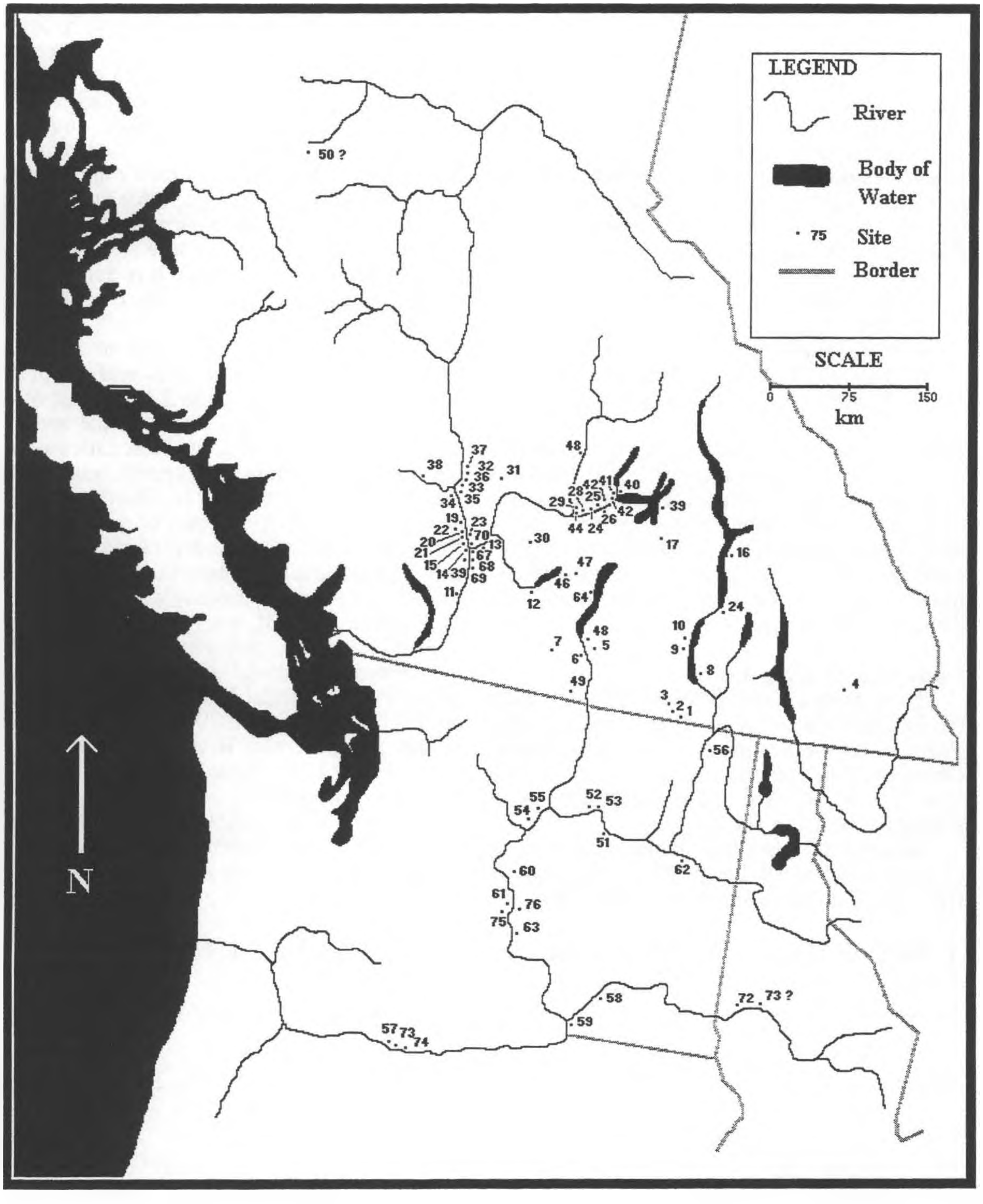


Figure 5.10. Sites with Nephrite on the British Columbia and Columbia Plateaus.

difficult tasks of the literature review. Even obtaining this data was troublesome because it often had to be derived from excavation areas illustrated on site maps. These data should, therefore, be considered an estimate rather than an absolute value.

Also included in the research was a review of all the sites where nephrite artifacts were not present. Working with excavated sites only, the type of information collected was similar to the nephrite bearing sites. This included:

1. Site Name
2. Site Type
3. Time Period
4. Number of Meters2 Excavated
5. Number of Formed Tools Recovered

This information was only collected for sites in the British Columbia interior. Sites without nephrite on the Columbia Plateau were not recorded. The decision not to collect this information was based on the lack of access to sufficient literature for the area and time considerations. The data for sites without nephrite is listed in Appendix 4.

Context and Distribution

Data were compiled from 283 sites from the British Columbia Plateau and the Columbia Plateau. Of these sites, 258 were from British Columbia and 25 were from the Columbia Plateau. The breakdown of the different types of sites reviewed is in Table 5.11.

Seventy-six sites had nephrite artifacts -- 57 from the British Columbia Plateau and 19 from the Columbia Plateau (Figure 5.10). A total of 171 nephrite artifacts were present at these sites. The majority were celts, followed by significantly fewer frequencies of other artifact types (Table 5.12). Thirteen of the sites only reported an 'unspecified' number of celts.

Only one recorded artifact could be thought of as ornamental. A 'jade pendant' was reported at a burial on the Columbia Plateau 45-FR-42 (Combes 1968), but there was no further material identification available. Because artifacts such as these are not present for areas around the source, it is doubtful that this item is jade or nephrite. The other artifacts were all utilitarian forms.

In addition to items made of nephrite, information was gathered on 24 artifacts of different material types (Table 5.13). Most of the material identifications made by the report's authors were on visual characteristics of the material type. Rarely were specific gravity and hardness tests performed to identify material types, along with other forms of mineral identification. This undoubtedly resulted in some mis-identification of material,but overall this probably does not seriously affect the results. It is quite evident, even with a 20% mis-identification rate, that nephrite would still be the dominant material used for celts. Anthophyllite is a material identification often used by Collier et al. (1942:70) for sites excavated in the mid-Columbia River region. They list the mouth of the Kettle river as a possible source or alternatively, the Fraser/Thompson River area. It is possible that this material is simply a form of nephrite. It is not identified in sites other than those investigated by Collier et al. (1942).

Table 5.12 -Reported Nephrite Artifacts Types for the British Columbia and Columbia Plateaus.

Artifact Type	BC	CP	Total
Celts	112	17	129
Chisels	3	-	3
Sawn Boulders	9	-	9
Celt Blank	1	-	1
Knives	7	-	7
Misc. Worked Fragments	15	4	19
Hammerstone	1	-	1
Unmodified Pebble	1	-	1
Pendant ?	-	1	1
Total	149	22	171

Changes in Nephrite Technology Though Time

As discussed in Chapter 3, nephrite artifacts have been present on the British Columbia Plateau from the Shuswap horizon ca. 3000 BP. Of the sample of nephrite artifacts, 124 (73%) had an assigned time period. The presentation of the number of artifacts and the size of celts associated with each horizon is in Table 5.14.

Considering the frequency of nephrite artifacts in the three horizons, there appears to have been an intensification in the use of the material over time. Looking strictly at the number of nephrite artifacts, the largest fraction is associated with the Kamloops horizon. This is followed by the Plateau and Shuswap horizons respectively. However, rate of occurrence based on the estimated amount of excavation carried out for each horizon indicates there is a slightly greater rate of nephrite artifacts associated with Plateau horizon deposits. This may be partially due to a large number of the Kamloops horizon artifacts coming from 'potted' burial contexts and excavations where the number of square meters excavated was not recorded.

Regardless of the number of artifacts associated with each horizon, the intensification of the nephrite industry can be seen in the dramatic increase in celt sizes over time. The average length of a nephrite celt in the Kamloops horizon is over twice the size of one from Plateau times (Table 5.13). Shuswap celts are also on average smaller than Plateau celts. Further evidence comes from the size range of the celts in each horizon. As is evident in Figure 5.11, celts in the Shuswap and Plateau horizon have a fairly limited size range in contrast to the Kamloops celts, which are very large in comparison.

Richards and Rousseau (1987:89) also note that an intensification in nephrite use occurred through time. They observe that small celts are present from the Shuswap horizon onward and that large celts develop in the Plateau horizon. They do not define what constitutes a small celt versus a large one, and it is not clear whether really 'large' celts were present before the Kamloops horizon. Richards and Rousseau (ibid.) likewise list celt blanks as a development in the Kamloops horizon and infer that a trade in unfinished celts then existed. During my review of the excavation reports, I found this artifact type was present in Kamloops horizon sites (e.g., EdRk 1, Sanger 1968b). They were not, however, very numerous.

Beyond the elaboration of celt forms, there was very little development of other types of nephrite artifacts on the British Columbia Plateau. During the Plateau horizon, ground nephrite knives appear at the Bell Site (Stryd 1973). Unfortunately, most of the knives come from unknown time periods and none were directly attributable to the Kamloops horizon. They, like celt blanks, never became very abundant. Because there is only a limited number of non-celt nephrite artifacts, very few conclusions can be made as to their function or value. There is also a lack of strictly ornamental objects made of nephrite.

The Distribution of Nephrite Artifacts

The overall distribution of nephrite artifacts on the British Columbia Plateau and the Columbia Plateau is presented in Figure 5.11 and includes sites that do not specify the number of nephrite artifacts. Major clusters occur in the Lillooet, Lytton, and Shuswap Lakes area. Smaller concentrations appear in the southern Okanagan Lake region, around the Arrow Lakes, the Grande Coulee/Chief Joseph Dam and Wanapum Dam areas, and the Dalles. These clusters, undoubtedly, are related to areas where more extensive archaeological investigations have been undertaken. In the following analyses, efforts will be made account for this bias to the sample. The interpretations offered are based on the current data available and future investigations may influence the results. The most distant artifacts occur in the Burns Lake area to the north (Borden in Sanger 1968a), the Kootenays to the East (Bussey 1978), and the Snake River in Idaho to the Southeast (Spinden 1915).

Celts have the broadest distribution pattern (Figure 5.12) and are found throughout the Interior. Knives and miscellaneous fragments were also recovered in various regions on the Plateaus (Figure 5.13). The only artifact class that had a very restricted distribution were sawn boulders. These items occur only in the Lytton and Lillooet region, corresponding with the sources of nephrite along the Fraser River. Because sawn boulders are usually the main debitage associated with nephrite manufacturing, these areas can be considered the production zone, using Sherratt's (1976) exchange system terminology.

There appears to be a general drop off in the frequency of nephrite items away from the source area (Figure 5.14). Most of the artifacts occur within 50 kilometers of the source. Using Lytton as a boundary for the eastern extent of nephrite sources, progressively fewer artifacts are found with increasing distance. One exception is the 100-150 km zone where there is a surge in frequency. The distribution of nephrite is affected by the location of mountain ranges and the courses of major rivers. Examining the distribution over time, some variation is present. During the Kamloops horizon, there are almost the same number of artifacts present in the 100-150 km zone as in the source area. In the Plateau horizon, most celts only occur in the 0-50 km area. Interestingly, only one Shuswap period celt was recovered in the Fraser River area, whereas, most were found a considerable distance away. The sample size for this time period, however, is so small it is difficult to make strong conclusions based on the limited data.

In Figure 5.15, the province of British Columbia is divided into sections based on 0.5 degree of latitude and 1 degree of longitude and the frequency of artifacts is plotted within this grid. Examination of the distance data in this format indicates a similar variation in the distribution of nephrite items is observable. The main concentrations occur in the Lillooet and Lytton Areas (squares F12 and F13) and by the Shuswap Lakes. Beyond these regions, the artifact numbers are more sporadic. The same trends are reflected when adding in the location data for the artifacts examined in section 5.1 of this chapter (artifacts that overlap between the two samples were removed). These artifacts appear most frequently in the Lillooet, Lytton and Western Shuswap Lakes areas. The range in which nephrite artifacts occur also stretches slightly northward.

The frequency of artifacts in any location is largely a product of the amount of investigation performed in the region. For instance, areas that have had more develop-ment usually have had more archaeological examination in order to meet cultural re-source management guidelines. In such regions, the number of artifacts present can be over-represented compared to areas with less development. To overcome this bias, one has to calculate the rate at which artifacts occur rather than an overall frequency. Only controlled excavations are amenable to

Table 5.13. Artifact Material Types.

Material	Celts ‡	Knives	Misc. Frag	Sawn Boulders	Hammer-stone	Pendant	Unmodified Pebble	Totals
Nephrite	90	4	19	3	-	-	1	117 61.2%
Nephrite/ * Serpentine	27	-	-	2	-	-	-	29 15.2%
Jade *	11	3	-	4	1	1	-	20 10.5%
Anthophyllite	6	3	-	-	-	-	-	9 4.7 %
Greenstone	5	-	-	-	-	-	-	5 2.6 %
Quartzite	3	-	-	-	-	-	-	3 1.6 %
Indurated Siltstone	1	-	1	-	-	-	-	2 1.1 %
Slate †	1	-	-	-	-	-	-	1 0.5%
Basalt	-	-	1	-	-	-	-	1 0.5 %
Unknown	4	-	-	-	-	-	-	4 2.1%
Total	147	10	21	9	1	1	1	191

‡ Includes Celts, celt blanks, and chisels

* For the purposes of this thesis, both jade and nephrite/serpentine classifications are all considered to be nephrite

† Slate knives are also occasionally found on the British Columbia Plateau. Because of the focus on celt technology, information on these artifacts was not collected.

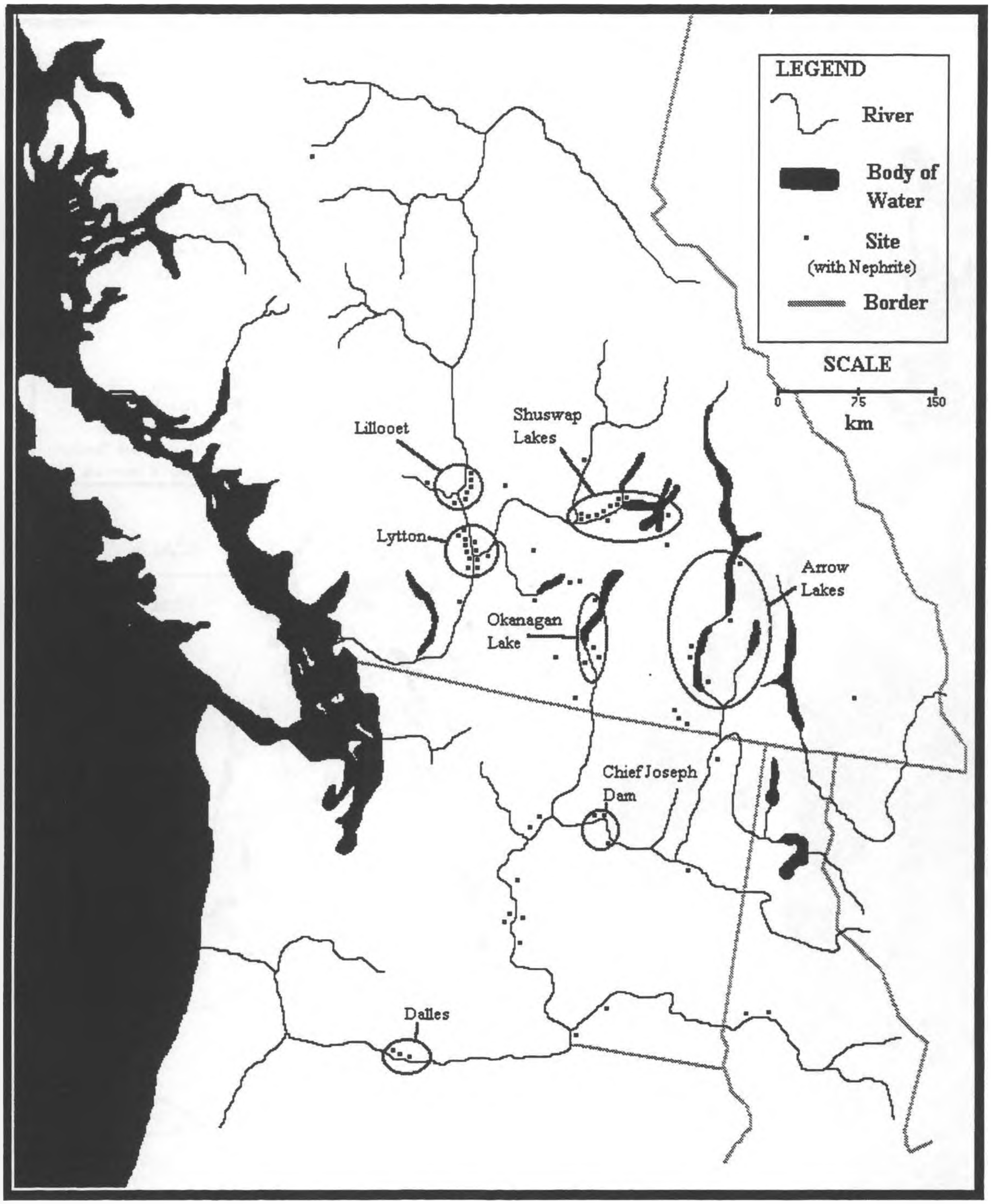


Figure 5.11. Nephrite Artifact Distribution.

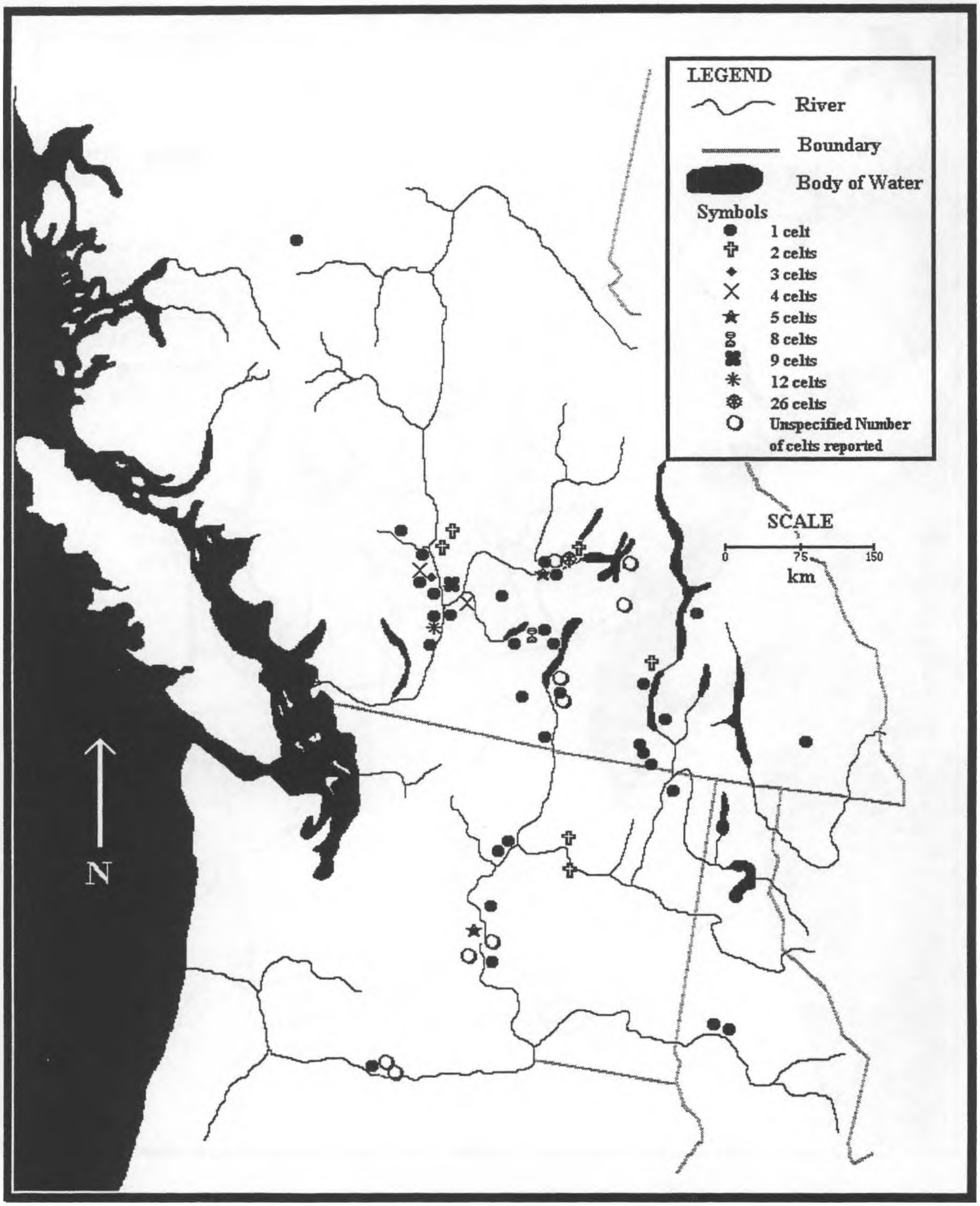


Figure 5.12. Celt Distribution on the British Columbia and Columbia Plateaux.

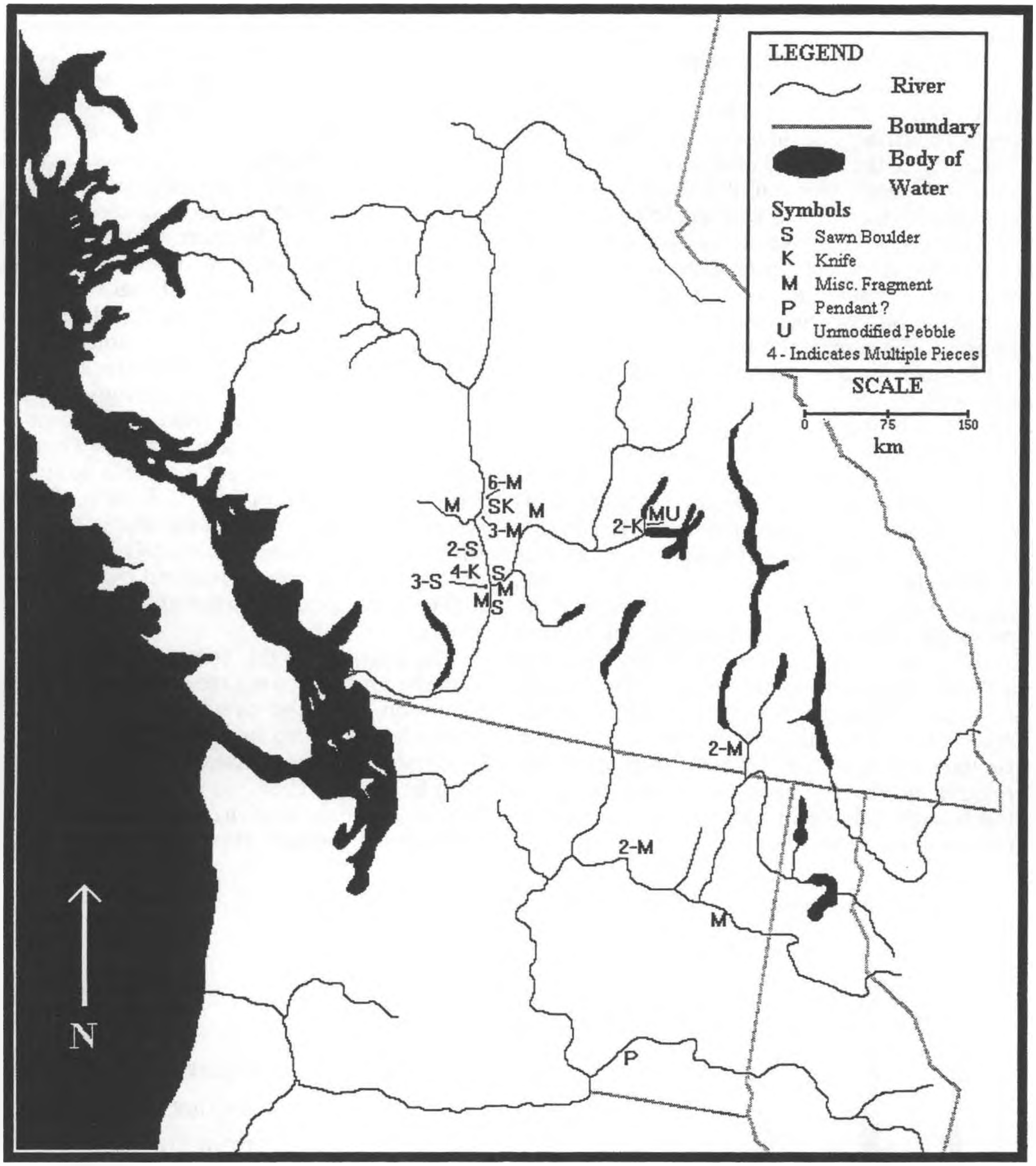


Figure 5.13. Distribition of Non-celt Nephrite Artifacts.

this type of archaeological research. Traditional surface survey, unless some controlled testing is involved, cannot account for spatial dimensions.

Because the number of square meters excavated at every site was recorded when possible, it is feasible to look at the "rate" at which nephrite artifacts occur in certain regions. In Figure 5.16, the number of square meters excavated per geographical unit and the number of nephrite artifacts found within controlled excavations are listed. No items recovered from non-excavation contexts (e.g. survey finds) and from sites where the amount of excavation could not be obtained were included in these figures. The number of square meters excavated for each area was determined for sites with and without the presence of nephrite. Results from this procedure seem to confirm the pattern seen with the uncontrolled frequency data with one exception, recovery rates in areas west of the Arrow Lakes region (I 10 and I 11) are greater than those for most of the Fraser Canyon. This may reflect some fortuitous discovery. In sector I 10, one site in particular, DgQo 1, has three pieces of nephrite that are probably attributable to one broken celt (Barlee 1968). However, even when taking this into account (the rate lowers to 0.026), there is still a greater frequency of nephrite artifacts in the area based on the amount of excavation. Beyond this anomaly, the same increase in the relative numbers of nephrite artifacts occurs in the western Shuswap Lakes area as with the raw frequency data.

Interestingly, very few nephrite artifacts appear north of the Lillooet region despite considerable investigation in some areas (Figure 5.17). This suggests that nephrite utilization in these areas was probably very low. It also appears that there was very little use of alternate materials for celt technology in the northern Interior and the Columbia Plateau. When looking at the distribution of artifacts associated with non-nephrite celt production, there are just as many of these artifacts recovered in the Lillooet (F13) and Western Shuswap Lakes (H13) area distributed in others. The celts found in the northwest are all made of greenstone. Again, on the Columbia Plateau, the main non-nephrite material is anthophyllite (Collier et al. 1942). The overall lack of alternative stone types in celt technology suggests alternate methods were used to accomplish woodworking tasks in these areas. This may indicate that nephrite celts were a luxury of sorts, particularly on the Columbia Plateau where they occur in small numbers. One celt, for example, recovered at 45-DO-176 (Site 60 on Figure 5.10) was considered by its excavators to be not practically functional (Galm et al. 1985).

In examining the spatial distribution of nephrite artifacts over time, there is only slight deviation from the overall pattern. Clearly from the Shuswap horizon onwards (Figure 5.18) nephrite trade occurred widely. Richardsand Rousseau (1987:30) indicate this as being the only real evidence for inter-plateau exchange at the time. However, the small num-

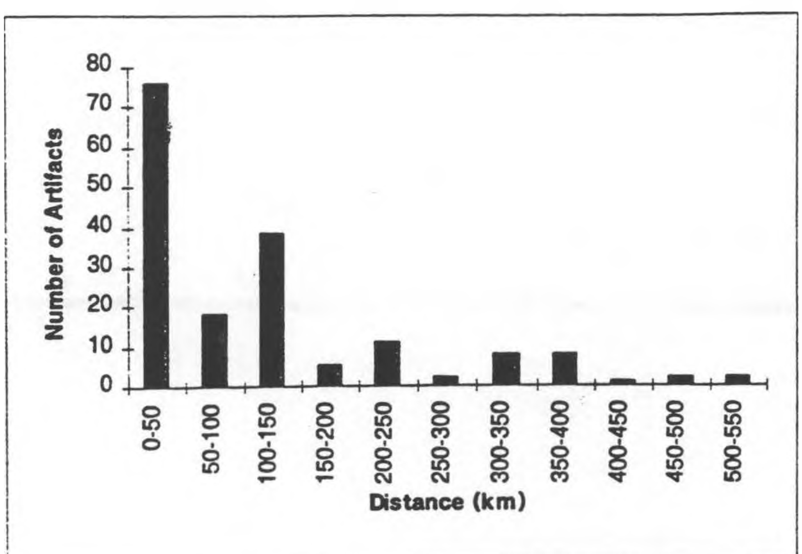


Figure 5.14. Nephrite Artifact Frequency from Source.

bers of celts attributable to this period are insufficient to make more specific conclusions. During the Plateau horizon (Figure 5.19), the results suggest that there was an elaboration of nephrite exchange as artifact numbers increase. Most of the nephrite artifacts associated with this period appear in the Lillooet area (F13). While this may be partially due to the large amount of investigation in this area, other sec - tors (except for I 10), have lower rates of nephrite recovery. This possibly corresponds with the proposed development of complex societies during this horizon (Stryd 1973; Hayden et al. 1985). From the location and abundance of nephrite artifacts related to the Kamloops horizon (Figure 5.20), nephrite exchange was probably at its zenith.

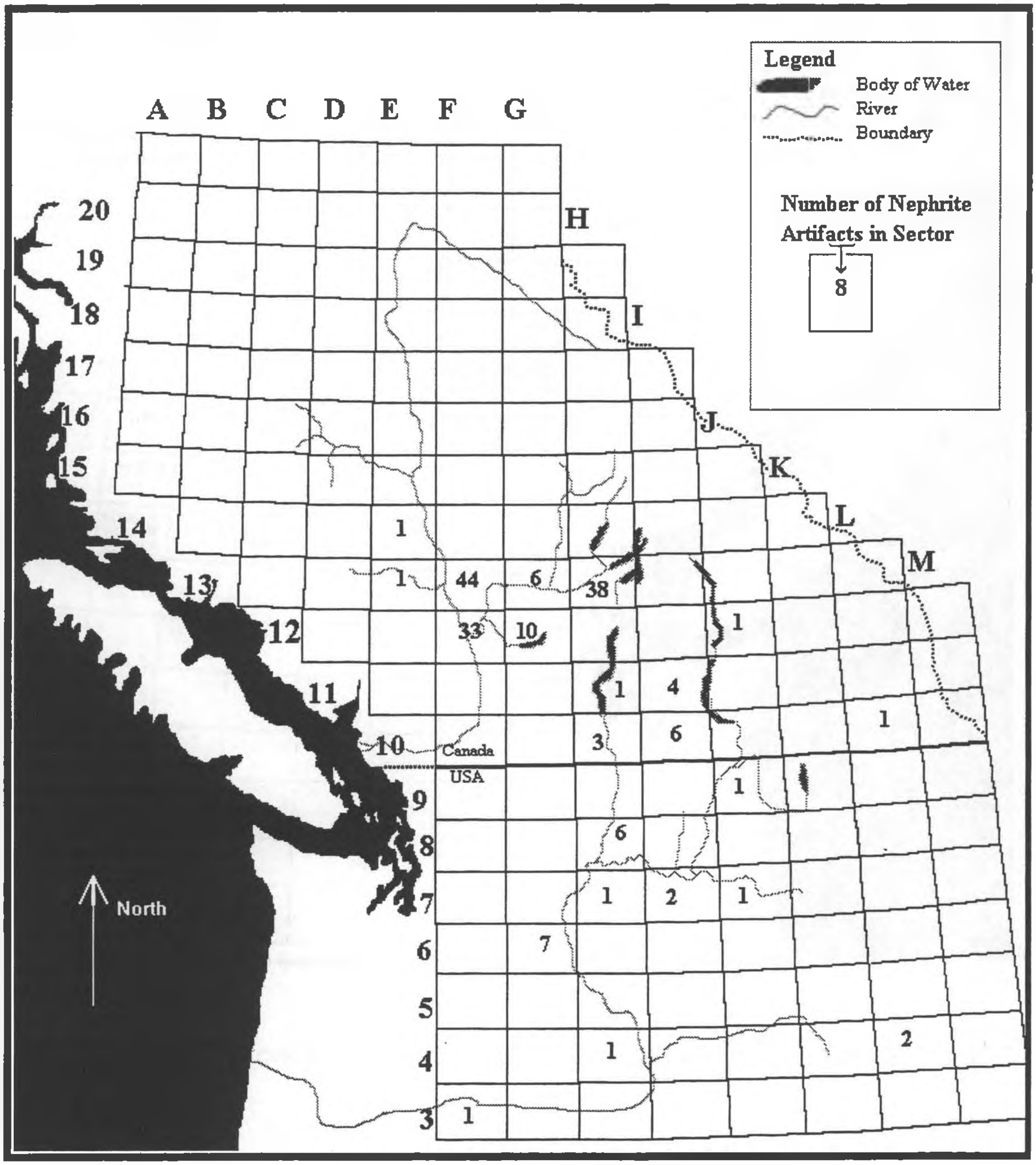


Figure 5.15. Nephrite Artifact Distribution by Grid Zone (literature review only).

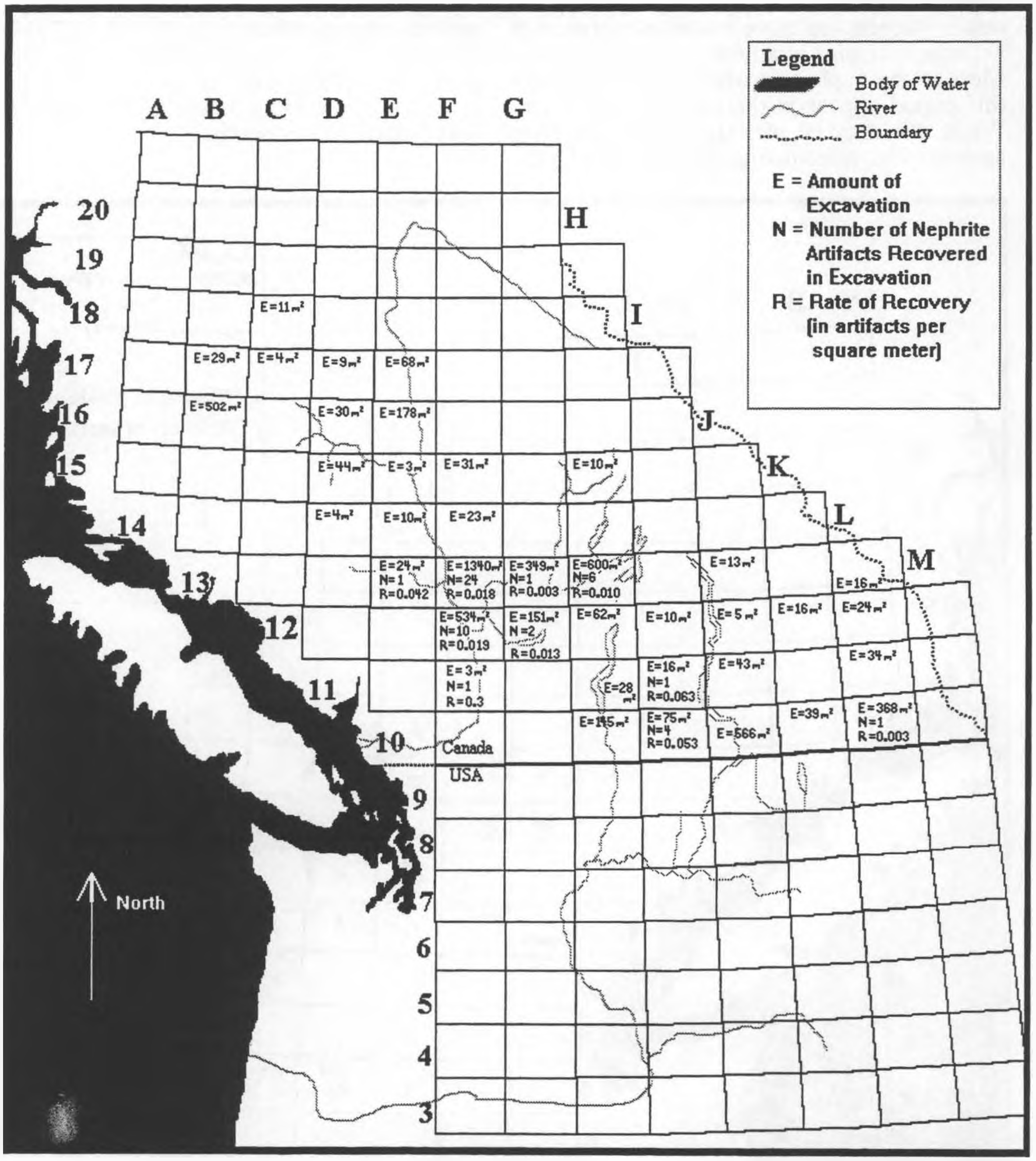


Figure 5.16. Nephrite Artifact Rates (artifacts/m^2) for Grid Zones.

Celt Sizes Over Distance from the Source.

Celt sizes do not decrease in a single linear fashion with increasing distance from the source on the British Columbia and Columbia Plateaus. Quite unexpectantly, average celt sizes increase with distance for the first 150 kilometers (Figure 5.21). For both the 50-100 and 100-150 km zones, the average length of a celt is over 180 millimeters. At a distance of 200-250 km from the source, the average celt size drops below that for the source area. Unfortunately no data were available for 150-200 km zone. Interestingly, there is no substantial decrease in celt size after this distance. Although there is a slight drop in size between 250-300 km, lengths increase again in the 300-350 and 350-400 km zones. After this distance no data is available until 500-550 km from the source where, suprisingly, two celts were recovered on the Snake River each measuring approximately 225 millimeters in length (Spinden 1915) (these celts are averaged with one celt from the Dalles region).

When examining the same data using the grid system, the same pattern exists (Figure 5.22). The largest average celt lengths in British Columbia occur in the Nicola Valley (G12) and the Western Shuswap Lakes regions (H13) and not along the Fraser River. In the Northern Arrow Lakes region (J12) only one celt was recovered during survey that measured 187 millimeters (Turnbull 1977), which may inflate the average size for that sector. Again, the averages for areas in proximity to the source are lower. On the Columbia Plateau, celt dimensions tend to be slightly greater than those recovered in the Okanagan.

To gain more insight into the nature of celt dimensions over the Plateaux, I examined the distribution of different celt lengths (Figure 5.23). For each sector, percentages were calculated for celt length increments of 50 millimeters. Some grid areas were combined because of small sample size. The distribution of sizes in the Lillooet (F13& E14) and Lytton areas (F12&F15) reveals that the percentage of small sized celts was greater in these regions than in the Nicola Valley (G12) and Western Shuswap (H13). Most of the celts in the Nicola valley are larger, whereas they vary in size in the Shuswap area. In both areas, large celts are far more frequent than along the Fraser River. In the Okanagan and Arrow Lakes area (J12&I11&I10), there is an increase in the percentage of small celts. No celts were over 200 millimeters in size in these regions. Similarly, in the mid Columbia River, area no celts over 200 millimeters were recovered. Half of the sample from this region was under 100 millimeters in length but no celts under 50 millimeters were recorded. Areas not included in Figure 5.23 include the Dalles (F3), the Snake River (L4) and the upper Columbia River in Washington (J9), because of small sample size.

Unfortunately, examination of these patterns over time is problematic due to minimal data prior to the Kamloops horizon. Average celt lengths from the Kamloops horizon reflect the same pattern of increase as noted for the entire assemblage (Figure 5.24). The average size of celts in the Nicola Valley (G12) and the Lillooet areas (F13) substantially increases in size from the Plateau horizon, whereas the average size is reduced in the Lytton area. The celts in the Western Shuswap Lakes area remain relatively the same, as do the averages on the Columbia Plateau. Data available for the lengths of Plateau and Shuswap phase celts are not substantial enough to make any conclusions about the spatial range of celt sizes during these time periods (Figure 5.25). Only three grid zones for Plateau celts (F13, H8 and I7) and only four for Shuswap celts (H8, H11, I 10, and I 11) have information available on artifact dimensions.

Summary of Distribution and Size

Comparison data obtained from the British Columbia and Columbia Plateaus to the four models presented by Hodder and Lane (1982), indicate a close match to the first model (postulated by Sherratt 1976). It appears that larger celts were traded to distant communities more often by producers (in the Lillooet and Lytton areas) because of their value as sociotechnic items (Binford 1962). This is demonstrated by the high percentage of large celts compared to smaller celts in the Nicola Valley and Western Shuswap Lakes region. Smaller celts appear to have been retained more often in the Lillooet and Lytton areas for local woodworking requirements.

In the Okanagan and Arrow Lakes regions, a high frequency of smaller celts were also recovered, and a similar ratio is present for the rest of the Columbia Plateau. It is unclear if there is a decrease in the number of nephrite artifacts over space because frequency data and the rate calculations indicate different levels of use of the material in the Okanagan and Arrow Lakes area.

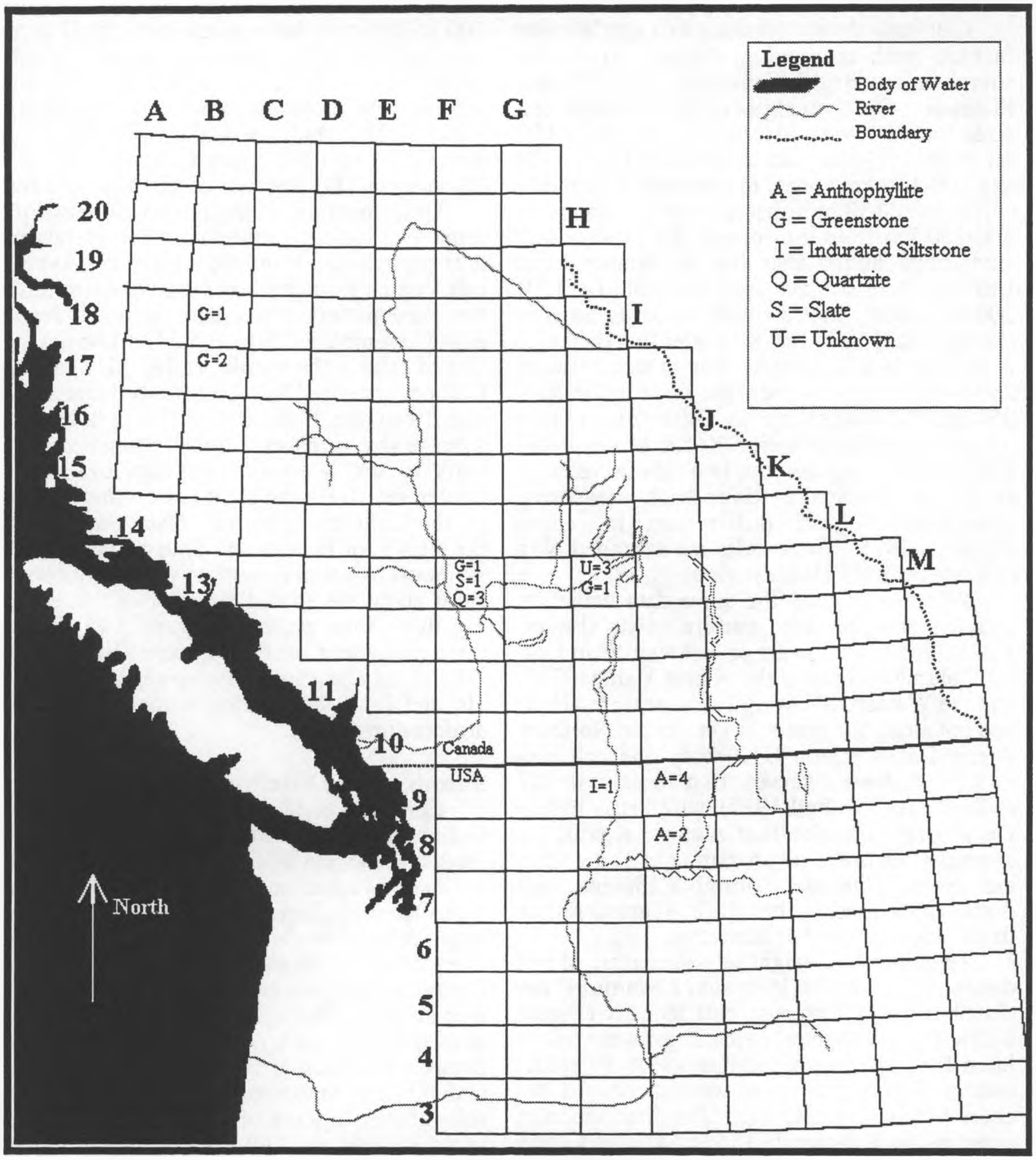


Figure 5.17. Distribution of Non-Nephrite Celts.

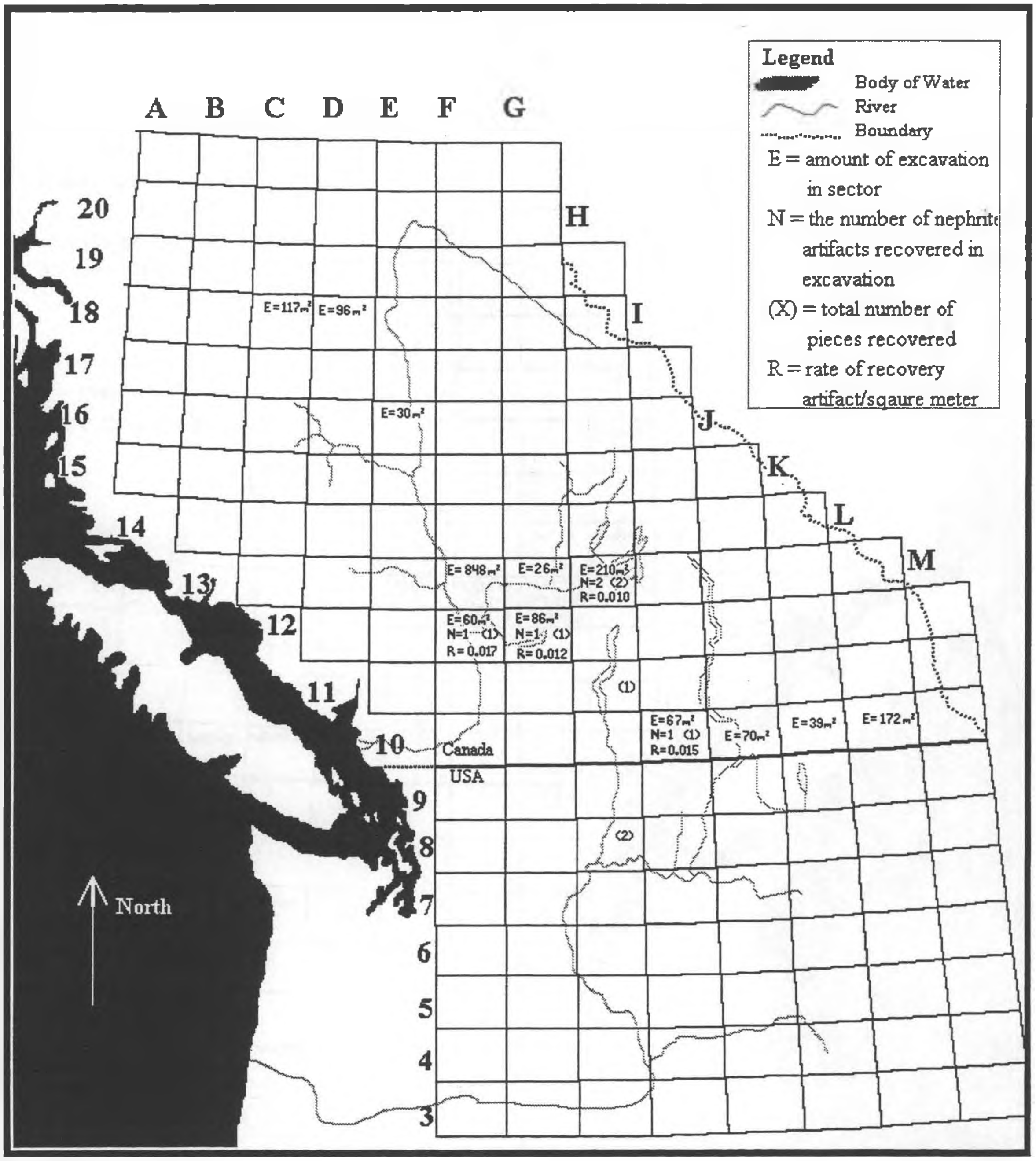


Figure 5.18. Distribution and Rates of Nephrite Artifacts in the Shuswap Horizon.

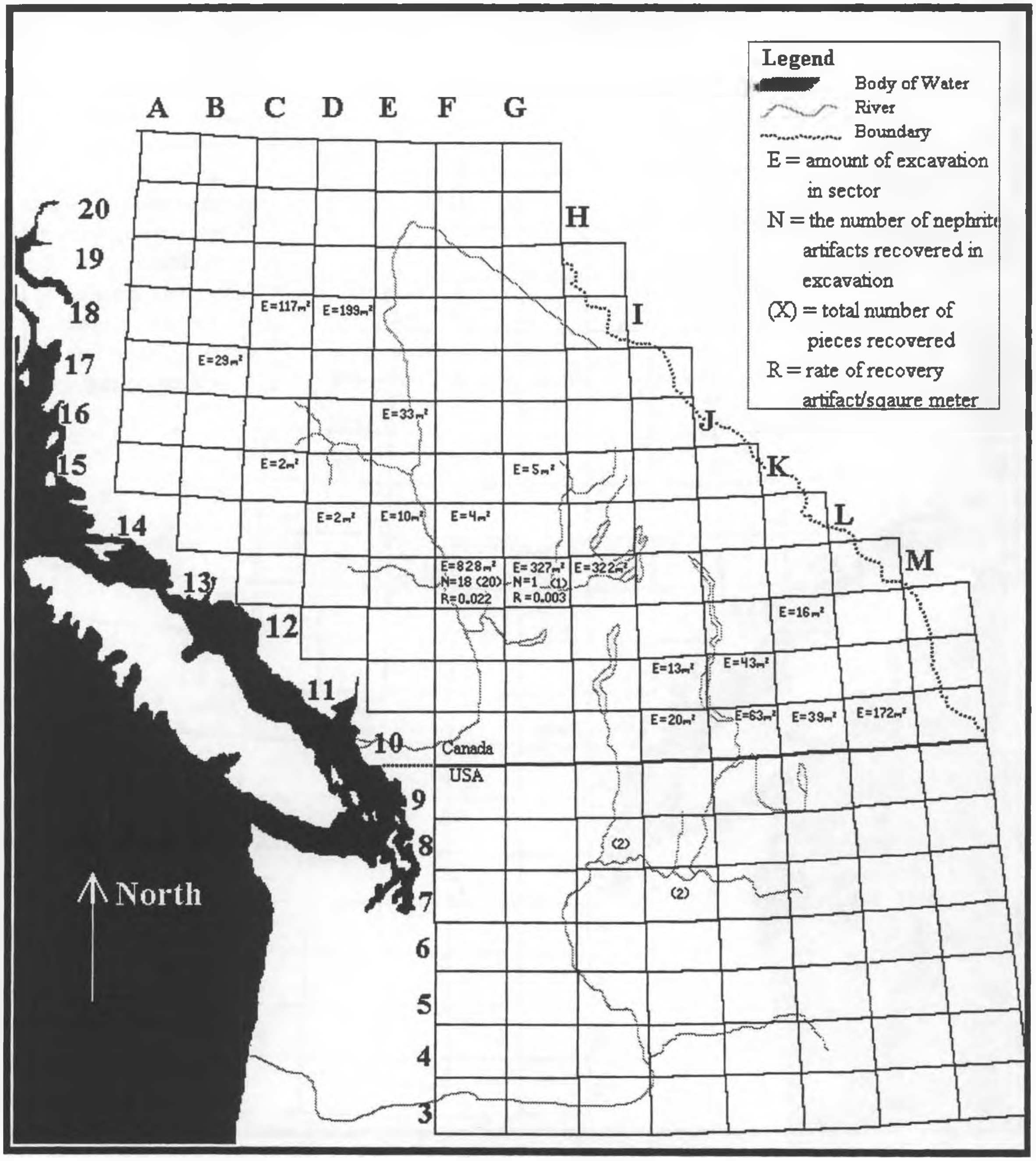


Figure 5.19. Distribution and Rates of Nephrite Artifacts in the Plateau Horizon.

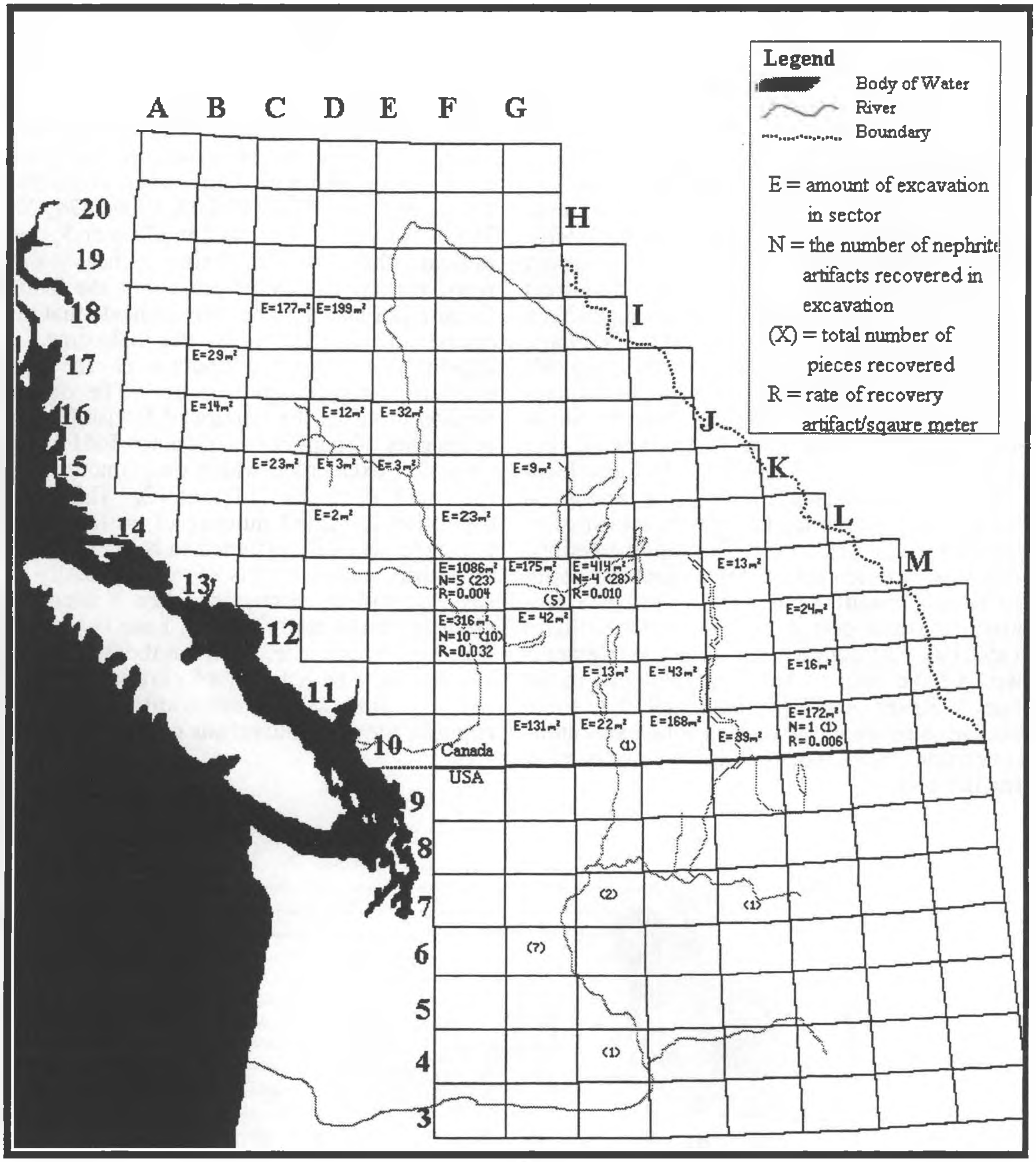


Figure 5.20. Distribution and Rates of Nephrite Artifacts in the Kamloops Horizon.

Change in the size distribution for nephrite celts in the Okanagan Valley, Arrow Lakes and Columbia Plateau regions possibly indicates the structure of a nephrite exchange system. Indicated by sawn boulder distributions, the production zone associated with nephrite manufacture is in the Lillooet and Lytton areas (Figure 5.26). Moving away from the production zone, the Nicola Valley and Western Shuswap Lakes areas comprise the direct contact zone (terminology following Sherratt 1976: 558). The Okanagan Valley, Arrow Lakes and Columbia Plateau areas are all in the indirect contact area. These zones are defined partly on geographical location but also on the dramatic differences in nephrite artifact density and celt size seen within them. These variations suggest that the Nicola Valley and Western Shuswap Lakes regions were secondary staging areas for the trade of nephrite. In these locations, it is possible that groups acting as 'middlemen' sectioned larger celts into smaller pieces for southern trade. A similar relationship was recorded for the Yir Yoront in Australia where 'middlemen' were a part of a prehistoric stone celt exchange system (Sharp 1952:19). Although some larger implements would have been traded (e.g., two celts in the Snake River Area [Spinden 1915]), most exchange between the direct contact and indirect contact zones would probably have been in smaller celts.

The only aspect of Sherratt's (1976) model that was not detected on the Plateaus was the replacement of nephrite by other stone materials for smaller celts in areas away from the source. As discussed previously, there was relatively little use of alternate materials for celts other than nephrite, suggesting that woodworking tasks were not primarily performed using celt technology. Ethnographic data from Teit (1900:183, 1906:203-204, 1909a:474, 709, 715, 1917:29), as reviewed in Chapter 3, does indicate that alternate forms of heavy duty woodworking tools were present on the British Columbia Plateau. This may indicate that any access to nephrite tools was a luxury. It appears that nephrite artifacts were rare items even in the production zone. The overall recovery rate for the Interior of British Columbia is only 50 nephrite artifacts for 5661 square meters of excavation which only amounts to a rate of 1 item per 111 meter2. This is an exceptionally small number of artifacts for a tool type generally assumed to be possessed by all family groups. This seems especially the case, as will be discussed, when it is considered that most nephrite celts have been recovered in burial contexts. Even though this low number may be a factor of curation, the evidence seems to suggest limited access to nephrite for most individuals on the Plateau.

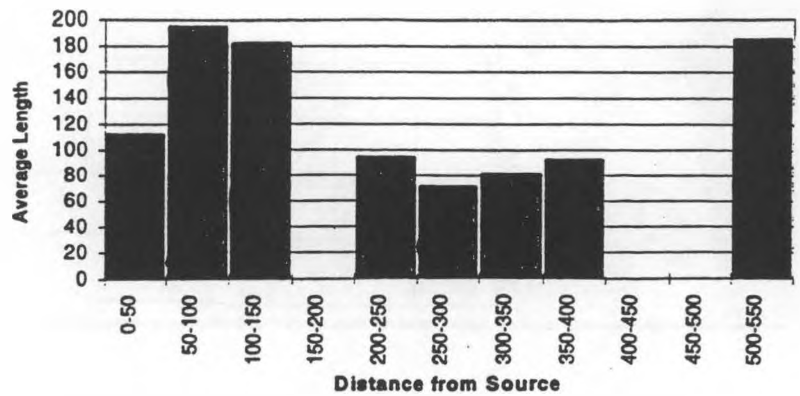


Figure 5.21. Average Celt Length (mm) versus Distance (km) from Source.

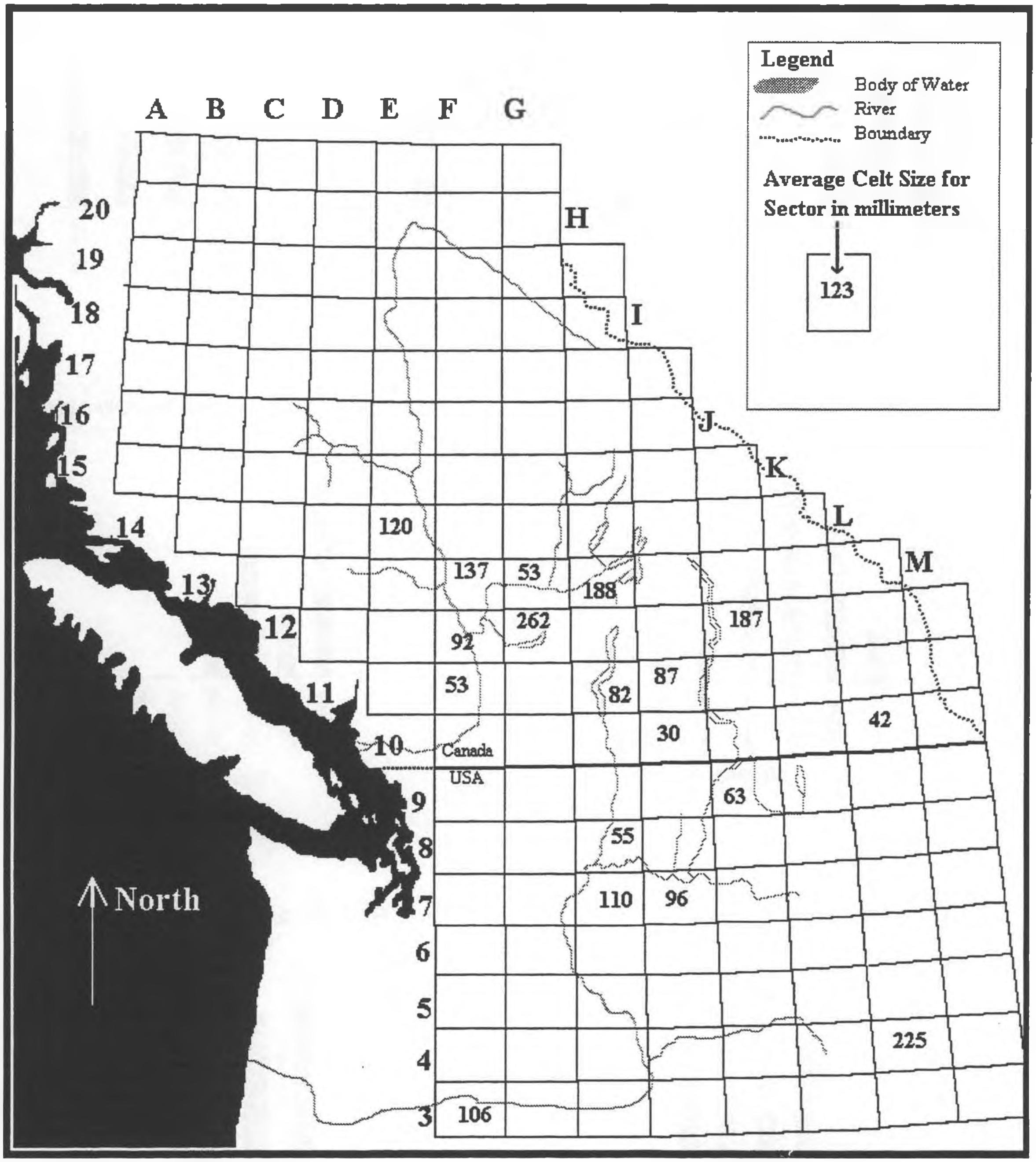
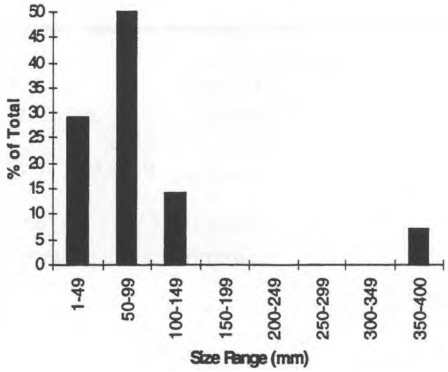
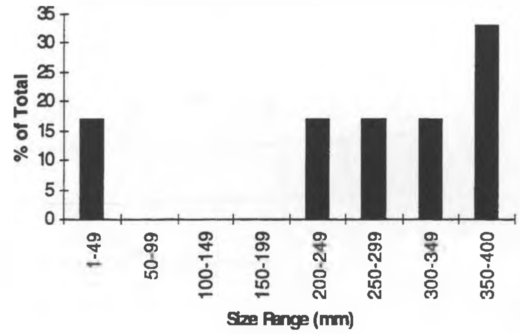


Figure 5.22. Average Celt Size in Grid Zones.

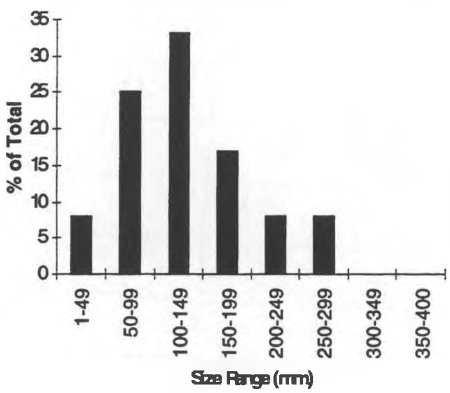
F12 & F15 Lytton



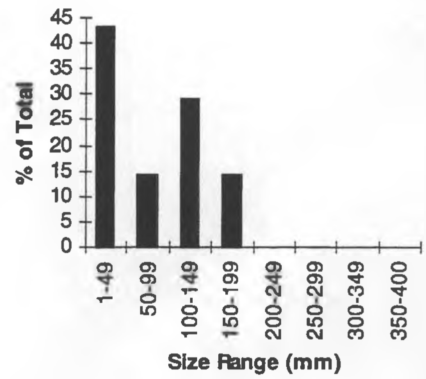
G12 Nicola Valley



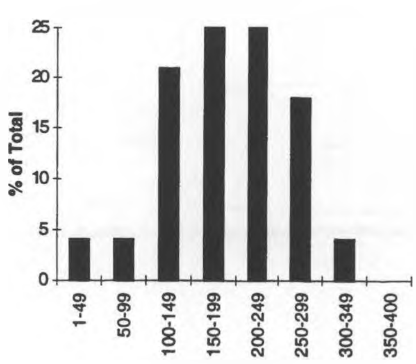
F13 & E14 Lillooet



J12&I10&I11 Arrow Lakes and Okanagan



H13 Western Shuwap Lakes



G6 & H7 & H8 & H9 Mid- Columbia Plateau

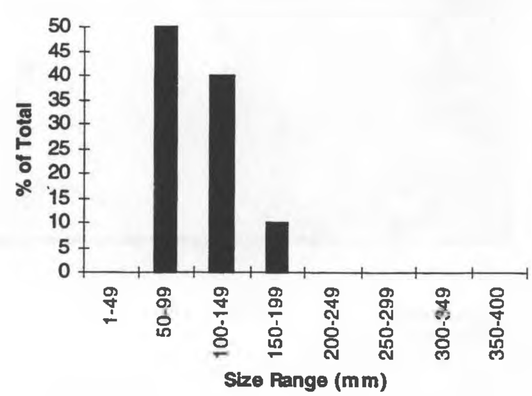


Figure 5.23. Distribution of Nephrite Celt Lengths for Areas on the British Columbia and Columbia Plateaus.

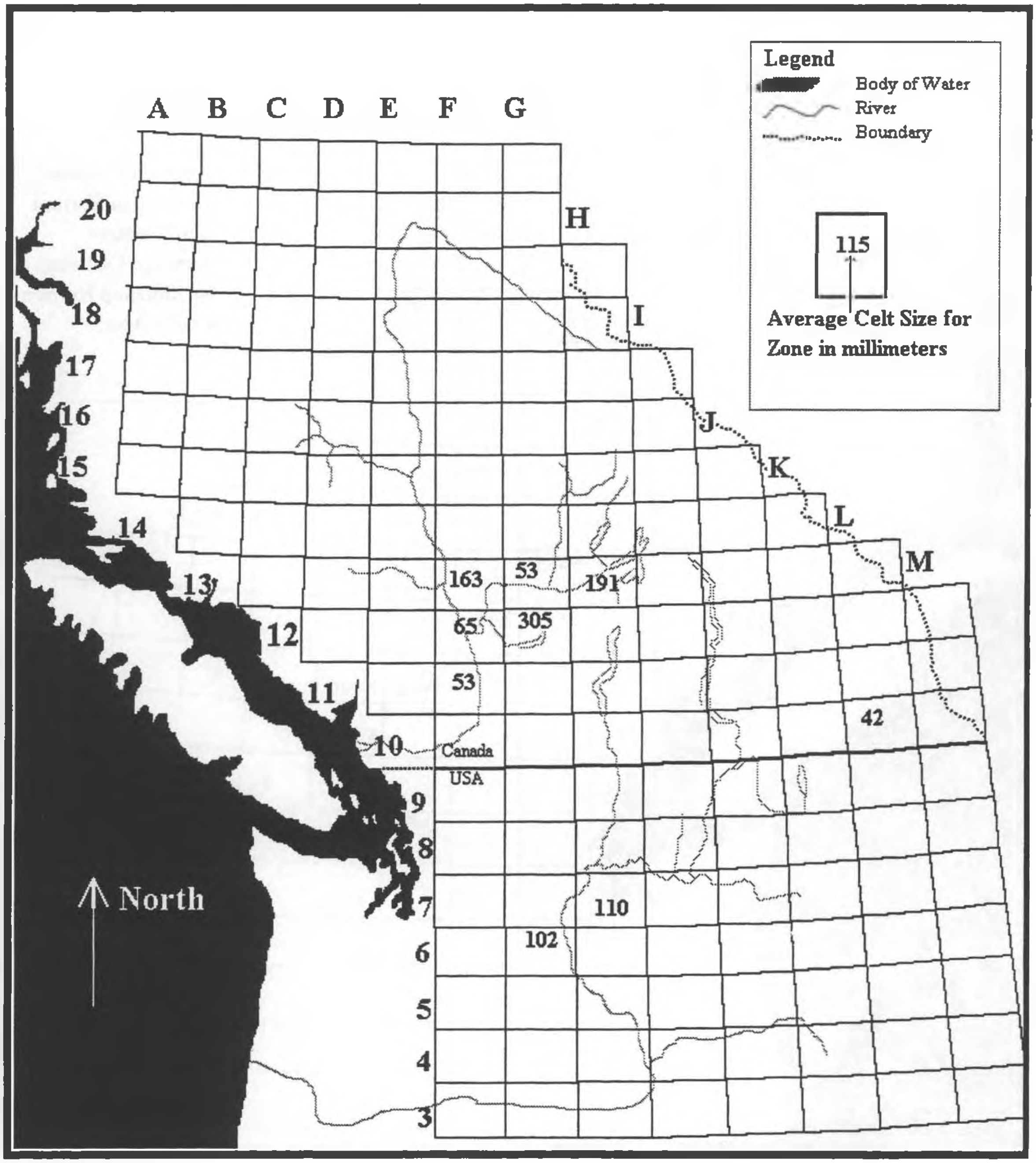


Figure 5.24. Average Celt Sizes for Grid Zones in the Kamloops Horizon.

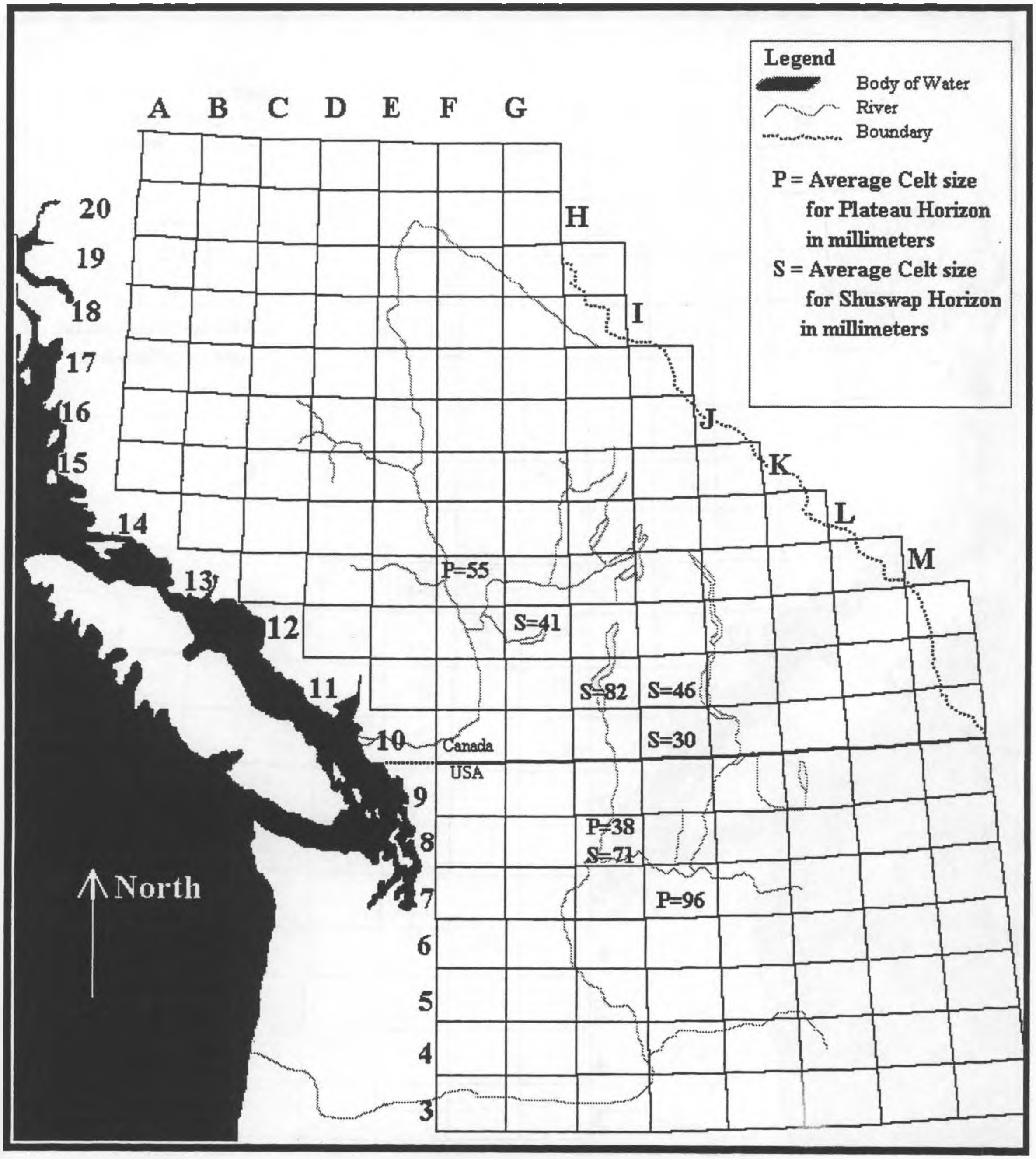


Figure 5.25. Average Celt Lengths for Grid Zones in the Shuswap and Plateau Horizons.

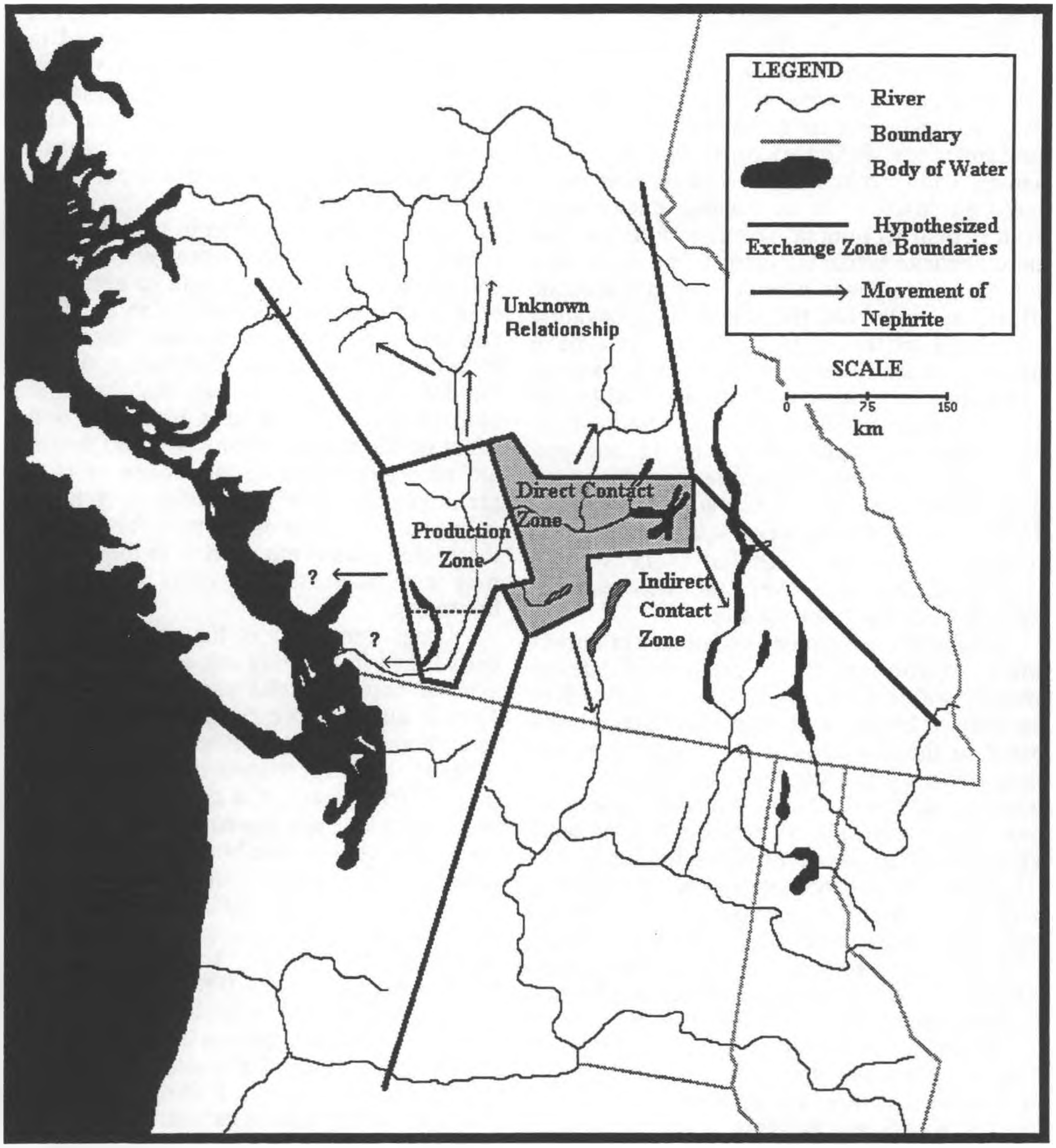


Figure 5.26. Proposed Structure of Nephrite Exchange on the British Columbia Plateau.

The Contexts of Nephrite Artifacts

The majority of excavated nephrite artifacts on the British Columbia and Columbia Plateau are found in burial contexts (Table 5.15). Of the total number of artifacts, 82 or 48% of the sample were associated with burial sites. An additional 58 or 33.9% were found in housepit sites, followed by campsites, lithic scatters and resource sites. The number recovered exclusively in systematic excavations from British Columbia, seems to indicate that more nephrite artifacts occur in housepits than in burials. However, when taking into account all sites recorded and the amount of excavation completed in the Interior, burial sites have almost 7 times the rate of nephrite per square meter than any other type of site. Although 61.5% of the excavation performed on the British Columbia Plateau has been in housepit sites, only 35 pieces of nephrite were recovered from those contexts. This equals a rate of 0.010 nephrite artifacts per square meter -- in contrast, burials have 0.067 artifacts/m^2. An even lower rate of recovery rate was recorded for campsites and resource sites.

Nephrite is also more prominent in burials when examining its overall presence or absence within sites. As depicted in Table 5.16 the ratio of burials with nephrite artifacts compared to those without is 0.83 for excavated sites. When comparing all the sites from the Interior, this rises to 1.58 -- i.e., it is more common to find a burial with nephrite than without. This ratio drops, however, when including burial features from other site types. The ratio of nephrite presence is considerably less for the other site types. Housepits only have ratios of 0.18 for excavated material or 0.25 for all sites combined. Lithic scatters, resource sites and campsites again have even lower ratios.

Examination of the contexts of nephrite over time indicates that there is some variation in the locations in which nephrite occurs. During the Kamloops horizon, nephrite artifacts are found mainly in burial contexts, using both presence or absence ratios (Table 5.17) and rates per square meter (Table 5.18). These results mirror those for the overall sample. In the Plateau horizon, the ratio of different site types with nephrite to those without nephrite changes. This ratio decreases to 1.0 (for all site types) or 0.16 when taking into account burial features found within other site types. No nephrite was recovered in excavated Plateau horizon burial contexts. No nephrite artifacts have been found in campsites, lithic scatters or resource sites in the Plateau horizon. The rate of nephrite recovery increased 2.5 times for housepits during this period compared to the Kamloops horizon. The same trends continued during the Shuswap, with the exception of one celt recovered from a lithic scatter site (Rousseau 1984). Unfortunately, information about the amount of excavation performed at this site was unavailable.

There is also variation in nephrite artifacts found within particular site types. Both celts and sawn boulders are found in greater numbers within burial contexts (Table 5.19). In contrast, miscellaneous worked fragments are found more often in housepit sites and the limited data for knives suggests that they are also more likely to be found in housepit contexts. Most of the miscellaneous worked fragments are probably debris from broken celts. The greater incidence of these artifacts in housepits suggests that celts were probably used, and therefore broken, more often in these areas. It may also indicate that celts were made in housepits.

Large variations in the nature of nephrite celts found in different site contexts exist. The size of nephrite celts associated with burial sites is almost three times longer on average than those found in housepit sites and twice as long as those recovered in campsites (Table 5.20). This is also the case when examining only complete specimens. Burial sites clearly have the largest number of associated celts (Figure 5.27). Most of the celts in burial contexts were over 150 millimeters in length. In both campsites and housepits, most celts were well under this length. The largest proportion of celts in campsites fall between 50-99 millimeters, and in housepits between 1-49 millimeters. In burials, there is an even distribution of all size classes that peaks in the 100-149 millimeter size range. I should also note, no recovery of nephrite celts over 200 millimeters in length occurred in non-burial contexts.

Beyond differences in size, variations in the integrity of nephrite celts also exist between the site types (Table 5.21). Using information available on the nature of celt breakage, it appears that complete celts are more often associated with burial sites and campsites. For burials, the ratio of complete to broken celts is 2.1 and for campsites 2.0. In housepit contexts, this level drops to 0.58 complete to non-complete celts. The other site types had insufficient data to calculate ratios.

Table 5.14. Distribution of Nephrite Artifacts during the Plateau Pithouse Tradition.

Horizon	Number of Nephrite Artifacts	Number of Celts	Number of Knives	Number of Sawn Boulders	Number of Other Artifacts	Average Celt Length (for those with data available)	Estimated Meters Excavated / Rate of Occurrence
Kamloops	86	76	0	3	7	n=55 x=160.8mm σ=90.7	3268 m^2 Associated with Excavation =22 Rate 0.007
Plateau	31	20	1	0	8	n=7 x=67.7mm σ=33.4	2450 m^2 Associated with Excavation =22 Rate 0.009
Shuswap	7	5	0	0	2	n=5 x=54.0mm σ=19.4	1824 m^2 Associated with Excavation =5 Rate 0.003
Unknown	47	25	5	5	7		858 m^2

Table 5.15. Frequencies and Rates of Nephrite Recovery.

Site Type	Total Number of Nephrite Artifacts Columbia Plateau Included		Total Number of Artifacts from Excavations in British Columbia	Estimated Number of Meters^2 Excavated in British Columbia		Ratio of Nephrite to Meters^2 of Excavation in British Columbia
Burial	82	48.0%	11	164	2.9 %	0.067
Campsite	11	6.4%	2	1652	29.2 %	0.001
Housepit	58	33.9%	35	3479	61.5 %	0.010
Lithic Scatter	4	2.3%	2	151	2.7 %	0.013
Resource	1	0.6%	1	215	3.8 %	0.005
Unknown	15		-	-		-
Total	171		50	5661		

Table 5.16. Presence/Absence of Nephrite Artifacts within Plateau Site Types.

Site Type	Number With Nephrite Including Columbia Plateau	Number of Sites Excavated with Nephrite in British Columbia	Number of Sites Excavated Without Nephrite in British Columbia	Sites With Nephrite to Without Nephrite Ratio	
				Exca	All
Burial	29	5 (19)	6 (12) [20] †	0.83	1.58 [0.95]
Campsite	11	3 (8)	54 (56)	0.06	0.14
Housepit	25	13 (19)	71 (77)	0.18	0.25
Lithic Scatter	4	2 (4)	18	0.11	0.22
Resource	1	1	20 (21)	0.05	0.05
Unknown	6	-	-	-	
Campsite/Burial	-	-	3	0	
Total	76	24 (51)	172 (183)		

( ) - Bracketed numbers are the total for the site type, including those not found in excavation

† This number reflects the total number of burials. Because burials can occur in other types of sites, this number reflects instances where burials are associated with other types of sites and nephrite was not found in association with the burial. Sites where this occurs include EeRk 4 (Stryd 1972), EfQu 3 (Sendey 1971), FiRs 1 (Fladmark 1976), EaRd 14 (Skinner and Thacker 1988), EdRk 9 (Sanger 1971), EiRh 1 (Lawhead 1980), DjQj 1 (Mohs 1985), EeRl 19 (McLeod and Skinner 1987).

Table 5.17. Sites on the British Columbia Plateau with Nephrite compared to those without.

Time Period	B with	B with out	C with	C with out	HP with	HP with out	LS with	LS with out	R with	R with out	Total with	Total with out
Kamloops	8	5 [10]	4	20	6	47	1	8	1	15	17	95
Plateau	1	1 [6]	-	21	4	29		4	-	6	7	61
Shuswap	-	[2]	-	11	3	10	1	3	-	2	4	26
Pre-Shuswap	-	-	-	6	-	-	-	3	-	-	-	9
Unknown	10	4	4	24	6	14	2	10	-	3	22	77

† This number reflects the total number of burials. Because burials can occur in other types of sites, this number reflects instances where burials are associated with other types of sites and nephrite was not found in association with the burial. Sites where this occurs include EeRk 4 (Stryd 1972), EfQu 3 (Sendey 1971), FiRs 1 (Fladmark 1976), EaRd 14 (Skinner and Thacker 1988), EdRk 9 (Sanger 1971), EiRh 1 (Lawhead 1980), DjQj 1 (Mohs 1985), EeRl 19 (McLeod and Skinner 1987).

Table 5.18. Rates of Nephrite Occurrence in Site Types during the Plateau Pithouse Tradition.

Horizon	Burial	Campsite	Housepit	Lithic Scatter	Resource
Kamloops	n=7 m^2=133 rate = 0.053	n=3 m^2=984 rate = 0.003	n=9 m^2=2108 rate = 0.004	n=1 m^2=109 rate = 0.009	n=1 m^2=117 rate = 0.009
Plateau	n=0 m^2=0 †	n=0 m^2=608	n=19 m^2=1901 rate = 0.010	n=0 m^2=18	n=0 m^2=74.5
Shuswap	n=0 m^2=0 †	n=0 m^2=345	n=4 m^2=1406 rate = 0.003	n=0 m^2=17	n=0 m^2=55

† Burial features attributed to the Shuswap and Plateau horizons were excavated in other site types. Although listed as 0, some investigation of these features did occur. However, the amount of excavation would probably not be even close to the amount of square meters opened for Kamloops horizon burials.

Table 5.19. Frequency of Nephrite Artifact Forms in Site Types.

	Burial	Campsite	Housepit	Lithic Scatter	Resource	Unknown	
Celts†	73 55.7%	10 7.6%	38 29.0%	2 1.5%	1 0.8%	7 5.3%	
Sawn Boulders	4 44.4%	-	1 11.1%	-	-	4 44.4%	
Misc. Worked Fragment	3 15.7%	1 5.3%	13 68.4%	2 10.5%	-	-	
Knives	1 25.0%	-	3 75.0%	-	-	-	
Other	1 33.3%		1 33.3%			1 33.3%	

† This category includes chisels and celt blanks

Table 5.20. Celt Dimensions in Burial Contexts.

Site Type	n	Σx	mean x	σ	Range
Burial - length (All)	53	9505	179.3	82.0	40 - 380 mm
- length (Complete)	16	2647	165.43	89.5	40 - 352 mm
- width (All)	46	2036	44.2	10.5	6 - 65 mm
Campsite - length (All)	8	752	**94.0**	49.1	42 - 187 mm
- length (Complete)	4	295	73.8	29.1	42 - 83 mm
- width (All)	8	357	36.5	15.5	18 - 62 mm
Housepit - length (All)	22	1457	**66.2**	46.7	16 - 187 mm
- length (Complete)	9	891	99.0	45.0	35 - 187 mm
- width (All)	18	654	36.3	13.8	6 - 58 mm
Lithic Scatter - length (All)	1	-	**82**	-	82
- width	1	-	22	-	22
Total - All - Complete	82 34				

A lack of information prevents an examination of context on a feature level. With housepit sites, it was only possible in some instances to determine the size of the depression where a nephrite artifact was recovered. Of the 56 nephrite items found in housepit contexts, only 20 had information concerning the depression size. As shown in Figure 5.28, most of these artifacts were found in depressions nine meters in size. This is mainly due, however, to the large number of celt fragments recovered in Housepit 1 at EeRk 7 (Sanger 1970). Spatial analysis of housepit sites in the British Columbia Interior is rare (for examples see Hayden and Spafford [1993] and Blake [1976]. Most reports on housepits are more concerned with chronology and site evaluation for CRM purposes. Rarely in these investigations is an entire housepit excavated.

The same lack of contextual data exists for burial sites. Because most nephrite artifacts recovered from burial sites are from non-professionally excavated collections, only 23 items can be attributed to individual burials on the British Columbia and Columbia Plateaux. According to Schulting (1995:156) a slightly higher proportion of these artifacts are associated with adult male burials with diverse burial assemblages. However the data (8 versus 5 pieces for males compared to females) is too limited to enable conclusions of this nature about artifact value. What can be seen is that the burials with nephrite present are predominantly those that are restricted to burial features away from dwelling or residential sites. Burials within other site types (e.g., EeRk 4 (Stryd 1972), EfQu 3 (Sendey 1971), FiRs 1 (Fladmark 1976), EaRd 14 (Skinner and Thacker 1988), EdRk 9 (Sanger 1971), EiRh 1 (Lawhead 1980), DjQj 1 (Mohs 1985), EeRl 19 (McLeod and Skinner 1987)) do not usually have nephrite associated with them.

Figure 5.29 illustrates the percentage of artifacts found in different site contexts over the British Columbia and Columbia plateaus. Most of the grid sectors in and around the source (E13, F12, G12, G13 and H13) have the largest percentage of nephrite in burial contexts. The only exception to this is the Lillooet sector (F13) where more artifacts are found in housepit sites. This undoubtedly is a factor of the large amount of housepit excavation in the area. In the Okanagan and Arrow Lake areas, only one zone (I 10) had the largest percentage of nephrite artifacts in burial contexts. The other sectors (H11, I 11 and J12) have nephrite only in campsites, housepit sites and lithic scatters. On the Columbia Plateau, only the grid zones furthest from the mid-Fraser have nephrite represented predominantly in burials. In most areas, either housepits or campsites, have the largest proportion of nephrite. Unfortunately, in sectors F3 and G6, the number of celts from burial sites is unspecified. This probably lowers the overall percentage of celts in burial contexts in these areas.

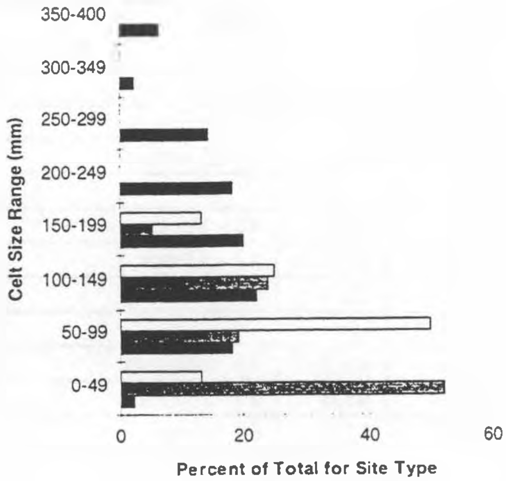


Figure 5.27. Distribution of Celt sizes in Burial, House pit and Campsite Contexts.

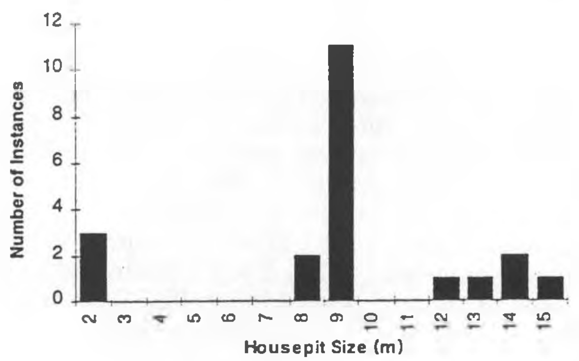


Figure 5.28. Housepit Sizes where Nephrite Celts have been Recovered.

Conclusions on Nephrite Artifact Contexts

Several conclusions can be made on the contextual data. Differences in numbers and types of nephrite celts in burials compared to other types of sites suggest that some form of special value was attached to these artifacts. This conclusion is based on the fact that nephrite celts in burials are almost twice the size of those found in other site types and they are also more often complete specimens. Since this type of intentional deposition represents an exceptional expenditure of value (especially long celts), it is likely that such inclusions were made for reinforcement of societal position rather than for any economic or personal reasons. In a strictly practical economic situation, nephrite celts in burials should be similar to celts in other site types in size and completeness (i.e., they should have been shorter and more fragmented). Many longer celts found inburials were more or less not practically functional (being over 200 mm in length). Their deposition within primarily ritual contexts probably indicates that they were never intended to be used strictly for practical purposes and were valued more for non-utilitarian reasons. As indicated by the distribution of celts in different contexts, this type of relationship is mainly found in the Lytton, Nicola Valley and Western Shuswap Lakes areas and possibly in the southern Arrow Lakes region. It may also be true for the Lillooet area.

The high percentage of miscellaneous worked fragments in housepit contexts, the overall shorter lengths, and the low ratio of complete to broken celts indicates that in this context they were probably functioned primarily as utilitarian tools that were abandoned or discarded in this context when they were no

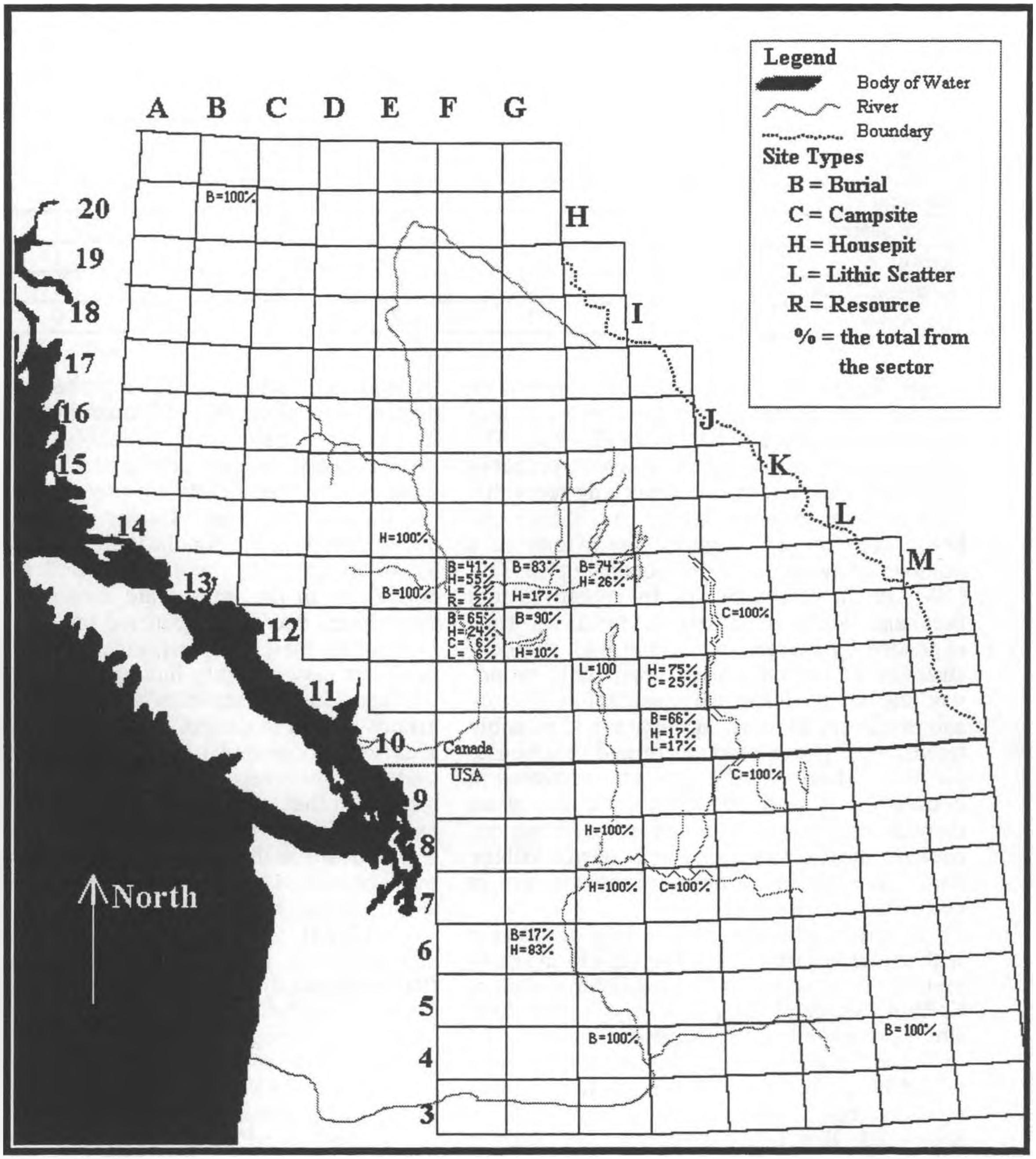


Figure 5.29 Percentage of Nephrite Artifacts in Site Types per Grid Zone

Table 5.21. Celt Integrity within Site Types.

Site Type	Complete	Broken - bit missing	Broken - pole missing	Broken - Medial	Broken - no info	Comp/ broken Ratio	No Information Available
Burial	19	1	4	1	3	2.1	41
Campsite	4	0	2	0	0	2.0	4
Housepit	10	0	4	1	12	0.58	4
Lithic Scatter	1	0	0	0	0	-	1
Resource	0	0	0	0	0	-	1
Housepit/Burial	0	0	0	0	4	-	0
Unknown	6	0	1	0	0	6	0

longer functional. A considerable amount of woodworking occurs during the construction of a pithouse structure (Teit 1900:192-196). The completion of such a dwelling would probably be aided by the use of woodworking tools that were less apt to break during use. Since pithouse construction required the efforts of a number of people (20-30 according to Teit [1900:192]), delays caused by repetitive tool breakage could be costly in terms of time expended by the group. Along with the construction of pithouse structures, other woodworking tasks, such as the manufacture of storage platforms, hunting equipment and possibly totems would have been performed near housepit sites. Most nephrite artifacts recovered in housepit sites were found in the depressions themselves. This is not unexpected, however, because most excavations in housepit village sites focus on those depressions and not in associated activity areas.

Nephrite artifacts were rarely associated with resource based sites. The only such site to yield a nephrite artifact was a fishing station, EeRk 4 (Sanger 1970), and very few of these site types have been excavated. Construction of fishing platforms, drying racks and weirs would have been necessary at such a site and therefore not surprising that celts should be associated. Roasting pits were also included in the classification of resource sites. Interpretation of these kinds of sites have generally focused on their use for roasting plant materials (e.g., Pokotylo and Froese 1983). Beyond gathering roots, activities would have been directed towards gathering firewood. However, no nephrite has ever been recovered at such sites.

Conclusions on Context and Distribution

It is more than likely that most celts were manufactured primarily of nephrite in a production zone along the mid-lower Fraser River. In this area, celts were probably crafted to serve utilitarian woodworking needs and others were created specifically for use as trade items or primitive valuables. Larger celts were traded to groups in the Nicola Valley and Western Shuswap Lakes to the east, as well as being consumed in the immediate area. Trade of these items may have occurred for ceremonial exchanges, material gains, emergency conversions, or may possibly have been obtained in warfare. The relationships between the trading groups is hard to define. It is possible that the area was connected by kinship patterns and trade was between lineages. This might not have been the case for the Nicola Valley, however, as it has been demonstrated that the region down to the Similkameen was occupied by Athapaskan speakers who became extinct shortly before contact (Bouchard and Kennedy 1984:12-24). If this were the situation, although the evidence is not conclusive (Richards and Rousseau 1984:56), exchange of nephrite artifacts could have occurred with competing groups. However, since Plateau societies appear not to have had tribal organization (Ray 1939), language may not have been a factor in trade.

Going beyond the direct contact area to the Okanagan and Columbia Plateau, celt sizes decrease and occur less frequently in burials, with the exception of the southern Arrow Lakes region. Alternate materials other than nephrite were not used more frequently for celts in these areas suggesting the use of some different form of technology for woodworking such as antler or bone chisels and celts. It would be likely that nephrite celts would have been valued in these areas distant from the main source. The decrease in size may represent the natural process of size decay away from the source or possibly the existence of secondary celt size reductions in the Nicola Valley and Shuswap Lakes area.

It should be noted that nephrite was only one component of a larger trade network. Many other valuable items were actively traded in conjunction with nephrite by the time of contact (Hayden et al. 1985; Richards and Rousseau 1987). The extent of this trade system ranged from the coast (Richards and Rousseau 1987; Fladmark 1982) down to the Columbia Plateau (Galm 1994). There has been no attempt to factor in the exchange of nephrite to the coast in this thesis. Large quantities of nephrite were exported to the Coast (see Mackie 1992) and Fladmark (1982) has even speculated that Coastal groups may have exerted influence into the Interior to ensure an adequate supply of the material. It is hard to speculate how much nephrite moved from north of the Lytton area onto the Coast because of access by lower Fraser groups to sources in the Hope region. Sites in the lower Fraser area have large numbers of nephrite artifacts, including manufacturing debris. In sites such as DjRi 5, DiRi 38 (von Krogh 1980), DiRi 14 (Roberts 1973; Eldridge 1979), DjRi 1 (Mitchell 1963), and DiRi 39) there are 79+ items reportedly made of nephrite or serpentine. Because this figure is over half the number of artifacts reported for the whole interior of British Columbia and the Columbia Plateau put together, it is highly likely that many of the celts found on the coast originated from the Lower Fraser rather than in the mid-Fraser region.

Examination of the nephrite celt industry through time indicates that changes that occurred in this artifact type appear to coincide with other events on the Plateau and outlying regions. The intensity of nephrite exchange started in the Plateau horizon (Richards and Rousseau 1987:39) at the same time nephrite use intensified on the coast during the Marpole phase , 2250-1500 BP (Burley 1980). There also appears to be increasing cultural complexity in the mid-Fraser region during the Plateau horizon (Hayden et al 1985; Stryd 1973; Fladmark 1982) and the distribution of nephrite at this time suggests that the center of activity in the Interior was in the Lillooet area. There is, however, limited contextual information for nephrite from this period. Nephrite from this time is primarily found in housepit contexts. Contrary to the pattern observed in the Kamloops horizon, this suggests emphasis was not placed on nephrite grave inclusions. However, Schulting (1995:180) notes that burial sites associated with some of the large housepit villages of the time (e.g. for the Bell Site EeRk 4 (Stryd 1973) or Keatley Creek EeRl 7 (Hayden and Spafford 1993)) have not been explored. Thus, it is possible that further investigations may indicate greater value was placed on nephrite artifacts during the Plateau horizon than is currently represented in the data.

During the Shuswap horizon, nephrite artifacts are rare. It is interesting, however, that they have a distribution across the British Columbia and Columbia Plateaux. That may suggest that special importance was ascribed to such objects from their original introduction onto the Plateau. Even though they could represent a solution developed to meet increased woodworking tasks, their sparse numbers suggests that they were novelties rather than a pervasive tool type. Richards and Rousseau (1987:30) also state that nephrite celts are the first form of evidence for inter-Plateau trading.

By the Kamloops horizon, it is evident that nephrite artifacts were important or valued commodities. At this time, the longest and most exaggerated nephrite celt sizes are found and the greatest differences exist between celts found in burials compared to other site types. Although it appears that there was an abandonment of large scale housepit villages and changes in social organizations after the early Kamloops horizon (Hayden et al. 1985), this does not seem to have affected the nephrite industry. If anything, there was an intensification in the manufacture of nephrite artifacts. Perhaps the changes in nephrite celts through time was part of an overall adaptation scheme to create a economic system that sought to reduce the threat of starvation from cyclical salmon shortages by maximizing the production of valuable commodities during times of surplus. As salmon resources may have been less predictable in the Plateau horizon (Richards and Rousseau 1987:57), and it has been demonstrated that there was the possibility of a large scale collapse in the cultural complexity in the Lillooet region because of the Texas Creek landslide (Hayden and Ryder 1991), it is possible that a more elaborate exchange system evolved to minimize the effects of resource failure.

6 Discussion and Conclusions

Combining the archaeological, ethnographic, and experimental evidence for nephrite use on the British Columbia Plateau indicates that there was considerable value invested in nephrite artifacts by pre-contact occupants of the Interior. This value primarily derived from the large amount of time needed to manufacture nephrite implements, the benefits of using nephrite to create durable celts, and the potential of nephrite celts to symbolize wealth.

Archaeological celts recovered in the Fraser River area generally reflect the ethnographic information provided by Emmons (1923) and Teit (1900, 1906, 1909) for the types of celts made in the region. Although three distinct celt sizes were not discerned from the archaeological data, (as found in the ethnographic record, Emmons 1923), different sizes of celts were manufactured. This is based on variation in the size and integrity of the celts found in burials compared to other site types. Nephrite celts over 200 millimeters in length are only reported from burial contexts. This roughly corresponds with the size differences observed between working axes and ceremonial axes in New Guinea (Sherratt 1976:576). Based on artifact analysis, however, there is some indication that most nephrite celts were utilized in some manner, regardless of size. The nature of this use was not investigated and it could be possible that the wear observed on large celts originated from some form of ceremonial use or a less percussive use such as hide working.

Analysis of the celts and related artifacts from the museum collections, clearly demonstrates that nephrite was the primary material chosen for celt production on the British Columbia Plateau. The stone types reported from the various excavations and surveys in the British Columbia Interior and the Columbia Plateau supports these findings. As determined by the experiments undertaken in this thesis, nephrite has one of the largest manufacturing costs in terms of time. This is in comparison to virtually any other material available in the Interior. Ironically, the same characteristics that make nephrite costly to manufacture are also beneficial for stone tool use. Nephrite may have been a vital for certain tasks, and it appears that prehistoric Plateau occupants *chose* to use this high cost material instead of 'cheaper' stone alternatives for celt manufacture. Alternatively, it is possible that certain Interior groups had the *luxury* of using such a costly material. There are no utilitarian benefits to exaggerated celt size -- if anything, the advantages decrease. It is reasonable to assume this purely represents *surplus*, as defined by Olausson (1983).

It is highly probable that nephrite celt manufacturing was primarily carried out in times or conditions of abundant food supply. Torrence (1983, 1989) postulates that the time needed to manufacture stone tools has to be balanced with the time needed to perform subsistence tasks. To meet the demands of food gathering activities, tools with the greatest importance in these activities will be manufactured or curated before less vital implements. Nephrite celts are not tools directly needed for subsistence gathering and as such, they constitute a large drain on the total amount of time available for re-tooling. This is especially the case with manufacturing over-sized celts where all the activity is non-essential. Therefore, in times where virtually all subsistence needs are attended to, time could be allocated to manufacture of nephrite celts. In the Fraser region, this could occur in the winter season when people were living on stored salmon resources (Teit 1900, 1906, 1909). However, this would be dependent on whether sufficient salmon supplies were harvested and dried during the summer. During a year where shortages were encountered, attention would be focused more on hunting activities or possibly on raiding for salmon supplies (Cannon 1992) and not on activities such as nephrite manufacturing.

It also is possible that only certain individuals or groups had access to raw materials or the ability to manufacture nephrite implements. Although almost anyone can perform the task, it is possible that not everyone would have had the time to expend making such implements. It has been postulated that social inequities developed during or before the Plateau horizon on the British Columbia Plateau (Stryd 1973; Hayden et al. 1985; Hayden 1992; Hayden and Spafford 1993). At this time development of "corporate groups" (Hayden and Cannon 1982) could have occurred, as indicated by a bimodal distribution of housepit sizes (Stryd 1973; Hayden et al. 1985). In this scenario, certain affluent family groups would have controlled access to resources and other poorer families would enter into service with these families to make a living. It is conceivable that members of the wealthy families would have had greater resources to manufacture nephrite celts, especially larger sized specimens. This is not to say that wealthy individuals would perform the actual grinding -- rather they would 'contract' the task out to families under their influence or possibly employed slaves that belong to their family. Once completed, the celt would subsequently be used to further the wealth of the family. Poorer families, locked in more of a struggle for existence may have been too busy with subsistence activities (Hayden and Spafford 1993) to afford the time to make nephrite implements for themselves. Again, this situation would not be unlike the ethnographic pattern of axe exchange in New Guinea (Phillips 1975; Dalton 1977; Sherratt 1976) or in Australian with the Yir Yoront (Sharp 1952) where clan heads or corporate leaders acquired axes to use for ceremonial exchanges.

From the distribution of celt sizes outside the Fraser River area, it appears that many smaller, utilitarian celts were being retained by the producers. Trade in nephrite with the outlying areas was primarily in larger celts. In an exchange system that extended to the Shuswap Lakes, these celts were possibly traded as "primitive valuables" (Hayden et al. 1985) in the sense defined by Dalton (1975, 1977). Although not producers of the celts, the groups in the direct contact zone (Sherratt 1976) would have traded other, equally important goods into the Fraser River area. As symbols of wealth, the same, if not more, value would be attributed to nephrite celts in the Nicola Valley and Shuswap Lakes regions as in the Fraser Canyon.

It can be hypothesized that this exchange occurred between kin related groups or in ceremonial exchanges between elite family heads. There are some ethnographic accounts which indicate that valuables were symbolically exchanged in historic times. For instance, Teit (1900:322-5, 1906:590-1, 1909:269) recorded that the Thompson, Shuswap, and Lillooet all encouraged marriage of individuals with partners outside their villages and that often 'presents' were exchanged to secure betrothals. Teit (1900:325) reported the following for the Thompson; "There seems, however, to have been an inclination, on the part of those who were wealthier, more successful, or more industrious, and so more distinguished, than others, to marry their children to other wealthy people." It seems likely that the 'presents' exchanged would reflect the economic station of the suitor. Teit (1900:322) does indicate that parents (and other kin) evaluated the presented gifts before deciding whether to allow the marriage. This was considered the most honorable form of betrothal in Thompson society (Teit 1900:322). Similar practices were noted for the Shuswap and Lillooet (Teit 1906:591, 1909:269).

Beyond marriage, there were other practices noted where exchange of primitive valuables may have occurred. For instance, the Thompson were said to have exchanged 'presents' with friendly bands (Teit 1900:271). In another example, the Canyon division of the Shuswap would charge 'certain fees' to those who wished to cross a bridge in their territory (Teit 1906:541). Additionally, the Canyon group often tried to maintain peace to ensure trade relations and this could entail offering "presents or blood-money for their slain relatives" (Teit 1906:541). This is also reported for the Lillooet, who often resolved feuds and murders through exchange of presents (Teit 1909:236). In the political sphere, power or influence in Interior society was recorded as being gained from ritualized gift-giving at potlatches or feasts (Teit 1900:289, 1906:569, 1909:255). Again, precious items may have been used during these festivities to cement political ties.

While all of these types of exchanges are from the ethnographic record, it is quite conceivable that similar occurrences happened between family groups in the past. Nephrite was not recorded as one of the ethnographic items traded, but Teit's descriptions of the 'presents' that were exchanged are exceptionally vague. Because the contexts of acquisition (Phillips 1975:109) are virtually invisible to archaeologists, only the final location of artifact deposition can give us clues as to the manner in which nephrite celts were exchanged. From the locations in which nephrite celts are found, it is evident that they are predominantly recovered in burial contexts. This is especially the case with longer specimens. Burial inclusions on the Plateau probably reflect the socioeconomic position of the individual with whom they are interred (Stryd 1973; Schulting

1995). It is therefore likely that special value was attached to nephrite placed in burials. Further evidence of this is indicated by differences between the relationship of artifacts found in votive contexts compared to non-ritual contexts (Levy 1982). Nephrite celts in burial contexts are on average twice the size and have a greater complete-to-broken ratio than those found in other site types. This further supports the notion that special value was attached to them.

When moving beyond the Shuswap Lakes and the Nicola Valley areas, celt sizes decrease and fewer specimens are found in burial contexts. While this might be a factor of sample size, it could also reflect a natural size decay with increasing distance from the source. The transition in average size is quite abrupt between the Shuswap Lakes and Nicola Valley compared to the Okanagan and Arrow Lakes areas. This may represent a significant ethnolinguistic boundary. Unfortunately, data were not available for the areas interspersed between the two regions. It is possible that the Nicola Valley and the Shuswap Lakes regions were staging areas where larger celts were reduced into smaller celts to trade to southern groups or that these were enemy confederacies. In this situation, groups in these areas would have acted like 'middlemen' and maximized their gains by trading more celts rather than large implements. At least one celt (from the Chase burial site) appears to have been cut from a larger specimen suggesting an interest in "maximizing profits". Groups present in the Nicola Valley and the Shuswap Lakes areas also had a geographical advantage to act as 'middleman' because of natural travel corridors between mountain ranges. Although frequencies of nephrite artifacts decrease markedly overall in the Okanagan and Arrow Lakes regions, the rates of recovery in some locations would suggest quantities of nephrite comparable to the Fraser River area. Of interest, nephrite is the only substance that solidly links contact with the Fraser River region by groups living in the Similkameen Valley (Vivian 1992:123). No other materials (e.g., chert) attributable directly to the Fraser Canyon were recovered in this area.

The trade routes between the British Columbia and Columbia Plateaus are generally thought to have followed the Similkameen and Okanagan rivers and possibly the Upper Columbia River (Galm 1994). Vivian (1992:37-9) and Galm (1994:298) have commented on how poor the understanding of the nature of the contact between the two areas is in current archaeological literature. In his study of the cultural interaction between the Similkameen Valley and areas adjacent to it, Vivian (1992:123) found that little in the way of common materials, such as cryptocrystalline stones, were transported through the valley from an external origin. He suggests that when prehistoric trading parties made their way through the valley, they "were likely restricted to small bands, which usually only transported small prestige items"(1992:129). It is likely that nephrite was one of those materials.

The numbers of nephrite artifacts found on the Columbia Plateau is not very large. There appears to have been no real alternate material to replace nephrite based on the limited number of celts made of different stone types. Average lengths of nephrite celts found on the Columbia Plateau are for the most part greater than those for the Okanagan and Arrow Lakes regions and two large celts (over 20 centimeters) were recovered along the Snake River in burial context (Spinden 1915). In addition, some of the celts recovered on the Columbia Plateau are deemed not practically functional because of their form (Galm et al. 1985). All of this evidence indicates that nephrite celts of any size were similarly valued on the Columbia Plateau as they were on the British Columbia Plateau.

The nature of nephrite exchange with the coast was not investigated in this thesis. At present, the relationship between producers of nephrite artifacts in the interior and consumers on the coast is not clear. Mackie (1992), in his analysis of coastal celts, determined that most celts followed a distinctive life-cycle because of their importance as woodworking tools, but he never fully addressed where the Coastal celts primarily originated. In fact, there is good evidence from sites in the Hope area that many Coastal nephrite celts were produced in that area (e.g., DjRi 5, DiRi 38 (von Krogh 1980), DiRi 14 (Roberts 1973; Eldridge 1979), DjRi 1 (Mitchell 1963), and DiRi 39). What remains undetermined is how many celts arrived on the southern coast by way of alternate routes such as the Lillooet River, rather than the Fraser Canyon. Until such issues are addressed, it will not be known what effect trade of nephrite outside of the Plateau had on the value of nephrite for Interior societies.

Data suggest that there was an intensification in the nephrite industry throughout the Plateau Pithouse traditions, that peaked in the Kamloops horizon. Although found over a broad area during the Shuswap period, it was not until the Plateau horizon that real growth in the nephrite industry occurred. During the Plateau horizon the center of the nephrite manufacture was probably the Lillooet region. By the start of the Kamloops period, it appears that the exchange of the material had expanded into the adjacent Shuswap Lakes and Nicola Valley regions.

Beyond the socioeconomic aspects of nephrite, it is possible that nephrite celts were primarily used at housepit sites and possibly campsites. This is based on the large number of miscellaneous worked fragments recovered at this type of site, many of which could have been the result of celt breakage during house construction or accidental breakage during manufacturing. Other kinds of sites have lesser numbers of celts and fragments, that suggest a lower use of the material in these locales (although few such sites have been excavated). The specific location where celts were manufactured could not be discerned. Sawn boulders, the primary debitage from the early manufacturing process, were found more often in burials than in other site types. This context might actually reflect the value attached to sawn boulders. Because the removal of secondary celt blanks from boulders probably required considerably less time compared to primary blanks, a previously worked boulder may have had considerable value. The association of these artifacts with burials, however, does not provide information on where the manufacturing occurred. One fragmentary sawn boulder was also found in a housepit (EeRl 19-Stryd and Hills 1972) which suggests it was the primary location for such activities. Emmons (1923:plt.3) reports the recovery of a sawn boulder with multiple cutting grooves from a placer deposit in the Fraser River. This may indicate that celt manufacturing occurred near the river because the boulder was probably washed downstream by flood activity. Neither of these cases provide conclusive evidence for tool manufacture and it is possible that production was not limited to a specific location.

To conclude whether nephrite artifacts were used by Plateau societies to fulfill utilitarian woodworking requirements or as items of status, property or wealth, it is likely that both functions were of importance, especially in the production zone along the Fraser River. In regions beyond this area on the British Columbia Plateau, however, it appears that the prestige roles of nephrite implements were more salient. Considering the time involved in manufacturing, the distribution and size of nephrite artifacts, the ethnographic information, and the contexts of nephrite object deposition, it seems probable that more emphasis overall was placed on the symbolic or wealth-bearing functions of the material rather than on its utilitarian uses. This is especially the case given the other 'lower-cost' alternatives for woodworking available on the British Columbia Plateau.

Recommendations for Future Research

The experimental procedures undertaken in this thesis represent an initial step in understanding prehistoric methods of nephrite manufacture. More work in the future will expand our understanding of how nephrite, abrasives, saws and lubricants interacted. There are many questions about nephrite manufacturing that remain unresolved. First, it would be worthwhile to determine whether it was advantageous to expend extra effort to collect hard abrasives, or saws with superior hardness, to increase sawing rates. The rates achieved during my experiments only represent preliminary data and no attempts were made to maximize cutting rates. What needs to be determined is whether appreciable gains can be made over the presently derived rates that would justify the additional energy expenditure. One alternative to experimentation would be to measure the hardness of sandstone saws recovered in archaeological sites. Second, it should be determined whether cutting speed could be increased by using grease instead of water for the lubricant. Johnson S. (1975) indicates that this may be the case. Third, there should be some assessment of whether the use of a thong or piece of wood instead of a sandstone saw would have been a practical alternative.

Another aspect that should be addressed is the endurance of celts made of nephrite in comparison to other materials. This should involve experimental use of celts of different materials for extended periods of time in similar types of woodworking tasks. In undertaking this sort of approach, it should be possible to compare the effectiveness and use-life of nephrite celts to other materials to determine whether the costs involved in making nephrite implements are warranted. Along with this, experimentation should be directed at determining the point at which the size of a celt starts to hinder its performance. This research should be aimed at defining ergonomic constraints and the failure/breakage rates for certain sizes of celts. The results of such a study may allow for more conclusive statements on the non-utilitarian functionality of exaggerated celt sizes.

In addition to the experimentation on the cost-benefit and manufacturing aspects of nephrite celt technology, some attention should be given to analyzing use wear patterns found on nephrite implements. This type of study could indicate the activities in which nephrite implements were utilized. It may also be able to decipher what sorts of patterns are attributable to manufacturing, resharpening, or use. These studies could be carried on in conjunction with the cost-benefit experimentation.

Moving beyond experimentation, more investigation is needed on other artifact types that have been labeled 'primitive valuables' (Dalton 1975, 1977) on the Plateau. Even though many of these items probably had special value attached to them, there has been only a limited amount of evidence offered to back up these assumptions. More study of the contexts in which these seemingly special objects occur needs to be undertaken. The study of the distribution of primitive valuables may also give some insight into the nature of the entire exchange system. Perhaps the distribution of other artifacts indicates the same trading relationship between the mid-Fraser region and the Shuswap Lakes - Nicola Valley as found in this study of objects made of nephrite.

References

Ainsworth, Thomas H.
1956 Tools of Stone. *Northwest Mineral News*, February-March, pp.9-12.

Alexander, Diana
1986 Report on Potato Mountain Archaeological Project (1985). Permit 1985-11 ALE, Report on File, Archaeology Branch, Victoria.
1992 A Reconstruction of Prehistoric Land Use in the Mid-Fraser River Area Based on Ethnographic Data. In *A Complex Culture of the British Columbia Plateau: Traditional* Stl'átl'imx *Resource Use*, edited by Brian Hayden, UBC Press, Vancouver, pp. 47-98.

Allaire, Louis
1979 The Cultural Sequence at Gitaus: A Case of Prehistoric Acculturation. In *Skeena River Prehistory*, edited by Richard Inglis and George MacDonald Archaeological Survey of Canada, Mercury Series Paper No.87, pp.18-62.

Ames, Kenneth
1979 Report of the Excavations at GhSv 2, Hagwilget Canyon. In *Skeena River Prehistory*, edited by Richard Inglis and George MacDonald, Archaeological Survey of Canada, Mercury Series, Paper No.87, p.181-218.

Ames, Kenneth M. and Alan G. Marshall
1980 Villages, Demography and Subsistence Intensification on the Southern Columbian Plateau. *North American Archaeologist* 2(1):25-52.

Arcas Associates
1985a Excavations at the Rattlesnake Hill Site (EeRh 61), Ashcroft, B.C. Permit 1984-2, Report on File, Archaeology Branch, Victoria.
1985b The Spallumcheen Heritage Inventory Project. Permit 1984-40, Report on File, Archaeology Branch, Victoria.
1985c The Spallumcheen Heritage Inventory Project, Pinas Lake Burial Salvage. Permit 1984-40, Report on File, Archaeology Branch, Victoria.
1985d Excavations at the Kopchitchin Site (DlRi 6) North Bend, B.C. Permit 1984-39, Report on File, Archaeology Branch, Victoria.

Arcas Associates
1986 Excavations at the Boyes Site (EfQq3), Malakwa, B.C. Permit 1985-24, Report on File, Archaeology Branch, Victoria.
1987 Excavations at Valley Mine, Highland Valley, British Columbia. Permit 1985-5, Report on File, Archaeology Branch, Victoria.
1988 Archaeological Investigations at the Sahhaltkum Bridge Site (EeQw 30), Chase, B.C. Permit 1987-28, Report on File, Archaeology Branch, Victoria.

Archer, David
1971 The Monck Park Site: EbRd 3, Summary Report. Report on File, Archaeo logy Branch, Victoria.
1976 A Preliminary Report on the 1976 Hope Archaeological Project. Permit 1976-2, Report on File, Archaeology Branch, Victoria.

Baker, James
1983 Murphy Creek Project Heritage Resource Detailed Impact Assessment. Ministry Order 1982-2, Report on File, Archaeology Branch, Victoria.

Bamforth, Douglas R.
1986 Technological Efficiency and Tool Curation. *American Antiquity* 51(1): 38-50.

Barlee, N.L.
1969 Salvage Excavation of a Burial near Grand Forks. Report on File, Archaeology Branch, Victoria.

Barrow, T.
1962 An Experiment in Working Nephrite. *The Journal of the Polynesian Society* 71:254.

Barwell, F.T.
1979 Theories of Wear and their Significance for Engineering Practice. Pp. 20-83 in *Wear* edited by D. Scott. Treaties on Material Science and Technology No. 13, Academic Press, New York.

Beck, Russell J.
1970 *New Zealand Jade: The Story of Greenstone*. A.H. & A.W. Reed, Wellington.

Best, Elsdon
1974 *The Stone Implements of the Maori.* A.R. Shearer, New Zealand.

Referencees

Binford, Lewis R.
1962 Archaeology as Anthropology. *Ameri can Antiquity* 28:217-225.

Blake, Michael
1974 Ollie Site (EeRk 9) - Final Report. Permit 1973-21, In *Archaeology of Kamloops*, by Robert Wilson and Catherine Carlson, Department of Archaeology, Simon Fraser University Publication No. 7.

Blake, Michael
1976 *The Rocky Point Site (EdQx 20): Spatial Analysis and Descriptive Report*. Occasional Papers of the Archaeology Sites Advisory Board of British Columbia, No.2, Victoria.
1981 *Archaeological Investigations at the Wild Horse River (DjPv 14)*. Occasional Papers of the Heritage Conservation Branch of British Columbia, No. 6, Victoria.

Blake, Michael and Morely Eldridge
1971 Pithouse on the South Thompson. Permit #1971-3, Report on File, Archaeology Branch, Victoria.

Boas, Franz
1966 *Kwakuitl Ethnography*. University of Chicago Press, Chicago and London.

Bordaz, J
1970 *Tools of the Old and New Stone Age*. David and Charles, Newton Abbot.

Borden, Charles
1952 The Results of Archaeological Investigations in Central British Columbia. *Anthropology in British Columbia*, 3.
1961 Fraser River Archaeological Project. *Anthropology Papers of the National Museum of Canada.*
1975 *Origins and Development of Early Northwest Coast Culture to about 3000 B.C.* Archaeological Survey of Canada, Mercury Series, Paper No. 87

Bousman, Britt C.
1993 Hunter-Gatherer Adaptations, Economic Risk and Tool Design. *Lithic Technology* 18(1-2):59-86

Bouchard, Randy and Dorothy Kennedy
1978 *Indian History and Knowledge of the Lower Similkameen River - Palmer Lake Area*. U.S. Army Corps of Engineers Technical Report.

Boydston, Roger A.
1989 A cost-benefit study of functionally similar tools. In *Time, Energy, and Stone Tools*, edited by R. Torrence, Cambridge Press, Cambridge.

Bradley, Richard
1990 *The Passage of Arms: An archaeological analysis of prehistoric hoards and votive deposits*. Cambridge University Press, Cambridge.

Brailsford, Barry
1984 *Greenstone Trails: The Maori Search for Pounamu*. A.H. and A.W. Reed Ltd., Wellington.

Brandon, John D. and Susan Irvine
1979 Archaeological Investigations in the Quesnel Area. Final Report of the Fall 1978 SWAT Salvage Crew. Permit 1978-7, Report on File, Archaeology Branch, Victoria.

Brandt, Richard C., Robert E. Newham, and J.V. Biggers
1973 The Toughness of Jade. *American Minerologist* 58:;727-732.

Burley, David
1980 *Marpole. Anthropological Reconstructions of a Prehistoric Northwest Culture Type*. Department of Archaeology, Simon Fraser University Publi cation, No.8, Burnaby.

Bussey, Jean
1977 *The Comparison of Lithics at Three Sites in the East Kootenay Area of British Columbia*. Unpublish M.A. Thesis, Department of Archaeology, Simon Fraser University.
1981 *Archaeological Investigations along the Pend D'Oreille River of South Central British Columbia*. Occasional Paper of the Heritage Conservation Branch, No. 7, Victoria.
1983 Alexis Creek Archaeological Investigations. Permit 1983-28, Report on File, Archaeology Branch, Victoria.
1984 Detailed Heritage Resource Impact Assessment: DgQo 13, Grand Forks Bridge Restoration, Ministry of Highways. Permit 1984-15, Report on File, Archaeology Branch, Victoria.
1986 Salvage Excavation at EdQa 8, near Invermere, B.C.: A Late Middle Prehistoric Camp. Permit 1986-8, Report on File, Archaeology Branch, Victoria.

Butler, B. Robert
1959 Lower Columbia Valley Archaeology: A Survey and Appraisal of some Major Archaeological Resources. *Tebiwa* 2(2):6-24.

Referencees

Caldwell, Warren
1954 An Archaeological Survey of the Okanagan and Similkameen Velleys of British Columbia. *Anthropology in British Columbia*, No. 4, 1953-1954.

Callahan, Errett
1993 Celts and Axes: Celts in the Pamunkey and Cahokia House Building Projects. *Bulletin of Primitive Technology* 1(5):37-40.

Campbell-Brown, H.
1969 Report on the Vernon Burial Site. Permit 1969-24, Report on File, Archaeology Branch, Victoria.

Cannon, Aubrey
1992 Conflict and Salmon on the Interior Plateau of British Columbia. In *A Complex Culture of the British Colum bia Plateau: Traditional* Stl'átl'imx *Resource Use*, edited by Brian Hayden, UBC Press, Vancouver, pp.506-524

Carl, Alan
1972 Salvage Archaeology at the Stafford Ranch Site (FaRn 3). Permit 1971-6, Report on File, Archaeology Branch, Victoria.

Carlson, Catherine
1980 Excavations at the Curr Site. In *Archaeology of Kamloops*, by Robert Wilson and Catherine Carlson, Department of Archaeology, Simon Fraser Publication No. 7.

Carlson, Roy L. and Philip Hobler
1993 The Pender Canal Excavations and the Development of Coast Salish Culture. In *Changing Times: British Columbia Archaeology in the 1980s*, edited by K.R. Fladmark, *B.C. Studies* No. .99,

Chapman, F.R.
1892 On the Working of Greenstone by the Maoris. *Transactions and Proceedings of the New Zealand Institute* 24:479-539

Chapell, J
1966 Stone Axe Factories in the Highlands of East New Guinea. *Proceedings of the Prehistoric Society* 32:96-121

Charlton, Arthur S
1974 Archaeological Investigations at Columbia Gardens (DgQj 1). Permit 1974-30, Report on File, Archaeology Branch, Victoria.

Choquette, Wayne
1984 Results of Slavage Excavation at the Levesque Site, DfQa-6, Mogie River Valley, B.C. Permit 1982-23, Report on File, Archaeology Branch, Victoria.
1985 Salvage Excavations at DiQj 18: A Test of a Model of Upper Columbia Basin Human Settlement Dynamics. Permit 1984-10, Report on File, Archaeology Branch, Victoria.

Coles, J
1973 *Archaeology by Experiment*. Scribners, New York.

Collier, Donald, Alfred E. Hudson, and Arlo Ford
1942 *Archaeology of the Upper Columbia Region*. University of Washington Press, Seattle.

Combes, John D.
1968 *Burial Practices as an Indicator of Cultural Change in the Lower Snake Region.* Unpublished M.A. thesis, Uni versity of Washington, Seattle.

Copp, Stan
1974 An Archaeological Site Survey of the Okanagan-Similkameen Regions in the Interior of British Columbia. Permit 1974, Report on File, Archaeology Branch, Victoria.
1986 DgQu 4: Salvage Recovery of Human Remains on the Osoyoos Indian Reserve. Report on File, Archaeology Branch, Victoria.

Crabtree, Don E.
1982 *An Introduction to Flintworking, Second Edition.* Occasional Papers of the Idaho Museum of Natural History No. 28, Pocatello.

Cummins, W.A.
1975 Neolithic stone axes: distribution and trade in England and Wales. Pp. 5-12 in *Stone Axe Studies. Archaeological, petrological, experimental, and ethno graphic*. edited by T.H. McKClough and W.A. Cummins. Council for Brit ish Archaeology, Research Report No. 23.

Cybulski, Jerome S., D.E. Howes, J.C. Haggarty and Morely Eldridge
1981 An Early Human Skeleton from South-Central British Columbia: Dating and Bioarchaeological Inference. *Canadian Journal of Archaeology* 5:49-59

Dalton, George
1975 Karl Polyani's analysis of long dis tance trade and his wider paradigm. In Ancient Civilizations and Trade, edited by J. Sabloff and C. Lamberg-Karlovs ky, University of New Mexico Press, Albuquerque.

Referencees

Dalton, George
1977 Aboriginal Economies in Stateless Societies. In *Exchange Systems in Prehistory*, edited by T. Earle and J. Ericson, Academic Press, New York.

Damkjar, Eric
1981 Life Histories of Some Northwest Coast Celts. Paper presented at the 14th annual CAA conference.

Davis, Stanley D.
1990 Prehistory of Southeastern Alaska. In *Handbook of American Indians, Vol. 7: Northwest Coast*, edited by W. Suttles, Smithsonian Institution, Washington D.C., pp. 197-202

Dawson, George M.
1887 Note on the Occurrence of Jade in British Columbia, and its Employment by the Natives. *Geological Survey Papers*, Montreal.

Deetz, James
1977 Material Culture and Archaeology -- What's the Difference? In *Historical Archaeology and the Importance of Material Things*, edited by L. Ferguson, Society for Historical Archaeology Special Publication Series, Number 2.

Dewhirst, John
1980 The Indigenous Archaeology of Yuquot, a Nootkan Outside Village. *The Yuquot Project*, Vol. 1, edited by W. Folan and J. Dewhirst, National Historic Parks and Sites Branch, Parks Canada, Environment Canada, History and Archaeology 39.

Dickson, F.P.
1981 *Australian Stone Hatchets, a study of designs and dynamics.* Academic Press, Sydney.

Digby, Adrian
1972 *Maya Jades.* Trustees of the British Museum, London.

Donahue, Paul F.
1972 Preliminary Report of Excavations at Tezli (FdSd 1) BC. Permit 1971-1, Report on File, Archaeology Branch, Victoria.
1977 *4500 Years of Cultural Continuity on the Central Interior Plateau of British Columbia.* Unpublished Ph.D. dissertation, Department of Anthropology, University of Wisconsin, Madison.

Drucker, Philip
1955 *Indians of the Northwest Coast.* The American Museum of Natural History, the Natural History Press, New York (reprinted in 1963).

Duff, Roger
1950 The Moa-Hunter Period of Maori Culture. *Canterbury Museum Bulletin* 1.
1970 Stone Adzes of South-east Asia: an Illustrated Typology. Canterbury Museum Bulletin 3.

Duff, Wilson
1952 *The Upper Stalo Indians of the Fraser River of B.C.* Anthropology in British Columbia, Memoir No. 1, B.C. Provincial Museum, Victoria.

Eldridge, Morely
1974 Recent Archaeological Investigations near Chase. Permit 1972-28, Report on File, Archaeology Branch, Victoria.
1979 Preliminary Report for the 1978 Hope Archaeological Project. Permit 1978-16, Report on File, Archaeology Branch, Victoria.

Elliott, K., D. Ellman, and I. Hodder
1978 The simulation of Neolithic axe dispersal in Britain. In Simulation Studies in Archaeology, edited by I. Hodder, Cambridge University Press, Cambridge, pp.79-81.

Emmons, George T.
1923 Jade in British Columbia and Alaska, and its use by the Natives. *Indian Notes and Monographs* No. 35.

Evans, J
1897 *The Ancient Stone Implements, Weapons and Ornaments, of Great Britain.* London.

Fladmark, Knut R.
1969 Archaeological Sites in the Shuswap - South Thompson Area, B.C. Report on File, Archaeology Branch, Victoria.
1970 Preliminary Report on the Archaeology on the Queen Charloote Islands: 1969 Field Season. Pp. 18-45 in Archaeology in British Columbia: New Discoveries, edited by R.L. Carl son, *B.C. Studies* Nos. 6 and 7, Special Issue.
1975 *A Paleoecological Model for North west Coast Prehistory*. Archaeological Survey of Canada, Mercury Series No. 43.

Referencees

Fladmark, Knut R.

1976 Punchaw Village: A preliminary report. The archaeology of a pre historic settlement. In *Current Research Reports,* edited by R. L. Carlson, Department of Archaeology, Simon Fraser University, Publication No. 3, pp.19-32.

1982 An Introduction to the Prehistory of British Columbia. *Canadian Journal of Archaeology* 6:95-156.

1989 The Native Culture History of the Queen Charlotte Islands. In *The Outer Shores*, edited by G.G.E Scudder and N. Gessler, from the proceedings of the Queen Charlotte First International Symposium, University of British Columbia, August 1984, pp. 199-221.

Fladmark, Sharon Johnson

1973 Report: Shuswap Lakes Archaeological Project. Permit 1972-19, Report on File, Archaeology Branch, Victoria.

Foshag, William F.

1957 Mineralogical Studies on Guatemalan Jade. *Smithsonian Miscellaneous Collections,* 135(5).

Fraser, Ross John

1972 *Nephrite in British Columbia.* M.A. Thesis, Department of Geology, University of British Columbia.

Fredlund, E. Dean and Clyde W. Tucker

1971 Lee Creek Dig, EfQv 1. Permit 1970-9, Report on File, Archaeology Branch, Victoria.

French, Diana E.

1973 Nelson Archaeological Project: Results of the Investigation of a Stratified Campsite, DiQi 1, Near Taglum, B.C. Permit 1972-16, Report on File, Archaeology Branch, Victoria.

Freisinger, Michael A.

1979 Phase I Report of the Boundary Archaeological Survey. Permit 1978-27, Report on File, Archaeology Branch, Victoria.

Galm, Jerry R.

1994 Prehistoric Trade and Exchange in the Interior Plateau of Northwestern North America. In *Exchange Systems in North America,* edited by T. Baugh and J. Ericson, Plenum Press, New York, pp.275-305.

Galm, Jerry R., Ruth Maston, R. Lee Lyman, Daniel G. Landis, Guy R. Muto, Linda Clark, and Keo Boreson

1985 *Aveyís Orchard. Archaeological Investigation of a Late Prehistoric Columbia River Community.* Eastern Washington University Reports in Archaeology and History, Report No. 100-42, Cheney, Washington.

Galvin, Eileen

1977 Taglum Bridge Site (DiQi 2) Salvage Excavation and Preliminary Analysis. Permit 1975-15.

Grabert, G.F.

1968 *North-Central Washington Prehistory.* University of Washington, Department of Anthropology, Reports in Archaeology No. 1.

1974 Okanagan Archaeology 1966-67. *Syesis* 7, Supplement 2.

Gould, Richard A. and Patty Jo Watson

1982 A Dialogue on the Meaning and Use of Analogy in Ethnoarchaeological Reasoning. *Journal of Anthropological Archaeology* 1:355-381.

Guralnik, David B. (chief editor)

1984 Webster's New World Dictionary of the American Language. Warner Books, New York.

Hall, John L.

1969 Archaeological Excavations at Clearwater River Park, August 12-29, 1968. Permit 1968-18, Report on File, Archaeology Branch, Victoria.

Ham, Lenord, A.J. Yip, L.V. Kullar, D.L. Cannon

1984 The 1982/83 Archaeological Excavations at the St. Mungo Site (DgHr 2), North Delta, British Columbia. Report on File, Archaeology Branch, Victoria.

Hansford, S. Howard

1950 *Chinese Jade Carving.* Lund Humphries & Co. Ltd., Bradford and Lon don.

Hanson, Gordon W.

1973 *The Katz Site: A Prehistoric Pithouse Settlement in the* Lower Fraser Valley, British Columbia. Unpublished M.A. thesis, Department of Anthropology and Sociology, University of British Columbia.

Referencees

Hayden, Brian

1987 From Chopper to Celt: the evolution of resharpening techniques. *Lithic Technology* 16(2-3):33-43.

1992 Conclusions. In *A Complex Culture of the British Columbia Plateau: Traditional Stlí·tlíimx Resource Use*, edited by Brian Hayden, UBC Press, Vancouver, pp. 525-565.

Hayden, Brian and Aubrey Cannon

1982 The Corporate Group as an Archaeological Unit. *Journal of Anthropological Archaeology* 1:132-158

Hayden, Brian, Morely Eldridge, Anne Eldridge, and Aubrey Cannon

1985 Complex Hunter-Gatherers in Interior British Columbia. In *Prehistoric Hunter Gatherers*, Academic Press, pp. 181-199.

Hayden, Brian and June M. Ryder

1991 Prehistoric Cultural Collapse in the Lillooet Area. *American Antiquity* 56(1):50-65.

Hayden, Brian and Rick J. Schulting

1997 The Plateau Interaction Sphere and Late Prehistoric Cultural Complexity. *American Anqiquity* 62(1):51-85.

Hayden, Brian and Jim Spafford

1993 The Keatley Creek Site and Corporate Group Archaeology. *BC Studies*, No. 93:106-139.

Hebda, Richard J and Rolf Mathews

1984 Holocene History of Cedar and Native Indian Cultures of the North American Pacific Coast. *Science* 225:711-713.

Henry, Donald O.

1989 Correlations between Reduction Strategies and Settlement Patterns. In *Alter native Approaches to Lithic Analysis*, edited by Donald O. Henry and George H. Odell, Archaeological Papers of the American Anthropology Association Number 1.

Hester, James J. and Sarah M. Nelson (editors)

1978 *Studies in Bella Bella Prehistory*. Department of Archaeology, Simon Fraser University Publication 4, Burnaby.

Hills, Len

1965 Preliminary Report on the Excavation at Agate Bay on Adams Lake, British Columbia. Permit 1965-2, Report on File, Archaeology Branch, Victoria.

Hodder, Ian

1982 Toward a Contextual Approach to Prehistoric Exchange. In *Contexts for Prehistoric Exchange*, edited by J. Erickson and T. Earle, Academic Press, New York, pp.213-236

Hodder, Ian and Paul Lane

1982 A Contextual Examination of Neolithic Axe Distribution in Britain. In *Contexts for Prehistoric Exchange,* edited by J. Erickson and T. Earle, Academic Press, New York, pp.213-236

Holland, Stuart H.

1962 *Jade in British Columbia*. Annual Report for 1961, British Columbia Department of Mines and Petroleum Resources

Howe, Geordie and Mike Rousseau

1979 Test Excavations at DhQv 6, South Okanagan Valley, British Columbia, 1978. Permit 1978-8, Report on File, Archaeology Branch, Victoria.

Huang, Tsui-Mei

1992 Liangzhu - a late Neolithic jade- yield ing culture in southeastern coastal China. *Antiquity* 66:75-83

Hunn, Eugene S.

1990 *Nchíi-W‡na ìThe Big River Mid-Columbian Indians and Their Land.* University of Washington Press, Seattle.

Irvine, C.M.

1973 Report on excavations at the South Yale Site DjRi 7, 1973. Permit 1973, Report on File, Archaeology Branch, Victoria.

Jeske, Robert J.

1989 Economies in raw material use by prehistoric hunter-gatherers. Pp. 34-35 in *Time, Energy, and Stone Tools*, edited by R. Torrence, Cambridge Press, Cambridge

1992 Energetic Efficiency and Lithic Technology: An Upper Mississippian Example. *American Antiquity* 57(3): 467-481

Johnson S., Maria Luisa

1975 Identifcacion de Jade Y Tecnica Para Trabajar el Jade de Mesoamerica. Paper presented at Mesa Redonda de la Sociedad Mexicana de Arqueologia, Tegucigalpa, Honduras, June de 1975.

Referencees

Johnstone, Dave
1991 *The Function(s) of a Shellmidden Site from the Southern Strait of Georgia.* Unpublish M.A. Thesis, Department of Archaeology, Simon Fraser University, Burnaby.

Kapches, Mima
1979 The Production of Celts. *Man in the Northwest* 18:63-81

Kenny, Ray
1972 Preliminary Report Deep Creek Site (FbRn 13). Permit 1972-33, Report on File, Archaeology Branch, Victoria.

Kew, Michael
1992 Salmon Availability, Technology, and Cultural Adaptation in the Fraser River Watershed. In *A Complex Culture of the British Columbia Plateau: Traditional Stl'åtl'imx Resource Use*, edited by Brian Hayden, UBC Press, Vancouver, pp.177-221.

Kinsella, Larry
1993 Personal Notes on Celt Use. *Bulletin of Primitive Technology* 1(5):41

Kreiger, Herbert W.
1928 A Prehistoric Pit House Village Site on the Columbia River at Wahluke, Grant County, Wash. No. 2732, *Proceedings U.S. National Museum*, Vol.73, Art. 11.

Kuijt, Ian
1989 Subsistence Resource Variability and Culture Change During the Middle-Late Prehistoric Cultural Transition on the Canadian Plateau. *Canadian Journal of Archaeology* 13:97-117.

Lange, Frederick W (editor)
1993 *Precolumbian Jade: new geological and cultural interpretations.* University of Utah Press, Salt Lake City.

Lawhead, Stephen
1979 Salvage Archaeology Project May-August, 1978. Permit 1978-9, Report on File, Archaeology Branch, Victoria.
1980 Salvage Archaeology Project, May 15 - Sept. 30, 1979. A Report of the Investigations of the 1979 Mobile Salvage Crew. Report on File, Archae--logy Branch, Victoria.

Leaming, S.F.
1978 *Jade in Canada.* Geological Survey of Canada Paper 78-19.

Leighton, Robert
1989 Ground Stone Tools from Serra Orlando (Morgantina) and Stone Axe Studies in Sicily and Southern Italy. *Proceedings of the Prehistoric Society* 55:135-159.
1992 Jade and Greenstone in the Prehistory of Sicily. *Oxford Journal of Archaeology* 11(2):179-199.

LeMoine, Genevieve
1994 Use Wear on Bone and Antler Tools from the Mackenzie Delta, Northwest Territories. *American Antiquity* 59(2):316-334.

Leone, Mark P.
1982 Some Opinions about Recovering Mind. *American Antiquity* 47:742-760

Levy, Janet
1982 *Social and Religious Organization in Bronze Age Denmark. An Analysis of Ritual Hoards Finds.* British Archaeological Reports International Series 124.

Luebbers, Roger
1978 Excavations: Stratigraphy and Arti facts. In *Studies in Bella Bella Prehistory*, edited by J. Hester and S.M. Nelson, Department of Archaeology, Simon Fraser University Publication No. 5, Burnaby

Mackie, Quentin
1992 *Classification and Use-life Cycle of Groundstone Celts from Coast Salishan British Columbia.* Unpublished M.A. Thesis, Department of Anthropology, University of Victoria.

Magne, Martin
1985a *Lithics and Livelihood: Stone Tool Technologies of Central and Southern Interior British Columbia.* Archaeological Survey of Canada Paper, Mercury Series No. 133.
1985b Taseko Lakes Prehistory Project Phase II: Preliminary Excavations. Permit 1984-11, Report on File, Archaeology Branch, Victoria.

Matson, R.G. and Lenord Ham
1974 Report to ASAB Shuswap Settlement Pattern Project. Permit 1974-10, Report on File, Archaeology Branch, Victoria.

Matson, R.G., M. Magne, D. Ludowicz, D.L. Pokotylo
1980 The Eagle Lake Project: Report on the 1979 Season. Report on File, Archaeology Branch, Victoria.

Referencees

McLeod, Ann and Mark Skinner
1987 Analysis of Burial 86-6 from the Fountain Creek Site (EeRl 19) near Lillooet. Permit 1986-20.

McKenzie, Kathleen
1976a Report of Archaeological Investigation of Two Southeastern BC sites near the headwater of the Columbia Plateau. Permit 1975-12, Report on File, Archaeology Branch, Victoria.
1976b Preliminary Report of Archaeological Investigation at Site EcPx 5 under Permit 1976-16. Permit 1976-16, Report on File, Archaeology Branch, Victoria.

McMurdo, John
1974 A Preliminary Report on Excavations at the Juniper Beach Site EeRg 13. Permit 1974-1, Report on File, Archaeology Branch, Victoria.

Merchant, Peter S., Ian Frank, Susan Woods, Mike K Rousseau, and Rick Schulting
1994 The 1992 Archaeological Investigations at the Woolford Point Site (EfQw 2), Adams Lake, South-Central B.C. Report on File, Archaeology Branch, Victoria.

M'Guire, Joseph D.
1892 Material, Apparatus, and Processes of the Aboriginal Lapidary. *American Anthropologist* 5:165-176
1891 The Stone Hammer and Its Various Uses. *American Anthropologist* 4(4)

Miss, Christian J., Sarah Campbell, S. Neal Crozier, Leon L. Leeds, Stephanie Livingston, R. Lee Lyman, Dorothy Sammons-Lohse, Nancy Stenholm
1984a *Archaeological Investigations at Site 45-DO-214, Chief Joseph Dam Project, Washington.* Office of Public Archaeology, Institute for Environmental Studies, University of Washington.

Miss, Christian J., S. Neal Crozier, Stephanie Livingston, Dorothy Sammons-Lohse, and Nancy A. Stenholm
1984b *Archaeological Investigations at Sites 45-OK-250 and 45-OK-4, Chief Joseph Dam Project, Washington.* Office of Public Archaeology, Institute for Environmental Studies, University of Washington.

Mitchell, Donald
1963 *Esilao - A Pit House Village in the Fraser Canyon, British Columbia.* Unpublished MA Thesis, Department of Anthropology and Sociology, University of British Columbia.
1968 Archaeological Investigations, Summer, 1967. Permit 1967-4, Report on File, Archaeology Branch, Victoria.
1969 Archaeological Investigations, Summer, 1968. Permit 1968-11,12,15, Report on File, Archaeology Branch, Victoria.
1970 Archaeological Investigations on the Chilcotin Plateau, 1968. Syesis 3(1-2):45-65.
1990 Prehistory of the Coasts of Southern British Columbia and Northern Washington. In Handbook of North American Indians, Vol 7: Northwest Coast, edited by W. Suttles, Smithsonian Institution, Washington D.C., pp.340-358.

Mohs, Gordon
1973 EkRo 48: A Preliminary Site Report. Permit 1972-11, Report on File, Archaeology Branch, Victoria.

Mohs, Gordon
1977 Arrow Lakes Reservoir Region Post Inundation Studies of Archaeological Resources. Permit 1977-11, Report on File, Archaeology Branch, Victoria.
1980a Shuswap Planning Study. The Heritage Resources of the Western Shuswap Basin. An Inventory, Interpretation, and Evaluation. Report on File, Archaeology Branch, Victoria.
1980b Heritage Resources of the Western Shuswap Basin: An Inventory, Interpretation and Evaluation. Report on File, Archaeology Branch, Victoria.
1981 Excavations of a Rectangular House pit: Heritage Site EdQs 14. Permit 1980-5, Report on File, Archaeology Branch, Victoria.
1985 Archaeological Investigations at the Vallican Site DjQj 1, Slocan Valley, Southeastern B.C. Permit 1981-16.

Montgomery, Pamela
1980 The Blackwater Drainage Study, A Heritage Inventory Project in the Vicinity of Quesnel, British Columbia. Permit 1979-22

Referencees

Moore, Desmond F.
1975 *Principles and Applications of Tribology*. Pergamon Press, Oxford.

Morice, A.G.
1893 Notes: Archaeological, Industrial and Sociological on the Western Denes with an ethnographic sketch of the same. *Transactions of the Canadian Institute, Session 1892-1893*.

Muir, Robert J. and Mike K. Rousseau
1992 An Archaeological Impact Assessment for a Proposed Residential Subdivision Development, McLeod Point, Adams Lake, B.C. Permit 1992-75, Report on File, Archaeology Branch, Victoria.

Muir, Robert, Mike K. Rousseau and Peter Merchant
1992 An Archaeological Impact Assessment for the Proposed Stein River Water Pipeline Project (Phase 1), Lytton, British Columbia. Permit 1992-32, Report on File, Archaeology Branch, Victoria.

Murray, Rebecca Anne
1982 *Analysis of Artifacts from Four Duke Point area Sites, Near Nanaimo, B.C.: An Example of Cultural Continuity in the Southern Gulf of Georgia Region.* Archaeological Survey of Canada, Mercury Series Paper No. 113.

Nelson, Charles M.
1969 The Sunset Creek Site (45KT28) and Its Place in Plateau Prehistory. Washington State University, Laboratory of Anthropology, *Report of Investigations*, No. 39, Pullman.

1973 Prehistoric Cultural Change in the Intermontane Plateau of Western North American. In The Explanation of Culture Change: *Models in Prehistory*, edited by C. Renfrew, University of Pittsburgh Press, Pittsburgh, pp. 371-390.

Olausson, Deborah S.
1983 Flint and Groundstone Axes in the Scanian Neolthic: An Evaluation of Raw Materials Based on Experiment. *Scripta Minora, Regaae Societatis Humaniorum Litterarum Lundensis* 1982-1983:2, CWK Gleerup.

Patenaude, Valerie C.
1985 The Pitt River Archaeological Site, DqRq 21: A Coast Salish Seasonal Camp on the Lower Fraser Coast, Volume II. Report on File, Archaeology Branch, Victoria.

Phillips, Patrica
1975 Stone axes in ethnographic situations: some examples from New Guinea and the Solomon Islands. In *Stone Axe Studies. Archaeological, petrological, experimental, and ethnographic edited by* T.H. McK Clough and W.A. Cum mins Council for British Archaeology, Research Report No. 23.

Pokotylo, David L. and Patricia D. Beirne
1978 Preliminary Inventory, Assessment, and Impact Evaluation of Cultural Heritage Resources in the Upper Hat Creek Valley, B.C. Permit 1977-30, Report on File, Archaeology Branch, Victoria.

Pokotylo, David L., Marian E. Brinkley, and A. Joanne Curtin
1987 The Cache Creek Burial Site (EeRh 1), British Columbia. *Contribution to Human History* 1:1-14.

Pond, A.W.
1930 *Primitive Methods of Working Stone. Based on Experiments of Halvor L. Skavlem.* Logan Museum Bulletin No. 2, Beloit College, Beloit, Illinois.

Rappaport, R.A.
1968 *Pigs for the Ancstors*. New Haven, London.

Ray, Verne F.
1939 *Cultural Relations in the Plateau of Northwestern America.* Publication of the Frederick Webb Hodge Anniversary Fund, Vol. III, Southwest Museum, Los Angeles.

Renfrew, Colin
1977 Alternative Models for Exchange and Spatial Distribution. In *Exchange Systems in Prehistory,* edited by T.K. Earle and J. E. Ericson, Academic Press, New York, pp.71-90.

Rice, David G
1968 Archaeological Investigations in the Coulee Dam National Recreation Area, Spring 1968. *Washington State University Laboratory of Anthropology Reports of Investigations*, No. 45.

Richards, Thomas
1978 Excavations ar EeRl 171: A Preliminary Report to the Archaeological Sites Advisory Board of British Columbia. Report on File, Archaeology Branch, Victoria.

Referencees

Richards, Thomas H. and Michael K. Rousseau

1982 Archaeological Investigations on Kamloops Indian Reservation No.1, Kamloops, British Columbia. Permit 1980-8, Report on File, Archaeology Branch Victoria.

1987 *Late Prehistoric Cultural Horizons on the Canadian Plateau*. Department of Archaeology, Simon Fraser University Publication No. 16.

Roberts, G.W.

1975 The Inkameep Archaeological Project 1973 and 1974. Permit 1974-9, Report on File, Archaeology Branch, Victoria.

Rousseau, Eunice and Michael Rousseau

1978 Burials from Site EiRn 15, Canoe Creek. Permit 1978-8, Report on File, Archaeology Branch, Victoria.

Rousseau, Michael

1984 Heritage Investigations on Tsinstikeptum Indian Reserve Number 10, West Side Locality, North Okanagan Valley, British Columbia. Non-permit report, on file with the Archaeology Branch, Victoria

1988 Heritage Resource Inventory and Investigation for the Ros Lake Provincial Park Campground Expansion, Upper Skagit Valley, British Columbia. Permit 1988-17, Report on File, Archaeology Branch, Victoria.

1989 The 1988 results of the archaeological investigations in Upper Oregon Jack Creek Valley and on the Cornwall Hill Summit near Ashcroft, British Columbia. Report on File, Archaeology Branch, Victoria.

Rousseau, Michael and R J. Muir

1991a Archaeological Investigations at Site FaRm 23: An Early Shuswap Horizon Deer Hide Preparation Focus, Williams Lake, South Central, British Columbia. Permit 1990-120, Report on File, Archaeology Branch, Victoria.

1991b The 1991 Archaeological Shovel Testing Program Conducted within and near Prehistoric Site EeRb 77, Kamloops Indian reserve No. 1, Kamloops, British Columbia. Permit 1991-90, Report on File, Archaeology Branch, Victoria.

1992a Archaeological Investigations at the Ducks Meadow Quarry Site, Monte Creek Valley, South Central B.C. Report on File, Archaeology Branch, Victoria.

Rousseau, Michael and R J. Muir

1992b An Archaeological Impact Assessment for the Stein River Water Supply Project, Water Treatment and Booster Station, Lytton, South-Central B.C. Non-Permit, Report on File, Archaeology Branch, Victoria.

Rousseau, Michael K., Peter Merchant, Robert J. Muir, and Jeff D. Bailey

1993 An Archaeological Impact Assessment for Eight Ministry of Transportation and Highways Development Projects (1992-1993) in the South Coast, Thompson-Okanagan, and Kootenay Highway Regions, Southern British Columbia. Report on File, Archaeology Branch, Victoria.

Rousseau, M., R. Muir, and D. Alexander

1991 The 1990 Archaeological Investigations Conducted at the Fraser Bay Site EfQt 1, Shuswap Lake, South Central British Columbia. Permit 1990-126, Report on File, Archaeology Branch, Victoria.

Rousseau, M., R. Muir, D. Alexander, J. Breffit, S. Woods, K. Berry and T. Van Galen

1991 Results of the 1989 archaeological investigations conducted in the Oregon Jack Creek locality, Thompson River Region, South Central British Columbia. Report on File, Archaeology Branch, Victoria.

Rousseau, M. K. and Thomas Richards

1988 The Oregon Jack Creek Site (EdRi-6): a Lehman Phase Site in the Thompson River Valley, British Columbia. *Canadian Journal of Archaeology* 12:39-63.

Romanoff, Steven

1992 Fraser Lillooet Salmon Fishing. In *A Complex Culture of the British Columbia Plateau: Traditional Stlí·tlíimx Resource Use*, edited by Brian Hayden, UBC Press, Vancouver, pp.222-265.

Sanger, David

1968a *The Chase Burial Site EeQw: 1, British Columbia*. National Museums of Canada Bulletin 224, Contributions to Anthropology VI: Archaeology, Ottawa.

1968b *The Texas Creek Burial Site Assemblage, British Columbia.* National Museum of Canada, Anthropology Paper 17, Ottawa

1970 The archaeology of the Lochnore-Nesikep locality, British Columbia. *Syesis* Vol. 3 (Supplement 1).

Referencees

Schiffer, Michael B.
1976 Behavioral Archaeology. Academic Press, New York.

Schulting, Rick J.
1995 *Mortuary Variability and Status Dif ferentiation on the Columbia-Fraser Plateau.* Archaeology Press, Simon Fraser University, Burnaby.

Semenov, S. A.
1964 *Prehistoric Technology: An Experimental Study of the Oldest Tools and Artifacts from Traces of Manufacture and Wear.* Barnes and Noble, London.

Sendey, John
1972 Preliminary Report of Excavations at Site EfQu 3, Shuswap Lake Provincial Park, 1971. Report on file, Archaeology Branch, Victoria.

Severs, Patricia D.S.
1974 Archaeological Investigations at Blue Jackets Creek, FlUa 4, Queen Char lotte Islands, British Columbia, 1973. *Canadian Association of Archaeology Bulletin* No. 6, 163-205.

Sharp, Lauriston
1952 North Thompson River Archaeological Project Report #2, Heritage Resource Investigations of Mid-North Thompson River Region, British Clumbia. Permit 1982-24, Report on File, Archaeology Branch, Victoria.

Sherratt, Andrew G.
1976 Resources, technology and trade: an essay in early European metallurgy. In *Problems in economic and social archaeology* , edited by G. de G. Sieveking, I.H. Longwoth, and K.E. Wilson, Duckworth, London, pp. 557-582

Shott, Michael J.
1994 Size and Form in the Analysis of Flake Debris: Review and Recent Approaches. *Journal of Archaeological Method and Theory* 1(1):69-110

Smith, Harlan I.
1899 The Archaeology of Lytton. *Memoirs of the American Museum of Natural History*, 2(3):129-161.
1900 Archaeology of the Thompson River Region, British Columbia. *Memoirs of the Museum of Natural History*, 2(6): 401-442.
1909 Archaeology of the Gulf of Georgia and Puget Sound. In *Memoirs of the American Museum of Natural History*, 4(6):301-441.

Skinner, Mark and Stanley Copp
1986 The Nicoman River Burial Site (EbRi 7), Near Lytton, British Columbia. Permit 1985-4, Report on File, Archaeology Branch, Victoria.

Skinner, Mark and Ron Thacker
1988 Quilchena Hotel Burial Site (EaRd 14), Nicola Lake, B.C. Permit 1987 2GSK1, Report on File, Archaeology Branch, Victoria.

Sneed, Paul G.
1977 Heritage Resources Impact Statement: Test Excavations at Siska Flat (EaRj-15). Permit 1977-19, Report on File, Archaeology Branch, Victoria.
1979 Archaeological Excavations at Siska Flat (EaRj 15) Heritage Inpact Assessment. In *Annual Report for the year 1977. Activities of the Provincial Archaeology Office of British Columbia and Selected Research Reports*, Victoria

Spinden, Herbert Joseph
1915 The Nez PercÈ Indians. *Memoirs of the American Anthropological Association*, Vol II, 1907-1915, Lancaster.

Sprague, Roderick
1967 *Aboriginal Burial Practices in the Plat eau Region of North America.* Unpublished PhD. Dissertation, Department of Anthropology, University of Arizona, Tucson.

Steensberg, Axel
1980 *New Guinea Gardens: A Study of Husbandry with Parallels in Prehistoric Europe*. Academic Press, London.

Stryd, Arnoud H.
1970 Prelininary Report of the 1970 Archaeological Excavations near Lillooet, British Columbia, Report on File, Archaeology Branch, Victoria.
1972 Salvage Archaeology at Lillooet, British Columbia: Site EeRl 40 and EeRl 41. Report on File, Archaeology Branch, Victoria.
1973 *The Later Prehistory of the Lillooet Area, British Columbia.* Ph.D. Dissertation, Department of Archaeology, University of Calgary.
1974 The Divide Site (EeRk 17) A Report to the Fountain Indian Band. Permit 1974-12, Report on File, Archaeology Branch, Victoria.

Referencees

Stryd, Arnoud H.

1981 The 1980 Investigations of the Monte Creek Archaeological Site (EdQx 15). Permit 1980-11, Report on File, Archaeology Branch, Victoria.

1989 Detailed Impact Assessment and Mitigation, Columbia Pacific Chip Mill Development, Cache Creek, British Columbia. Permit 1988-73, Report on File, Archaeology Branch, Victoria.

Stryd, Arnoud H and L.V. Hills

1972 An Archaeological Site Survey of the Lillooet-Big Bar Area, British Columbia. *Syesis* 5.

Stryd, Arnoud H. and Stephen Lawhead

1983 Bethlehem Copper Corporation Lake Zone Development Heritage Mitigation Study. Report on File, Archaeology Branch, Victoria.

Stryd, Arnoud and Thomas Richards

1990 Archaeological Excavations at Site EfQv 121, EfQv 123 and EfQv 133 Near Squilax, B.C. Volume 1, Report on File, Archaeology Branch, Victoria.

Szymanski, Andrzej, and Janusz Mikolaj Szmanksi

1989 *Hardness Estimation of Minerals, Rocks and Ceramic Materials*. Material Science Monographs 49, Polish Scientific Publishers, Warszawa.

Teit, James A.

1900 The Thompson Indians. *American Museum of Natural History Memoirs* 2:4, New York.

1906 The Lillooet Indians. *American Museum of Natural History Memoirs* 2(5):195-292, New York.

1909a The Shuswap. *American Museum of Natural History Memoirs* 4(7):447-758, New York.

1909b Notes on the Chilcotin. *American Museum of Natural History Memoirs* 4(7):759-789, New York.

1912 Mythology of the Thompson. *Ameri can Museum of Natural History Mem oirs* 12, New York.

1930 The Salishan Tribes of the Western Plateaus. *Annual Report of the Bureau of American Ethnology* 45:295-396, Washington.

Thomas, Lorie

1977 Archaeological Salvage Investigations at Dragon Lake (FfRo 4). Permit 1977-17, Report on File, Archaeology Branch, Victoria.

Torrence, Robin J.

1983 Time budgeting and hunter-gatherer technology. In *Hunter-Gatherer Economy in Prehistory: A European Perspective,* edited by G. Bailey, Cambridge University Press, Cambridge, pp.11-22

1989 *Time, Energy, and Stone Tools.*(editor) Cambridge University Press, Cambridge.

Treganza, A.E. and L.L. Valdivia

1955 The manufacture of pecked and ground stone artifacts: a controlled study. *Reports of the University of California Archaeological Survey* 32.

Turnbull, Christopher J.

1977 *Archaeology and Ethnohistory in the Arrow Lakes, Southeastern British Columbia.* Archaeological Survey of Canada, Mercury Series 65, Ottawa.

Turner, F.J.

1935 Geological investigation of the nephrites, serpentines, and related Green stones used by the Maoris of Otago and South Canterbury. *Transactions of the Proceedings of the Royal Society of New Zealand*, Vol. 65(2).

Vivian, Brian

1992 *Similkameen Valley Prehistory: Cultural Interaction Across the Interior Plateau of* British *Columbia and Washington State.* Unpublished MA Thesis, Department of Archaeology, University of Calgary.

Von Krogh, Hennig

1980 Archaeological Investigations at the Flood and Pipeline Sites, near Hope, British Columbia. *Occasional Papers of the Archaeological Sites Advisory Board of British Columbia* 1, Victoria.

Wales, W. Derek

1980 Archaeological Site Survey and Excavation, Seton Portage - Shalalth. A Preliminary Report. Permit 1974-31, Report on File, Archaeology Branch, Victoria.

Whitlam, Robert

1976 Archaeology of the Williams Lake Area, British Columbia. *Occasional Papers of the Archaeology Sites Advisory Board of British Columbia,* No. 1.

1980 Archaeological Investigations at Cache Creek. *Occasional Papers of the Heritage Conservation Branch,* No. 5.

Referencees

Wigen, Becky

1984 Archaeological Salvage and Monitor ing Proceedings at Site EeRl 192, Seton Generating Substation Project. Permit 1984-28, Report on File, Archaeology Branch, Victoria.

Wilmeth, Roscoe

1978 *Anahim Lake Archaeology and the Early Historic Chilcotin Indians.* Archaeological Survey of Canada, Mercury Series, Paper No. 82.

Wilson, Ian

1991 Excavations at EdQx 41 and 42 and Site Evaluation at EdQx 43, Monte Creek, British Columbia. Report on File, Archaeology Branch, Victoria.

Wilson, Robert L.

1980 Archaeological Investigations near Kamloops. In *Archaeology of Kamloops*, by Robert Wilson and Catherine Carlson. Department of Archaeology, Simon Fraser University, Publ. 7.

Wilson, Robert L.

1983 North Thompson River Archaeological Project Report #2, Heritage Resource Investigations of Mid-North Thompson River Region, British Columbia. Permit 1982-24, Report on File, Archaeological, petrological, experimental, and ethnographic edited by T.H. McK Clough and W.A. Cummins. *Council for British Archaeology, Research Report* No. 23.

Wolley, A.R., A.C. Bishop, R.J. Harrison, & I.A. Kinnes

1975 European Neolitic jade implements: a preliminary mineralogical study. Pp. 91-96 in Stone Axe Studies.

Wu, C. Cm., K.R. McKinney, and R.W. Rice

1990 Strength and toughness of jade and related natural fibrous materials. *Journal of Material Sciences* 25:2170-2174

Wyatt, David

1972 *The Indian History of the Nicola Valley, British Columbia.* Unpublish PhD. Dissertation, Department of Anthropology, Brown University.

Appendix 1 - Museum Collection Data

Catalogue Number	Collection	Artifact Type	Provenience	Length	Width	Thickness
1	Fladmark	Celt	Little River	181	53.9	13.3
2	Fladmark	Celt	EeQw 3, Little River	78	46.3	13
3	Fladmark	Celt	EeQw 6, Little River	69.7	45.1	8.4
4	Fladmark	Celt	EeQw 3, Little River	108.1	53.9	10.5
5	Fladmark	Celt	EfQv 2, Little River	100.5	57.9	16.9
6	Fladmark	Celt	EeQw 3, Little River	54.6	45.9	11.2
7	Fladmark	Knife	EeQw 5 ?, Little River	66.5	47.6	5
8	Fladmark	Knife	EeQw 5 ?, Little River	77.8	18	4.8
9	Fladmark	Celt/Chisel	EeQw 6, Little River	62.3	31.7	5.3
10	Fladmark	Gouge ?	South Thompson (EpSi1?)	46	20.1	4.6
11	SFU Museum 93-1-1273	Celt (Pick ?)	Lytton	290	35.9	29.3
12	SFU Museum 2964	Sawn boulder frag.	EeRl 19, Fountain Site	105.2	53.2	60.1
13	SFU Museum 93-1-1272	Celt	North Lytton	179	40.5	17.2
14	SFU Museum 2646	Celt	Lillooet	114.1	30.3	7.4
15	SFU Museum 93-1-926	Celt	North Lytton	65.1	52.6	12.8
16	SFU Museum 93-1-1007	Celt	Lytton	53.6	42.9	17.7
17	SFU Museum 93-1-113	Celt	East Lillooet	80.5	51.7	10.3
18	SFU Museum 93-1-1114	Celt	Lillooet	55.8	52.8	11.8
19	SFU Museum 93-1-927	Celt	North Lytton	49.4	26.1	12.1
20	SFU Museum 93-1-993	Chisel	North Lytton, Burial 2	44.2	14.3	2.8
21	SFU Museum 93-1-1127	Miscellaneous worked frag.	East Lillooet	37.6	18.4	5.7
22	SFU Museum 93-1-1076	Celt	Interior	29.3	12.2	4.4
23	SFU Museum 6777	Celt	Bostok Ranch, Tranquil	80.7	56	15.5
24	SFU Museum 177	Celt	EfQv 2	54.9	48.1	11.4
25	SFU Museum 2636	Manufacturing debris	Lillooet	99.6	77.5	15.3
26	SFU Museum 2641	Celt	Lillooet	89.6	66	13.3
27	SFU Museum 15b	Celt blank	Lillooet	159.5	81.9	23.2
28	SFU Museum 4519	Celt blank	Cache Creek	85.2	55.4	6.6
29	SFU Museum 2635	Celt	Lillooet	113.7	65.8	16.5
30	SFU Museum 2635	Manufacturing debris	Lillooet	205.9	45.2	19.2
31	SFU Museum 178	Celt	EfQv 2	121.1	57.3	21.5
32	SFU Museum 6951	Celt	Pitt Meadows *	115.9	56.6	15.6
33	SFU Museum 7145	Knife	Egmont *	51.6	23.4	6.6
34	SFU Museum 2642	Celt	Lillooet	65.5	45.2	13.3
35	SFU Museum 2637	Manufacturing debris	Lillooet	105.1	29.6	25.8
36	SFU Museum 3313	Celt blank/manufacturing debris	Lytton ?	165.3	69.9	27.2
37	SFU Museum 7190	Celt	Nicola Valley	85.2	40.9	12.6
38	SFU Museum 2638	Celt	Lillooet	96.5	46.4	8.5
39	SFU Museum 3313	Manufacturing debris	Lytton	113.8	39.1	20
40	SFU Museum 4068	Celt/Chisel/Gouge	Tsawwassen *	112.8	23.1	10.9
41	SFU Museum 3296	Manufacturing debris	Lytton	140	76.8	20.2
42	SFU Museum ElRn 14:2	Celt	ElRn 14	119.5	70.2	29.3
43	SFU Museum ElRn 13:3	Celt	ElRn 14	86	56.7	21.4
44	SFU Museum 2638	Celt	Lillooet	70.7	30.8	17.7
45	SFU Museum 2640	Celt	Lillooet	80.9	49	12.7
46	SFU Museum 6	Celt	Lytton	126.1	34.3	20.1
47	SFU Museum 15c	Manufacturing debris	Lytton	71.9	17.6	13.6
48	SFU Museum 16c	Chisel	Lytton	39.5	19.7	4.5
49	SFU Museum 16a	Celt/Chisel	Lytton	56.5	22.3	5
50	SFU Museum 15d	Manufacturing debris	Lytton	54.7	37.4	13.6
51	SFU Museum 11a	Celt	Lytton	97.7	49	12.6
52	SFU Museum 7647	Celt/Chisel	Unknown	109.2	24.3	5.5
53	SFU Museum 16a	Celt	Lytton	76.1	45.3	14.1
54	SFU Museum 93-1-1003	Celt/Chisel	Lytton	40.1	27.2	10.2
55	SFU Museum 11d	Celt (Double Bit)	Lytton	125	54.3	12.1
57	SFU Museum 11c	Celt	Lytton	63.5	28.9	15.6
58	SFU Museum 11d	Celt	Lytton	48.3	35.5	10.8
60	SFU Museum 16b	Celt	Lytton	51.3	33.8	13.7

61	SFU Museum 2750	Celt	Lillooet	209.1	51.4	18.8
62	SFU Museum 2748	Celt (Double Bit)	Lillooet	221.1	42.1	13.5
63	UBC EeQw1-41	Celt	EeQw 1 (Chase)	262	48.1	14.1
64	UBC EeQw1-50	Celt	EeQw 1 (Chase)	144	53.6	14.4
65	UBC EeQw1-122	Celt	EeQw 1 (Chase)	108.5	51.3	15.5
66	UBC EeQs1:1D.1M.1	Celt	EeQs 1	59.7	23.7	13.8
67	UBC EeQl 3:1	Celt	EeQl 3	156	48.5	13
68	SFU Museum 7170	Celt	Nicola	46.8	39.6	13.5
69	SFU Museum 7191	Celt	Nicola	104.2	49.8	11.3
70	UBC EfQv1:3	Celt	EfQv 1	275	54.1	18.3
71	Keatley Creek 5534	Celt	EeRl 7 (Lillooet)	82.5	58	13.8
72	Keatley Creek 5923	Celt	EeRl 7 (Lillooet)	12	23.3	5.2
73	Keatley Creek	Miscellaneous frag.	EeRl 7 (Lillooet)	12.1	9.6	2.4
74	SFU Museum 15a	Sawn boulder	Lytton	218	78	74
75	SFU Museum 2815	Sawn boulder	Lillooet	451	116	92
76	UBC EfQv1:2	Celt	EfQv 1	167	51.6	12.6
77	UBC EfRl 258-428	Celt blank	EfRl 253	134	79	19.6
78	UBC FaRn-x:10	Sawn boulder	FaRn (Williams Lake area)	338	187	58.6
79	SFU Museum EbRj 92	Celt rejuvenation frag.	EbRj 92 (Lytton)	34.3	25.9	8.1
80	UBC EeRl-x:4	Celt	EeRl (Lillooet area)	147	52	12.5
81	UBC EeRl-x:5	Celt blank	EeRl (Lillooet area)			
82	UBC EeRl-x:3	Celt blank	EeRl (Lillooet area)	141	74.5	21.1
83	UBC EeRm-x:2	Celt	EeRm (Seton Lake)	71.1	50.9	5.3
84	UBC EdRk-3:3	Celt	EdRk 3 (Lochnore locality)	132	29.4	15.8
85	UBC EdRk-3:11	Miscellaneous frag.	EdRk 3 (Lochnore locality)	131	54.7	16.3
86	UBC EeRl-x:12	Sawn boulder	EeRl (Lillooet Area)	279	142	86
87	UBC EbRj-1:26	Manufacturing debris	EbRj 1 (Lytton)	74	19.2	13.2
88	UBC EbRj 1:378	Celt	EbRj 1 (Lytton)	33.5	25.6	11.1
89	UBC D1.470	Manufacturing debris	Interior ?	217	48.2	39

Appendix 1 - Museum Collection Data Continued

Cat. No.	Weight	Specific Gravity	Hardness	Working Edge Angle	Use Wear	Material Color
1	283.4	3	n/a	43	Minor striations on bit	spinach green, semi-translucent
2	95.5	2.96	6-6.5	57	Minor edge damage	spinach green, semi-translucent
3	40.2	2.91	6	43	Minor edge damage, pole battered	black/spinach green
4	114.2	2.92	5-6	58	Heavy striations on bit	black to dark spinach
5	168.8	3.05	6-6.5	57	Minor striations on bit	dull dark green
6	51.2	2.91	n/a	52	Minor edge damage	dull redish brown
7	26.8	2.96	n/a	29	None observable	emerald to spinach green
8	10.2	2.97	n/a	41	Minor striations	emerald green, semi-translucent
9	15.15	2.94	6-6.5	43	Minor edge damage	emerald green, semi-translucent
10	n/a				None observable	emerald green, semi-translucent
11	411	3	6-6.5		Severe edge damage	emerald to lawn green
12	348.5	2.99	6		n/a	light green, dull luster
13	263.5	2.99	6-6.5		n/a	emerald green, semi-translucent
14	48.5	2.94	6-6.5	46	Minor edge damage, pole battered	emerald green with black mottles
15	61.65	2.97	6-6.5		n/a	emerald green
16	80.05	2.95	6-6.5	53	Severe edge damage	spinach green, not translucent
17	66.1	2.96	6-6.5	34	None observable	emerald green, semi-translucent
18	50.85	2.92	6-6.5	65	Minor edge damage	lawn green
19	28.5	2.86	5-6	64	Heavy striations on bit	spinach green, not translucent
20	2.65	n/a	24		Minor striations on bit	light green, translucent
21	4.4	6-6.5			n/a	emerald green, semi-translucent
22	6-6.5	44			n/a	emeral green, translucent
23	133.05	2.97	6-6.5	68	Striations on bit, minor edge damage	emerald green, semi-translucent
24	38.9	2.95	6-6.5		Severe edge damage	medium green, not translucent
25	121.3	3	6-6.5		n/a	emerald green, semi-translucent
26	115.55	2.98	6-6.5	41	None observable	emerald green, semi-translucent

27	578.1	3.02	6		n/a	spinach green, semi-translucent
28	48.2	2.94	6		n/a	medium green
29	187.5	2.98	6-6.5	66	Bit dulled	mottled emerald green,
30	170.2	2.95	5-6		n/a	emerald green, semi-translucent
31	270.7	2.96	6-6.5	30	Minor edge damage	spinach green, semi-translucent
32	173.5	2.86	4-5	58	Minor edge damage	mottled grey brown
33	10	n/a	44		None observable	spinach green, semi-translucent
34	72.5	2.92	n/a	62	Striations on bit, minor edge damage	off white all over
35	75.5	2.95	5-6		n/a	emerald green, semi-translucent
36	447.95	2.99	6-6.5		n/a	spinach green, semi-translucent
37	82.8	2.98	6-6.5	72	Striations on bit, min	spinach green, semi-translucent
38	73.9	2.94	6-6.5		n/a	emerald green, semi-translucent
39	112.55	2.99	6-6.5		n/a	mottled medium green
40	41.7	2.84	n/a	35	Striations on bit	striated green and black
41	240	2.97	6-6.5		n/a	lawn green, semi- translucent
42	418.1	2.99	5-6	53	Heavy striations on bit	medium green, not translucent
43	151.5	3.01	6-6.5		n/a	medium green, not translucent
44	78.4	2.96	6-6.5		None observable	black and beige
45	123.5	2.64	n/a	53	Heavy striations, edge damage	greenish beige
46	145.9	2.97	5-6 (on cortex)	32	Minor edge damage	emerald to light green
47	17.6	6			n/a	emerald green, semi-translucent
48	n/a	33			None observable	spinach green, semi-translucent
49	n/a	39			None observable	medium green with prox
50	28.1	2.9	6.5-7		n/a	spinach green
51	128.6	2.94	6-6.5	47	Severe edge damage	spinach green, semi-translucent
52	23.4	n/a	45		None observable	spinach green, semi-translucent
53	71.4	2.6	6-6.5	62	Striations on bit, minor edge damage	medium green
54	n/a	44			None observable	emerald green, semi-translucent
55	170	2.85	n/a	57	Minor striations on front bit	black with brown striations
57	40.4	2.87	5-6	58	Minor edge damage	meduim green with white mottles
58	n/a	68			Heavy striations on bit	emerald green, semi-translucent
60	n/a	64			Heavy striations on bit	spinach green, not translucent
61	400.55	2.95	6-6.5	62	Striations on bit, min	emerald to medium green
62	173.2	3.03	6-6.5	49	Straitions on front bit	dark spinach green
63	n/a	56			None observable	emerald green, semi-translucent
64	n/a	63			Striations present on	emerald green, semi-translucent
65	n/a	56			None observable	emerald to spinach green
66	n/a				n/a	black to deep spinach green
67	n/a	39			Heavy striations on bit	beige green, not translucent
68	42.2	2.59	5-6	62	Heavy striations on bit	spinach green
69	114.4	2.94	6-6.5		n/a	light green
70	n/a	33			Striations present on	emerald to medium green
71	83.8	2.95	6-6.5	68	Striations on bit	emerald green, semi-translucent
72	6-6.5	37			Striations on bit	emerald green, semi-translucent
73	6-6.5				n/a	emerald green, semi-translucent
74	2151.1	3	6-6.5		n/a	spinach green, semi-translucent
75	10390.9	2.99	6-6.5		n/a	emerald green, semi-translucent
76	n/a	55			Striations present on	emerald to medium green
77	n/a				n/a	green
78	n/a				n/a	medium green, semi-translucent
79	6.5-7				n/a	spinach green, semi-translucent
80	n/a				n/a	medium green, semi- translucent
81	n/a	32			n/a	emerald to medium green
82	n/a				n/a	spinach green, semi-translucent
83	n/a	41			n/a	spinach green, translucent
84	n/a				n/a	spinach green, semi-translucent
85	n/a				n/a	spinach green, semi-translucent
86	n/a				n/a	spinach green, semi-translucent
87	n/a				n/a	spinach green, semi-translucent
88	n/a				n/a	green
89	n/a				n/a	spinach green, semi-translucent

Appendix 1 - Museum Collection Data Continued

Catalogue Number	Portion	Bit	Pole	Margins	Cross-section	Blank Type	Manufacturing
1	Complete	Unifacial with slight beveling	Roughly formed	Slightly tapering,	Rectangular	Sawn blank	One groove present
2	Distal - pole missing	Bifacial, straight	not present	Ground straight	Rectangular	Sawn blank	Two grooves left in margins
3	Distal - pole missing	Unifacial, diagonal	not present	Broken	Rectangular	Sawn blank	none observable
4	Complete	Unifacial, diagonal	reworked	Ground straight	Rectangular	Sawn blank	Two grooves are present
5	Complete	Bifacial, straight	Chipped	Slightly tapering	Oval/Rectangular	Flaked blank	Flake scars still present
6	Complete	Unifacial with slight beveling	Partially formed	Tapering	Rectangular	Sawn blank	none observable
7	Complete	One margin unifacial	n/a	n/a	Triangular	Unknown	none observable
8	Complete	One margin unifacial	n/a	Roughly ovate in shape	Rectangular	Sawn blank	Groove left in one side
9	Complete	Diagonal but cut straight	Ground flat	Tapering, bevelled	Plano-convex	Indeterminante	none observable
10	Complete	No working edge	n/a	Totally rounded	Rectangular	Unknown	possible snap scar
11	Complete	Bifacial	Not finished, battered	Rectangular	Semi-rectangular	Sawn blank	Groove present in one side
12	Fragment of larger celt	n/a	n/a	n/a	n/a	n/a	Snap scars present
13	Proximal - bit missing	Not present	Ground flat	Slightly tapering	Rectangular	Sawn blank	Grooves present in one side
14	Complete	Bifacial, diagonal	Roughly formed	Slightly tapering	Rectangular	Sawn blank	Groove present in one side
15	Medial - pole and bit missing	n/a	n/a	rounded	Oval	Indeterminante	none observable
16	Distal - pole missing	Unifacial with slight bevelling	n/a	One margin ground flat	Rectangular	Sawn blank	snap scar and groove present
17	Complete	Unifacial, concave	Not finished	Irregular	Irregular	Flake blank	Flake scars present
18	Complete	Unifacial, convex	Formed	Tapering, ground round	Oval	Flake blank	Flake scars present
19	Distal - pole missing	Bifacial, straight	n/a	Snap scar and groove	Rectangular	Sawn blank	Snap scars present
20	Complete	Unifacial with slight bevelling	Ground flat	One ground flat	Oval	Flake Blank ?	none observable
21	n/a	n/a	n/a	n/a	n/a	n/a	Snap and groove scars
22	Bit Fragment	n/a	n/a	n/a	n/a	n/a	n/a
23	Complete	Unifacial with slight bevelling	Battered but was formed	Tapering, ground flat	Rectangular	Sawn blank	Grooves present
24	Distal/Mediall	Indeterminante	n/a	Groove present in one face	Indeterminante	Sawn blank ?	Groove present in one side
25	n/a	n/a	n/a	n/a	n/a	n/a	Large groove marks
26	Complete	Unifacial, convex	Not finished	Tapering, one margin	Rectangular	Flake blank	Flake scars present
27	Complete	Not present yet	n/a	n/a	Rectangular	Sawn blank	Snap scar present
28	Complete	Not present yet	Semi-ground	Roughly tapering	Irregular	Flake blank	Flake scars present
29	Complete	Bifacial, convex	Not finished	Tapering, one side	Oval	Flake blank	Flake scars present
30	n/a	n/a	n/a	n/a	Rectangular	Sawn blank	Snap scar present
31	Distal - pole missing	Unifacial	n/a	Ground flat	Rectangular	Sawn blank	Groove present in one side
32	Distal - pole missing	Bifacial, diagonal	n/a	Slightly tapering	Rectangular	Sawn blank	Two grooves present
33	Distal	Unifacial, cutting	n/a	n/a	Oval	Flake blank ?	none observable
34	Complete	Bifacial, slightly	Cortex covered	Slightly tapering	Rectangular	Sawn blank	Cortex
35	n/a	n/a	n/a	n/a	n/a	n/a	Several ground areas
36	n/a	n/a	n/a	n/a	Rectangular	Sawn blank	Snap scar present
37	Complete	Unifacial with slight bevelling	Cortex covered	One margin is cortex	Rectangular	Sawn blank	Groove present in one side
38	Medial - pole and bit missing	n/a	n/a	Ground flat	Rectangular	Sawn blank	none observable
39	Medial Fragment?	n/a	n/a	n/a	Rectangular	Sawn Blank	Two grooves present

40	Complete	Bifacial, convex	Finished	One rounded	Oval	Indeterminante	none observable
41	n/a	n/a	n/a	n/a	n/a	n/a	One sawn area present
42	Distal - pole missing	Bifacial, convex	n/a	Grooves present	Rectangular	Sawn blank	Sawn from a flat piece
43	Complete	One side ground, other chipped	Flaked into shape	Tapering, partially	Oval	Flaked blank	Flake scars present
44	Proximal - bit missing	not present	Cortex covered	Ground flat	Rectangular	Sawn blank	none observable
45	Complete	Straight	Possible cortex covered	Ground flat	Rectangular	Sawn blank ?	none observable
46	Complete	Unifacial	Cortex covered	Ground flat	Rectangular	Sawn blank	none observable
47	n/a	n/a	n/a	n/a	n/a	n/a	Snap scar present
48	Distal - pole missing	Unifacial, diagonal	n/a	One margin ground flat	Rectangular	Sawn blank	Snap scar and groove
49	Distal - pole missing	Unifacial with slight bevelling	n/a	Ground flat, slightly tapering	Not recorded	Indeterminante	None observable
50	n/a	n/a	n/a	n/a	n/a	n/a	n/a
51	Complete	Unifacial with slight bevelling	Unfinished	Ground flat	Rectangular	Sawn blank	none observable
52	Distal - pole missing	Bifacial, straight	n/a	One margin rounded	Rectangular	Sawn blank	Snap scar present
53	Complete	Slightly convex, unifacial bevelling	Reworked	Groove and snap present	Rectangular	Sawn blank	Snap scar present
54	Complete	Bifacial, diagonal	Reworked	Expanding	Rectangular	Indeterminante	none observable
55	Complete	Unifacial with slight bevelling	No pole - double bi	Ground flat, slight	Rectangular	Sawn blank	none observable
57	Distal - pole missing	Bifacial, straight	n/a	Cut straight	Irregular	Sawn blank	One groove in face
58	Complete	Straight		Tapering	Rectangular	Sawn blank	none observable
60	Complete	Bifacial, diagonal	Ground flat	Ground round	Rectangular	Indeterminante	none observable
61	Complete	Bifacial, straight	Damaged	Straight, groove present	Rectangular	Sawn blank	Groove present in one side
62	Complete	Bifacial, slightly diagonal	Small bit, bifacial	Extremely tapered	Rectangular	Sawn blank	Groove present in one side
63	Complete	Unifacial, slighlty diagonal	Cortex covered	Slightly tapering	Rectangular	Sawn blank	Deep manufacturing
64	Complete	Straight	Snap scar	Straight	Rectangular	Sawn blank	Groove present in one side
65	Complete	Bifacial, convex	Cortex covered	Slightly tapering	Rectangular	Sawn blank	Snap scar present
66	Proximal - bit missing	n/a	Ground flat	Semi-rectangular	Indeterminante	none observable	
67	Complete	Unifacial, convex	Cortex covered	Ground flat	Rectangular	Sawn blank	Snap scar present
68	Distal - pole missing	Bifacial	n/a	Tapering, ground round	Rectangular	Sawn blank	none observable
69	Proximal - bit missing	Bifacial, straight	Cortex covered	Ground flat, groove	Rectangular	Sawn blank	Snap scar present
70	Complete	Bifacial, straight	Cortex covered		Rectangular	Sawn blank	Snap scar present in margins
71	Distal - pole missing	Bifacial, convex	n/a	One ground flat	Rectangular	Sawn blank	Cortex present on on margins
72	Bit Fragment	Bifacial	n/a	n/a	n/a	n/a	n/a
73	n/a	n/a	n/a	n/a	n/a	n/a	ground
74	Complete	n/a	n/a	n/a	n/a	n/a	Sawing grooves present
75	Complete	n/a	n/a	n/a	n/a	n/a	Several sawn gooves
76	Complete	Unifacial with slight bevelling	Thin and rounded	Tapering, snap scar	Rectangular	Sawn blank	Snap scars present
77	Complete	Not present yet	Not finished	Tapering	Oval	Flaked blank	Flake scars present
78	Complete	n/a	n/a	n/a	n/a	n/a	Snap scar
79	n/a	n/a	n/a	n/a	n/a	n/a	n/a
80	Medial - pole and bit missing	n/a	n/a	Straight, ground flat	Rectangular	Sawn blank	none observable
81	Complete	Partially ground	Cortex covered	One margin is cortex	Rectangular	Sawn blank	Snap scar present on one side
82	Medial - pole and bit missing	n/a	n/a	Snap scar present on side	Rectangular	Sawn blank	n/a
83	Distal - pole missing	Bifacial, straight	Pole missing	Ground flat	Rectangular	Sawn blank	none observable
84	Medial - pole and bit missing	n/a	n/a	Taper, ground flat	Rectangular	Sawn blank	Snap scar present on one side
85	n/a	n/a	n/a	n/a	n/a	n/a	n/a
86	Complete	n/a	n/a	n/a	n/a	n/a	n/a
87	n/a	n/a	n/a	n/a	n/a	n/a	n/a

88	Medial Fragment	n/a	n/a	Snap scar present	Indeterminante	n/a	Snap scar present
89	n/a	n/a	n/a	n/a	n/a	n/a	Two snap scars

Appendix 2 - Nephrite Artifacts from Literature Review

Site #	Site	Reference	Artifacts Present	Total #	Total Excavation	Site Type	Time Period	Investigation Level	Estimated Excavation (m^2)
1	DgQo 1	Barlee 1969	1 celt, 2 misc. pieces	3	3	Burial	Unknown	Excavated	2
2	DgQo 2	Freisinger 1979	1 celt	1		Burial	Unknown	Survey	-
3	DgQo 3	Freisinger 1979	1 celt	1		Campsite	Kamloops	Survey	-
4	DhPt 10	Bussey 1981	1 celt	1	1	Campsite	Kamloops*	Excavated	196
5	DhQv 34	Copp 1979	unspecified number of celts			Housepit	Unknown	Survey	-
6	DhQv 48	Copp 1979	1 celt	1		Campsite	Unknown	Survey	-
7	DhQx 10	Copp 1979	1 celt	1		Lithic Scatter	Unknown	Survey	-
8	DiQm 4	Turnbull 1977	1 celt	1	1	Housepit	Shuswap	Excavated	20
9	DkQm 3	Turnbull 1977	1 celt	1		Campsite	Unknown	Survey	-
10	DkQm 5	Turnbull 1977	2 celts, 1 chisel	3	1	Housepit	Unknown	Excavated	13
11	DlRi 6	Arcas Associates 1985	1 celt	1	1	Campsite	Kamloops	Excavated	17
12	EbRc 6	Wyatt 1972	1 celt	1	1	Housepit	Shuswap	Excavated	86
13	EbRi 7	Skinner and Copp 1986	4 celts	4	4	Burial	Kamloops	Excavated/ Potted	10 ?
14	EbRj 1	Rousseau et.al. 1993	4 celts	4	4	Housepit/ Burial	Kamloops	Excavated/ Tested	8.5
15	EbRj 92	Muir et al 1992	1 misc. worked fragment	1	1	Lithic Scatter	Plateau/ Kamloops	Excavated/ Tested	18
16	EcQk 3	Turnbull 1977	1 celt	1		Campsite	Unknown	Survey	-
17	EdQs 32	Arcas Associates 1985	unspecified number of celts			Burial	Unknown	Survey	-
18	EdQx 20	Blake 1976	1 chisel	1	1	Housepit	Kamloops	Excavated	88
19	EdRk 1	Sanger 1968b	3 celts, 1 celt blank, 2 sawn boulders	6		Burial	Kamloops	Disturbed	-
20	EdRk 3	Sanger 1970	9 celts	9		Burial	Kamloops	Excavated/ Potted	-
21	EdRk 4	Sanger 1970	1 celt	1	1	Resource	Kamloops	Excavated	25
22	EdRk 5	Sanger 1970	1 celt	1		Housepit	Kamloops	Excavated	8
23	EdRk 7	Sanger 1970	9 celts	9	9	Housepit	Plateau ?	Excavated	80
24	EeQl 3	Mohs 1977	unspecified number of celts			Campsite	unknown	Survey	-
25	EeQw 1	Sanger 1968a	26 celts	26	2	Burial	Kamloops	Excavated/ Potted	(12.3)
26	EeQw 3	Fladmark 1969	3 celts + unspecified number	3		Housepit	Unknown	Survey	-
27	EeQw 5	Fladmark 1969	2 knives	2		Housepit	Unknown	Survey	-
28	EeQw 6	Fladmark 1969	2 celts + unspecified number	2		Burial	Unknown	Survey	-
29	EeRb 10	Richards and Rousseau 1982	1 celt	1	1	Housepit	Plateau	Excavated	77
30	EcRg 4b	Stryd and Lawhead 1983	1 celt	1	1	Campsite	Plateau/Kamloo ps	Excavated	30
31	EeRh 3	Whitlam 1980	1 misc. worked frag.	1	1	Lithic Scatter	Unknown	Excavated/ Survey	34
32	EeRk 4	Stryd 1973	1 knife, 3 misc. worked frag.	4	4	Housepit	Plateau	Excavated	388
33	EeRl 19	Stryd and Hills 1972	1 sawn boulder, 1 misc. worked frag.	2		Housepit	Kamloops/ Unknown	Excavated/ Survey	-
34	EeRl 192	Wigen 1984	1 celt	1	1	Burial	Kamloops	Excavated	15
35	EeRl 22	Stryd 1970	3 misc. worked frag.	3	3	Housepit	Kamloops	Excavated	43
36	EeRl 30	Stryd and Hills 1972	2 celts	2		Burial	Plateau	Survey/ Potted	-

37	EeRl 7	Hayden and Spafford 1992	3 celts, 2 misc. worked frag.	5	5	Housepit	Plateau	Excavated	215+
38	EeRn 11	Wales 1974	1 misc. worked frag.	1	1	Burial	Unknown	Excavated	24
39	EfQs 1	Fladmark 1969	unspecified number of celts			Burial	Unknown	Survey	-
40	EfQu 3	Sendey 1971	1 misc. worked frag., 1 unmodified pebble	2	2	Housepit	Shuswap	Excavated	106
41	EfQv 1	Fredlund and Tucker 1971	1 misc. worked frag.	1	1	Housepit	Kamloops	Excavated	4.6
42	EfQv 2	Fladmark 1969	unspecified number of celts	1		Housepit	Unknown	Survey	-
43	EhRn 17	Wilson 1983	1 celt	1		Housepit	Unknown	Potted	-
44	Kamloops	Smith 1900	4 celts, 1 chisel	5		Burial	Kamloops	Excavated/ Potted	not listed
45	Lytton Burial	Smith 1899	3 celts, 1 knife, 2 sawn boulders	7		Burial	Unknown (Kamloops)	Excavated/ Potted	not listed
46	Nicola Lake	Smith 1900	8 celts	8		Burial	Kamloops	Excavated/ Potted	not listed
47	Nicola Valley	Smith 1900	1 celt	1		Burial	Kamloops	Excavated/ Potted	not listed
48	CO47	Caldwell 1954	unspecified number of celts			Burial	Unknown	Excavated/ Potted	-
49	CO93	Caldwell 1954	1 celt	1		Burial	Unknown	Potted	-
50	GbSk1	Borden in Sanger 1968	1 celt	1		Burial	Unknown	Excavated ?	-
51	45-DO-214	Miss et al 1984	2 celts	2	2	Campsite	Plateau	Excavated	122
52	45-OK-250	Miss et al 1984	2 misc. worked frag.	2	2	Housepit	Kamloops/ Plateau	Excavated	196
53	45-OK-4	Miss et al 1984	2 celts	2	2	Housepit	Plateau *	Excavated	154
54	45-OK-58	Grabert 1968	1 celt	1	1	Housepit	Shuswap *	Excavated	60
55	45-OK-78	Grabert 1968	1 celt	1	1	Housepit	Shuswap *	Excavated	70
56	UC43	Collier et.al. 1942	1 celt	1		Campsite	Unknown	Excavated	not listed
57	Little Dalles	Collier et.al. 1942	unspecified number of celts			Burial	Unknown	Excavated	not listed
58	45-FR-42	Combes 1968	1 jade pendant?	1		Burial	Kamloops	Excavated	-
59	45-BN-15	Crabtree 1957	Unspecified number of celts			Burial	Kamloops*	Excavated	-
60	45-DO-176	Galm et.al. 198	1 celt	1	1	Housepit	Kamloops*	Excavated	448+
61	45-KT-28	Nelson 1969	6 celts	6	6	Housepit	Kamloops*	Excavated	120
62	45-LI-6	Rice 1968	1 misc. worked frag.	1	1	Campsite	Kamloops*	Excavated	18
63	Crab Creek	Sprague 1967	1 celt	1		Burial	Kamloops*	Survey	
64	DlQv 39	Rousseau 1984	1 celt	1		Lithic Scatter	Shuswap	Excavated	
65	Lytton	Emmons 1923	1 sawn boulder,5 celts, 3 knives, 1 misc. frag.	10		Unknown	Unknown	Potted	
66	10 miles N of Lytton	Emmons 1923	1 sawn boulder	1		Unknown	Unknown	Potted	
67	Mouth of Thompson River	Emmons 1923	1 sawn boulder	1		Unknown	Unknown	Potted	
68	6 miles S of Lytton	Emmons 1923	1 sawn boulder	1		Unknown	Unknown	Potted	
69	5 miles S of Lytton	Emmons 1923	1 celt	1		Unknown	Unknown	Potted	
70	7 miles N of Lytton	Emmons 1923	1 celt	1		Unknown	Unknown	Potted	
71	Captain John Creek	Spinden 1915	1 celt	1		Burial	Unknown	Potted	
72	Kouse Creek	Spinden 1915	1 celt	1		Burial	Unknown	Potted	
73	Dalles: Maybe Island	Butler 1959	unspecified number of celts			Burial	Unknown	Potted	
74	Indian Well	Butler 1959	unspecified number of celts			Burial	Unknown	Excavated	

75	Wahluke	Kreiger 1928	unspecified number of celts			Burial	Unknown	Excavated	
76	45-GR-131	Crabtree 1957	unspecified number of celts			Burial	Unknown	Excavated	

Appendix 3 - Celt Data from Literature Review

Celt No.	Site	Artifact	Material	Length/	Width/	Thick	Celt Shape	Blank Type	Bit Shape	Celt Condition	Manufacture	Time Period	Site Type
1	DgQo 1	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	unknown	Burial
2	DgQo 2	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	unknown	Burial
3	DgQo 3	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	campsite
4	DhPt 10	Celt	Nephrite	42	56	18	Tapering	indeterminante	straight	chipped	not listed	Kamloops*	campsite
5	DhQv 48	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	unknown	campsite
6	DhQx 10	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	unknown	Lithic Scatter
7	DiQm 4	Celt	Nephrite	30	36	12	Rectangular	indeterminante	not listed	not listed	not listed	Shuswap	Housepit
8	DkQm 3	Celt	Nephrite	136	17		Tapering	indeterminante	convex	broken - pole missing	not listed	unknown	campsite
9	DkQm 5	Celt	Nephrite	125	25		Rectangular	sawn blank	straight	broken - no description	not listed	unknown	Housepit
10	DkQm 5	Celt (Chisel)	Nephrite	40	30		Slightly tapering	sawn blank	not listed	broken - no description	not listed	unknown	Housepit
11	DkQm 5	Celt	Nephrite	46	27		Tapering	sawn blank	convex	broken - pole missing	not listed	Shuswap	Housepit
12	DlRi 6	Celt	Nephrite	53	33	7	Tapering	sawn blank	diagonal	complete	cutting groove	Kamloops	campsite
13	EbRc 6	Celt	Nephrite	41	17		Tapering	sawn blank	not present	broken - medial	cutting groove	Shuswap	Housepit
14	EbRi 7	Celt	Nephrite	93	42	14	Tapering	sawn blank	convex	broken - pole missing	cutting groove	Kamloops	Burial
15	EbRi 7	Celt	Nephrite	86	32	12	indeterminante	sawn blank	not present	broken - bit missing	cutting groove	Kamloops	Burial
16	EbRi 7	Celt	Nephrite	132	51	15	Slightly tapering	sawn blank	convex	complete	ground away	Kamloops	Burial
17	EbRi 7	Celt	Nephrite	125	54	16	Slightly tapering	sawn blank	straight	broken - pole missing	cutting groove	Kamloops	Burial
18	EbRj 1	Celt	Nephrite	17	9	2	not listed	not listed	not listed	broken - no description	not listed	Kamloops	Housepit /Burial
19	EbRj 1	Celt	Nephrite	16	13	4	not listed	not listed	not listed	broken - no description	not listed	Kamloops	Housepit /Burial
20	EbRj 1	Celt	Nephrite	21	16	3	not listed	not listed	not listed	broken - no description	not listed	Kamloops	Housepit /Burial
21	EbRj 1	Celt	Nephrite	19	16	2	not listed	not listed	not listed	broken - no description	not listed	Kamloops	Housepit /Burial
22	EcQk 3	Celt	Nephrite	187	40		Rectangular	unknown (sawn)	not listed	not listed	not listed	unknown	campsite
23	EdQx 20	Celt (Chisel)	Nephrite	35	6	3	Rectangular	unknown	convex	complete	not listed	Kamloops	Housepit
24	EdRk 1	Celt	Quartzite	138	65		Tapering		convex	complete	flake scars	Kamloops	Burial
25	EdRk 1	Celt	Quartzite	160	65		Tapering	flaked blank	convex	complete	flake scars	Kamloops	Burial
26	EdRk 1	Celt	Quartzite	170	80		Tapering	flaked blank	convex	complete	flake scars	Kamloops	Burial
27	EdRk 1	Celt	Slate	190	60		Tapering	flaked blank	convex	complete	not listed	Kamloops	Burial
28	EdRk 1	Celt	Nephrite	215	52		Slightly tapering	unknown	straight	complete	cutting groove	Kamloops	Burial
29	EdRk 1	Celt	Nephrite	155	54		Rectangular	sawn blank	straight	complete	cutting groove	Kamloops	Burial
30	EdRk 1	Celt	Nephrite	165	50		Tapering	sawn blank	straight	complete	cutting groove	Kamloops	Burial
31	EdRk 3	Celt	Nephrite	270			not listed	not listed	not listed	sawn blank	not listed	Kamloops	Burial
32	EdRk 3	Celt	Nephrite	65			not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
33	EdRk 3	Celt	Nephrite	132	29.4	15.8	Tapering	sawn blank	not present	broken - pole	snap scar indicated	Kamloops	Burial

34	EdRk 3	Celt	Nephrite	131			broken	not listed	not listed	not listed	not listed	Kamloops	Burial
35	EdRk 3	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
36	EdRk 3	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
37	EdRk 3	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
38	EdRk 3	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
39	EdRk 3	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
40	EdRk 4	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	resource
41	EdRk 5	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Housepit
42	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
43	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
44	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
45	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
46	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
47	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
48	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
49	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
50	EdRk 7	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Plateau ?	Housepit
51	EeQw 1	Celt	Nephrite/ Serpentine	380	65		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
52	EeQw 1	Celt	Nephrite/ Serpentine	280	23		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
53	EeQw 1	Celt	Nephrite/ Serpentine	276	46		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
54	EeQw 1	Celt	Nephrite/ Serpentine	268	44		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
55	EeQw 1	Celt	Nephrite/ Serpentine	265	50		Slightly tapering	sawn blank	straight	complete	cutting groove	Kamloops	Burial
56	EeQw 1	Celt	Nephrite/ Serpentine	240	48		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
57	EeQw 1	Celt	Nephrite (white)	216	46		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
58	EeQw 1	Celt	Nephrite/ Serpentine	215	50		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
59	EeQw 1	Celt	Nephrite/ Serpentine	212	44		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
60	EeQw 1	Celt	Nephrite/ Serpentine	210	52		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
61	EeQw 1	Celt	Nephrite/ Serpentine	204	42		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
62	EeQw 1	Celt	Nephrite/ Serpentine	200	50		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
63	EeQw 1	Celt	Nephrite/ Serpentine	195	40		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
64	EeQw 1	Celt	Nephrite/ Serpentine	178	40		Tapering	sawn blank	not listed	not listed	not listed	Kamloops	Burial
65	EeQw 1	Celt	Nephrite/ Serpentine	170	44		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
66	EeQw 1	Celt	Nephrite/ Serpentine	160	45		Slightly tapering	sawn blank	diagonal	complete	cutting groove	Kamloops	Burial
67	EeQw 1	Celt	Nephrite/ Serpentine	156	42		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
68	EeQw 1	Celt	Nephrite/ Serpentine	150	40		Tapering	sawn blank	not listed	not listed	not listed	Kamloops	Burial
69	EeQw 1	Celt	Nephrite/ Serpentine	150	34		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
70	EeQw 1	Celt	Nephrite/ Serpentine	145	55		Rectangular	sawn blank	straight	complete	cutting groove	Kamloops	Burial
71	EeQw 1	Celt	Nephrite	142	50		Tapering	sawn blank	not	not listed	not listed	Kamloops	Burial

			(white)						listed				
72	EeQw 1	Celt	Nephrite (white)	140	44		Tapering	sawn blank	not listed	not listed	not listed	Kamloops	Burial
73	EeQw 1	Celt	Nephrite/ Serpentine	125	30		Tapering	sawn blank	not listed	not listed	not listed	Kamloops	Burial
74	EeQw 1	Celt	Nephrite/ Serpentine	110	55		Tapering	sawn blank	straight	complete	cutting groove	Kamloops	Burial
75	EeQw 1	Celt	Nephrite (white)	56	44		Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
76	EeRb 10	Celt	Nephrite				Tapering	indeterminante	not listed	broken - no description	not listed	Plateau	Housepit
77	EcRg 4	Celt	Nephrite	79	18	13	Tapering	sawn blank	diagonal	complete	cutting groove	Plateau/ Kamloops	campsite
78	EeRl 192	Celt	Nephrite	146	59	13	Tapering	sawn blank	straight	complete	cutting groove	Kamloops	Burial
79	EeRl 30	Celt	Nephrite	70	42		Rectangular	sawn blank	not listed	broken - no description	not listed	Plateau	Burial
80	EeRl 30	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Plateau	Burial
81	EeRl 7	Celt	Nephrite	83	58	14	indeterminante	sawn blank	convex	broken - pole missing	cut from a pebble	Plateau	Housepit
82	EeRl 7	Celt	Nephrite	12	23	5	indeterminante	indeterminante	unknown	Broken - fragment	not listed	Plateau	Housepit
83	EfQv 2	Celt	unknown	125	80	0	Tapering	flake blank	convex	complete	flake scars	unknown	Housepit
84	EfQv 85	Celt	unknown	135	75	0	Tapering	flake blank	convex	complete	Flake scars	unknown	unknown
85	EfQv 98	Celt	unknown	148	70	0	Tapering	flake blank	convex	complete	flake scars	unknown	unknown
86	EhRn 17	Celt	Nephrite	120	50	0	Tapering	sawn blank	convex	complete	not listed	unknown	Housepit
87	Governmen t	Celt	Greenstone				not listed	not listed	not listed	not listed	not listed	Plateau	Burial
88	Kamloops	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
89	Kamloops	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
90	Kamloops	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
91	Kamloops	Celt (Chisel)	Nephrite	40	6		Rectangular	indeterminante	convex	complete	not listed	Kamloops	Burial
92	Kamloops	Celt	Nephrite	66	30		Tapering	pebble	diagonal	complete	not listed	Kamloops	Burial
93	EbRj 1 (Lytton)	Celt	Nephrite	70	26		Tapering	sawn blank	straight	chipped	cutting groove	unknown (Kamloops)	Burial
94	EbRj 1 (Lytton)	Celt	Nephrite	93	40		Rectangular	sawn blank	straight	broken - pole missing	cutting groove	unknown (Kamloops)	Burial
95	EbRj 1 (Lytton)	Celt	Nephrite	63	42		Irregular	flake blank	convex	complete	flake scars	unknown (Kamloops)	Burial
96	Nicola Lake	Celt	Nephrite	350			Rectangular	sawn blank	not listed	not listed	not listed	Kamloops	Burial
97	Nicola Lake	Celt	Nephrite	325			not listed	sawn blank	not listed	complete	not listed	Kamloops	Burial
98	Nicola Lake	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
99	Nicola Lake	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
100	Nicola Lake	Celt	Nephrite	264	60		Rectangular	sawn blank	straight	broken - pole missing	cutting groove	Kamloops	Burial
101	Nicola Lake	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops	Burial
102	Nicola Lake	Celt	Nephrite	352	48	10	Rectangular	sawn blank	straight	complete	cutting groove	Kamloops	Burial
103	Nicola Lake	Celt	Nephrite	238	50	14	Rectangular	sawn blank	straight	complete	Ground away	Kamloops	Burial
104	Nicola Valley	Celt	Nephrite				not listed	not listed	not listed	broken - no description	not listed	Kamloops	Burial
105	UC 24	Celt	Anthophyllite	216	56	15	Tapering	indeterminante	straight	broken - pole missing	not listed	unknown	Burial
106	UC 31	Celt	Anthophyllite	0	50	13	not listed	not listed	not listed	broken - no description	not listed	unknown	campsite (burial)
107	UC 31	Celt	unknown	88	63	11	not listed	not listed	not listed	not listed	not listed	unknown	campsite (burial)
108	UC 43	Celt (Chisel)	Nephrite	63	26	16	not listed	not listed	not listed	not listed	not listed	unknown	campsite
109	UC 46	Celt	Anthophyllite	295	59	22	Rectangular	sawn blank	straight	complete	cutting groove	unknown	Burial
110	UC 47	Celt	Anthophyllite	125	50	22	Tapering	indeterminante	straight	complete	not listed	Kamloops	Burial
111	UC 47	Celt	Anthophyllite	169	53	9	Tapering	indeterminante	convex	broken - pole missing	not listed	unknown	Burial

112	UC 47	Celt	Anthophyllite	225	62	16	not listed	not listed	not listed	not listed	not listed	unknown	Burial
113	45-DO-214	Celt	Nephrite	75	42	17	Rectangular	sawn blank	diagonal	broken - pole missing	cutting groove	Plateau *	campsite
114	45-DO-214	Celt	Nephrite	117	62	15	Tapering	pebble	convex	complete	not listed	Plateau *	campsite
115	45-OK-30	Celt	Indurated				not listed	not listed	not listed	not listed	not listed	unknown	campsite
116	45-OK-4	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Plateau *	Housepit
117	45-OK-4	Celt	Nephrite	38	26		Rectangular	sawn blank	straight	complete	not listed	Plateau *	Housepit
118	45-OK-58	Celt	Nephrite	71	40	14	Rectangular	sawn blank	straight	chipped	cutting groove	Shuswap *	Housepit
119	45-OK-78	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Shuswap *	Housepit
120	CO 93	Celt	Jade				not listed	not listed	not listed	not listed	not listed	unknown	Burial
121	45-KT-28	Celt	Nephrite/ Serpentine	187	47	20	Rectangular	sawn blank	convex	complete	cutting groove	Kamloops *	Housepit
122	45-KT-28	Celt	Nephrite/ Serpentine	114	48	19	not listed	not listed	not listed	not listed	cutting groove	Kamloops *	Housepit
123	45-KT-28	Celt	Nephrite/ Serpentine	76	41	9	Rectangular	sawn blank	convex	complete	not listed	Kamloops *	Housepit
124	45-KT-28	Celt	Nephrite/ Serpentine	56	48	7	Tapering	sawn blank	straight	broken - pole missing	not listed	Kamloops *	Housepit
125	45-KT-28	Celt (Chisel)	Nephrite/ Serpentine	79	45	15	Rectangular	sawn blank	straight	complete	not listed	Kamloops *	Housepit
126	Crab Creek	Celt	Nephrite				not listed	not listed	not listed	not listed	not listed	Kamloops *	Burial
127	45-DO-176	Celt	Nephrite	110	30		Tapering	indeterminante	diagonal	complete	not listed	Kamloops *	Housepit
128	Little Dalles	Celt	Nephrite	106	53	9	Tapering	sawn blank	straight	complete	not listed	unknown	Burial
129	EeRl 7	Celt	Nephrite				not listed	sawn blank	not listed	chipped bit	not listed	Plateau	Housepit
130	EfQv 2	Celt	Nephrite	121	57	21	Slightly exp	sawn blank	straight	complete	cutting groove	unknown	Housepit
131	GbSk 1	Celt	Jade				not listed	not listed	not listed	not listed	not listed	unknown	Burial
132	FcSi1	Celt	Greenstone				not listed	not listed	not listed	not listed	not listed	Kamloops	Housepit
133	FcSi2	Celt	Greenstone	65	35		Slightly tapering	flaked blank	straight	complete	rounded edges	Proto-histo	Housepit
134	FiRs 1	Celt	Greenstone				not listed	flaked blank	not listed	not listed	flake scars	Kamloops	Housepit /Burial
135	FiSi 2	Celt	Greenstone	83	53		Slightly tapering	flaked blank	convex	complete	Flake scars	Kamloops	campsite
136	DlQv 39	Celt	Nephrite	82	22		Rectangular	sawn blank ?	convex	complete	not listed	Shuswap	Lithic Scatter
137	7 miles N	Celt	Jade	381	57	19	Slightly tapering	sawn blank	straight	complete	not listed	unknown	unknown
138	5 miles S	Celt	Jade				Slightly tapering	sawn blank	slightly convex	complete	not listed	unknown	unknown
139	Lytton	Celt	Red-brown Jade				Slightly tapering	sawn blank	slightly convex	complete	not listed	unknown	unknown
140	Lytton	Celt (Chisel)	Jade				Tapering	sawn blank	straight	broken - pole missing	not listed	unknown	unknown
141	Lytton	Celt (Chisel)	Jade				Irregular	indeterminante	straight	complete	not listed	unknown	unknown
142	Lytton	Celt (Chisel)	Jade				Tapering	indeterminante	convex	complete	not listed	unknown	unknown
143	Lytton	Celt (Chisel)	Jade				Slightly tapering	indeterminante	diagonal	complete	not listed	unknown	unknown
144	Captain Johe	Celt	Jade	224	42	11	Rectangular	sawn blank	slightly diagonal	complete	snap scar present	unknown	Burial
145	Kouse Creek	Celt	Jade	226	51	9	Slightly tapering	sawn blank	straight	complete	not listed	unknown	Burial
146	EdRk 1	Celt (Blank)	Nephrite	194	37		not listed	sawn blank	not installed	complete	not listed	Kamloops	Burial
147	EeQw1	Celt (Blank)	Nephrite	266	40		Rectangular	sawn blank	not installed	not listed	not listed	Kamloops	Burial
148	45-KT-28	Celt	Nephrite/ Serpentine				not listed	not listed	not installed	not listed	not listed	Kamloops*	Housepit

Appendix 4 - Non-Nephrite Containing Sites

Site Number	Borden	Site Type	Time Period	Estimated Meters Excavated	References
1	FaRn 3	Housepit	Plateau to Protohistoric	32	Whitlam 1976, Carl 1972
2	ElRn 3	Housepit	Plateau	10	Whitlam 1976
3	FaRm 3	Housepit	Unknown	81	Whitlam 1976
4	DjPv 14	Campsite	Unknown	34	Blake 1981
5	DgQi 2	Campsite	Kamloops	2	Bussey 1981
6	DgQi 3	Campsite	Kamloops	33	Bussey 1981
7	DhPt 1	Campsite	Shuswap to Protohistoric *	64	Bussey 1977
8	DhPt 4	Campsite	Shuswap to Protohistoric *	108	Bussey 1977
9	EdRk 6	Housepit	Kamloops	36.5	Sanger 1971
10	EaRj 15	Resource	Kamloops	19	Mitchell 1963
11	EeQw 30	Housepit	Kamloops	38	Arcas Associates 1988
12	Government	Burial	Plateau		Smith 1900
13	EcRg 3	Lithic Scatter	Kamloops	8	Arcas Associates 1987
14	EdRg 1	Campsite	Kamloops	49.5	Arcas Associates 1987
15	EdRg 2	Lithic Scatter	Kamloops	16	Arcas Associates 1987
16	EfQq 3	Lithic Scatter	Kamloops	12.75	Arcas Associates 1986
17	EcRh 61	Campsite with midden	Lehman	14.58	Arcas Associates 1985a
18	EcQv 2	Burial	Kamloops	1.24	Arcas Associates 1985b
19	EbRd 3	Housepit	Kamloops		Archer 1971
20	EeQx 2	Housepit	Kamloops	16	Blake and Eldridge 1971
21	FhRs 35	Campsite	Plateau to Kamloops	103	Brandon and Irvine 1979
22	FaRt 16	Resource	Kamloops	6	Bussey 1983
23	FaRt 17	Roasting Pit	Kamloops	6	Bussey 1983
24	EcQt	Burial	Kamloops to Protohistoric		Campbell-Brown 1969
26	DiQj 18	Housepit	Unknown		Choquette 1985
27	DgQa 6	Campsite	Shuswap to Kamloops	39	Choquette 1984
28	DgQv 4	Burial	Kamloops to Protohistoric		Copp 1986
29	FiRs 1	Housepit/Burial	Shuswap to Kamloops	96	Fladmark 1976
30	EeQx 14	Housepit	Kamloops	6	Eldridge 1974
31	EdQx 5	Housepit	Kamloops	6	Eldridge 1974
32	EeQw 6	Housepit	Kamloops	21	Fladmark 1973
33	EeQw 15	Housepit	Kamloops	10	Fladmark 1973
34	EfQv 4	Resource	Pre-Shuwap	17	Fladmark 1973
35	EfQv 5	Housepit	Plateau	13	Fladmark 1973
36	EfQv 19	Housepit	Plateau to Kamloops	14	Fladmark 1973
37	EfQw 1	Burial	Unknown		Fladmark 1973
38	DiQi 2	Housepit	Shuswap to Kamloops	48	Galvin 1977
39	DiQi 1	Campsite	Shuswap to Kamloops	15	French 1971
40	EjRa 1	Housepit	Unknown	28	Hall 1969
41	EkRo 18	Housepit	Kamloops	1	Matson and Ham 1979
42	EkRo 31	Housepit	Kamloops	1	Matson and Ham 1979
43	EkRo 48	Housepit	Kamloops	1	Matson and Ham 1979
44	DhQv 6	Housepit	Kamloops	7	Howe and Rousseau 1979
45	EhRv 2	Housepit	Plateau	2	Magne 1985
46	EhRw 11	Resource	Kamloops to Protohistoric	1	Magne 1985
47	EhRw 15	Resource	Kamloops to Protohistoric	1	Magne 1985
48	DkQm 2	Housepit	Unknown	3	Mitchell 1969
49	EbQl 1	Housepit	Unknown	4.5	Mitchell 1969
51	EkSe 1	Housepit	Kamloops to Protohistoric	13	Mitchell 1969
53	DiQm 1	Housepit	Shuswap	47	Mitchell 1968
54	DiQl 6	Housepit	Unknown	5	Mitchell 1968
55	DiQm 13	Campsite	Unknown	4	Mitchell 1968
56	DjQj 1	Burial/Housepit	Plateau to Protohistoric	43	Mohs 1985
57	EdQs 14	Housepit	Kamloops	33	Mohs 1981
58	EbPw 1	Housepit	Plateau to Kamloops	16	Mohs 1980
59	EeRj 1	Roasting Pit	Plateau to Kamloops		Pokotylo and Froese 1983
60	EcPx 5	Campsite	Kamloops	24	McKenzie 1976a

61	EcQa 1	Housepit	Unknown		McKenzie 1976b
62	EeRg 13	Housepit	Shuswap	16	McMurdo 1974
63	EeRj 71	Roasting Pit	Plateau	4	Pokotylo and Froese 1983
64	EeRj101	Roasting Pit	Plateau	9	Pokotylo and Froese 1983
65	EeRj 55	Roasting Pit	Plateau	38	Pokotylo and Froese 1983
66	EeRj 49	Roasting Pit	Unknown	2	Pokotylo and Froese 1983
67	EeRb 64	Housepit	Shuswap to Plateau	17	Richards and Rousseau 1982
68	EeRb 67	Cache pit	Unknown	1	Richards and Rousseau 1982
69	EeRb 68	Housepit	Plateau	5	Richards and Rousseau 1982
70	EeRc 20	Housepit	Shuswap to Plateau	3	Richards and Rousseau 1982
71	EeRc 21	Cache pit	Unknown	1	Richards and Rousseau 1982
72	DgQv 17	Housepit	Plateau to Kamloops	40	Roberts 1975
73	DgQv 12	Housepit	Plateau to Kamloops	16	Roberts 1975
74	DgQv 14	Campsite	Unknown	12	Roberts 1975
75	DgQv 16	Housepit	Plateau to Kamloops	68	Roberts 1975
76	FaRm 23	Resource	Shuswap	30	Rousseau and Muir 1991
77	EiRn 15	Burial	Protohistoric		Rousseau and Rousseau 1978
78	EaRj 15	Resource	Shuswap to Protohistoric	15	Snead 1977
79	EaRd 14	Burial/Campsite	Kamloops		Skinner and Thacker 1988
80	EfQv 121	Housepit	Kamloops	30	Stryd and Richards 1990
81	EfQv 123	Housepit	Shuswap to Kamloops	46	Stryd and Richards 1990
82	EeRh 233	Campsite	Plateau to Kamloops	12	Stryd 1989
83	EeRh 235	Campsite	Unknown	1	Stryd 1989
84	EeRh 240	Campsite	Plateau	1	Stryd 1989
85	EeRh 241	Campsite	Unknown	1	Stryd 1989
86	FfRo 4	Campsite	Unknown	7	Thomas 1977
87	EeRl 71	Campsite	Kamloops to Protohistoric	16	Richards 1978
88	EcRg 2AA	Campsite	Plateau to Kamloops	60	Stryd and Lawhead 1983
89	EcRg 2BB	Lithic Scatter	Plateau to Kamloops	3	Stryd and Lawhead 1983
90	EcRg 2CC	Campsite	Unknown	4	Stryd and Lawhead 1983
91	EcRg 2DD	Campsite	Plateau to Kamloops	9.85	Stryd and Lawhead 1983
92	EcRg 2EE	Lithic Scatter	Unknown	2	Stryd and Lawhead 1983
93	EcRg 2FF	Lithic Scatter	Unknown	2	Stryd and Lawhead 1983
94	EcRg 2GG	Lithic Scatter	Plateau to Kamloops	1	Stryd and Lawhead 1983
95	EcRg 4A	Campsite	Plateau to Kamloops	52	Stryd and Lawhead 1983
96	EeRb 3	Housepit	Plateau	48	Wilson 1980
97	EeRb 11	Housepit	Plateau to Kamloops	7	Wilson 1980
98	EdRa 9	Housepit	Plateau to Kamloops	115	Wilson 1980
99	EdRa 11	Cache Pit	Kamloops	8	Wilson 1980
100	EeRc 8	Burial	Unknown	3.5	Wilson 1980
101	EeRd 3	Burial	Unknown	2	Wilson 1980
102	EdRa 22	Housepit	Plateau to Kamloops	45	Carlson 1986
103	EeRa 4	Housepit	Plateau	5	Carlson 1986
104	DiQj 5	Housepit	Unknown	68	Turnbull 1977
105	EeRk 9	Housepit	Kamloops to Protohistoric	100	Blake 1973
106	EgQw1	Burial	Unknown		Hills 1965
107	EdQx 41	Campsite	Lehman to Kamloops	11.5	Wilson 1991
108	EdQx 42	Campsite	Lehman to Shuswap	46	Wilson 1991
109	EiRa 3	Resource	Kamloops to Protohistoric	3.5	Wilson 1983
110	EhRa 5	Housepit	Plateau to Kamloops	5	Wilson 1983
111	EaRd 2	Housepit	Kamloops	41	Wyatt 1972
112	EbRh 1	Housepit	Plateau	3	Wyatt 1972
113	EbRc 3	Housepit	Plateau		Wyatt 1972
114	EbRa 1	Housepit	Kamloops	65	Wyatt 1972
115	EbRg 1	Housepit	Kamloops	40	Wyatt 1972
116	EbRc 1	Housepit	Plateau		Wyatt 1972
117	EbRa 2	Housepit	Kamloops	24	Wyatt 1972
118	EjSb 26	Roasting Pit	Kamloops	1	Alexander 1986
119	EjSb 33	Roasting Pit	Kamloops	1	Alexander 1986
120	EjSb 12	Roasting/Cache Pit	Plateau to Kamloops	4	Alexander 1986
121	EjSb 52	Cache Pit	Unknown	1	Alexander 1986
122	EjSb 39	Roasting Pit	Plateau to Kamloops	0.5	Alexander 1986
123	EjSb 35	Housepit	Kamloops	2	Alexander 1986
124	FcSi 2	Housepit	Protohistoric	488	Wilmeth 1978

125	FcSi 1	Housepit	Kamloops	14	Wilmeth 1978
126	DgRg 2	Lithic Scatter	Pre-Shuwap to Shuswap	3	Rousseau 1988
127	FaRm 14	Lithic Scatter	Unknown	1	Lawhead 1979
128	FaRm 16	Lithic Scatter	Unknown	1	Lawhead 1979
129	FaRm 15	Lithic Scatter	Unknown	1	Lawhead 1979
130	EdRi 2	Rock Shelter	Pre-Shuswap to Plateau	4	Rousseau 1989, Rousseau et al 1991
131	EdRi 11	Campsite	Pre-Shuswap to Plateau	24	Rousseau 1989, Rousseau et al 1991
132	EeRb 77	Housepit	Plateau	4	Rousseau and Muir 1991
133	EdRi 10	Rock Shelter	Plateau	1	Rousseau et al 1991
134	EdRi 25	Roasting Pit	Shuswap	6	Rousseau et al 1991
135	FiSi 2	Campsite	Kamloops		Borden 1952
136	EeRl 18	Burial	Kamloops to Protohistoric	84	Stryd 1970
137	EeRl 26	Housepit	Protohistoric	8	Stryd 1970
138	EeRl 27	Housepit	Protohistoric	8	Stryd 1970
139	EeRl 40	Housepit	Kamloops	18	Stryd 1972
140	EeRl 41	Housepit	Kamloops to Protohistoric	16	Stryd 1972
141	EeRk 17	Campsite	Unknown		Stryd 1974
142	EiRh 4	Burial/Campsite	Plateau to Protohistoric	14	Lawhead 1980
143	FfRo 6	Campsite	Unknown		Lawhead 1980
144	FfRo 10	Campsite	Unknown	61	Lawhead 1980
145	DgQo 13	Campsite	Unknown	2	Bussey 1983
146	DgQk 1	Campsite	Unknown	22.5	Baker 1983
147	DiQj 21	Campsite	Unknown	9	Baker 1983
148	DiQj 1	Campsite/Burial	Kamloops	70.2	Baker 1983
149	DhQj 2	Campsite	Unknown	46	Baker 1983
150	DhQj 27	Campsite	Unknown	11	Baker 1983
151	DhQk 4	Lithic Scatter	Unknown	6	Baker 1983
152	DhQk 5	Campsite	Shuswap	6.5	Baker 1983
153	DgQj 1	Campsite	Unknown	224	Charlton 1974
154	EaQa 8	Campsite	Plateau	15.5	Bussey 1986
155	EdQx 39	Resource	Kamloops	23	Rousseau and Muir 1992
156	EdRi 6	Campsite	Lehman	11	Rousseau and Richards 1988
157	EdQx 15	Housepit	Plateau to Kamloops	43.4	Stryd 1981
158	EcRg 4C	Campsite	Plateau to Kamloops	4	Stryd and Lawhead 1983
159	EcRg 4D	Campsite	Plateau	12	Stryd and Lawhead 1983
160	EcRg 4E	Campsite	Unknown	20	Stryd and Lawhead 1983
161	EcRg 4F	Campsite	Shuswap to Kamloops	7	Stryd and Lawhead 1983
162	EcRg 4G	Campsite	Shuswap to Plateau	8	Stryd and Lawhead 1983
163	EcRg 4H	Campsite	Shuswap to Plateau	11	Stryd and Lawhead 1983
164	EcRg 4I	Campsite	Shuswap to Plateau	5	Stryd and Lawhead 1983
165	EcRg 4J	Campsite	Pre-Shuswap	9	Stryd and Lawhead 1983
166	EcRg 4K	Lithic Scatter	Unknown	2	Stryd and Lawhead 1983
167	EcRg 5	Campsite	Kamloops	18	Stryd and Lawhead 1983
168	EcRg 6	Campsite	Unknown	34	Stryd and Lawhead 1983
169	FbRn 13	Housepit	Unknown	32	Kenny 1972
170	FfRx 9	Campsite	Unknown	1	Lawhead 1979
171	FfRx 29	Campsite	Unknown	8	Lawhead 1979
172	FfSa4	Campsite	Unknown	4	Lawhead 1979
173	DiQw 19	Campsite	Unknown	1.75	Rousseau et al 1993
174	EfQw 2	Housepit	Kamloops	34	Merchant et al 1994
175	EfQw 4	Housepit	Unknown	3	Muir and Rousseau 1992
176	EfQw 22	Lithic Scatter	Unknown	1	Muir and Rousseau 1992
177	EbRj 3	Lithic Scatter	Shuswap to Kamloops	13.75	Muir et al 1992
178	EbRj 174	Resource	Kamloops	2.75	Muir et al 1992
179	EbRj 173	Housepit	Unknown	2.7	Muir et al 1992
180	EbRj 10	Housepit	Unknown	2	Muir et al 1992
181	FaRx 1	Campsite	Unknown	18	Mitchell 1969,1970
182	EkSe 1	Housepit	Unknown	16	Mitchell 1970
183	FdSi 2	Campsite	Plateau to Kamloops	29	Mitchell 1969,1970
184	FgSd 1	Housepit	Pre-Shuswap to Protohistoric	117	Donahue1977
187	DiQw 2	Housepit	Unknown	28	Grabert 1974
188	EbQr1	Campsite	Unknown	10	Grabert 1974
189	EcQt 2	Housepit	Kamloops	17.5	Grabert 1974
190	EcQv 4	Lithic Scatter	Unknown	20	Grabert 1974

191	EkSa 5	Housepit	Kamloops	4	Matson et al 1980
192	ElRw 4	Housepit	Kamloops	3	Matson et al 1980
193	CR 92	Lithic Scatter	Kamloops	2	Matson et al 1980
194	19-1	Lithic Scatter	Unknown	3	Matson et al 1980
195	CR 64	Campsite	Plateau	2	Matson et al 1980
196	CR 73	Housepit	Kamloops	4	Matson et al 1980
197	EeRh 1	Burial	Kamloops	10	Pokotylo et al 1987
198	FiSi 19	Housepit	Shuswap/Kamloops		Wilmeth 1980
199	FdSi 11	Housepit	Shuswap to Kamloops		Wilmeth 1980
200	DlQv 37	Lithic Scatter	Shuswap to Kamloops		Rousseau 1984
225	EdRk 9	Housepit/burial	Shuswap to Plateau	47	Sanger 1971
226	EdRk 8	Housepit	Shuswap to Plateau	6	Sanger 1971

Appendix 5 - Non-celt Artifacts from Literature Review

Artifact Number	Site	Artifact Type	Material	Length	Width	Thickness	Site Type	Time Period
1	45-OK-250	Misc. worked frag.	Nephrite				Housepit	Plateau/Kamloops
2	45-OK-250	Misc. worked frag.	Nephrite				Housepit	Plateau/Kamloops
3	DgQo 1	Misc. worked frag.	Nephrite				Burial	Unknown
4	DgQo 1	Misc. worked frag.	Nephrite				Burial	Unknown
5	EbRj 92	Misc. worked frag.	Nephrite	33	25	8	Lithic Scatter	Plateau/Kamloops
6	EdRk 1	Sawn Boulder	Nephrite	220	35		Burial	Kamloops
8	EdRk 1	Sawn Boulder	Nephrite	190	75		Burial	Kamloops
9	EeRh 3	Misc. worked frag.	Nephrite				Lithic Scatter	Unknown
10	EeRk 4	Knife	Nephrite	60	44		Housepit	Plateau
11	EeRk 4	Misc. worked frag.	Nephrite				Housepit	Plateau
12	EeRk 4	Misc. worked frag.	Nephrite				Housepit	Plateau
13	EeRk 4	Misc. worked frag.	Nephrite				Housepit	Plateau
14	EeRl 19	Misc. worked frag.	Nephrite				Housepit	Unknown
15	EeRl 19	Sawn Boulder	Nephrite	105	53	60	Housepit	Kamloops
16	EeRl 22	Misc. worked frag.	Nephrite				Housepit	Kamloops
17	EeRl 22	Misc. worked frag.	Nephrite				Housepit	Kamloops
18	EeRl 22	Misc. worked frag.	Nephrite				Housepit	Kamloops
19	EeRn 11	Misc. worked frag.	Nephrite	55	37		Burial	Unknown
20	EfQu 3	Unworked pebble	Nephrite				Housepit	Shuswap
21	EfQu 3	Misc. worked frag.	Nephrite				Housepit	Shuswap
22	Lytton Burial	Knife	Nephrite	86			Burial	Unknown (Kamloops)
23	Lytton Burial	Misc. worked frag.	Nephrite	114			Burial	Unknown (Kamloops)
24	Lytton Burial	Sawn Boulder	Serpentine	192			Burial	Unknown (Kamloops)
25	Lytton Burial	Sawn Boulder	Serpentine	154			Burial	Unknown (Kamloops)
26	UC 46	Knife	Anthophyllite	25	19	3	Burial	Unknown
27	UC 46	Knife	Anthophyllite	25	25	5	Burial	Unknown
28	UC 46	Knife	Anthophyllite	31	31	6	Burial	Unknown
29	EeQw 5	Knife	Nephrite	67	48	5	Housepit	Unknown

30	EeQw 5	Knife	Nephrite	77	18	5	Housepit	Unknown
31	EfQt 1	Misc. worked frag.	Indurated Siltstone	20	20	1	Campsite	Shuswap
32	EeRk 1	Misc. worked frag.	Basalt				Housepit	Unknown
33	10 miles N of Lytton	Sawn Boulder	Jade				Unknown	Unknown
34	6 miles S of Lytton	Sawn Boulder	Jade				Unknown	Unknown
35	Lytton	Sawn Boulder	Jade				Unknown	Unknown
36	Lytton	Knife	Jade				Unknown	Unknown
37	Lytton	Knife	Jade				Unknown	Unknown
38	Lytton	Knife	Jade				Unknown	Unknown
39	mouth of Thompson River	Sawn Boulder	Jade				Unknown	Unknown
40	Lytton	Hammerstone	Jade				Unknown	Unknown
41	45-FR-42	Pendant ?	Jade ?				Unknown	Unknown
42	EeRl 7	Misc. worked frag.	Nephrite				Housepit	Plateau
43	EeRl 7	Misc. worked frag.	Nephrite				Housepit	Plateau
44	45-LI-6	Misc. worked frag.	Nephrite				Campsite	Kamloops