LITHIC RAW MATERIAL UTILISATION PATTERNS IN THE OLDMAN RIVER VALLEY, SOUTHERN ALBERTA

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ABSTRACT

Lithic Raw Material Utilisation Patterns in the
Oldman River Valley, Southern Alberta.

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The application of Cultural Resource Management data to the study of lithic raw material utilisation in southern Alberta is assessed in this study. Data recorded for the Oldman River Dam Mitigation Project provided the basis for this evaluation. Assemblages from five sites excavated during this project, DjPl-13, DjPm-44, DjPm-228, DjPm-100 and DjPl-13, were analysed. These totalled 17, 083 artifacts from the Middle Prehistoric through Protohistoric periods (approximately 3,600 B.P. -76 B.P.).

A qualitative research strategy was developed in order to maximize the interpretive value of this data. The representation, by both count and weight, of toolstones for several artifact classes is determined and compared between sites and occupations. The possibility of selective procurement and use of various toolstones, as well as technological considerations, is examined.

Results indicate a long-standing pattern of raw material use which was not highly selective and was based on a large suite of lithic types. These do not generally support Reeves' (1970, 1983, 1990) differential patterns of lithic use developed as a set of definitive cultural-historical markers. In addition, the technological strategies of curation and expediency are also identified in the dataset. The generalised nature of the datasets preclude more specific interpretations. Thus, Cultural Resource Management data is best used to assist planning stages of a research project.

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INTRODUCTION

Introduction

In archaeology, the discrepancy between theory and practice has wide ranging effects on applications and results. The limitations of archaeological data have prompted numerous debates ranging from reevaluations of the underlying paradigms of archaeology to specific questions concerning the best use of particular types of data. Despite numerous discussions regarding appropriate methodological considerations, archaeological practice does not fully conform to the ideals set out in the literature. This statement may seem obvious, yet the discrepancy between the theory and practice of archaeology is an important consideration in any study.

In the ideal archaeological research strategy, field work and analysis are performed in accordance with a research design intended to answer a particular question (Redman 1987). In practice, however, it is usually not possible given the ever-present constraints of time and funding to develop new projects to address all of the new theories and ideas put forward in the literature. Entirely new research projects are often not possible, or even desirable, and the obvious alternative is to utilise previously collected data to test new theories. This study examines Cultural Resource Management (CRM) data from southern Alberta and addresses its suitability for application to questions which were not a focus of the original study.

Most of the archaeological research conducted in Alberta is CRM completed by archaeological consultants in order to mitigate the impact of the effects of development on archaeological resources. This work consists of immediate sampling (surface collection, excavation) and later descriptive analysis. The recovery and storage of both data and artifacts provides a wealth of material for future research.

This study of a CRM database uses lithic data collected during a large-scale mitigation project in southwestern Alberta. The Oldman River Dam Project (OMRD Project) provides an excellent case from which to test the value of mitigative data against larger archaeological concerns. The investigation followed basic standardized procedures outlined for CRM work in the province, and because a number of consulting firms participated, the project emphasised field recording and analytical techniques. The focus of this study is lithic raw material utilisation.

There are a number of reasons why lithic raw material resources were chosen as a focus. First, the artifactual material from the OMRD Project is largely lithic in character (in this study the term 'lithic' does not include either fire-cracked rock, or any rock used for a feature), as is typical of most archaeological assemblages from this region. Second, lithic procurement strategies have come under increasing scrutiny as they have been determined to provide important insights not only into intragroup relationships , but also into specific technologies. As Anta Montet-White (1991:iii) notes:

> It is widely recognized that the proximity and accessibility of material outcrops as well as the relative abundance of good chert did influence the technological choices of prehistoric tool makers...but the systematic study of processes of acquisition, distribution and use of lithic raw materials is a relatively recent focus of lithic studies.

The recent focus on understanding the management of raw material resources by past stone toolmakers echoes the trend to study lithic assemblages using a technological organisational approach (Nelson 1991). This approach is characterised by the integrated study of stone working activities with a broader focus on past lifeways. The technological organisational approach (Carr 1994a) has been offered in response to criticisms of lithic analysis as being trivial, atheorectical and tangential to current archaeological pursuits (Cross 1983; Dunnell 1980; Thomas 1986; Torrence 1989). As the procurement of raw material is the first step in the production of stone tools, lithic resource studies may offer some valuable insights to intersocietal relationships and economic and technological studies. Hence, this study of lithic resource use provides valuable information pertinent to the overall understanding of lithic technology in southern Alberta.

A third reason for choosing raw material as a focus of study is that many archaeological cultures are considered to have characteristic suites of raw materials as part of their distinguishing traits. For example, raw material utilisation patterns have been used by Alberta archaeologists to characterise prehistoric cultural periods and thus form a basis for hypotheses of broader prehistoric cultural change. These studies follow Reeves' (1990) pioneering efforts. Here, I examine patterns in the OMRD dataset to evaluate the validity of Reeves' conclusions for that region.

This study will attempt to discover what sources of variation may underlie utilisation patterns. To accomplish this, the analysis compares patterns between sites and occupations (i.e., change over time), and evaluates an array of technological considerations. However, the specific methodological approach used to address these questions depends on the available data (see below). Following preliminary evaluation of the potential of the OMRD dataset, it is determined that the most useful and least problematic use of the data is broad material representation. Material representation is compared for both count and weight over a number of artifact classes. This analysis is undertaken in order to identify the strengths and weakness of utilising previously recorded CRM data because the aim of this study is to maximize the usefulness of the CRM dataset for answering a broader range of archaeological questions within the constraints of the existing dataset.

Organisational Framework

My discussion begins in Chapter 2 with an overview of the study area including regional and local environments, prehistory of southern Alberta, the history of archaeology in Alberta and the OMRD Project. A review of raw material studies follows in Chapter 3. The methodology employed in the OMRD Project as well as in this specific study are presented in Chapter 4. The results of the data analysis appear in Chapter 5 and are discussed in Chapter 6. A summary and conclusions follow in Chapter 7.

Chapter 2

THE STUDY AREA: AN OVERVIEW

Introduction

This chapter presents a background discussion of southern Alberta and the study area, as defined by the Oldman River Dam Project (OMRD Project). I situate the environment of this area in the context of southern Alberta and follow with a brief outline of the environment in the immediate area of the reservoir. I then present a brief discussion of the prehistory and practice of archaeology in southern Alberta, including a discussion of the OMRD Project, and conclude with a description of the sites used in this study.

Regional Environment

Much of southern Alberta, excluding the foothills and mountain region in the extreme west and the Aspen Parkland regions to the north, is part of the Northwestern Plains, traditionally thought of as the short and mixed grassland areas of Alberta, Saskatchewan, Montana, the Dakotas and Wyoming (Vickers 1986:4; Wedel 1961:23). The Alberta Plains are flanked on the west by the foothills of the Rocky Mountains and bordered on the north by the Aspen Parklands transitional zone between the grasslands and the vast Boreal forest zone. The topography of this region was shaped by the underlying bedrock geology and frequent glaciation, most recently by the Wisconsin episode which ended approximately 12,000 to 15,000 years ago (Landals 1994: 3). It varies from rolling glacial (or hummocky) moraine to flat featureless areas characteristic of glacial lake beds. Several major uplands including the Cypress, Porcupine, Wintering, and Hand Hills interrupt this topography and provide a number of different microenvironments which support the growth of varying vegetation.

Unlike the rest of the Plains, most of the rivers in Alberta eventually drain into Hudson Bay or the Arctic Ocean. Southern Alberta is drained from west to east by a number of major rivers, the largest of which is the South Saskatchewan River system draining into Hudson Bay. Major tributaries of this system include the Bow, Oldman (which is the focus of this thesis), Red Deer, Belly, St. Mary's and Highwood Rivers. An exception is the Milk River in extreme southern Alberta, which is part of the Missouri-Mississippi system eventually draining into the Gulf of Mexico. These river valleys, parkland extensions and the northeastern slopes of the uplands provide the main source of wooded vegetation in an area which is predominantly grassland. A number of deeply incised glacial erosional channels or 'coulees' also dissect this region, but they generally have neither abundant water nor wood resources.

Southern Alberta has a continental climate with extremes of summer and winter temperatures. It is characterised by low precipitation, high winds, low mean annual temperatures and a relatively short growing season (Hardy 1967; Longley 1967; Sanderson 1948; Strong and Leggat 1981). Most of the precipitation falls as rain in the spring during May and June with rainfall generally decreasing from west to east (Vickers 1986:7). Summer is relatively short with the warmest temperatures occurring in July.

The mean average temperature for July is 27°C (Hardy 1967). The fall months of September, October and November tend to be dry, although there is usually some snow cover by November. The winter months (December, January and February) are cold (Strong and Leggat 1981). While this description presents a general view of climatic conditions, it does not express the degree of variability in weather conditions experienced by a particular region. This consideration is especially relevant as the climate of southern Alberta is extremely variable both from one year to the next, as well as throughout the year (Vickers 1986:7; Wormington and Forbis 1965:6). The strong seasonal westerly winds called Chinooks help to temper winter temperatures. These warm dry winds blow down from the mountains, bringing rapid increases in temperature; Chinooks have been observed to raise temperatures 22^0 Celsius in ten minutes (Longley 1967:55). As the effects of these winds are felt most strongly in the foothills and westernmost portion of the Plains, Chinooks were likely an important factor in the study area.

Local Environment

The study area is defined by the location of the Oldman River Dam and its reservoir (See Figure 1). The Oldman Dam Project area is located in the transitional zone between the foothills and the plains at the south end of the Porcupine Hills (Landals 1994:3) near the town of Pincher Creek, Alberta. The dam itself is located on the upper reaches of the Oldman River, its reservoir affecting three different rivers, the Oldman (including the North Fork), the Crowsnest, and the Castle. The rivers themselves are

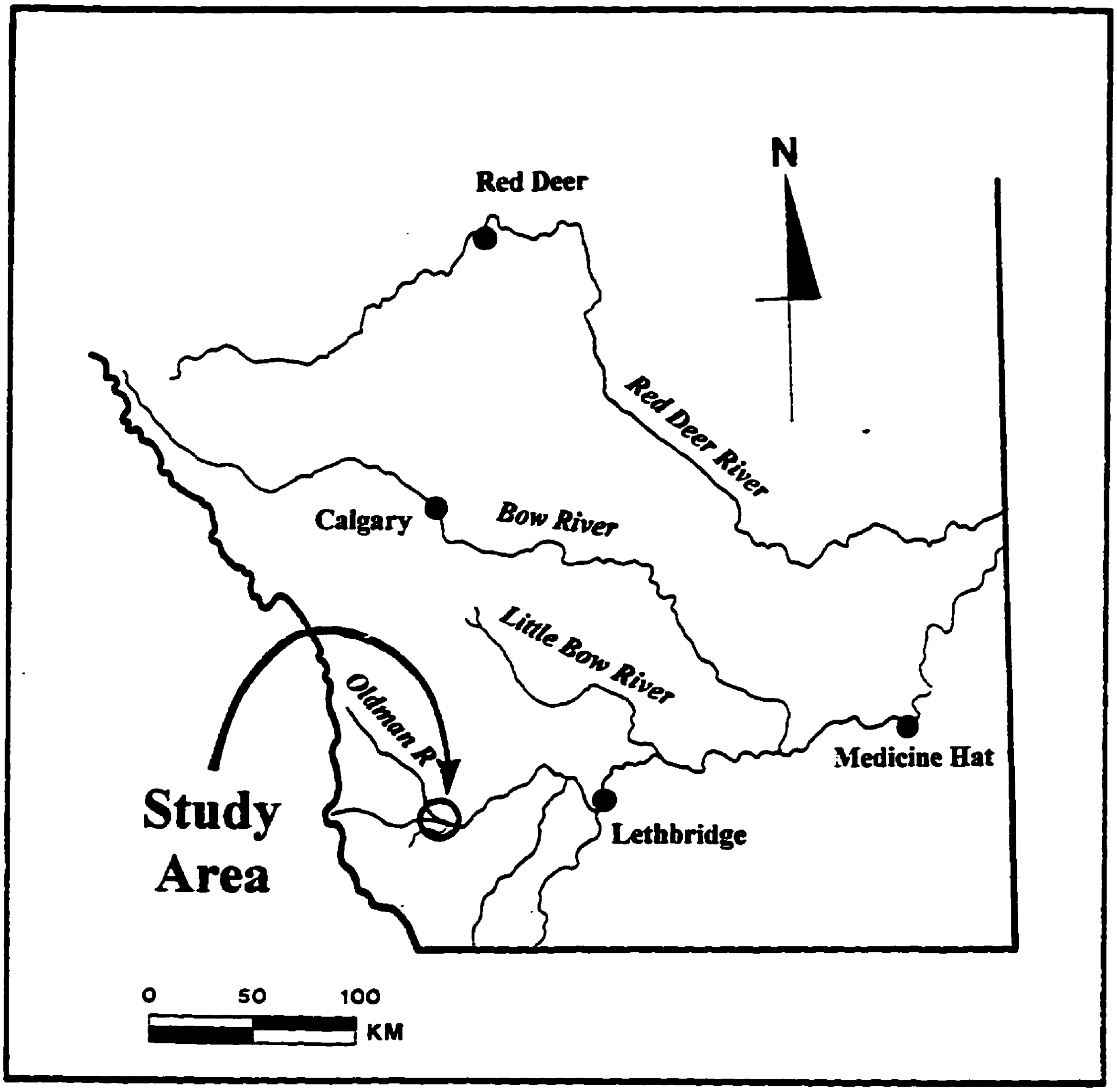

Figure 1: Generalized map of southern Alberta, illustrating study area location.

thought to have been established in late glacial times (Landals 1994:4). The Oldman River, for example, is believed to have had its present course established as a result of a glacial outburst flood in excess of 12, 000 years ago (Landals 1994:3). The Oldman and the Crowsnest Rivers flowing eastward through the project area have relatively broader shallower valleys than the north / south flowing North Fork of the Oldman and the Castle River which are characterised by narrower, more deeply incised valleys (Landals 1994:3). Topographically the valleys are complex and are described by Landals (1994:3) as including "high and intermediate glacial terraces/benches, recent floodplains, abandoned channels, in-filled meanders, bedrock outcrops and escarpments, steep-sided tributary streams and deep adjoining coulee systems".

As previously mentioned, the study area is situated between the Foothills Belt, (defined by the underlying geologic structure of folded and faulted beds) and the Plains (defined by sandstone and shale bedrock characterised by horizonal strata). Much of this study area is a rolling hummocky till plain cut into by river valleys. The till has been described as a "heterogeneous, non-bedded mixture of rock material of all sizes" with igneous and metamorphic erratics from the Canadian Shield, as well as finer particles of a local origin (Beaty 1975:65).

Strong and Leggat (1981) characterise the study area as being on the border between mixed grass (grama-spear grass, *Bouteloua gracilis* and *Stipa comata*, and wheat grass, *Agropyron Spp.)* and fescue grass (*Festuca scabrella*) ecoregions of the province. Van Dyke (1994:3) notes, however, that the reaches of the Oldman and the Crowsnest Rivers at the upper end of the reservoir were predominately rough fescue in the past. The soils tend to be brown chernozems. The river valleys themselves have a number of vegetative communities. Saskatoon-Chokecherry shrub (*Prunus sp.*) communities can be found on the north and northeast facing slopes while the south and west facing slopes are often characterised by Skunk-Creeping Juniper (*Juniperus sp.*) communities. Stands of trees including species of pine, spruce, willow, and cottonwood / aspen-poplar (*Pinus sp., Picea sp., Salix sp.* and *Populus sp.*) tend to be restricted to deep coulees, tributary valleys, the deeply incised Castle River drainage, and the steep north and east facing slopes along the Oldman and Crowsnest Rivers (Van Dyke 1994:3).

A number of animal species inhabited this area prior to European colonization, but many are no longer found in their natural environments. The best example is, of course, the previously most numerous of the large mammals, the Plains and Wood Bison (*Bison bison bison* and *Bison bison athabascae*), but also includes elk (*Cervus elaphus*), moose (*Alces alces*), bighorn sheep (*Ovis canadensis*), and wolf (*Canis lupus*). Mammals present today included various species of deer (mule deer, *Odocoileus hemionus*, white-tailed deer, *Odocoileus virginianus.*) and Pronghorn antelope (*Antilocapra americana*). Carnivorous species include the bear (*Ursus sp.*), coyote (*Canis latrans*), swift fox (*Vulpes velox*), and bobcat (*Lynx rufus*). Smaller residents of the plains include the beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), badger (*Taxidea taxus*), porcupine (*Erethizon dorsatum*), weasels (*Mustela ssp.*), and ground squirrels (*Spermophilus sp.*). Bird life is abundant and includes many raptors (red-tailed hawks, peregrine falcons, prairie falcons), grouse, partridges, owls, songbirds and a variety of seasonal waterfowl (cranes [*Grus canadensis, Grus americana*], ducks, geese

[*Branta canadensis*, *Branta bernicula*, *Chen caerulescens*, *Chen rossii*], herons [*Ardea herodias*] and swans [*Cygnus buccinator*, *Cygnus cygnus*]). The rivers are rich in fish species including, mountain and lake whitefish (*Prosopium williamsoni* and *Coregonus chapeaformis*), rainbow and cutthroat trout (*Oncorhynchus mukiss* and *Salmo clarki*), sucker (*Catostomus spp)* and burbot (*Lota lota*).

The History of Archaeology in Alberta

The first attempt to coordinate archaeological research in Alberta was undertaken by the Glenbow Foundation in 1955 (Wormington and Forbis 1965:1). Although earlier work had been carried out in the province, such as Junius Bird's 1938 excavations at Head-Smashed-In (Duke 1991:6), it was the work sponsored and organised by the Glenbow Foundation which demonstrated the potential of Alberta archaeology (Vickers 1986:3). The Universities of Alberta and Calgary became involved with Alberta archaeology in the early 1960's. Dr. Richard Forbis, who was originally hired as the first full-time archaeologist by the Glenbow Foundation, joined the faculty at the University of Calgary in 1963 (Vickers 1986:3). In 1964, the first Department of Archaeology in Canada was established at the University of Calgary with Dr. Richard S. MacNeish as Chairman. As a result, the University of Calgary became quite prominent in archaeological research in southern Alberta (Duke 1991:6). An interest in the archaeology of southern Alberta continued with the work of Reeves (1970), whose synthesis for the cultural-historical sequence for the area is still used in modified form today.

The energy exploration boom of the 1970's radically altered this initial academic focus. Rapid development led to the passage of the Alberta Heritage Act in 1973, which declared all archaeological material to be property of the Crown (Vickers 1986:3). It also stated that if any site was to be destroyed, developers were responsible for hiring a consultant archaeologist for impact assessment and necessary mitigation. The Archaeological Survey of Alberta (ASA) was subsequently established to regulate land development and protect archaeological resources. A number of private archaeological consulting firms also formed to meet the demand for contract archaeologists.

The boom in development, which increased the need for assessment and mitigation, coincided with a decrease in funding for university research. This led to a situation which continues to the present, in which most of the archaeological work in Alberta is conducted in a CRM framework.

Human Occupation of Southern Alberta

Southern Alberta has a long period of human occupation. Until European colonization, the inhabitants of this part of the Northern Plains pursued a big-game hunting strategy which endured for at least 10, 000 years. Reliance on bison as the main staple food necessitated a highly nomadic lifestyle to follow the constantly moving herds. There has been much debate concerning the nature of bison herd movement, in particular the question of whether the herds engaged in distinct migratory patterns. Modern ecological studies, as well as evidence drawn from historical documents, indicates that bison herds did not engage in huge annual migrations as has been suggested but, rather, followed a pattern of shorter seasonal movements (Bamforth 1987; Hanson 1984; Moodie and Ray 1976; Morgan 1980). Seasonal migration involved movement between winter and summer ranges. In late spring and summer, bison herds moved onto the open plains to graze; when the weather turned cold the herds moved into more sheltered areas such as major river valleys, aspen parklands to the north and foothills to the west (Vickers 1991). Consequently, a seasonal round has been suggested for the prehistoric inhabitants of southern Alberta. It is logical that there was movement into winter ranges, not only to follow the food supply, but also to obtain shelter and a supply of firewood (Vickers 1991).

The Prehistoric Sequence of Southern Alberta

Vickers (1986:12-13) has provided a useful review of the cultural historical sequence of southern Alberta. He summarized Reeves' cultural historical sequence, supplemented with information from Kreiger (1962, 1964), Willey (1966) and Bryne (1973) as follows:

> 1. Pre-Projectile Point horizon (+11,500 B.P.) -This period is simply a rubric to handle the possibility of pre-Clovis or 'Early Man' discoveries in the New World (Kreiger 1962, 1964; Willey 1966:29) and the data base for this time period in Alberta is, at best, minimal.
>
> 2. Early Prehistoric Period (11,500 B.P.-7,500 B.P.) - This period is characterized by large, lanceolate projectile points thought to have been hafted to heavy, stabbing spears. Complexes included are Clovis, Folsom, Agate Basin, Hell Gap, Alberta, Cody, Frederick, and Lusk.
>
> 3. Middle Prehistoric Period (7,500 B.P.-1,750/1,250 B.P.) - This period is characterized by medium sized, notched or stemmed projectile points thought to have been hafted to darts propelled by an atlatl (spear thrower).

The period is further divided into:
a) Early Middle Prehistoric I (7,500 B.P.-5,000 B.P.) - This is characterized by the Mummy Cave Complex (Bitteroot, Salmon River point types) and subsumes the Altithermal (Hypsithermal, Atlantic) climatic episode and cultural units of that time (Reeves 1973).
b) Early Middle Prehistoric II (5,000 B.P.-3,500 B.P.) - This is characterized by Oxbow, McKean, and Late Mummy cave materials (Reeves 1973a).
c) Late Middle Prehistoric (3,500 B.P. -1,750/1,250 B.P.) - This includes Pelican Lake and Besant complexes. Reeves (1983:37) also includes a Hanna Phase.

4. Late Prehistoric Period (1,750/1,250 B.P. - 250 B.P.) - This period is characterized by small notched, or triangular projectile points thought to have been hafted to arrows propelled by bows. Complexes and phases occur in abundance represented by Avonlea, Late Plains and Prairie Side Notched, and Triangular points. This period is also indicated by the introduction of ceramics.

5. Protohistoric Period (250 B.P. -76 B.P.) - This period is characterized by the addition of European trade goods to the Late Prehistoric material culture and, ultimately, the replacement of the latter by trade items (Byrne 1973).

In addition to the preceding cultural-historical scheme, the OMRD Project also included an Old Women's Phase (OWP). The Old Women's Phase is somewhat of a catchall category for the post-Avonlea prehistoric record, generally including both Prairie and Plains side-notched points. Despite the common treatment of OWP as a single cultural entity, it is possible that more than one cultural manifestation is subsumed within the term (Vickers 1994:22-23).

The Oldman River Dam Project

The Oldman River Dam Project (1988-1991) is the largest archaeological mitigation project ever conducted in Alberta. It was undertaken to mitigate the effects of dam construction on prehistoric sites on the Oldman River. The objectives of the Oldman Dam Project were to reconstruct the prehistory of the area, as well as investigate the relationship of "long term winter exploitation of bison by Plains groups operating from river valleys" (Ives 1988:108). The dam was projected to flood approximately 24 km of the Oldman, Castle and Crowsnest rivers, covering an area of 2,420 hectares at full supply. In 1985 and 1986, Reeves (1987) conducted an Historical Resources Impact Assessment with Lifeways of Canada Limited which evaluated 315 prehistoric sites and 46 historic sites, 144 of which were located within the proposed reservoir. This demonstrated that many of these sites were in well sheltered situations favourable for winter settlement. Some of the faunal evidence also supported the interpretation of winter occupation. As well, many sites showed evidence of repeated use. On the basis of this work, Reeves concluded that the area represented a major prehistoric wintering locale. Consequently, one of the major research questions set out for the mitigation project concerned winter exploitation of the sheltered valleys. Mitigation commenced in 1988.

Due to the large scale of the project, it was separated into four contracts awarded to different companies. Three of the contracts were awarded on the basis of functionally distinct sites. Environmental Management Associates Limited were responsible for the killsites, Ethos Consultants Limited for the stone features, and Bison Historical Services

Ltd. for the campsites. Operationally, the division of sites was not as clear cut as it may appear. Several sites were determined to have both kill and campsites in one locale and so were excavated by two different companies. In order to provide overall consistency to the project, a fourth contract was awarded to Ethos Consultants as an over-all management program. The co-ordinator of this component, John Brumley, was responsible for the development of research design, ensuring consistency in field and analytical methodology, and the reporting of results. The project was undertaken over a period of three years, 1988-1990. Each company was responsible for a final report summarizing all the results of work completed (see Van Dyke 1994 for campsites; Landals 1994 for killsites; and Dau 1994 for stone features). The management contractor's final report synthesizing and interpreting the results from the entire project is still pending.

To narrow the scope of this study, I limited my investigation to five selected campsites, for the following reasons. First, as habitation areas, campsites tend to reveal a broader range of activities than more specialized sites such as killsites. Thus, a broader range of stone tool making and maintenance activities are more likely to be present at habitation sites. Second, my objective was to assess the potential for examining raw material lithic utilisation patterns from CRM data and not to reconstruct raw material utilisation patterns for the entire area.

The Occupation Sequence

Five sites were chosen for analysis in this study. The research strategy of comparing assemblages over time and between sites determined the criteria by which the sites were chosen. Multicomponent sites permit the study of change over time within and between sites. By controlling for the variable of site location, I limited my study to Middle and Late Prehistoric to Protohistoric time periods because of the scarcity of early occupations. I use Van Dyke's (1994) term 'occupation' to refer to all material and features associated with a particular phase or complex. Before describing the sites, it would be useful to summarize the conclusions which resulted from the OMRD Project.

The campsites research program confirmed Reeves' (1970) interpretation that the Oldman River valley was a major seasonal wintering locale (Van Dyke 1994:282). This valley was occupied for a span of at least 9,000 years. However, the most intense and sustained use of the valley began approximately 3,600 years ago with evidence of the McKean Phase (Van Dyke 1994:277). As the earliest occupation recovered for the sites analysed here is McKean, my discussion starts with this occupation and continues to the end of the sequence, at, or just before European contact.

All McKean occupations are overlain by Pelican Lake material. The McKean occupation of the project area was originally interpreted as being minimal (Van Dyke et al. 1991:43), but Van Dyke (1994:182) altered his view to suggest that rather than being underrepresented, the McKean occupation was underemphasized. He further indicates that the McKean occupation was underemphasised as a result of the difficulty in separating the McKean material from the overlying Pelican Lake assemblages. Therefore, the amount of McKean material which was separated with confidence is very low.

On the basis of this data, however, a number of things concerning the McKean occupation were noted. McKean was the earliest occupation with evidence of fire broken rock and stone circles. In addition, the limited nature of the tool classes suggest that occupations were brief and that the valley was not used for overwintering but as temporary camps as part of a wider seasonal round (Van Dyke et al. 1991:42-43).

The Pelican Lake occupations represent the most intensive use of the Oldman River Valley overall. Evidence includes the presence of major killsites, very extensive processing facilities such as boiling pits, hearths and fire-broken rock piles, sites located in sheltered areas, seasonal indicators from faunal material and a wide range of tool classes. These data have led to the interpretation by its investigators that the Oldman River area was used by the Pelican Lake populations as a fall hunting and intensive processing area, as well as for overwintering (Van Dyke 1994:279; Van Dyke et al. 1991:45).

The Besant occupation of the valley is considerably less intensive. Although there is evidence for overwintering (for smaller populations than Pelican Lake), a possible summer utilisation of the valley is indicated as well at two stone circle sites on the valley margins (Dau 1994). No Besant material has been recovered in the major killsites in the valley. This suggests that the Besant settlement pattern may have been focused on the use of major fall drives elsewhere and split into smaller groups for overwintering in the valley (Van Dyke et al. 1991:48).

The presence of the Avonlea Phase in the project area is minimal. The cultural inventory is very restricted for the six components in which it was identified (Van Dyke et al. 1991:52). The only significant Avonlea occupation was at a processing campsite designated as DjPm-100. However, because Avonlea material was mixed with OWP material and was labelled as an undifferentiated component (Van Dyke et al. 1991:54), it will not be considered in this study.

An intense Late Prehistoric occupation of the Oldman River Valley is indicated by both the OWP and Protohistoric evidence. The OWP occupation is represented by a large number of stone circles and bison processing areas. A number of small killsites also are associated with this Phase and the faunal evidence suggests a fall and winter use of the valley (Van Dyke 1994:281). The presence of metal points, European pipe fragments, horse bones, beads and metal tools helped define the Protohistoric occupation of the project area (Van Dyke 1994:281). Again an intensive use of the valley is indicated from December to early spring from the assemblages at both killsites and campsites (Van Dyke et al. 1991:59). Although not all of these components are present at all of the sites chosen for analysis here, all of them are found at multicomponent sites. A brief description of the sites follows.

Descriptions of Sites

DjPl-13

DjPl-13 is located on a 12 m high terrace on the north bank of the Oldman River, upstream from its confluence with the Castle River (Van Dyke 1994:38; see Figure 2). Although the site is situated close to water and trees, it is not very well-protected. The total excavation at the site included 183 square meters removed to a depth of 70 cm in

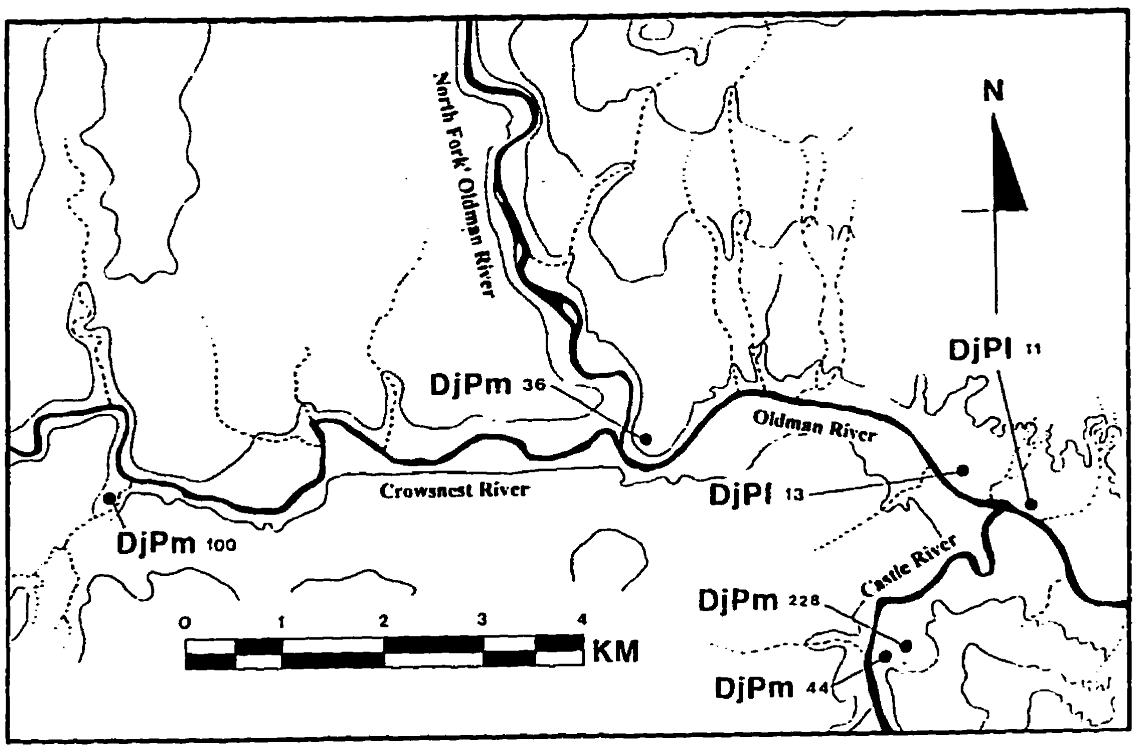

Figure 2: Oldman River Dam Project Area illustrating the location of campsites used in this study (adapted from Van Dyke 1994:2).

four major blocks and four small 2-x-2-m test units (Van Dyke 1994:40). McKean, Pelican Lake, Besant, Avonlea and Old Women's Phase occupations were confirmed at the site (Van Dyke 1994:50). The presence of stone circles, boiling pits, hearths and concentrations of fire-broken rock suggest that DjPl-13 was a campsite at which extensive food-processing activities took place (Van Dyke 1994:103). Supporting lines of evidence for this conclusion include the presence of foetal bison bone, features located external to the habitation structures and the exposed nature of the site. Evidence suggests that it was used in the late spring (Van Dyke 1994:103).

DjPm-44

DjPm-44 is a stratified tipi ring and bison processing site located on a 10 m terrace at the south end of Horseshoe Canyon on Castle River (see Figure 2). The site is well protected with southern exposure, near to water and a well wooded area (Van Dyke et al. 1991:46). A total of 196 square metres was excavated including two complete stone circles and six additional test blocks. The two excavated stone circles belong to the surface occupation which is Protohistoric. Both stone circles yielded metal artifacts and historic beads. The presence of foetal bison bone suggests that this component was occupied in late winter to early spring (Van Dyke 1994:211). Underlying this was a Besant occupation which was located between 20-50 cm below surface (Van Dyke 1994:196). Two living floors were well-defined in the Besant occupation. A possible boiling pit and habitation structure were also located within this occupation. Of particular interest to this study was the recovery of a workshop area represented by 250 flakes, predominately of black banded chert (Van Dyke 1994:205). A minimum of three living floors were present in the Pelican Lake occupation. These were located at depths between 50 and 130 cm. The Pelican Lake occupation is represented by a number features such as hearths and light bone scatters (Van Dyke 1994:202). No seasonality data from the faunal record was available for either the Pelican Lake or Besant occupations, however the protected nature of the site suggests that it may have been occupied in the winter.

DjPm-100

DjPm-100 is located in Warriner's Coulee upstream from the confluence of the coulee and the Crowsnest River (Van Dyke 1994:233; see Figure 2). It is located on the west side of the coulee and is well protected and near to a wooded area. Four stone rings were excavated at this site, which along with the excavated inter-ring areas totalled 147 square meters. While compression of the layers is apparent, two occupations were defined by the surface rings. The remaining underlying components were simply assigned to a general Late Prehistoric status as it was almost impossible to separate the buried occupations (Van Dyke 1994:235-237). Two of the rings were assigned a Protohistoric status on the basis of recovered early historic artifacts. These two surface rings both exhibit central hearths (Van Dyke 1994:247). A late winter occupation is likely, given the faunal evidence which supports considerable processing of bison (Van Dyke 1994:249). The OWP occupation was defined on the basis of two surface stone circles, and associated artifacts and features. The associated features included concentrations of fire-broken rock and rock-lined hearths (Van Dyke 1994:244). Faunal evidence suggests that the site was occupied in late winter or early spring (Van Dyke

1994:246).

DjPm-228

DjPm-228 is located on a high relict landform in the Horseshoe Canyon (Van Dyke 1994:260; see Figure 2). The site is very exposed and not situated near water nor a very well-wooded area. This land form was utilised as a peninsular trap to hunt bison. As the site straddles the full supply zone, a different excavation strategy was utilised. An intensive program of 78 screen shovel tests and 18 test blocks were excavated instead a single large test (Van Dyke 1994:266). Three different components were excavated at this site. The earliest occupation was defined as McKean on the basis of a single diagnostic point: it was restricted to a six metre square test pit (Van Dyke 1994:264). The Pelican Lake occupation, including 11 Pelican Lake points, represents most of the material recovered from this site. The exploitation of the landform is believed to have reached its peak with this occupation (Van Dyke 1994:265). Foetal bison bone suggest a later winter or early spring occupation (Van Dyke 1994:268). A small surface scatter, including a diagnostic point, forms the third component which has been identified as Besant.

DjPl-11

DjPl-11 is located on the same terrace as DjPl-13 (Figure 2). Five occupations, OWP, Avonlea, Besant, Pelican Lake and McKean, are present at this site. The OWP, Avonlea, Besant and McKean occupations are fairly small, defined by a living floor and associated artifacts. A boiling pit was recorded in the McKean occupation. The Pelican Lake occupation is represented by a number of living floors, dominated by partial or complete stone circles (Van Dyke 1994:28). Seasonality data is unavailable.

Summary

To summarize, DjPm-44 and DjPm-100 are both well-protected sites thought to be occupied in the late winter or early spring. The former contains Late Middle Prehistoric and Protohistoric components, the latter Late Prehistoric and Protohistoric components. Both have ample evidence of bison processing as well. DjPm-228 is also thought to have been occupied in the late winter or early spring, however the site is located in a very exposed location, which is less suitable for winter camping. Its association with the peninsular bison trap explains the location, and use of the site, however. It contains Early Middle and Late Middle Prehistoric components. DjPl-13, represented by early Middle to Late Middle Prehistoric components, is also situated in a location which is not that well-protected. It is thought, however, to have been occupied during the late spring. Evidence for food processing is also prominent at this site. DjPl-11 contains Early Middle Prehistoric through Late Prehistoric, or possibly even Protohistoric, components. Like DjPl-13, this site is not well-protected. Season of occupation has not been determined.

Chapter 3

RAW MATERIAL STUDIES: A DISCUSSION

Introduction

Lithic raw material studies can be approached from a number of different perspectives. Church (1994:1) describes these as an overlap of three disciplines: geoarchaeology, archaeometry and archaeology. The first two disciplines are mainly concerned with locating lithic source areas (quarries etc.) and identifying their characteristics. This information can then used to present an archaeological perspective on prehistoric lithic use. The following chapter is concerned with raw material research as it applies to the discipline of archaeology. Material identification and characterization is presented below, in Chapter 4.

The following discussion focuses on raw material studies of hunter-gatherer societies, as is appropriate given that the assemblages analysed in this study are the products of hunting and gathering groups. I review previous studies in this area and consider the history and goals of raw material research. The implications of this research to the present study are also considered. This discussion is organised topically, reflecting the different approaches employed by researchers.

Raw Material Studies

It is difficult to pinpoint the beginnings of archaeological interest in lithic raw materials. However, it is clear that the recognition that raw material sourcing of prehistoric artifacts could be used to provide information on past behaviour is not a new one. An overview of early work on lithic resources in Europe can be found in Smolla (1987). W.H. Holmes (1893) is generally considered to be one of the first to emphasize this type of research in North America, but after his death, few archaeologists showed continued interest in this topic (Ball 1941; Bryan 1950; Church 1994:2). A concentrated effort towards understanding the role of raw material in the prehistoric use of stone was renewed in the late 1960's and 1970's.

The increasing sophistication of the physical and chemical techniques utilised for material characterization and sourcing occurring at this time were important in fostering and inspiring raw material research (Francis 1983:2). The early focus of research, which both supported and benefitted from these increasingly sophisticated analytical techniques, was overwhelmingly concerned with prehistoric trade systems, in particular the trade of obsidian in the Near East. These studies (ie. Cann and Renfrew 1964; Renfrew et al. 1968; and Wright 1969) formulated various models of trade which were tested by examining the distribution of obsidian in the Near East. Basically, they attempted to differentiate patterns of exchange through the examination of variation in falloff patterns around a source by plotting the abundance of a raw material against distance. The underlying conceptual framework for these patterns assumed that transport costs of materials should influence distance from source in a direct linear fashion (Findlow and Bolognese 1984:71; Renfrew 1977:72). There also have been attempts to improve the measurement of transport costs by standardizing the effect of topographic relief (Findlow and Bolognese 1984:71). Other studies have combined models in a attempt to more realistically deal with distance to source area(s) in specific instances (Clark 1984; Renfrew 1972), or to investigate the effects of source distance on various metrical attributes (Newman 1994). However, although the factor of distance plays a role in most raw material studies, a strict application of mathematical models has not been the focus of many of these studies. The numerous analyses of Mesoamerican obsidian (e.g., Andrews et al. 1989; Asaro et al. 1978; Clark and Lee 1984; Coe and Flannery 1964; Dreiss and Brown 1989; Healy et al. 1984; Heizer et al. 1965; Johnson 1976; McKillop and Jackson 1989; Moholy-Nagy et al. 1984; Sidrys et al. 1976; Spence 1967; Spence and Parsons 1967) provide a good example of this more general type of study with a focus on trade-related lithic research. These generally involve the location and characterization of various source locations of lithic raw material followed by documentation of their archaeological distribution. The specific focus on trade has also continued, but hunter-gatherer research is generally less concerned with trade as the principal means of lithic procurement. The fact that trade is only one of a number of possible methods of lithic resource procurement is more heavily emphasised in hunter-gatherer research.

In many hunter-gatherer studies there are two fundamentally different strategies used to explain the presence of lithic raw material at a site: direct and indirect procurement. Direct procurement refers to material obtained directly by the user at the source location. Indirect procurement refers to material obtained from at least one intermediary, thus invoking mechanisms of trade and exchange. Several articles have focussed on the problem of distinguishing indirect and direct procurement in archaeological assemblages (e.g., Meltzer 1989; Morrow and Jefferies 1989), but much of the research on hunter-gather lithic resource procurement tends to focus on direct procurement. This reflects the strong emphasis placed upon environment and subsistence in hunter-gatherer research. Direct procurement ties in neatly with current general views of environmental exploitation.

This interest in direct procurement is exemplified by the so-called 'Binford-Gould debate', a series of articles in which Binford (1979, 1980, 1982, 1985; Binford and Stone 1985) and Gould (1980, 1985; Gould and Saggers 1985) offer contrasting views on the procurement of stone resources by hunter-gatherers. Binford suggests that much of the acquisition of lithic raw material occurs within the framework of normal food-getting activity; that is, it is 'embedded' within normal subsistence strategies. The concept of 'embedded' procurement has become quite prominent in many studies undertaken since then. In contrast, Gould's work led him to document a more deliberate pattern of lithic procurement. However, there is in fact no reason that any number of possibilities could not have been utilised in prehistory; the different strategies documented by Binford and Gould should in fact be expected given the very different ethnoarchaeological examples from which they were drawn (Francis 1983:20; Straus 1991:170).

Both strategies are often included in some form in studies which attempt to list methods by which lithic material could be directly acquired. In a study of procurement strategies in Wyoming, Francis (1983:23) offers casual and deliberate procurement as two possibilities based on the amount of planned effort required. Morrow and Jefferies (1989:28) list "special purpose trips to source areas" as well as strategies which are "embedded within seasonal movements throughout the region". Meltzer (1989:12) distinguishes between direct acquisition of primary sources versus secondary sources of lithic materials. Holen (1991:401) lists "nearest source/direct procurement", "qualitative suitability", and "procurement within the territory utilised during the yearly round" as possibilities.

The interest in understanding procurement patterns is not surprising given the attention paid to subsistence-related topics in hunter-gatherer research. The mechanisms of lithic resource procurement is one area of interest in raw material studies. The intuitive beginning point for such research, the quarry, has however received less attention than may be warranted. The difficulties of the huge volumes of material and the lack of diagnostic material which plague many quarry sites has deterred research. However, most of the source area studies which have been undertaken emphasize the utility of the examination of such areas (i.e., Gramly 1980; Purdy 1984). Francis (1983) repeatedly stresses the importance of this type of study for a thorough understanding of how the material was procured.

An interest in defining procurement patterns is also present in the raw material literature. There are differing views regarding the effectiveness of distinguishing the different types of procurement in the archaeological record. Morrow and Jefferies (1989), Holen (1991) and Francis (1983) are all reasonably positive that procurement strategies may be distinguished in the archaeological record. Meltzer (1989), in contrast, cites the problem of equifinality of archaeological evidence, and the near impossibility of attempting to distinguish different types of procurement patterns archaeologically. Understanding how particular materials were procured has ramifications for the interpretation of lithic utilisation patterns. The attention paid to, and in numerous cases, the assumption of direct procurement in many studies is not surprising given the emphasis on mobility and land use patterns in hunter-gatherer research. An outline of some of these studies is presented below.

Tracing lithic materials found in archaeological contexts to their geological sources provides the distributional relationships needed for this type of research. The assumption that the raw material composition of an assemblage provides information on group mobility, land use pattern and intergroup relations, has a long history in studies of territoriality, seasonal rounds and settlement patterns (Custer, Cavallo and Stewart 1983; Hester and Grady 1977; Reher and Frison 1980; Loendorf 1973; Wilmsen 1974; Wobst 1974). More recently, several articles in a volume edited by Ellis and Lothrop (1989) have emphasised this approach. Curran and Grimes (1989) utilised models of paleoecological reconstruction and seasonal exploitation, as well as an understanding of lithic distribution, to demonstrate the dynamic relationship between lithic procurement and the exploitation of biotic resources. Lepper (1989) demonstrated the potential of data on raw material distribution, using fluted points to understand Paleoindian land use. Tankersley (1989) discussed settlement mobility with respect to lithic procurement in the Midwest and extended his interest in this type of research in a study which examined very early Paleoindian lithic resource use (Tankersley 1991). On the basis of the distribution of Clovis points with respect to source areas of raw materials, he argued that the unidirectional nature of distribution patterns supports the idea that this may be a result of initial colonization and diffusion as put forward by other researchers such as Storck (1988). In a somewhat different approach to settlement and mobility strategies, Reher (1991) questioned whether theories of embedded or casual procurement can account for the scale of several prehistoric quarries known to archaeologists, such as the 'Spanish Diggings' quarry in Wyoming.

Not surprisingly, interest in this topic has also generated criticism and reevaluation. For example, Deller (1989:219) criticizes the practice of using projectile points from isolated findspots to infer population movements. He suggests that the treatment of all finds as one homogeneous mass ignores potential sources of variation which might have serious effects on interpretation. Hoffman (1991) comments on the use of linear distance as a measure of cost or availability and concludes that it is unrealistic. He further suggests that other variables, including the number of retooling events, perceived distance and individual variation in access to materials may also be important factors.

In a recent evaluation of mobility and raw material studies, Ingbar (1994:45) criticizes the practice of relying solely on source presence, stating that there "is only a general consensus that raw material sources must indicate something about prehistoric mobility or intergroup relations". To examine some of these assumptions, Ingbar (1994) set up a number of simulations to demonstrate why a good correspondence between raw material source proportions and territory does not exist. The results of Ingbar's (1994:50) 'thought' experiment suggest that even in a simple hypothetical universe, source proportions rarely indicate the minimal extent of a group's territory. Changing the two parameters of hypothetical speed of mobility and tool replacement episodes in the simulations significantly altered the outcome of the simulation, leading Ingbar (1994:50) to conclude that source proportions may reflect behaviour responsive to how the technology is organised. Ingbar (1994:54) suggests that source proportions can only be understood within the "entire context of stone tool production, use, maintenance and discard". While Ingbar raises some interesting points, it should be noted that factors such as production and patterns of use have been examined in the past.

While a focus on regional mobility and territoriality has been common, many studies have examined the utilisation patterns of lithic raw materials without this specific focus. In some cases, consideration of raw material has simply consisted of casual mention in site reports and project summaries in which the types and representation of source material are only very briefly outlined. In other cases, there has been a strong focus on investigating utilisation patterns in considerable detail. The documentation of changes in lithic representational patterns over time in order to characterise various archaeological cultures has been a common approach. Ahler's (1977) demonstration that a consistent difference in the representation of material types between the Middle Missouri Tradition and the Coalescent Tradition in the Middle Missouri Subarea provides a good example. Other examples include Clark (1984), Craig (1983), Hoffman and Morrow (1985) and Johnson (1985). Indeed, much of the discussion of the archaeological presence of different lithic types in southern Alberta assemblages is within the context of change over time.

Another more technological approach to raw material studies has been utilised both as a method for better describing utilisation patterns, as well as a particular focus of study. For example, the examination of source utilisation with respect to different tool types, use and rejuvenation patterns, as well as production strategies and debitage analysis have been undertaken by a number of researchers (Beck and Jones 1990; Blanton 1985; Jamieson 1984; Munson and Munson 1984; Odell 1989; Perttula 1984). The consideration of raw material as a factor within a larger framework of production and use has become increasingly important in recent years, as researchers acknowledge the benefits of investigating this factor in a broader context than gross source representation. Studies which include technological considerations for raw material utilisation can be divided into two categories based on their overall focus. The first includes those studies whose main focus is the raw material itself, such as those studies cited earlier. The second group are those studies which focus upon technological issues in which raw material is considered to be a factor. These concerns echo a recent trend in lithic analysis which emphasizes the understanding of organisational strategies. In the literature on technological organisation, there are a number of interesting approaches to raw material factors. A brief definition of technological organisation, followed by the treatment of lithic raw material within these studies is presented below.

There is some confusion surrounding the definition of technological organisation and its application, despite a considerable body of literature on the topic (Sassaman 1994:99). In a comprehensive review of the literature on the subject, Nelson (1991:57) defines technological organisation as:

> The study of the selection and integration of strategies for making, using, transporting and discarding tools and the materials needed for their manufacture and maintenance. Studies of the organization of technology consider economic and social variables which influence those strategies.

The advent of organisational studies is generally attributed to Binford (1977, 1978, 1979, 1983). Since that time a significant number of papers concerning this topic have been published of which Amick (1987), Bamforth (1986,1990), Bleed (1986), Carr (1994b), Keeley (1982), Kelly (1988), Koldehoff (1987), Nelson (1991) and Shott (1986) are but a few examples. In a recent volume of papers on this topic (Carr 1994a), a number of points concerning technological organisation studies are emphasised. The dynamic role played by technology to solve problems posed by the physical and social environments is heavily stressed (Amick 1994; Carr 1994b). This type of investigation relates technological strategies to the larger context of human behaviours and cultural change. Organisational studies are presented as a response to earlier critiques of lithic analysis which was thought to be theoretical, too focused on methodology, and of no relevance to current archaeological pursuits (Amick 1987, 1994; Carr 1994b; Cross 1983; Dunnell 1980; 1984; Thomas 1983).

Raw material is not discussed as a relevant variable in these studies. In some earlier work, lithic raw materials are treated as a scarce resource, if they are considered at all. The usual assumption behind the idea of resource scarcity is that lithic resources are restricted to localized areas and would not always be accessible when people were involved in subsistence activities. Models of time management, tool design, and curational practices have been offered as buffering mechanisms for a number of variables including raw material shortage (i.e., Bleed 1986; Kelly 1988; Kuhn 1994; Shott 1989). Few studies pay any attention to raw material other than stating that it is a restricted resource. However, not all of the earlier studies treat lithic raw material as a static resource; seasonal differences, larger scale climatic changes, and social factors may alter the availability of a particular material.

Not all studies dealing with organisational strategies have been characterised by a superficial treatment of raw material. In fact, the acknowledgement of the importance of raw material as a variable is increasingly common in recent literature. Bamforth (1986, 1990, 1991, 1992) and Wiant and Hassen (1985) argue for the potential importance of raw material beyond the assumption of it's restricted availability. Parry and Kelly (1987) discuss the correlation of formalized and expedient technologies with high mobility and sedentism, and briefly outline the possible effects of resource-poor areas versus resource-rich areas. Ricklis and Cox (1993) utilise distance from lithic source as a measure of cost in their economic model of trade-off costs and benefits for the examination of technological organisation in the Central Texas Coastal region. Recently, Andrefsky (1994a, 1994b) criticizes the cavalier treatment of raw material in theories which relate technological organisation to mobility patterns. He stresses the consideration of local conditions including the availability and quality of raw material, arguing that technological variability is directly related to the geological occurrence of raw materials for stone tools. The variable of lithic raw material plays an important role in Jeske's (1992) discussion of lithic technology and the concepts of energy efficiency and economizing strategies.

The increasing emphasis on raw material in technological organisation is not surprising. Raw material is the starting point for any stone tool, and variability in this resource most likely influenced the development of strategies involving its procurement. As well, there is a recent trend in organisational studies to place a higher degree of importance upon the potential influence of local factors than was common in earlier studies.

<u>Summary</u>

Raw material studies of hunter-gatherer societies tend to echo the interests of hunter-gatherer research and lithic analysis in general. The concern for subsistence and mobility related topics reflects what has been one of the major areas of inquiry in hunter-gatherer studies. Interest in lithic raw material as a factor in assemblage variability likewise reflects general concerns in lithic analysis, as does the increasing interest in organisational studies. Lithic raw material research presents a spectrum of studies ranging from mainly descriptive studies such as Ahler (1977) to those which attempt to explain raw material presence (i.e., Ingbar 1994). Many of the more recent studies have had a mainly economic focus, in terms of the attention paid to subsistence related topics, as well as attempts to understand how environmental variables (biotic and geological) influence assemblage variability. In some cases, such a focus has verged on being environmentally deterministic, particularly with regards to studies concentrating on energetic efficiency. Such an approach is likely to be limited, as it assumes efficiency with little room for cultural choice. The explanations offered for material presence in these studies tend to have a strong economic bias.

There are notable exceptions to this strong environmental focus. The first concerns the selection of lithic resources. A number of researchers have argued that aesthetics played an important role in Paleoindian lithic preference (e.g., Hayden 1982). Gould (1980:141-159) has also suggested that ideological factors were likely important in material use. Social factors have also been considered by Ellis (1989) who conducted a detailed investigation of Paleoindian lithic preference. Ellis (1989:163) suggests that the Paleoindian focus on particular lithic resources served as a risk pooling strategy for groups against resource failure by serving as a symbol of group homogeneity. Driver (1993) offers a similar theory for the Late Prehistoric time period in the Crowsnest Pass area of southern Alberta. Arguing that technological considerations cannot fully account for the strong presence of exotics found in sites in a reasonably lithic rich area, he offers two alternative hypotheses to explain the presence of exotics in his study area:

> 1. The exotics themselves may be linked to the acquisition of non-formalized individual status.
> 2. The trade in exotics may cement social relations over wide areas, thus increasing resource sharing during times of stress [Driver 1993:51]

Jamieson (1984) presented a similar hypothesis nearly ten years earlier. In general, the common, and often implicit inclusion of social and cultural factors is common in studies concerned with change over time in raw material usage. This is particularly evident in areas in which no drastic change in subsistence patterns have occurred; the northern Plains being an excellent example.

To summarize, the nature of stone resources, that they are durable and often traceable back to source origins, accounts for much of the popularity of this research. Lithic materials have been used as a method of examining the relationships of past peoples to the regions and resources they exploited, as well as potential relationships with other groups and other social and ideological factors. Increasing sophistication in sourcing techniques as well as growing collections of source information has helped to provide the initial database for this type of research. There is great variation in the scale of different lithic resource studies, a reflection of the particular research questions which form the focus of each study. For this thesis, the use of data from one fairly restricted region, as well as the strong seasonal focus precludes large scale regional study. However, these same conditions provide an ideal opportunity for examining a narrower set of variables than broad land use patterns. This analysis of the OMRD Project data will focus on differences at site level and between occupations, in keeping with the interest in change over time in southern Alberta archaeology. As well, this study will investigate a number of technological factors including whether availability (overwintering in the Oldman River Valley may have led to seasonal scarcity in lithic resources) or quality of lithic material may have played a role in material use patterns. The analytical approach to these questions will be dictated by the available data. A discussion of the OMRD Project data and its applications to these problems is presented in the next chapter.

Chapter 4

FIELD AND ANALYTICAL PROCEDURES

Introduction

This chapter presents the methods and procedures used to collect and analyse the data for this study. The data were collected for the Old Man River Dam Project (OMRD Project) and given to me in the form of a computer database. The first part of my discussion describes the procedures followed for the OMRD Project. Because a very detailed description of the methods and procedures for the OMRD Project has been laid out elsewhere (Brumley 1988; Van Dyke 1994), the discussion below focuses on those methodological aspects of particular interest to this study. Following this is an evaluation of the usefulness of the data. A description of how the data were manipulated forms the third part of this chapter.

Field Procedures

The OMRD Project's excavation techniques conformed to the standard of CRM work elsewhere in Alberta. Excavation of sites for this project involved trowelling and 'shovel shaving', the pedestalling of features, their mapping and photography in place, and the screening of soil for recovery of artifacts through 1/4 inch mesh. Because the use of 1/4 inch mesh is standard, the likelihood that the sample is deficient in lithics that would pass through this mesh size should be noted. The recording of data also was standardized through the use of prescribed recording forms for levels, profiles, and daily records specified in the procedural requirements manual (Brumley 1988).

The basic excavation unit was a 1 m x 1 m square, 10 cm deep. All materials, features, and living floors were assigned to a Cultural Material Unit (CMU) defined by Brumley (1988:13) as "broad-based, spatial and stratigraphic sorting and grouping categories the investigator intends to use in subsequent analysis, data summary and reporting". Van Dyke and colleagues provide a very useful description of CMU's as presented below.

> As used here, the CMU is a construct which integrated basic excavation data. Units, levels, living floors and features thought to contain associated archaeological material are referred to by a single CMU. Similarly, cultural material intermediate between other CMUs (and presumably mixed) are also referred by a CMU designation. Thus, cultural material units can be either archaeologically meaningful or insignificant, well defined or poorly defined (Van Dyke et al. 1991:27).

Although all of the excavated material was assigned to CMUs, the excavators found it difficult to describe a site based on this construct because of the variable nature of its significance with regards to archaeological interpretation (Van Dyke 1994:11). For that reason the final report on campsites was organised by grouping all CMUs of a similar age and archaeological cultural affiliation into a larger grouping which, in most cases, referred to a specific Phase or Complex designation (e.g., Pelican Lake Occupation).

Laboratory Procedures

Barb Neal conducted the lithic analysis for the campsites project using the procedural requirements outlined by Brumley (1988), with a few modifications made during the actual analysis. Artifacts were assigned to categories based on a combination of technological and functional criteria typical of those used in southern Alberta archaeology. Brumley's (1988) definition for the artifact categories are provided below. Each category has attributes specific to itself and others which are commonly shared. The description of the attributes provided below will begin with those attributes common to all categories and then concentrate on each specific category. A detailed description of the methodology can be found in Brumley (1988).

All of the lithic artifacts had a number of metric observations recorded for them. In order to achieve some consistency in measurement, Brumley (1988) provided both a written and illustrated description of how each specimen should be oriented for analysis and measurement. All artifacts were weighed to the nearest 0.1 g. All artifacts except Marginally Retouched Stone Tools (MRST) and debitage had their length and width measured to the nearest 0.1 cm. The size measurement for debitage and MRST reflects the longest dimension of the specimen to the nearest 0.1 cm. Projectile points, as diagnostic artifacts, have an entire series of extra measurements illustrated by Brumley (1988:12.8), a number of which define the different types of projectile points.

As well as metric observations, there are a number of other attribute classes in common across the artifact categories. 'Preform categories' is an attribute listed for all categories except debitage and refers to what the preform was (if it is possible to tell) with the four possibilities of pebble, cobble, flake and shatter. General shape categories are also common across the classes and include the following choices: circular, oval, circle slice, quarter circle, one-third circle, semi-circle, triangle, quadrilateral, polygons other than triangles or quadrilateral and irregular. The lithic raw material type categories were also defined for all artifacts and will be discussed in a separate section below. The remainder of the attributes recorded are specific to the artifact category.

Cores

Brumley (1988:7.2) offers the common definition of cores as "masses of material utilised for the production of flakes". Cores are usually characterised by a number of attributes including negative flake scars and one or more striking platforms (Brumley 1988:7.2). Most of the attributes recorded for cores are understandably related to how the core was reduced, such as the extent of striking platform utilisation and the approximate number of flakes removed from a given platform surface. How many flakes have been removed unifacially or bifacially is described in the category of the nature of flake removal (Brumley 1988:7.4). Attributes concerning the striking platform are also outlined, including the location of both the platform edge and face using the specific descriptions provided by Brumley (1988:7.5) for specimen orientation. Length of edge of flake removals measured in millimetres and the angle formed by the intersection of the platform surface and face are also described. The 'other attributes' category includes the presence or absence of common features such as edge trimming and hinge fracturing.

Core Tools

This category appears to have been added by the excavators of the project. It includes large core tools which for the most part appear to be large chopping tools although some may be recycled cores. Whether the utilisation was marginal or extensive was also recorded for these tools.

Marginally Retouched Stone Tools (MRST)

Because this category refers to any tool which is characterised by marginal primary flaking (one or more edges) which has not resulted in any major modification to the preform (Brumley 1988:9.2), the MRST category is a very variable one. The attributes which were recorded include: the amount of cortex cover through a primary, secondary and tertiary system, the number of retouched edges, and the type and character of retouch based on whether or not the retouch appears to be intentional as well as the regularity of the spacing of the retouch, shape of retouched edge, and orientation of retouched edge.

Endscrapers

Brumley (1988:10.2) defines endscrapers as having " a steep, uniformly retouched working edge located at one end of the specimen and convex in plan view". Other working edges may be present but they are not common. Many of the attributes recorded for endscrapers are similar to those on MRSTs including amount of cortex cover, types of retouch and character of retouch. The extent of flaking is also assigned to one of three categories: marginal, extensive, and overall, describing the extent of flaking on the outer surface of the endscraper. The angle of the working edge was also recorded (Brumley

1988:10.6).

Bifaces

This category includes only general bifaces as the most distinctive and specialized forms of bifaces, projectile points, were assigned to separate artifact categories. It is a technological category defined by "the complete modification of a preform as a result of bifacial flaking" (Brumley 1988:11.2). The generalised bifaces are assigned to one of two categories based on form and symmetry. The first are those bifaces " which in terms of overall shape can be categorised into the basic projectile point forms of unnotched, stemmed, or notched, but due to overall size or lack of symmetry are not considered to be projectile points" (Brumley 1988:11.3). Specimen orientation and measurements are the same as those for projectile points. The second type of generalised biface are those not shaped like projectile points which tend to be only roughly symmetrical. As with the artifact classes above the amount of cortex cover was noted. Other attributes which were recorded included the character and extent of flaking for both the outer and inner surfaces, the extent of flaking is described through the categories of absent, marginal, extensive or overall, and the character of flaking described through categories of use, irregular or well-patterned (Brumley 1988:11.4). Cross-sectional shape was also described.

Projectile Points (PPT)

This is a functional category which includes all artifacts hafted to the shaft of an arrow, dart or lance, manufactured to facilitate penetration (Brumley 1988:12.2). The projectile points were divided into classes of presumed function (i.e., arrow, dart/spear and indeterminate: see Brumley 1988:54-57) and these classes were further subdivided into the diagnostic point types recognized in southern Alberta. The rest of the attributes recorded are the same as has been already described.

Unifaces

Unifaces are a technological category defined by Brumley (1988:13.2) as "chipped stone tools whose form and working edge have been produced entirely as a result of unifacial flaking". The attributes recorded for these artifacts are the same as has already been described.

Miscellaneous Tools

Brumley (1988:63-64) also defined a category of miscellaneous tool types. These tools are mainly functional categories and include drills, awls, spokeshaves, gravers, sides scrapers, anvils, hammers, and net sinkers. Similar attributes as the ones described for the above classes were also recorded for these tool types. A category of elongated pebble is also included to refer to a manuport which may or may not show signs of use (Brumley 1988:64).

Debitage

Debitage refers to the resultant lithic debris of stone tool manufacture (Brumley 1988:8.2). Debitage is split into the two categories of flake or shatter based on the presence or absence of production characteristics. The size class (0-2.5 cm, 2.5-5 cm, >5 cm) of each piece of debitage was also recorded. Debitage was then assigned to 'primary, secondary or tertiary' categories based on the amount of cortical cover (Brumley 1988:8.2)

Evaluation of the Dataset

As lithic raw material is the specific focus of this study, a detailed discussion of how this attribute was identified and recorded is warranted. The identification and sourcing of the lithic material was done through visual macroscopic analysis accomplished through the use of a reference collection and written description prepared by John Brumley (1988; see also Appendix 1). There has been considerable disagreement concerning the validity of visual analysis. One main criticism is the subjectivity of the descriptions of different visual attributes; this leads to problems in comparing or replicating results between researchers (Church 1994; Luedtke 1992). However, geochemical techniques, often viewed as a superior method of material identification, also suffer from a number of problems. Many of these techniques are destructive and most are prohibitively expensive. As well, sedimentary rock which forms the bulk of the lithic resources utilised in southern Alberta is difficult to characterise and source geochemically and an immense project would be necessary to identify a suitable suite of elements (Miller 1991:474). Given these problems, visual analysis remains at present the most practical and accessible approach to raw material description and identification and most raw material studies employ this technique.

Another point raised in the defense of visual analysis is that visual properties were likely used by past stoneworkers in choosing raw materials (Luedtke 1992:63). Suggestions which have been put forward to increase the accuracy of visual analysis include a more systematic programme of geologic survey for many areas (Church 1994:4), a more systematic and objective system of material description (Luedtke 1992) and a better understanding of geology and geological terms (Miller 1991). The visual description, identification, and sourcing of lithic raw material for the OMRD Project as outlined by Brumley (1988) is based on a number of commonly used features, uses standard terminology, and is as objective as possible at this time. A brief description of the visual characteristics utilised in the raw material analysis (Brumley 1988) is provided below.

Colour

Brumley bases his colour descriptions on the Munsell colour chart (1973). Luedtke (1992:66) suggests that the Munsell colour chart is one of the most practical ways of describing colours, although Church (1994:46) offers the Rock-colour Chart (1984) as another alternative. Although not perfectly unambiguous (some soils and rocks do not match the colours well and colours vary depending on the amount of moisture present, the time of day, and the eyes of the observer), the Munsell chart is widely available to archaeologists and is a better means than purely qualitative descriptions.

Texture

Geological sedimentary texture refers to "the small scale features that arise from the size, shape and orientation of individual sediment grains" (Boggs 1987:105). Brumley's (1988:6.5) classes such as "fine grained, very fine-grained, coarse and very coarse", appear to suggest that he uses his category of 'Texture' to describe grain size. However, it is likely that for most lithic types Brumley's category 'Texture' reflects a description of the fracture surface. For example, the grain size in cherts is too small to be seen without a microscope and any visible differences noted are likely to be variations in the smoothness of the fracture surface (Luedtke 1992:70). The fact that Brumley included obsidian and massive quartz under the one category of 'vitreous', further suggest that this category is a rough description of visual appearance than actual geological texture based on grain size.

Luster

Luster can be described as being the appearance of the light reflected off the rock. Luster refers not only to the quality, but also the quantity of light reflected. . Brumley (1988) relies on standard geological descriptive categories.

Translucency

The degree to which light passes through a material without being absorbed or reflected differs between rock types. The thickness of the material is also a factor in its ability to transmit light (Luedtke 1992:68). The recognition of this characteristic can be seen in Brumley's (1988:6.6) descriptive categories. The subjective nature of these descriptions are fairly typical. Although there have been some suggestions for a more objective measure of translucency for archaeologists (Ahler 1983; Luedtke 1992), they are not yet in widespread use.

Other Attributes

Brumley includes a listing of other features which can vary between material types. These features refer to the structure of the material, both in terms of replacement features or structures resulting from chert diagenesis such as banding and dendritic patterns, as well as erosional features .

These attributes were used to organize the lithic material into a number of types. The manner in which Brumley's (1988) catalogue was organised will be described in the following paragraphs.

At the most general level the lithic raw material was divided into rock types such as quartzite or basalt. Those rocks commonly used as toolstones and which tend to be visually distinctive, were further divided into subcategories. Each material type was assigned a name and a reference code composed of a letter and number; the letter referred to the general rock type and the number to the subcategory (e.g. red/brown argillite([a-1]). If the general rock type was not further subdivided, the material would simply be labelled by rock type with an undifferentiated label.

There are two main ways lithic raw materials found in an archaeological region have been described and catalogued. The first is to label them by the source name if the source of the material is known. The second is a purely descriptive label without any indication of possible source provenance. Brumley (1988) employs both of these methods in his categorisation of lithic types, perhaps as a reflection of the differing levels of confidence to which different materials utilised by the prehistoric inhabitants of southern Alberta can be assigned to a particular source. There are several categories of well-known lithic types which are labelled by source name. Others are labelled in descriptive terms but are assigned to a specific source area. There are also descriptively labelled lithic types, less visually distinctive, assigned to a number of potential source areas. The last group of lithic types are those assigned to purely descriptive categories.

Although such a system might seem confusing, it reflects the state of knowledge for lithic raw material sources at this time. I discuss the implications of this classification including the possible sources of error in Chapter 6.

At first glance it would seem that a fairly extensive database of attributes has been recorded but a number of difficulties arise. With a closer examination of both the listed attributes as well as the subcategories used to describe each attribute for the tools, it is obvious that the goal of recording these attributes was an almost purely descriptive exercise. As the data were collected for a mitigation project this is not surprising. The collection and storage of data about to be destroyed is the main point of salvage archaeology. Unfortunately, many of the attributes and, in particular, the subcategories used to describe them appear unrelated to the literature on lithic analysis. For example, it is difficult to interpret what a combination of convex and irregular retouched edge on a marginally retouched flake signifies. Even for those attributes which seem significant, such as the descriptive terms 'moderated', 'marginal' and 'extensive', interpretation is difficult.

Attributes recorded for the debitage are less numerous, but do conform to those discussed in the literature. As a waste product from a reductive technology, debitage may provide some insight into the intermediate stages of manufacture in addition to its contextual significance. Archaeologists have long acknowledged the potential of debitage as a source of technological information although there has been considerable debate over what analytical strategy is best for retrieving and recording this information. Ahler (1989a) divides the two main goals of debitage analysis into studies focussed on a specific technological factor such as knapping technique and those studies which attempt to place debitage within a production trajectory. The latter goal is the source of most of the debate, and several analysts suggest that a more realistic view of lithic reduction is as a continuum, or several continua, rather than a series of discrete stages (i.e., Sullivan and Rozen 1985; Teltser 1991:366).

The three types of data recorded for the OMRD Project which could be of potential use for this type of analysis are the size class, debitage class and amount of cortical cover. Size distributions are the basis of an analytical technique known as mass analysis. Ahler (1975, 1989a, 1989b) has long argued that an understanding of size distributions in debitage can be used to distinguish different technological attributes. Through a series of experimental reductions, he has outlined a series of size grades and the various patterns of representation thought to be technologically meaningful. If the size grades used in the OMRD Project are compared those of Ahler (1989a), it becomes obvious that the smallest size class used in the OMRD Project is the largest limit of that used by Ahler. It is therefore impossible to undertake a program of mass analysis with the recorded OMRD Project data.

Sullivan and Rozen (1985) have presented another type of debitage analysis based on the separation of flakes (debitage bearing evidence of production features) from shatter (debitage without any production features) and the criterion of flake completeness. While the debitage for the OMRD Project was separated into flakes and shatter, the four categories of flake completeness utilised by Sullivan and Rozen (1985) were not recorded. As well, there are a number of differing opinions concerning the effectiveness of this technique as an interpretive tool (Bradbury and Carr 1995; Ensor and Roemer 1989; Prentiss and Romanski 1989; Tomka 1989).

The last attribute to be recorded was that of cortical coverage described within the traditional primary/secondary/tertiary typology, usually thought to reflect different stages of cobble reduction as the outer cortex layer is progressively removed. Recently however, an extensive experimental study was undertaken testing the effectiveness of this technique for technological interpretation. The conclusions reached by the analysts Bradbury and Carr (1995:108) were that such a scheme was unreliable, essentially corroborating previous critiques (Fish 1978; Jamieson 1984; Magne 1985; Sullivan and Rozen 1985). Therefore this analytical technique will not be employed here.

The limitations of the data as outlined in the preceding paragraphs preclude the possibility of engaging in detailed debitage analysis. The difficulties in using previously recorded data to answer specific research questions is clearly evident. From the above examination of the data set, broadly-defined material type representation provides the most appropriate and least problematic use of this data.

Analytical Procedures of this Study

I shall first consider the catalogue of lithic types (Brumley 1988) which I have modified for the purposes of this study (see Appendix 1). To make the data more manageable, I have collapsed a number of Brumley's (1988) categories. For example, I have combined the descriptive subcategories of a material type from a known source area which do not have any meaning with respect to being from a specific outcrop. I have labelled these categories by the common source names most often represented in the literature and I have combined a number of the little-represented categories which are alike both in terms of their descriptive qualities and source area. In collapsing Brumley's scheme I have tried to err on the side of caution and maintain most of his lithic categories.

For the purposes of interpretation and discussion, and in keeping with the convention followed in many lithic research studies, I have organised the material types into local, non-local and other categories. I am using Church's (1994:19) definitions of these terms which define local as "material(s) available within or immediately adjacent to the site" and non-local as "material(s) available outside the immediate site". A brief description of the material types given below are organised into these categories and will present my modification of Brumley's (1988) system. Unfortunately, there is a considerable discrepancy between the amount of information which is known about different sources.

Non-Local Materials

Some of the material types listed below have several possible source areas. Figure 3 illustrates the location of some of the known sources.

Swan River Chert

Swan River Chert is highly variable at the macroscopic level (Campling 1980). It is a secondary source found in gravels and glacial deposits in west-central Manitoba, southern Saskatchewan into the southeastern corner of Alberta, although it is most highly

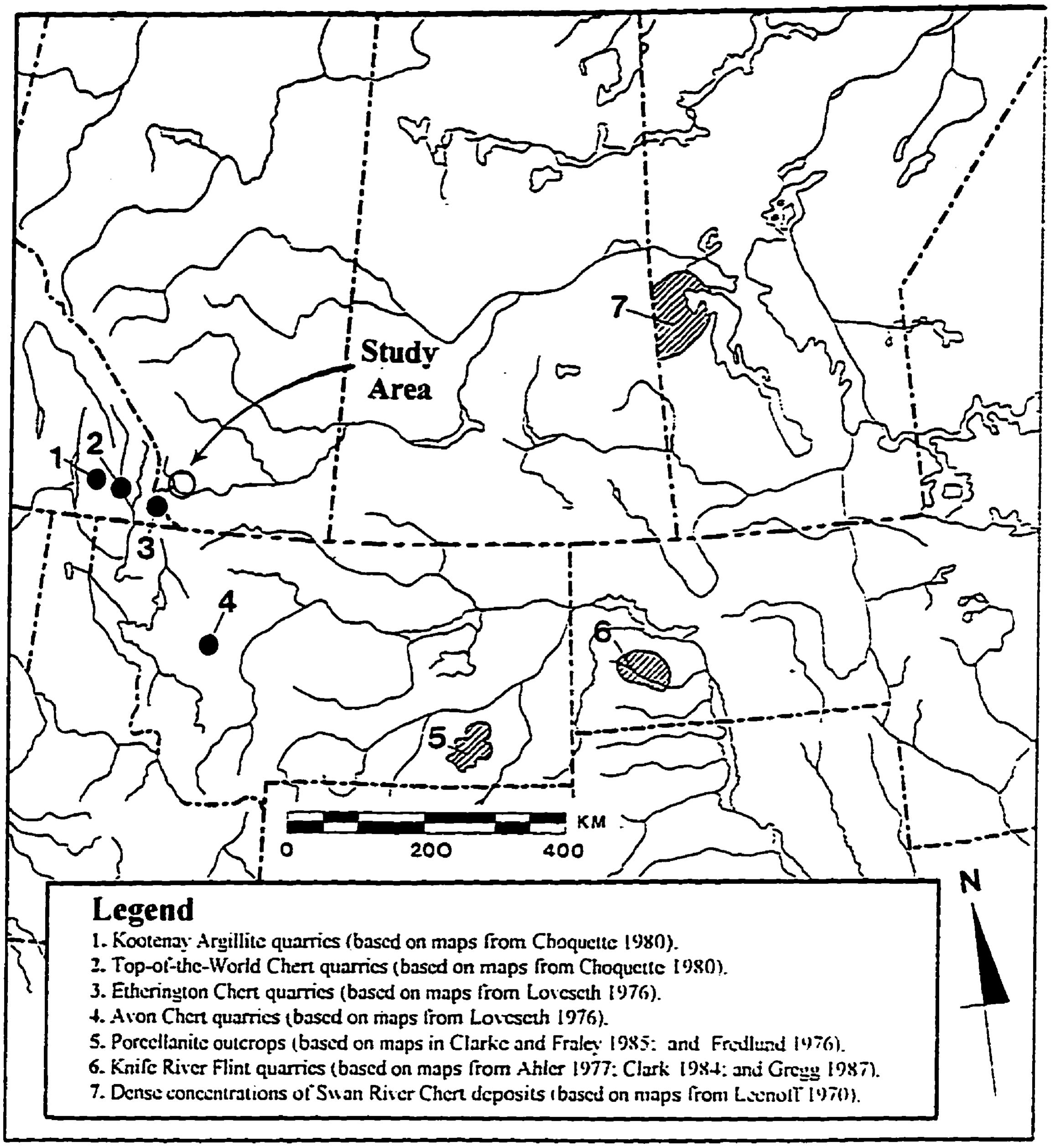

Figure 3: Raw Material Sources

concentrated in the Swan River Valley of west-central Manitoba (Brumley 1988:6.18; Leonoff 1970:28; Low 1996:172).

Kootenay Argillite

Kootenay Argillite is found in several quarry locations around the Kootenay Lakes in southeastern British Columbia (Choquette 1980:33). Harlan I. Smith located one quarry on the west shore of Kootenay Lake in the early 1900's. The northeast shore of the lake has at least one other quarry location. Secondary sources of this material in the form of float pebbles in stream and beach gravels were likely also exploited. The material itself has a characteristically pale green colour although yellowish, pinkish-green, purplish and brownish colours are also found (Brumley 1988:6.9; Choquette 1980:33; see Appendix 1).

Basalt

It is difficult to trace basalt to a source area due to its relative homogeneity in visual characteristics between different source areas. Potential source areas for basalt include central Montana, Idaho, British Columbia and Washington (Loveseth 1980).

Quartz

Two possible sources of massive quartz include quarries in Montana and southern British Columbia (Brumley 1988:6.11).

Knife River Flint

This category combines Brumley's (1988) categories of brown chalcedony and patinated brown chalcedony. Knife River Flint is a very well-known high quality lithic material which has a huge distribution range in archaeological sites (Ahler 1977; Clark

1984). The primary quarrying location of Knife River Flint occurs in Dunn and Mercer counties, North Dakota, where at least 29 open pit quarries have been located (Clayton et al. 1970:282). Ahler (1977:138) describes Knife River Flint as a "cryptocrystalline, dark brown, translucent, non porous flint". Although it is translucent, this stone lacks the fibrous microstructure characteristic of chalcedonies and is thought to be a silicified lignite (Clayton et al. 1970:288). This material ranges in colour from blonde to black, but is typically a honey brown colour. Solely on the basis of archaeological examples, Knife River Flint has usually been characterised as having excellent flaking characteristics. An examination of the material at the source quarries has demonstrated that, in fact, a broad range of specimens from poor to excellent flaking quality occur (Gregg 1987:368).

Montana Cherts

Yellow chert, yellow chalcedony, patinated yellow chalcedony, and red chalcedony have been included under this category (See Brumley 1988 and Appendix 1). The Montana Cherts comprise a very broad category encompassing a variety of cherts thought, not surprisingly, to originate in Montana. While it is common to see references to Montana Chert there is a significant lack of published literature describing this material. In general however, it is thought to originate in the Madison formation which outcrops in southwestern Montana (Miller 1991:461). The same formation also outcrops in northern Wyoming although the literature does not make it clear if similar cherts are available in this state as well. While a number of specific quarry locations have been located, only the material from the Avon quarry (described below) is considered distinctive enough to be quarry specific. Although, as mentioned above, Montana Cherts encompass a large range of variation in visual characteristics as a group they are distinguishable from other lithic types. The colour range for these cherts includes a large range of various shades of red and yellow in various degrees of translucency. Individual specimens tend to be complexly coloured with the presence of mottling, dendrites and banding. As well, Montana Cherts tend to have vitreous lustre and very good conchoidal fracture, the latter characteristic making them an ideal material for knapping (Brumley 1988:6.12-6.15).

Avon Chert

Avon Chert is a type of Montana Chert which is considered to be sufficiently distinctive and source specific, from well-known quarry sites, to be classed as a separate variety (see Figure 3). Avon Chert has a distinctive patinated surface which is primarily white to light grey; it is sometimes described as having a curdled milk-like appearance (Brumley 1988:6.13). Unlike other varieties of the Montana Cherts, Avon Chert has a dull lustre but does have very good fracture qualities.

Grey-Brown Chalcedony

Although lacking the yellow colour, this material is similar to some of the Montana Cherts and may represent a variety of this material type. It is also similar to other materials found in Montana from secondary sources in the Little Snowy Mountains. Likewise, it is similar to some of the Etherington Chert from southern Alberta and may also represent this source (Brumley 1988:6.15).

Red Chert

Again, this material resembles, and may be a variety of, Montana Chert. However it is also similar to materials derived from the Little Snowies (Brumley 1988:6.15).

Mottled Chert

This material type may derive from two separate sources. The first potential source are the Etherington quarries in the Livingstone Range in the Crowsnest Pass (Loveseth 1976, 1980). A quarry in the Bear Paw Mountains of northern Montana is the second potential source (Brumley 1988; 6.17).

Top-of-the-World Chert

The source of Top-of-the-World Chert is located on a high plateau (2134 m asl) of the same name in southeastern British Columbia. This chert originates in the basal Beaverfoot formation of the Van Nostrand range in the British Columbian Rocky Mountains (Choquette 1980:25-27). Several workshops and quarries have been located on this plateau, an extensive area of alpine meadowland. The quarries generally consist of horizontally stacked lenses of chert projecting from softer limestone which has weathered back. The lenses of chert exposed on vertical cirque walls were pounded and snapped off by prehistoric workers (Choquette 1980:24).

Top-of-the World Chert is typically white, or light to dark grey with a slight bluish tinge in colour (Brumley 1988:6.19; Choquette 1980:26-27). Some specimens of Top-of-World Chert commonly exhibit banding or mottling/speckling as well as the occasional presence of dendrites. This chert has excellent fracture qualities, is very fine-grained and has a highly vitreous lustre. Potential tool size is limited, however, to a maximum dimension of 8-10 cm due to the highly brecciated nature of the source lens (Choquette 1980:27).

Obsidian

The most likely sources of this very distinctive material include British Columbia, Wyoming and Idaho (Godfrey-Smith and Magne 1988).

Banded Black Chert

This material is commonly referred to as Banff Chert. The most typical, or at least classic, distinguishing characteristic of Banff Chert is its obvious fine banding (usually less than 1 mm in thickness) of dark grey/blue black and lighter grey colours (Brumley 1988:6.20). Fedje and White (1988:236) describe Banff Chert as a nodular cryptocrystalline silicate. The source of this chert is the Lower Livingston and Upper Banff formations of the Rocky Mountains, outcrops of which occur throughout the Rocky Mountains of southern Alberta and northern Montana. Prehistoric exploitation of this resource was extensive. Several large quarries of this material have been located 15 km east of the Vermilion Lakes in Banff National Park (Fedje and White 1988).

Porcellanite

As porcellanite is a "fused shale derived from sediments metamorphosed by burning coal and lignite deposits" (Clarke and Fraley 1985:10), sources of it are obviously restricted to coal burning formations. Deposits of Ft. Union porcellanite, a label which also includes material from the Wasatch formation, can be found in Montana, Wyoming and North Dakota. This material occurs in a variety of colours including black, purple and yellow, although the most common colours by far are various shades of grey and red (Clark 1984:35). The lustre characteristics of porcellanite vary in response to formational characteristics including the degree of heat and rate of cooling and both vitreous and non-vitreous varieties occur in these formations (Clarke and Fraley 1985:35; Fredlund 1976:209). Ft. Union porcellanite has good fracture qualities (although not as good as high quality cherts) and tend to be slightly softer than chalcedonies and cherts, between 5 and 6 on the Moh's scale of hardness (Fredlund 1976:210).

Local Sources

Raw material which can be found within or close to the study area are all secondarily derived from glacial and river gravel deposits. One of the most abundant material types is quartzite, which is highly variable with respect to visual characteristics. For the purposes of this study I have included Brumley's (1988) two categories of coarse and fine quartzite together in a general category of quartzite. Black pebble cherts are also fairly common in these secondary sources and are described under the category of black chert. Silicified siltstone also is common. Other material types which are potentially available include red and green argillite. Kootenay Argillite can be visually distinguished from the green argillite given its distinctive platy structure. It also tends to be lighter in colour and finer grained (Brumley 1988:6.9). Petrified peat and petrified wood are two more material types which can occur in gravel deposits. As they have similar properties, are sometimes difficult to distinguish and are found in similar gravels, these two categories were combined as petrified peat\wood for the purposes of this study.

Two other material types which are locally available, limestone and dolomite, were also included as one category for similar reasons.

Other Materials

A number of material types could not be assigned to a source area. These included Brumley's (1988) categories green chert, grey chert and mottled chalcedony. A miscellaneous category which was labelled as 'undifferentiated' by the OMRD Project analyst is also included in this category. The 'undifferentiated' label will be utilised in this study.

Data Presentation Formats

The representational analysis of these various material types is presented as follows. Each site is described separately. As all of the sites are multi-component, the basic level of analysis is the components of these sites assigned to a specific Phase or Complex recognized in southern Alberta archaeology. The data are summarized in tables except for the tool and core samples which total less than 10 artifacts each, as well as those debitage samples which total less than 100 artifacts. These cutoff points were arbitrarily designated following a review of the literature to determine what the standards for sample size were for the presentation of data. Representation of cores and debitage involves measures of both number and weight to the nearest tenth of a gram. The consideration of both count and weight adds another dimension to the analysis, as representation between the two varies significantly with size differences between artifacts. Tools are represented only by count due to the fact that the size of artifacts within tool categories (e.g., projectile points) varies considerably, hence could give anomalous results for the combined tool data. The tables present proportional data given that assemblages are extremely variable between sites . This simplifies inter-site comparisons. Assemblages with very small sizes are not included in tables but are discussed in the text.

Chapter 5

RESULTS

Introduction

Results are presented site by site with occupations listed in chronological order. The data from the larger assemblages are presented in tables, while assemblages with very small sample sizes are listed in the text as outlined in the previous chapter. In addition to a description of material type representation, the types of stone tool related activities which might have occurred at these sites is also considered in order to provide a broader understanding of lithic utilisation patterns. The reader should be cautioned, however, that because the assemblages represent the remains left by relatively small mobile hunting and gathering groups, not all are of a size to permit 'hard' conclusions to be drawn from observed patterns of lithic use. Therefore, some observed patterns and the conclusions which I draw from them are tentative and subject to confirmation, modification, or refutation as more data becomes available.

In this study, I recorded different lithic resources not only by count, but also by weight for debitage and cores. Weight, as well as count, can be important in an examination of representational patterns. The use of flake size distribution patterns as a method of debitage analysis has had a long history, despite the traditional focus on attribute analysis. Following the classic experimental study by Newcomer (1971), who demonstrated that flake size progressively decreases as reduction continues, numerous studies have examined the use of size grading for the technological study of flaking debris (e.g., Ahler 1975, 1989a, 1989b; Patterson 1981, 1982, 1987, 1990; Patterson and Sollberger 1978; Stahle and Dunn 1982, 1984; Sullivan and Rozen 1985). The results of such experimental studies suggest that flakes produced early in the reduction sequence should have relatively larger numbers in the large size class and relatively smaller numbers in the small size classes, while flakes produced later in the process should have relatively larger numbers in the small size class and relatively smaller numbers in the large size class (Ahler 1989a:90). Not surprisingly, experiments by Teltser (1991:307) indicate that flake size is strongly correlated with weight. However, other experiments have also demonstrated that small flakes are always produced in greater numbers than large flakes and will tend to be numerically dominant in any given sample (Patterson 1982; Patterson and Sollberger 1978:104). Ahler (1975, 1989a, 1989b) advocates a specific type of flake aggregate analysis termed mass analysis, and has argued for the use of weight as well as count as a measure of size variation. He has also suggested that weight may be useful for measuring variation in flake shape (Ahler 1989a:91). The data in the present study have not been analysed using these specific techniques, due to the problematic size classification system used in the collection of the data.

The difference between representation by weight and count for the different lithic types is clearly apparent from the results. Certain types of lithic material tend to have a greater or equal representation by weight over count, while other materials have significantly lower weight proportions when compared with count. A larger weight per count ratio generally indicates a larger mean flake size, consequently that the assemblage may have resulted from earlier stages of reduction. A smaller ratio generally indicates a higher proportion of small flakes, perhaps middle to late in the reduction trajectory. There are complicating interpretational factors here, however. Larger flakes may simply indicate that larger pieces of raw material were being worked and\or larger tools were being produced. As well, larger flakes can be diagnostic of technological processes.

The nomadic lifestyle of past Northern Plains cultures plays an important role in lithic interpretation. This is particularly important for the interpretation of the lithic assemblages from the OMRD Project. An archaeological consequence of the highly mobile lifestyle of these cultures is the rarity of an entire reduction sequence, from unmodified raw material to tool discard, in a single assemblage. An examination of which portions of an artifact's life cycle are present at a site, for each raw material type, provides clues as to whether differences exist between lithic resource use at the site. In general, the presence or absence of material types between tools, debitage and cores may provide an indication of the types of flintknapping and procurement strategies which may have been employed at a site. Tools of a certain material type with no accompanying debitage may suggest that the tool was introduced to the site in its finished form. In contrast, the presence of a particular material type in the debitage, but not the tool sample, records the manufacture or maintenance of a tool which may have been removed from a site. The presence of cores implies that manufacturing activity may have taken place. These are very general inferences, however, and a fuller interpretation would require an extremely detailed and time consuming lithic analysis, far beyond the scope of the present study.

The interpretation of sample size in the debitage assemblage is especially problematic. In many of the assemblages a large number of material types are represented by a very few pieces of debitage. It is difficult to infer more from this than the presence of the particular material type in the toolkit. The intuitive inference is that these few pieces do not represent involved manufacturing activity. Evidence from experimental replicative studies suggests that manufacturing activity generates relatively large numbers of debitage (Ahler 1989b; Bradbury and Carr 1995; Collins 1975; Magne 1985; Newcomer 1971). Given the possibility of post-depositional factors, as well as recovery bias, only general speculation concerning debitage sample size can be made.

The analysis here is essentially qualitative in nature, and descriptive terms are meant to be relative only to other assemblages analysed in the study. Due to this, interpretations are highly generalised and the possibility of a number of alternate scenarios exists.

DjPl-13

DjPl-13 has the largest assemblage analysed in this study. Materials from the four occupations totals 630 tools, 60 cores and 9,808 pieces of debitage. Each occupation is described separately beginning with the McKean phase.

McKean

The McKean tool assemblage is represented by only five items: one biface of mottled chert, three MRST made from grey chert, silicified siltstone and Swan River Chert, and one core tool of limestone.

A considerably greater number of toolstone types are represented by the debitage assemblage, which consists of 524 pieces weighing 716.4 grams. There were no cores recovered from the McKean occupation. The only raw material types missing in Table 1 from the list prepared by Brumley (1988) are green chert, porcellanite, basalt, petrified wood\peat and red argillite. Of those material types present, most occur in very small proportions, with many making up less than 5% of the total. Indeed, several types represent less than 1% of this total. As Table 1 indicates, a large number of lithic resources were used but there are a number of peaks to their distribution because the five highest proportions by count and weight are not of the same material type. The five highest material types by count are silicified siltstone, quartzite, Montana Chert and mottled chert. The five highest by weight are quartzite and silicified siltstone, followed by undifferentiated and mottled chert.

That most of the material types in the assemblage are not represented as tools suggests that these were retained in the toolkit and curated after the site was abandoned. The very small percentages (all less than 5%, or approximately 10 pieces) for most of the toolstone types listed in Table 1 suggests that they are not indicative of major manufacturing activity. This, in turn, suggests they were likely brought into the site in the form of finished tools. This inference coupled with the lack of cores does indicate a lack of manufacturing activity at DjPl-13. However, quartzite, silicified siltstone and Montana Chert are all well-represented in the debitage sample which strongly suggests that these toolstones were being knapped at the site.

In an examination of relative flake size by comparison of weight and count, it

Table 1. Percentage of lithic types for broad classes of the McKean occupation at DjPl-13

Material Type	Debitage N=524; 716.4 g	
	Count %	Weight %
<u>Local</u>		
Green Argillite	0.9	3.2
Quartzite	27.3	49.9
Black Chert	1.7	2.8
Silicified Siltstone	29.0	15.6
Limestone/Dolomite	1.7	2.4
<u>Non-Local</u>		
Swan River Chert	1.3	0.3
Kootenay Argillite	0.6	0.5
Quartz	0.8	0.4
Knife River Flint	1.7	1.5
Montana Chert	17.2	2.8
Grey-Brown Chalcedony	3.2	0.9
Red Chert	0.2	0.01
Mottled Chert	7.1	6.8
Top-of-the-World Chert	0.4	0.1
Obsidian	1.7	0.5
Banded Black Chert	0.8	0.9
Avon Chert	1.0	0.3
<u>Other</u>		
Mottled Chalcedony	0.2	0.3
Undifferentiated	1.9	10.0
Grey Chert	1.3	0.4

would be useful to use those materials which have markedly differing weight and count proportions as these will potentially provide the most information about the reduction trajectory. Quartzite weight is twice that of count, which may suggest the presence of larger sized flakes and an earlier stage of reduction. In contrast, Montana Chert is present at a weight proportion not even a quarter that by count, and may indicate smaller flake sizes, hence late stage manufacture and maintenance. In addition, analysis of the McKean assemblage lithics pointed to two patterns for raw material types that are repeated throughout many other assemblages. The distinctive undifferentiated toolstone category typically has a very high weight proportion compared to count, while the mottled chert category tends to be of equal or higher weight compared to its count. The most straightforward interpretation of this pattern, barring sampling problems, is that both of these toolstone types were relatively accessible (i.e., readily available) to occupants of the Oldman River mitigation area from the Early Middle through Protohistoric periods. This will be discussed at greater length in the following chapter.

Pelican Lake

The tool sample assigned to the Pelican Lake occupation is considerably larger than the McKean, with a total of 166 tools. Material types not represented include green chert, porcellanite, quartz, basalt, Kootenay Argillite and red argillite. Table 2 demonstrates the proportional representation of material types. Black chert and undifferentiated toolstone types are well-represented at 19.3% and 15.1% of the tool assemblage, respectively. Quartzite and silicified siltstone both occur at just over 10%. Mottled chert, grey chert and Knife River Flint have frequencies of slightly over 5%.

Table 2. Percentage of lithic types for broad artifact classes of Pelican Lake occupation at DjPl-13.

Material Type	Tools N=166	Cores N=12; 2633.3 g		Debitage N=2942; 7041.9 g	
	Count %	Count %	Weight %	Count %	Weight %
Local					
Red Argillite	—	—	—	0.3	0.4
Green Argillite	0.6	—	—	2.5	5.3
Quartzite	19.3	8.3	1.0	17.2	37.0
Black Chert	2.4	16.7	0.6	11.2	7.3
Petrified Peat/Wood	11.4	—	—	0.8	0.5
Silicified Siltstone	0.6	8.3	0.04	18.2	10.4
Limestone/Dolomite	11.2	—	—	0.3	1.6
Non-Local					
Swan River Chert	3.6	16.7	2.6	5.8	4.6
Kootenay Argillite	—	—	—	0.6	1.4
Basalt	—	—	—	0.4	1.0
Quartz	—	—	—	0.7	1.1
Knife River Flint	5.4	—	—	7.9	3.4
Montana Chert	7.8	—	—	6.1	1.9
Grey-Brown Chalcedony	0.6	—	—	4.9	2.3
Red Chert	1.8	—	—	0.5	0.5
Mottled Chert	3.0	25.0	1.1	7.6	5.4
Top-of-the-World Chert	4.2	—	—	0.7	0.4
Obsidian	1.0	—	—	1.1	0.3
Banded Black Chert	2.4	—	—	3.5	1.8
Porcellanite	—	—	—	0.1	0.1
Avon Chert	3.0	—	—	2.7	0.6
Other					
Mottled Chalcedony	1.2	—	—	0.5	0.4
Green Chert	—	—	—	0.7	1.1
Undifferentiated	15.1	25.0	94.6	3.6	10.0
Grey Chert	5.4	—	—	1.8	0.7

Green argillite, grey-brown chalcedony, and limestone have a negligible representation of under 1%. Remaining material types are represented by frequencies ranging from 1-5%.

The material representation for tool types is as follows. A total of 13 bifaces were recovered, two each of which are represented by quartzite, silicified siltstone, Montana Chert and red chert. Black chert, Swan River Chert, mottled chert, Top-of-the-World Chert and mottled chalcedony are represented by one tool each. Of the 19 endscrapers recovered: five are of black chert; four were grey chert; three each are of Knife River Flint, and Montana Chert; and there were one each of quartzite, Swan River Chert, Top-of-the-World Chert, and Avon Chert. Seven unifaces (two of quartzite, one each of mottled chalcedony, Avon Chert, Knife River Flint, Swan River Chert and petrified peat\wood), two spokeshaves (one of quartzite and one of black chert) and one petrified peat\wood drill or awl were recovered. Of the 12 core tools present in this assemblage, four are made from black chert, three from quartzite and one each from petrified peat\wood, Swan River Chert, silicified siltstone, banded black chert and undifferentiated material. The MRST category has the greatest number of material types represented, although this may simply reflect the 'large' sample size for this category. Black chert has the highest representation within this tool category with 18 artifacts, followed by silicified siltstone with 13, undifferentiated with 10, quartzite with six, Montana Chert with five, Avon Chert with three, and two tools each of Knife River Flint, Top-of-the-World Chert, obsidian, banded black chert and grey chert, and one tool each of green argillite, petrified peat\wood, Swan River Chert, red chert, mottled chert and limestone. Other tool type categories include: 11 elongated pebbles (nine undifferentiated and two silicified siltstone), three hammers (one quartzite, two undifferentiated) and one each of an anvil, smoothed stone from use and a grooved maul, all of undifferentiated material.

There does not appear to be a clear preference between local and non-local sources for the different tool types, as both occur in most categories. However, there does appear to have been a slight bias towards undifferentiated material, and several local sources for the less formal and ground stone tool type categories.

There are a total of 12 cores, three each of undifferentiated and mottled chert, two of Swan River Chert and black chert and one of silicified siltstone and quartzite. Table 2 emphasizes once again the discrepancy between material type representation by count and weight. Over 90% of the total weight of the cores is represented by undifferentiated material. Swan River Chert has the second highest representation at just over 2%. The remaining material types are negligibly represented.

All material types are found in the debitage assemblage (Table 2). By count, the three most common toolstones are silicified siltstone and quartzite at just under 20%, followed by black chert at just over 10%. Mottled chert, grey-brown chalcedony, Montana Chert, Knife River Flint and Swan River Chert are represented at just over 5% each. The remaining material types are present in very small amounts.

Proportional representation by weight shows a different pattern. There is a high mass of quartzite at 37.0%. Silicified siltstone and grey chert follow at around 10%. black chert (7.3%), mottled chert (5.4%) and green argillite (5.3%) are moderately well-represented by weight. Other toolstones are present in very low amounts.

All of the lithic types listed by Brumley (1988) are present in the Pelican Lake assemblage, and this assemblage appears to represent a toolkit in which a wide variety of material resources were utilised. Local sources are strongly in evidence in all artifact classes suggesting that the entire reduction sequence may be present for these materials. Twelve cores in total attest to possible manufacturing activity for quartzite, black chert, Swan River chert, silicified siltstone, mottled chert and undifferentiated material. As Table 2 shows, the undifferentiated cores make up over 90% of the proportional weight representation. The relatively higher mass of the undifferentiated cores and their likely larger extrapolated size is a common feature across all of the sites analysed in this study. Count and weight proportions present in Table 2 indicate that the weight proportion (10.0%) is considerably larger than that of the count (3.6%), which in turn suggests a larger average size for undifferentiated debitage. Quartzite and green argillite also have greater weight (37.0% and 5.3 % respectively) than count (17.2% and 2.5 %) proportions, and therefore a larger average flake size. The inferred smaller flake size for the non-local sources may indicate late-stage manufacturing or maintenance debitage.

In general, local sources seem to have a higher weight/count proportion than non-local sources. Local sources are present at 50.5 % by count and 62.5 % of the debitage sample by weight, indicating a generally greater mass for local sources. Essentially, a large number of material types are represented, however it is predominantly local sources which reflect all stages of manufacture. An exception to this pattern can be found in two non-local sources, mottled chert and Swan River Chert.

These patterns of toolstone use may reflect two commonly discussed technological strategies: curation and expediency. Binford (1973, 1979) was one of the earliest proponents of these concepts. He defined these technological strategies on the basis of both behavioral strategies and the expected nature of the toolkit. For example, curation, as defined by Binford (1973, 1977, 1979), included a number of characteristics such as: transport of tools, manufacture of tools in anticipation of use, design of tools for multiple purposes, maintenance of tools through various use episodes, and the recycling of tools. An expedient technological strategy, in contrast, is characterised by minimalised technological effort in which tools are manufactured, used, and discarded at use locales (Binford 1977). The expected toolkit, would therefore be, formally less patterned. Not all characteristics need necessarily be present for either strategy.

The Pelican Lake assemblage may demonstrate evidence of both of these strategies. The apparent introduction of many of the non-local toolstones as finished (or nearly finished) tools, as well as the possible presence of maintenance debitage, is consistent with a curated toolkit. In contrast, the best evidence for on-site manufacture, as well as use and discard, which may indicate an expedient technology, lies with the local sources. Overall, expediency seems to be most strongly suggested by the undifferentiated material. In addition to the evidence of on site manufacture, use and discard, there appears to be a slight bias, mentioned above, for the use of this toolstone for the less formal tool type categories. One interpretation for this may be the opportunistic use of this toolstone at the site when the need arose. Similar observations can be made for a number of the following assemblages as well.

Besant

The Besant occupation has the largest assemblage at DjPl-13 with 251 tools, 17 cores and 5,082 pieces of debitage. All material types are represented in the tool assemblage except for porcellanite, quartz, basalt and red argillite. The proportional representation of observed material types is illustrated in Table 3. There is no clear peak in this representation, with the highest frequency being Knife River Flint at 12.7%. Montana Chert follows with a proportion of 12%. Black chert, quartzite, undifferentiated and silicified siltstone have representations near 10%, with 11.1%, 10.8%, 10.4% and 9.6%, respectively. Mottled chert follows with 8.4 %. The remaining material types are present at frequencies of less than 5%.

Tool type representation for this occupation is as follows. A total of 32 bifaces were recovered, manufactured from 11 different material types: seven Montana Chert, six mottled chert, five Knife River Flint, three each of quartzite and Swan River Chert, two each for both black chert and silicified siltstone, and one each for petrified peat\wood, grey-brown chalcedony, Top-of-the-World Chert and green chert. The 24 endscrapers are manufactured from 12 different material types (six Knife River Flint, four Montana Chert, two each of black chert, red chert, Avon Chert and grey chert, and one each of Swan River Chert, silicified siltstone, Kootenay Argillite, grey-brown chalcedony, mottled chert and Top-of-the-World Chert). The projectile point sample includes the following material types: six Knife River Flint, four quartzite, three each of Montana Chert and mottled chert, two each of petrified peat\wood, Swan River Chert, Kootenay Argillite, mottled chalcedony and grey chert. Only 16 core tools are present

Table 3. Percentage of lithic types for broad artifact classes of the Besant occupation at DjPl-13.

Material Type	Tools N=251	Cores N=17; 3298.7 g		Debitage N=5082; 5171.6 g	
		Count %	Weight %	Count%	Weight %
<u>Local</u>					
Red Argillite	—	—	—	0.07	0.1
Green Argillite	1.6	—	—	0.5	5.5
Quartzite	10.8	23.5	74.3	9.1	22.6
Black Chert	11.1	5.9	0.4	14.8	16.4
Petrified Peat/Wood	2.0	—	—	0.1	0.1
Silicified Siltstone	9.6	11.8	0.3	5.1	9.0
Limestone/Dolomite	0.3	—	—	0.09	0.8
<u>Non-Local</u>					
Swan River Chert	4.8	23.5	0.9	1.1	1.8
Kootenay Argillite	1.6	—	—	0.03	0.7
Basalt	—	—	—	0.1	0.3
Quartz	—	—	—	0.05	0.1
Knife River Flint	12.7	—	—	6.7	1.4
Montana Chert	12.0	—	—	16.9	4.1
Grey-Brown Chalcedony	3.2	5.9	0.3	31.0	4.8
Red Chert	1.2	—	—	0.2	0.1
Mottled Chert	8.4	11.8	0.9	3.2	8.3
Top-of-the-World Chert	3.2	—	—	0.6	0.4
Obsidian	0.3	—	—	0.17	0.1
Banded Black Chert	1.2	5.9	1.5	0.2	0.8
Porcellanite	—	—	—	0.04	0.04
Avon Chert	3.6	—	—	6.2	1.0
<u>Other</u>					
Mottled Chalcedony	0.1	—	—	0.5	1.5
Green Chert	0.7	—	—	0.3	2.1
Undifferentiated	10.1	5.9	21.2	1.8	17.4
Grey Chert	2.0	5.9	0.2	1.0	0.9

(three each for limestone\dolomite and undifferentiated, two each for black chert and mottled chert, and one each of quartzite, petrified peat\wood, silicified siltstone, Montana Chert, grey-brown chalcedony and mottled chalcedony).

The large number of 121 MRSTs is divided into material types as follows: 18 black chert, 16 quartzite, 14 each of Knife River Flint and Montana Chert, 13 silicified siltstone, 10 undifferentiated, six Swan River Chert, five each of mottled chert and Avon Chert, four each of Top-of-the-World Chert and banded black chert, three grey-brown chalcedony, two each of green argillite, Kootenay Argillite, and grey chert, and one of petrified peat\wood, obsidian and green chert. Four elongated pebbles (three undifferentiated, one silicified siltstone), six netsinkers (four undifferentiated, one limestone\dolomite, one silicified siltstone) and one hammer, a grinding stone and a burnished stone, all of undifferentiated material, are also included in this assemblage. Also present are nine unifaces (two mottled chert, two quartzite, one Avon Chert, Knife River Flint, undifferentiated, green argillite and Montana Chert), six drill\awls made from mottled chalcedony, black chert, silicified siltstone, Swan River Chert, banded black chert and red chert, and an Avon Chert sidescraper.

A considerable difference is obvious between the proportional representation of count and weight for the cores recovered from the Besant occupation. By count, quartzite and Swan River Chert have the highest representation at 23% with four cores each. Mottled chert and silicified siltstone follow at just over 10% with two cores each. Grey chert, undifferentiated, banded black chert, grey-brown chalcedony and black chert are all present with one core each. Representation by weight is rather biased, with quartzite nearly 74% of the total weight. Undifferentiated materials are second with 23% of the total weight. The remaining material types have negligible representation with only banded black chert (1.5%) having a proportion greater than 1%.

All material types are present in the Besant debitage assemblage. As with the cores, there is a considerable difference in the representation between count and weight. Grey-brown chalcedony has the highest representation by number (31.0%) and is roughly twice that of the next highest material, Montana Chert (16.9%). Black chert has the third highest representation with 14.8%. Quartzite, Knife River Flint, Avon Chert and silicified siltstone all have proportions between 5-10%. With the exception of mottled chert at 3.2% and undifferentiated materials at 1.8%, the remaining toolstone types have proportions less than 1%. By weight, quartzite has the highest representation at 22.6%. undifferentiated and black chert follow closely with 17.4% and 16.4%, respectively. Moderately well-represented are silicified siltstone with 9.0%, mottled chert with 8.3%, banded black chert with 4.8%, and Montana Chert with 4.1%. The remaining material types each represent less than 2% of the total weight.

Lithic raw material representation for this occupation is noticeably different from that of the Pelican Lake component. The Besant lithic pattern was similar to Pelican Lake in the absence of porcellanite, quartz, basalt and red argillite in the tools and negligible representation in the debitage. However, for the remaining material types, non-local resources play a larger role than in the Pelican Lake component. Knife River Flint, Montana Chert, mottled chert, Swan River Chert and grey-brown chalcedony are well-represented in both the tool and debitage assemblages. For local sources, quartzite, black chert and silicified siltstone are well-represented throughout the entire lithic assemblage. For the cores, undifferentiated materials and quartzite represent 80% of the weight. Black chert, silicified siltstone and quartzite are well represented in the debitage, with greater average flake size indicating earlier stages of reduction. High numbers of tools also indicates a high degree of discard for these materials. Non-local materials such as Swan River Chert, grey-brown chalcedony, mottled chert and banded black chert were all represented by cores, and debitage, except for banded black chert which has a negligible representation in both tools and debitage. There is a considerable difference between weight and count proportions for the best represented local and non-local sources. Local materials, such as quartzite, black chert and silicified siltstone, all have weight proportions higher than count, while Knife River Flint, grey-brown chalcedony, Avon Chert and Montana Chert have count proportions considerably higher than weight indicating a very different assemblage in terms of average sample size. These non-local sources are the only ones with very high count/weight proportions and this may indicate of a smaller average flake size, reflecting late stage reduction or maintenance activity.

This assemblage again presents evidence that different technological strategies may have been employed for different toolstones. The transportation of a number of non-local sources as finished tools, as well as the possible presence of maintenance activity, again suggests a curated toolkit. On-site manufacture, use and discard is again most prominent in local sources. Undifferentiated material, as with the Pelican Lake assemblage, presents the best evidence for expediency.

Avonlea

The Avonlea occupation has the second smallest assemblage with 84 tools, 9 cores and 128 pieces of debitage. Fifteen material types are represented in the tool assemblage (see Table 4). Those material types not present include green chert, Avon Chert, porcellanite, banded black chert, obsidian, red chert, basalt, Kootenay Argillite, green argillite and red argillite. Of those material types present, grey-brown chalcedony, undifferentiated, mottled chert and Knife River Flint all occur near 15%. Grey chert and silicified siltstone have equal representation at 9.5%, quartzite represents 4.8%, black chert 4.8% and petrified peat\wood represents 3.5 % of the tool assemblage. The remaining material types have proportions less than 2 % of the assemblage.

Material representation by tool type includes one mottled chert biface and seven endscrapers: four Knife River Flint, and one each of quartzite, Top-of-the-World Chert and mottled chalcedony. The 14 projectile points are represented in the following manner: four each of Knife River Flint and Montana Chert, and two each of silicified siltstone, grey-brown chalcedony, and grey chert. A total of 31 MRST are present in the assemblage: six each of Montana Chert and grey-brown chalcedony, three grey chert, two each of quartzite, Swan River Chert and Knife River Flint and one each of black chert, petrified peat\wood, Top-of-the-World Chert, undifferentiated materials and limestone\dolomite. Other tool categories include seven netsinkers, one hammer, one elongated pebble and one grooved maul all of undifferentiated material. Also included are four unifaces (two grey-brown chalcedony, one quartzite and one Knife

Table 4. Percentage of lithic types for broad artifact classes of the Avonlea occupation at DjPl-13.

Material Type	Tools N= 84	Debitage N=128	
	Count %	Count %	Weight %
Local			
Quartzite	4.8	4.7	3.5
Black Chert	2.3	1.2	0.2
Petrified Peat/Wood	—	2.3	7.0
Silicified Siltstone	9.5	27.3	8.5
Limestone/Dolomite	1.2	8.6	55.5
Non-Local			
Swan River Chert	2.3	11.7	5.6
Basalt	—	1.2	0.2
Quartz	1.2	1.2	0.3
Knife River Flint	14.3	—	—
Montana Chert	15.5	6.3	1.4
Grey-Brown Chalcedony	16.7	11.7	2.4
Mottled Chert	2.3	5.5	4.1
Top-of-the-World Chert	2.3	1.2	0.1
Obsidian	—	2.3	0.2
Banded Black Chert	—	0.7	0.1
Avon Chert	—	1.2	3.8
Other			
Mottled Chalcedony	1.2	0.7	0.7
Undifferentiated	15.5	1.2	2.8
Grey Chert	9.5	8.6	3.5

River Flint), and two drills\awls made from grey-brown chalcedony and Montana Chert.

Only nine cores were recovered from the Avonlea occupation. Three of these were of mottled chert (13.2 g in total), two were Swan River Chert (34.1 g) and one each of silicified siltstone (5.4 g), grey-brown chalcedony (5.4 g), and undifferentiated materials (82.0 g; see Table 4). Count and weight proportions also differ, with mottled chert having the highest representation by count, and undifferentiated materials representing greater than 50% of the total weight.

The Avonlea component has a small debitage assemblage of 128 pieces weighing 358 g (Table 4). Material types not included are green chert, porcellanite, red chert, Knife River Flint, Kootenay Argillite , green argillite and red argillite. Silicified siltstone has by far the highest numerical representation at 27.3%. Grey-brown chalcedony and Swan River Chert have a somewhat lower representation at just over 10%. Grey chert and limestone\dolomite follow with a proportion of 8.6% each. The remaining material types have proportion less than 5%. In terms of weight, over 50% of the total weight is represented by limestone\dolomite: silicified siltstone, petrified peat\wood and Swan River Chert follow with 8.5%, 7.0%, and 5.6%, respectively. The remainder are below 5%.

The most noticeable thing about the Avonlea assemblage is the number of tools compared to the size of the debitage sample. This suggests that little manufacturing activity was occurring to replace the tools which were abandoned at this site (Ricklis and Cox 1993:460). Three non-local sources, Knife River Flint, Montana Chert and grey-brown chalcedony, had three of the highest proportional representations for the tools, although local undifferentiated materials also were well-represented. Interestingly, Knife River Flint was not present in the debitage assemblage. This supports the idea that many of the lithic materials, particularly non-local sources, were brought into the site in the form of finished tools, as part of a curated assemblage. In the debitage assemblage, limestone comprised over half of the proportional weight representation. As 18 material types represented only 128 pieces of debitage, no material type clearly dominated. Silicified siltstone had the highest representation by count at 35 pieces. These numbers do not appear to represent any major manufacturing activity. However, in apparent contradiction to this, are the nine cores that were also recovered from this site, five of which are non-local in origin. It is possible that associated manufacturing debris was simply not recovered in the excavations, a problem of recovery bias mentioned in the introduction to this chapter. An alternative explanation may be that the cores do not indicate the early stages of reduction, and/or a store of raw material, but rather may have been abandoned because they were exhausted. The latter explanation seems to be supported by other evidence, which suggests that a large number of tools were discarded without being replaced. It may be that the past inhabitants of this site, anticipating a journey to a source of raw material, discarded the exhausted portion of their toolkit. A more detailed examination of this assemblage would be necessary in order to confirm this speculation.

OWP

The OWP assemblage includes 125 tools, 22 cores and 1,132 pieces of debitage. Material types not present in the tool assemblage are red argillite, green argillite, quartz, porcellanite, green chert, Kootenay Argillite, mottled chalcedony and limestone\dolomite. Silicified siltstone and undifferentiated materials both have the highest representation at 12.8% (Table 5). Black chert follows with 11.2% of the assemblage. Montana Chert and grey-brown chalcedony each represent 8.8% of the total. Quartzite, Swan River Chert, mottled chert and obsidian are represented at just over 6%. Obsidian (4%), grey chert (4%) and Knife River Flint (3.2%) have moderate representation. The remaining material types are present in low numbers.

Material type representation by tool type categories follows. A total of 14 bifaces include: four mottled chert, three Montana Chert, two quartzite, and one each of Swan River Chert, red chert, Top-of-the-World Chert, obsidian and banded black chert. Only four endscrapers, two Knife River Flint, one of black chert and one of grey-brown chalcedony, are present in this assemblage. The 22 projectile points are made of the following toolstones: four Montana Chert, three each of black chert and grey-brown chalcedony, two Swan River Chert, and one each of quartzite, petrified peat\wood, silicified siltstone, Knife River Flint, red chert, mottled chert, Top-of-the-World Chert, obsidian, banded black chert and grey chert. A total of 16 core tools are present (eight undifferentiated, two each of grey-brown chalcedony mottled chert and grey chert, and one each of Swan River Chert, and limestone\dolomite). The material type representation for MRST is as follows: 10 black chert, eight silicified siltstone, six Top-of-the-World Chert, five each of quartzite and petrified peat\wood, and four of Swan River Chert and grey-brown chalcedony, three each of Montana Chert and obsidian, two grey chert and one each of basalt, Knife River Flint, mottled chert and Avon Chert.

Table 5. Percentage of lithic types for broad artifact classes of the Old Woman's Phase occupation at DjPl-13.

Material Type	Tools N=125	Cores N=22; 1755.1 g		Debitage N=1132; 2998.0 g	
	Count %	Count %	Weight %	Count %	Weight %
<u>Local</u>					
Green Argillite	—	4.5	6.9	1.1	7.1
Quartzite	6.4	9.1	1.3	4.9	32.2
Black Chert	11.2	—	—	35.7	7.2
Petrified Peat/Wood	4.8	—	—	1.8	1.7
Silicified Siltstone	12.8	4.5	0.2	6.5	2.5
Limestone/Dolomite	—	—	—	0.4	0.1
<u>Non-Local</u>					
Swan River Chert	6.4	4.5	0.3	3.4	1.8
Basalt	0.8	—	—	—	—
Quartz	—	—	—	0.8	0.3
Knife River Flint	3.2	4.5	0.08	1.0	0.4
Montana Chert	8.8	—	—	10.2	5.8
Grey-Brown Chalcedony	8.8	4.5	0.06	9.1	3.4
Red Chert	0.8	—	—	0.4	0.1
Mottled Chert	6.4	22.7	4.0	12.4	22.8
Top-of-the-World Chert	6.4	—	—	1.1	0.3
Obsidian	4.0	—	—	1.1	0.2
Banded Black Chert	1.6	5.9	—	0.2	0.1
Porcellanite	—	—	—	0.1	0.03
Avon Chert	0.8	—	—	0.9	0.3
<u>Other</u>					
Mottled Chalcedony	—	—	—	0.4	0.4
Green Chert	—	—	—	0.2	0.1
Undifferentiated	12.8	13.6	90.7	44.3	31.0
Grey Chert	4.0	31.8	1.5	1.9	1.0

Other tool type categories include one grey-brown and one black chert uniface, one silicified siltstone and one obsidian graver as well as one Montana Chert drill\awl. A total of nine (eight undifferentiated and one silicified siltstone) and one undifferentiated grooved maul are also present.

A total of 22 cores was recovered from the OWP occupation. As illustrated in Table 5, grey chert (31.8%) and mottled chert (22.7%) represent over half of the core assemblage by count. Undifferentiated materials and quartzite follow at 13.6% and 9.1%, respectively. The remaining material types each represent less than 5% of the sample. Quartzite represents almost the entire core sample by weight at 90.7%. Green argillite and mottled chert follow at 6.95 and 4.0%, respectively. The remaining material types are represented by very low percentages.

All material types except red argillite and basalt are present in the OWP debitage assemblage illustrated in Table 5. By count, quartzite and undifferentiated toolstones are the most common material types at 32.2% and 31.0%, respectively. Mottled chert, Montana Chert and grey-brown chalcedony follow with representations of 12.4%, 10.2%, and 9.1%, respectively. With the exception of silicified siltstone (6.5%) the remaining material types have representations less than 5%. The two most common materials by weight are quartzite (32.2%) and undifferentiated (31.0%). Mottled chert follows at 22.8%. Green argillite, black chert and Montana Chert are represented at just over 5%. The remaining material types are present in low amounts with respect to their weights.

This occupation has a large number of cores (22), which may indicate manufacturing activity for this assemblage. The undifferentiated material represents over 90% of core weight. Undifferentiated toolstones also have the greatest representation in debitage and tools, and likely represent all stages of manufacture. This combined with the bias for the use of this toolstone for informal tools may again indicate the strategy of expediency. Grey chert is somewhat anomalous as this material type is represented by five cores, but comprises a very small proportion (1.9%) of the debitage. Cores of the following material types were also present and could potentially represent manufacturing activity: Green argillite, quartzite, silicified siltstone, Swan River chert, Knife River Flint, grey-brown chalcedony, mottled chert and banded black chert. The small proportional representation of some of the remaining material types, red chert, Top-of-the-World Chert and obsidian (a total of 2.6% by count), of the debitage sample suggests that they were likely brought into the site in finished (or nearly finished) form and discarded. Because quartz, porcellanite, green chert, limestone\dolomite, Kootenay Argillite and mottled chalcedony have relatively low proportional representation in the debitage sample and are not present in the tool sample, I infer that their presence indicates the maintenance of tools. The tools may have subsequently been removed from the site, possibly as part of a curated toolkit, or alternatively, were present in an unexcavated area of the site.

DjPm-44

DjPm-44 is the second largest site examined in this study. The total artifact count for the three occupations at this site is 202 tools, 3,021 pieces of debitage and 48 cores. Unlike DjPl-13 the earliest occupation begins with Pelican Lake.

Pelican Lake

A total of 106 tools were assigned to the Pelican Lake occupation. Knife River Flint is the most highly represented material type in the tool assemblage composing nearly 20% of the sample (see Table 6). Quartzite, obsidian and undifferentiated materials are also well-represented at 13.2%, 11.3% and 11.3% respectively. Montana Chert (7.5%), mottled chert (7.5%), green argillite (6.6%), Avon Chert (5.7%) and petrified peat\wood (4.7%) are moderately well-represented. The remaining material types are present only in small amounts not exceeding 2%. Kootenay Argillite, grey-brown chalcedony, Top-of-the-World Chert, banded black chert, porcellanite, mottled chalcedony, green chert and limestone\dolomite were not found.

Tool types include two bifaces (obsidian, Montana Chert), five unifaces (two Montana Chert, one petrified peat\wood, one mottled chert, one Knife River Flint), one Knife River Flint sidescraper, and one silicified siltstone drill\awl. A total of 11 endscrapers are also present in this assemblage and are represented by material type as follows: four Knife River Flint, three each of Montana Chert and Avon Chert, and one grey chert. The 14 projectile points from this assemblage are divided into material types as follows: four obsidian, two each of Knife River Flint and mottled chert, and one each of petrified peat\wood, Avon Chert, quartzite, Swan River Chert, grey chert and silicified siltstone. A total of 52 MRST (11 Knife River Flint, nine quartzite, seven obsidian, four each of green argillite, mottled chert and undifferentiated, three petrified peat\wood, two each of Montana Chert, basalt, red chert and Avon Chert, and one each of Swan River Chert and quartz) are also present in this assemblage. Other tool type categories include

Table 6. Percentage of lithic types for broad artifact classes of the Pelican Lake occupation at DjPm-44.

Material Type	Tools N=106	Cores N=23; 24757.4 g		Debitage N=2167; 6940.1 g	
	Count %	Count %	Weight %	Count %	Weight %
Local					
Red Argillite	0.9	—	—	0.6	1.3
Green Argillite	6.6	13.0	1.2	6.3	42.2
Quartzite	13.2	8.7	12.1	4.3	11.6
Black Chert	1.9	—	—	1.1	0.6
Petrified Peat/Wood	4.7	—	—	0.7	0.2
Silicified Siltstone	1.9	4.3	29.7	3.5	4.4
Limestone/Dolomite	—	8.7	12.7	0.5	3.0
Non-Local					
Swan River Chert	1.9	—	—	0.3	0.7
Kootenay Argillite	—	—	—	0.9	0.03
Basalt	1.9	4.3	0.008	0.6	0.2
Quartz	0.9	—	—	0.5	0.3
Knife River Flint	18.9	8.7	0.001	2.8	1.0
Montana Chert	7.5	—	—	3.4	0.4
Grey-Brown Chalcedony	—	—	—	5.6	0.1
Red Chert	1.9	—	—	—	—
Mottled Chert	7.5	26.1	0.9	36.5	10.1
Top-of-the-World Chert	—	8.7	0.4	0.2	0.1
Obsidian	11.3	—	—	13.3	0.6
Banded Black Chert	—	4.3	0.009	11.2	1.1
Avon Chert	5.7	—	—	3.1	0.2
Other					
Mottled Chalcedony	—	—	—	0.9	0.03
Green Chert	—	—	—	0.5	0.004
Undifferentiated	11.3	13.0	31.7	5.0	20.4
Grey Chert	1.9	—	—	0.2	0.4

one undifferentiated elongated pebble and three hammers (two undifferentiated, one quartzite).

The proportional representation of cores by count and weight is presented in Table 6. There is a considerable difference in results between these two methods of quantifying representation. By count, there is a peak of mottled chert at just over 25%. green argillite and undifferentiated follow with just over 13%, which translates to three cores each. Quartzite, Knife River Flint, Top-of-the World Chert and limestone\dolomite have two cores each. Only one core was found for silicified siltstone, basalt, and banded black chert. As previously mentioned, representation by weight differs. Undifferentiated and silicified siltstone are relatively common at 30%. The next group of material types, green argillite, quartzite and limestone\dolomite, are all represented at just over 10%. Remaining material types have negligible representation by weight.

Differing proportional representation between count and weight is also seen in the debitage illustrated in Table 6, where all material types but porcellanite are represented. By count, mottled chert is present at a considerably higher percentage (36.5%) than the remaining material types. Banded black chert follows at 11.2%. Green argillite, grey-brown chalcedony and undifferentiated are all represented at an intermediate level at or just above 5%. Material types occurring at 1-5% include silicified siltstone, Knife River Flint, Montana Chert and Avon Chert. The rest of the material types are present at percentages below 1%. By weight however, green argillite shows the highest representation at 42.3% of the sample. Undifferentiated follows with 20.4%. Quartzite and mottled chert are present at just over 10% each. The remaining material types make up a very small proportion of the sample by weight.

The Pelican Lake assemblage once again has a large sample size (N=2296; see Table 6). A noticeable difference between the Pelican Lake occupation of DjPl-13 and DjPm-44, is the larger amount of obsidian and green argillite present in the latter. Local and non-local sources also differ in this occupation. Non-local sources represent a larger proportion of the total sample than local sources as compared with DjPl-13. However, in the tool and debitage samples, local material is represented at a considerably higher level than non-local material. Green argillite has a very high representation, at least three times that of the other local materials. Undifferentiated material also had a very high weight representation. Most of the non-local materials have smaller weight than count proportions, suggesting a smaller flake size.

The total of 23 cores in this occupation is the largest number of cores recovered for the sites analysed in this study. Of the non-local cores, mottled chert is the only material type well represented in the debitage, as well as the tools, suggesting that all stages from manufacture to discard may be present. While two cores of Top-of-the-World Chert were recovered, this material type is represented by a negligible amount of debitage and no tools. There are a number of possible explanations for this pattern. The manufacturing debris may have been located in the area of the site which was not excavated. Alternatively, the cores may have been abandoned without being utilised, or were perhaps transported, but were abandoned upon discovery of a more readily available local source. Knife River Flint is represented by two cores, a moderate amount of debitage, and the highest percentage of tools. Once again, this suggests that the potential utility of this material was abandoned at this site. Green argillite, quartzite and perhaps silicified siltstone may be indicative of manufacturing activity. It is possible that some of the material types were discarded as exhausted tools and replaced by mottled chert.

Besant

The most striking observation from the lithic assemblage for the Besant occupation is the strong presence of green argillite. Of the 77 tools assigned to this occupation, 36.4% are represented by green argillite (Table 7). The material type with the next highest representation is undifferentiated at 16.9%. Black chert, Montana Chert and Knife River Flint each represent 6.5% of the sample. The remaining material types are present in proportions below 5%. Red argillite, Swan River Chert, quartz, obsidian, porcellanite, mottled chalcedony, Top-of-the-World Chert and green chert were not represented.

Tool types for the Besant assemblage include 11 bifaces (two each of green argillite, quartzite, Knife River Flint and Montana Chert, and one each of mottled chert, red chert and grey-brown chalcedony), four endscrapers (one each of Knife River Flint, Avon Chert, black chert and Montana Chert), three projectile points (one each of black chert, Montana Chert and Avon Chert) and one undifferentiated spokeshave. A total of 19 core tools are present in this assemblage with a material representation as follows: 12 green argillite, four undifferentiated, two banded black chert and one silicified siltstone. The material type representation for the 28 MRST is as follows: 8 green argillite, three each of Knife River Flint and Avon Chert, two each of quartzite, grey chert, black chert,

Table 7. Percentage of lithic types for broad artifact classes of the Besant ocupation at DjPm-44.

Material Type	Tools N=77	Cores N=18; 9032.4 g		Debitage N=662; 4575.4 g	
	Count %	Count %	Weight %	Count %	Weight %
<u>Local</u>					
Red Argillite	—	—	—	0.5	0.2
Green Argillite	36.4	50.0	29.8	29.9	46.7
Quartzite	2.6	22.2	43.4	14.7	21.1
Black Chert	6.5	3.6	0.04	2.6	0.2
Petrified Peat/Wood	1.3	—	—	0.4	10.0
Silicified Siltstone	1.3	—	—	1.5	0.4
Limestone/Dolomite	1.3	—	—	—	—
<u>Non-Local</u>					
Swan River Chert	—	—	—	0.2	0.01
Kootenay Argillite	1.3	—	—	0.3	0.1
Basalt	1.3	—	—	0.9	0.4
Quartz	—	—	—	0.6	0.1
Knife River Flint	6.5	—	—	1.4	0.2
Montana Chert	6.5	—	—	6.2	0.6
Grey-Brown Chalcedony	1.3	—	—	0.9	0.1
Red Chert	2.6	—	—	—	—
Mottled Chert	1.3	5.6	0.04	1.4	0.5
Top-of-the-World Chert	1.3	—	—	—	—
Obsidian	—	—	—	0.3	0.02
Banded Black Chert	3.9	—	—	24.0	2.7
Avon Chert	5.2	—	—	2.6	0.2
<u>Other</u>					
Mottled Chalcedony	—	—	—	0.8	0.07
Undifferentiated	16.9	16.7	26.7	11.6	26.6
Grey Chert	2.6	—	—	—	—

Montana Chert and undifferentiated, and one each of basalt, Top-of-the-World Chert, petrified peat\wood and Kootenay Argillite. The last tool type category is composed of 13 elongated pebbles (eight undifferentiated, three green argillite, one limestone\dolomite and one red chert).

As Table 7 demonstrates, half of the 18 cores are green argillite. Quartzite follows with 22.2% or four cores, undifferentiated with 16.7% or three cores, and mottled chert and black chert have one core each (5.6%). In terms of proportional presence by weight, quartzite has the highest representation 43%. Green argillite and undifferentiated follow with 29.8% and 26.7% respectively. Mottled chert and black chert have negligible representation in terms of weight.

Green argillite has the highest representation by count and weight in the debitage assemblage illustrated in Table 7, at 28.9% and 46.7% respectively. By count, banded black chert follows with 24%. Quartzite at 14.7% and undifferentiated at 11.6% are the next highest. With the exception of Montana Chert, with a proportional representation of 6.2% of the sample, the rest of the material types have a low representation at less than 3%.

The four material types with the highest representation by count also have the highest representation by weight, although the order differs. Undifferentiated material has the second highest representation after green argillite with 26.6%. Quartzite follows with 21.1%. Banded black chert has the fourth highest proportion by weight, although it is considerably lower at 2.7% which differs considerably from the representation by count. The remaining material types are present in proportions below 1%. Material types not represented include red chert, Top-of-the-World Chert, porcellanite, green chert, grey chert and limestone\dolomite.

The practice of both expediency and curation are also suggested in this assemblage. The large presence of green argillite, likely represented by all manufacturing stages, and mainly used for informal tool types, conforms to the expectations for expediency. The representation of this material type is similar to that of the undifferentiated material both in this assemblage as well as previously discussed ones. Many of the non-local toolstones again appear to have been transported into the site in finished form, which suggests the opposite strategy of curation.

Protohistoric

The Protohistoric occupation is small compared to the two earlier ones. Only 19 tools were recovered. Material type representation may be found in Table 8. Green argillite has the highest representation at 31.6% which translates to 6 tools. Quartzite and undifferentiated both have four tools. Montana Chert is represented by three tools and black chert and obsidian are present with one tool each.

Only three tool type categories are present in the Protohistoric assemblage. These include three projectile points (one each of black chert, Montana chert and obsidian), three core tools (two undifferentiated, one quartzite) and 13 MRST (four each of green argillite and undifferentiated, three quartzite and two Montana Chert).

A total of seven cores were recovered. Three of these cores are quartzite (4343.5 g in total mass), three are green argillite (1959.7 g) and one was undifferentiated material

Table 8. Percentage of lithic types for broad artifact classes of the Protohistoric occupation at DjPm-44.

Material Type	Tools N=19	Debitage N=192; 5375.5 g	
	Count %	Count %	Weight %
Local			
Red Argillite	—	1.6	0.02
Green Argillite	31.6	30.7	28.8
Quartzite	21.1	31.8	44.9
Black Chert	5.3	4.7	0.1
Petrified Peat/Wood	—	0.5	0.007
Silicified Siltstone	—	4.7	4.0
Non-Local			
Swan River Chert	—	1.0	0.02
Basalt	—	9.4	11.8
Knife River Flint	—	4.2	0.1
Montana Chert	15.7	2.1	0.1
Mottled Chert	—	1.0	0.1
Top-of-the-World Chert	—	0.5	0.002
Obsidian	5.3	0.5	0.005
Avon Chert	—	0.5	0.002
Other			
Mottled Chalcedony	—	4.2	0.03
Undifferentiated	2.1	2.1	7.8
Grey Chert	—	0.5	0.001

(1228.8 g).

The debitage assemblage is also fairly small with a total of 192 pieces (5375.5 g; see Table 8). Quartzite has the highest representation in terms of both count and weight, with 31.8% and 44.9% respectively. Green argillite has the second highest representation with 30.7% by number and 28.8% by weight. Basalt has the third highest representation again in both count and weight with 9.4% and 11.8% respectively. The remaining material types are present at less than 5% by count. By weight, undifferentiated material represents 7.8%, silicified siltstone 4.0% and mottled chalcedony 2.2%. The rest are present at proportions less than 1%. Material types not represented in the debitage assemblage are Kootenay Argillite, grey-brown chalcedony, quartz, red chert, banded black chert, porcellanite, green chert and limestone\dolomite. This assemblage showed a predominance of green argillite. The high representation of green argillite suggests that manufacturing activity was occurring. Tools were also discarded in this occupation, thus the entire spectrum of the reduction sequence is represented. In addition, green argillite has a high proportional weight representation, suggesting a large average size for the flakes and cores. Quartzite is almost as well-represented as green argillite, and has a similar proportional weight representation. Considerably fewer tools are present which suggests removal from the site if manufacture was occurring. A large average flake size is suggested by the representation for the undifferentiated material. The spike in banded black chert representation likely corresponds to the workshop area noted by Van Dyke (1994: 202). It therefore appears that quartzite and banded black chert were utilised for manufacture, and that many of the tools may have been removed from the site. In contrast, green argillite is well represented throughout the assemblage. This suggests that it was used for the manufacture of tools and that many of the tools were discarded. Given that most of the tools made from green argillite were large core tools, the abandonment of these heavy tools is reasonable. In general, an expedient strategy is again evident for green argillite and the undifferentiated material. Many of the non-local materials, in contrast, conform more to the expectations of a curatorial strategy.

DjPm-228

McKean

A total of six tools were recovered from the McKean occupation. Included in this assemblage are one Avon Chert Projectile Point, two endscrapers made from mottled chalcedony and black chert as well as three MRST, two quartzite and one grey chert. One quartzite core was also recovered. In terms of debitage, only 40 pieces were recovered, weighing a total of 532.7 g. Quartzite represents almost half of the sample with 18 pieces (81.7 g) in total. Undifferentiated has the next highest presence with nine pieces (411.9 g). Green argillite has five pieces (20.2 g). There were two pieces each of the following material types: black chert (0.7 g), silicified siltstone (1.0 g) and Montana Chert (3.9 g). Kootenay Argillite and Swan River Chert are both represented in the assemblage by one piece each and 4.5 g and 8.8 g respectively

DjPm-228 has a very small McKean sample which makes it difficult to draw inferences. However, a number of general observations may be made. Firstly, although there are only 47 artifacts, 11 material types are represented, again demonstrating the wide variety of material types present in the tool kit. Most of these material types are represented in the assemblage by only one or two artifacts. Secondly, undifferentiated material is present at a considerably larger weight to count proportion, than the other material types, conforming to the pattern noted in previous assemblages.

Pelican Lake

The Pelican Lake occupation has a considerably higher sample size. Of the 130 tools, the only material types not represented are petrified peat\wood, quartz, porcellanite, green chert and limestone\dolomite. The proportional representation of those material types present in the assemblage is given in Table 9. Clearly, quartzite has the highest representation (22.3%), nearly twice that of the next highest material type, Avon Chert (11.5%). Obsidian and green argillite follow at around 10%. With the exception of silicified siltstone (7.7%), Montana Chert (6.2%), undifferentiated (5.4%) and black chert (5.4%), the remaining material types are present in proportions below 5%. Of these, basalt, Knife River Flint and banded black chert fall below 1%.

Material type representation for the 14 bifaces present in the assemblage is as follows: three quartzite, two each of Top-of-the-World Chert and silicified siltstone, and one each of black chert, Swan River Chert, basalt, Montana Chert, red chert, obsidian and grey chert. A total of 13 endscrapers (four Avon Chert, three quartzite, two black chert and one each of Top-of-the-World Chert, silicified siltstone, grey-brown chalcedony and grey chert) and 15 projectile points (three Avon Chert, two each of Montana Chert, Top-of-the-World Chert and obsidian, one each of quartzite, mottled

Table 9. **Percentage of lithic types for broad artifact classes of the Pelican Lake occupation at DjPm-228.**

Material Type	Tools N=130	Cores N=20; 5104.5 g		Debitage N=2167; 6283.7 g	
	Count %	Count %	Weight%	Count %	Weight %
<u>Local</u>					
Red Argillite	1.5	—	—	1.3	3.0
Green Argillite	9.2	10.0	4.5	9.8	21.3
Quartzite	22.3	4.5	72.1	38.0	47.6
Black Chert	5.4	10.0	0.2	10.8	1.7
Petrified Peat/Wood	—	—	—	0.1	0.01
Silicified Siltstone	7.7	—	—	3.3	2.5
<u>Non-Local</u>					
Swan River Chert	3.1	—	—	2.2	0.4
Kootenay Argillite	1.5	—	—	0.9	0.9
Basalt	0.8	—	—	1.0	0.5
Quartz	—	—	—	0.5	0.4
Knife River Flint	0.8	—	—	3.9	0.9
Montana Chert	6.2	—	—	4.3	0.8
Grey-Brown Chalcedony	1.5	—	—	2.8	0.5
Red Chert	1.5	—	—	0.6	0.2
Mottled Chert	3.1	20.0	1.6	1.6	1.8
Top-of-the-World Chert	4.6	—	—	2.2	0.6
Obsidian	10.0	10.0	0.2	4.3	0.8
Banded Black Chert	0.8	—	—	0.2	0.03
Porcellanite	—	—	—	0.2	0.04
Avon Chert	11.5	—	—	4.6	0.9
<u>Other</u>					
Mottled Chalcedony	1.5	—	—	1.2	0.2
Undifferentiated	5.4	5.0	21.4	3.9	14.5
Grey Chert	1.5	—	—	2.4	0.4

chert, Kootenay Argillite, red chert, grey-brown chalcedony and mottled chalcedony) are also present in this assemblage. Core tools have the following representation in terms of material type: six quartzite, five green argillite and one each of silicified siltstone, Montana Chert, red argillite, Swan River Chert, undifferentiated and banded black chert. The MRST category again has the greatest number of tools, 57, represented in this assemblage (12 quartzite, 10 obsidian, seven green argillite, six Avon Chert, four each of black chert, silicified siltstone, and undifferentiated, three each of Montana Chert and mottled chert, two Swan River Chert and one each of red argillite, Knife River Flint, Top-of-the-World Chert and mottled chalcedony). Other tool type categories include two elongated pebbles (silicified siltstone, undifferentiated), one undifferentiated hammer, seven unifaces (three quartzite, one Kootenay Argillite, one silicified siltstone, one Avon Chert, one Montana Chert), one Avon Chert drill/awl, and one quartzite spokeshave.

Table 9 also illustrates the proportional representation of count and weight for cores. Clearly, quartzite has the greatest representation for both count and weight with 45% and 72.1% of the total sample, respectively. Mottled chert has the next highest representation by number at 20%. Green argillite, black chert and obsidian are present with 10% or two cores each, and undifferentiated is represented by only one core. As the undifferentiated core represents over 20% of the sample by weight, it has a considerable mass. The rest of the material types have very low representation by weight.

The debitage assemblage is relatively large with 1268 pieces weighing 6283.7 g for the Pelican Lake occupation. As clearly shown in Table 9, most of the material types have a very small proportional representation by number and weight with some less than

5 % and most less than 1%. All material types except limestone\dolomite and green chert are represented. Quartzite has the highest representation by number and by weight by a wide margin with 38.0% and 47.6% of the sample, respectively. Black chert has the second highest representation by number with 10.8% of the sample but low proportional representation by weight. Green argillite has the third highest representation by count with 9.8% and is second by weight with 21.3%. Undifferentiated has a high representation by weight , 14.5%. but low by number 3.9%. The rest of the material types are poorly represented.

Quartzite dominates this assemblage for all artifact types with 22.3% of tools and 38.0% of debitage by count. Quartzite cores are only 4.5% of the core sample by count, but comprise 72.1% of the mass for cores. The entire range of activities from manufacture to discard appear to be present for this material. Two other material types, green argillite and black chert are also well-represented in the debitage sample, with the majority of the debitage sample represented by local materials. The representation of these materials by count and weight, however, is rather different, with green argillite having a higher weight representation than count (21.3% versus 9.8%) and the opposite for black chert (10.8% by count and 1.7% by weight). As noted previously, green argillite is represented by high proportional weights suggesting a larger average flake size. If material type by tool type is examined for this assemblage, it is clear that green argillite is only present in the less formal tool types, MRST and core tools. Technologically, the larger flake size is to be expected if none of the later shaping stages were undertaken. There is also a considerably larger core size for green argillite.

Undifferentiated material is well represented by weight in the debitage and core samples, not surprising given the typically large size of artifacts made from this material. Two non-local materials, mottled chert and obsidian, also are represented in the core sample. Both are relatively well-represented in the debitage sample, along with Knife River Flint, Montana Chert, grey-brown chalcedony and Avon Chert. Of these non-local sources, all except mottled chert has a considerably higher count to weight proportion, possibly representing late-stage and/or maintenance debitage. The dominance of local material in the debitage sample is not seen to the same extent in the tool sample. Except for the peak of quartzite, local and non-local materials are present in similar amounts. Obsidian and Avon Chert are particularly well-represented. Petrified peat\wood, quartz, and porcellanite are found in negligible quantities in the debitage sample and also are the only material types not represented in the tool sample. Similar arguments to those presented above concerning the expedient use of green argillite, undifferentiated material and perhaps quartzite as well, apply to this assemblage, as do those for curation.

Besant

The Besant occupation has a total of six tools: one black chert projectile point, and five MRST, two of which are made from green argillite, and one each of Swan River Chert, quartzite and Knife River Flint . One black chert core was recovered weighing a total of 532.7 g. Only 20 pieces of debitage were recovered (49.6 g in total). The eight material types represented by this small debitage assemblage are as follows: nine quartzite (33.5 g), three Knife River Flint (1.4 g), three Montana Chert (5.3 g) and one each of grey chert (1.0 g), red argillite (4.8 g), porcellanite (6.2 g), silicified siltstone (2.7

g) and Swan River Chert (1.7 g).

The Besant lithic assemblage at DjPm-228 is very small. A total of ten material types are represented by the 27 artifacts recovered from this occupation. Green argillite and black chert are present in the tools but not the debitage, and the only core recovered was of black chert. If any manufacturing debris was produced from this core, it was not located in the OMRD Project excavations. Overall, this assemblage does not appear to result from any major manufacturing activity, and likely represents the maintenance and discard of materials brought into the site in the form of finished tools.

DjPm-100

The combined totals for the Besant, OWP and Protohistoric occupations are 63 tools, 4 cores and 391 pieces of debitage. This results in small sample sizes for each of the occupations.

Besant

The Besant lithic assemblage comprises three tools, no cores and only six pieces of debitage. The tool sample consists of one mottled chalcedony endscraper, one undifferentiated core tool and one Knife River Flint Projectile Point. In terms of debitage, there are two pieces of black chert (1.6 g), and one piece each of Knife River Flint (0.2 g), Swan River Chert (6.8 g), Montana Chert (0.8 g) and Avon Chert (1.5 g). A total of nine lithic artifacts were recovered from this occupation. Given the small artifact sample recovered, few inferences can be made concerning this assemblage, except to note that five of the seven material types present are of non-local origin.

OWP

The OWP occupation has a larger tool assemblage with a total of 26 tools. As can be seen in Table 10, quartzite has the highest representation at 19.2%, which translates to 5 tools. Knife River Flint is represented by four tools, Swan River Chert, Montana Chert, grey-brown chalcedony and mottled chert by three tools, and black chert, petrified peat\wood and grey chert by one tool. The only core recovered is of mottled chert. Material type representation by tool type is as follows: seven bifaces (two mottled chert, one Knife River Flint, one petrified peat, one quartzite, one Swan River Chert and one Montana Chert), 11 MRST (four quartzite, three black chert, one Swan River Chert, one grey-brown chalcedony, one Knife River Flint), four projectile points (two grey-brown chalcedony, one petrified peat/wood, one black chert), two endscrapers (one Knife River Flint, one Montana Chert) and two unifaces (one undifferentiated, one Knife River Flint).

The proportional representation of the debitage assemblage is also presented in Table 10. By count, quartzite has the highest representation at 20.6%. Following quartzite are mottled chalcedony, Swan River Chert, Knife River Flint and petrified peat\wood represented at 16.5%, 15.7%, 13.2% and 12.4%, respectively. Mottled chert, obsidian, silicified siltstone, Top-of-the-World Chert and grey-brown chalcedony have proportions between 1-5%. The remaining material types are present with proportions of less than 1%. As previously observed, proportional representation by weight shows a very different pattern from that by count. Quartzite represents the majority of the assemblage by weight at 74.2%. The next highest is mottled chert at 6.1%, followed by

Table 10. Percentage of lithic types for broad artifact classes of the Old Woman's Phase occupation at DjPm-100.

Material Type	Tools N=26	Debitage N=121; 504.3 g	
	Count %	Count %	Weight %
Local			
Red Argillite	—	0.8	0.2
Quartzite	19.2	20.6	74.2
Black Chert	7.7	0.8	0.3
Petrified Peat/Wood	7.7	12.4	3.9
Silicified Siltstone	—	2.5	1.1
Non-Local			
Swan River Chert	11.5	15.7	6.0
Kootenay Argillite	—	0.8	0.1
Knife River Flint	15.4	13.2	2.9
Montana Chert	11.5	—	—
Grey-Brown Chalcedony	11.5	3.3	0.3
Mottled Chert	11.5	5.0	6.1
Top-of-the-World Chert	—	2.5	0.2
Obsidian	—	5.0	0.4
Other			
Mottled Chalcedony	—	16.5	3.6
Grey Chert	3.8	0.8	0.6

Swan River Chert at 6.0%, petrified peat\wood at 3.9%, mottled chalcedony at 3.6%, Knife River Flint at 2.9% and silicified siltstone at 1.1%. The rest of the material types are present at a proportion of less than 1%. Material types not represented include: green argillite, basalt, quartz, Montana Chert, red chert, banded black chert, porcellanite, Avon Chert, green chert , undifferentiated, mottled chalcedony and limestone\dolomite.

Undifferentiated material and green argillite are noticeably absent from the OWP occupation. In contrast, petrified peat\wood plays a larger role proportionally in this assemblage than in most of the others previously discussed (See Table 10). It is difficult to infer anything about potential manufacturing activity. The proportional representation of quartzite by weight is almost three times that of count, suggesting that flake size for this material is relatively large. Mottled chert is the only other material type with a greater proportional representation by weight. It is also the material represented by the only core, which may indicate some manufacturing activity. For the rest of the materials, the count proportion is higher than weight, suggesting a relatively smaller flake size, and may be the result of later stage or maintenance activity. It is unlikely that this assemblage represents any major manufacturing activity. Tools discarded include local, the two nearest non-local sources, Swan River Chert and mottled chert, and sources from the south and east. The two British Columbia sources recorded by debitage, are not seen in the tool assemblage. However, the small sample sizes of this occupation must be taken into account when evaluating these patterns.

Protohistoric

The Protohistoric occupation at DjPm-100 has a slightly larger lithic assemblage.

The proportional representation of tools by material types is illustrated in Table 11. There is a clear peak in representation with Montana Chert comprising 23.5 % of the tool sample. Swan River Chert follows with 14.7%, then Knife River Flint and grey-brown chalcedony with 11.8% each. Mottled chert and undifferentiated are each represented by 5.9 % of the sample. The rest of the material types are at less than 5%. Red argillite, green argillite, petrified peat\wood, Kootenay Argillite, basalt, quartz, obsidian, banded black chert, porcellanite, green chert and limestone\dolomite were not observed. Material type representation by tool type is as follows: eight MRSTs (two Montana Chert, two Knife River Flint, two Swan River Chert, one mottled chert and one mottled chalcedony), six bifaces (two grey-brown chalcedony, two Montana Chert, one Knife River Flint, one Swan River Chert), six endscrapers (one Knife River Flint, one black chert, one mottled chert, one Montana Chert, one grey-brown chalcedony and one silicified siltstone), three unifaces (one red chert, two Montana Chert), two core tools (one black chert, one undifferentiated), one undifferentiated elongated pebble and one undifferentiated hammer.

Of the three cores recovered, two are of mottled chert weighing a total of 44.7 g. The third is a large quartzite core (153.7 g).

The debitage assemblage totals 264 pieces weighing 1038.3 g. The distribution by raw material is illustrated in Table 11. Mottled chert has the highest representation both by count (36.4%) and weight (53.4%). Of the remaining material types, only four have representations greater than 5% by count. These include petrified peat\wood, Swan River Chert, quartzite, and Montana Chert at 18.6%, 11.4% and 7.2% and 8.0%,

Table 11. Percentage of lithic types for broad artifact classes of the Protohistoric occupation at DjPm-100.

Material Type	Tools N=34	Debitage N=264; 1038.3 g	
	Count %	Count %	Weight %
Local			
Red Argillite	—	0.4	0.1
Green Argillite	—	1.1	1.1
Quartzite	2.9	8.0	16.2
Black Chert	8.8	1.9	6.5
Petrified Peat/Wood	—	18.6	9.1
Silicified Siltstone	2.9	1.1	0.1
Limestone/Dolomite	—	0.8	3.8
Non-Local			
Swan River Chert	14.7	11.4	4.3
Quartz	—	1.1	0.3
Knife River Flint	11.8	3.1	1.1
Montana Chert	23.5	7.2	0.7
Grey-Brown Chalcedony	11.8	—	—
Red Chert	2.9	1.1	5.5
Mottled Chert	5.9	36.4	53.4
Top-of-the-World Chert	2.9	1.5	0.3
Obsidian	—	1.5	0.2
Avon Chert	2.9	0.4	0.04
Other			
Mottled Chalcedony	2.9	—	—
Undifferentiated	5.9	2.3	2.2
Grey Chert	2.9	2.3	1.0

respectively. The rest are present in proportions of less than 5%, with most under 2%. Montana Chert dominates the debitage sample by weight. Quartzite has the second highest representation at 16.2%, followed by petrified peat/wood with 9.1%, red chert with 5.5% , Swan River Chert at 4.3%, and limestone at 3.8%. The rest of the material types have proportions close to or less than 1%. Materials which were not represented include basalt, porcellanite, banded black chert, mottled chalcedony and green chert.

There is a noticeable difference in material type representation between the debitage and tools. Montana Chert, Knife River Flint, grey-brown chalcedony and Swan River Chert have the four highest proportional representations, together making up 61.8% of the tool sample. This lost or discarded tool utility may have been replaced by mottled chert. Two cores of this material and the highest proportional representation in the debitage (36.4% by count and 53.4% by weight; see Table 11) may indicate manufacturing activity. Quartzite likewise may have been used for manufacture (Table 11). It is likely that the low amounts of debitage for most of the remaining material types (i.e., most material types are represented by less than ten pieces of debitage) does not represent any major manufacturing activity, suggesting these materials were brought into the site in the form of finished tools as part of a curated toolkit.

DjPl-11

There are five occupations at DjPl-11. Most of these, however, have very small sample sizes. Only the results for the Pelican Lake occupations will be presented in a table. The totals for the five occupations are 76 tools, 13 cores and 450 pieces of debitage.

McKean

There are a total of 13 tools recovered from the McKean occupation. These material types are divided between the two tool types present, core tools and MRST, as follows: core tools (three undifferentiated, one quartzite and one silicified siltstone), MRSTs (four undifferentiated, two green argillite, one black chert and one silicified siltstone). No cores were recovered.

The debitage assemblage totals 65 by count and 218.4 g by weight. Undifferentiated (52 pieces, 122.5 g) represented 80% of the debitage by count and over 50% by weight. Silicified siltstone was the next common by number (9) and third by weight (39.4 g). Green argillite, black chert, mottled chert and red chert are represented by one piece each. The weights of these material types are 61.8 g, 1.5 g, 2.4 g and 1.0 g, respectively

This assemblage is dominated by undifferentiated material. Local materials, green argillite, silicified siltstone, and black chert, comprise most of the remaining assemblage. It is interesting that only the less formal tool categories were abandoned at the site, as the undifferentiated material and silicified siltstone both commonly associated with these tool types are common in this assemblage. The debitage records the presence of two non-local sources, mottled chert and red chert. The tools made from these materials were not found at the site. It is possible that only large less formal tools, (perhaps a result of expedient technology) were discarded there, although this is speculation.

Pelican Lake

The material type representation of the 49 tools recovered from the Pelican Lake occupation is given in Table 12. Silicified siltstone (18.4%) and undifferentiated (18.4%) are the most common material types. Swan River Chert and Top-of-the-World Chert follow at 14.3% and 10.2%, respectively. Black chert, grey-brown chalcedony, mottled chalcedony and grey chert are present with three tools each, obsidian is present with two tools, and the remaining tool types are present with one tool each.

Two bifaces made from grey-brown chalcedony and Swan River Chert were recovered. The three endscrapers are made from Top-of-the-World Chert, black chert and Swan River Chert. A total of seven projectile points (four Top-of-the-World Chert, one Knife River Flint, one mottled chalcedony and one petrified peat\wood) were recovered. Two undifferentiated, one silicified siltstone and one black chert core tool were also are included in the tool assemblage. The material type representation for the MRST category is as follows: (eight silicified siltstone, six undifferentiated, five Swan River Chert, three grey chert, two each of grey-brown chalcedony, mottled chalcedony and obsidian, and one each of green argillite, black chert, mottled chert and green chert). The one remaining tool is an undifferentiated elongated pebble.

The proportional representation of cores by count and weight is presented in Table 12 and demonstrates that the Pelican Lake cores follow a pattern similar to that previously noted. Silicified siltstone has the highest representation at just over 30%, with four cores. Quartzite is represented by two cores. The remaining material types are represented by one core each. By weight, the representation is very different, with

Table 12. Percentage of lithic types for broad artifact classes of the Pelican Lake occupation at DjPl-11.

Material Type	Tools N=49	Cores N=13; 465.1 g		Debitage N=2167; 943.6 g	
	Count %	Count %	Weight%	Count %	Weight%
Local					
Red Argillite	—	—	—	0.3	0.1
Green Argillite	2.0	7.7	7.0	4.1	6.0
Quartzite	—	23.1	69.4	27.9	29.3
Black Chert	6.1	—	—	5.2	2.5
Petrified Peat/Wood	2.0	—	—	0.3	0.2
Silicified Siltstone	18.4	30.8	3.5	29.3	12.1
Non-Local					
Swan River Chert	14.3	7.7	3.8	9.7	10.5
Kootenay Argillite	—	7.7	12.5	0.3	0.1
Basalt	—	—	—	0.3	0.9
Quartz	—	—	—	0.7	0.5
Knife River Flint	2.0	—	—	0.7	0.3
Montana Chert	—	—	—	1.4	0.1
Grey-Brown Chalcedony	6.1	—	—	4.1	1.0
Red Chert	—	—	—	0.7	0.4
Mottled Chert	2.0	—	—	6.9	2.4
Top-of-the-World Chert	10.2	7.7	2.2	0.7	0.04
Obsidian	4.1	—	—	—	—
Banded Black Chert	—	15.4	1.7	2.4	0.9
Avon Chert	—	—	—	0.7	0.2
Other					
Mottled Chalcedony	6.1	—	—	1.7	2.4
Green Chert	2.0	—	—	—	—
Undifferentiated	18.4	—	—	2.1	30.6
Grey Chert	6.1	—	—	0.3	0.1

quartzite having the greatest proportional representation at 69.7%. The second most common material type is Kootenay Argillite at 12.5%. The remaining material types are present in low proportions.

All material types are present in the debitage assemblage except obsidian, porcellanite, green chert and limestone\dolomite. The majority of the observed material types are present in small proportions both by number and weight. By count, silicified siltstone (29.3%) and quartzite (27.9%) are the most common material types. With the exceptions of Swan River Chert (9.7%), mottled chert (6.9%) and black chert (5.2%) the rest of the material types are represented at less than 5%.

Quartzite and silicified siltstone dominate the debitage assemblage and are also represented by four and three cores each, respectively (Table 12), suggesting manufacturing activity. Unlike silicified siltstone, which represented 18.4% of the tool assemblage, no quartzite tools were recovered, indicating that if the tools were manufactured, they were removed from the site. Kootenay Argillite and banded black chert are also present in the core and debitage samples, but were not recovered in the tool assemblage. Besides silicified siltstone only three other material types, green argillite, Swan River Chert and Top-of-the-World Chert, are present in all three artifact categories. This may indicate the presence of all stages of manufacture. The non-local materials have the highest proportional representation of these three material types. Swan River Chert and Top-of-the-World Chert have the third highest proportion for tools for this occupation. These toolstones are represented by one core each. However, while Swan River Chert is relatively well-represented in the debitage with respect to the rest of the material types (9.7 % for count 10.5 % for weight), Top-of-the-World Chert is present in a negligible amount (0.7 % for count 0.04 % for weight). This either indicates that Swan River Chert played a more important role in site manufacturing activities, or that the debitage associated with Top-of-the-World Chert was not recovered in the excavations. None of the rest of the material types likely records the presence of manufacturing activity. The presence of these material types is recorded as discarded tools and a small amount of debitage (black chert, petrified peat\wood, Knife River Flint, grey-brown chalcedony, mottled chert, mottled chalcedony and grey chert), as tools alone (obsidian and green chert), and as debitage alone (red argillite, basalt, quartz, Montana Chert, red chert and Avon Chert). There does not appear to be any concentration of material types from a specific area (western sources for example) for material types which were discarded as tools and those which appear to have been maintained in the toolkit. It can be noted again however, that in general, these non-local toolstones appear to reflect a curated technology.

Besant

A total of nine tools were recovered from the Besant occupation. Included in this tool assemblage are one silicified siltstone biface, one Knife River Flint and one quartzite core tool. Three MRST (two mottled chert, one silicified siltstone) also were recovered. The miscellaneous category includes two undifferentiated netsinkers and one limestone\dolomite elongated pebble. No cores were recovered. Seventy pieces of debitage were found, represented by nine material types in the following manner: 28 pieces of Montana Chert (6.7 g in total), 19 pieces of Knife River Flint (9.6 g), eight pieces of Avon Chert (18.2 g), five pieces of silicified siltstone (21.2 g), five pieces of mottled chert (10.2 g), two pieces of quartzite (0.9 g), one piece of black chert (1.0 g), one piece of grey-brown chalcedony (4.0 g) and one piece of Swan River Chert (0.8 g).

This small assemblage displays a predominance of non-local sources for the debitage (77.5%). Except for Knife River Flint and mottled chert, the non-local sources were not discarded as tools, suggesting that their potential utility was not yet exhausted.

Avonlea

Only four tools were recovered from the Avonlea occupation. These included one Knife River Flint projectile point, one red chert biface, one Montana Chert MRST and one red chert drill\awl. Only 16 pieces of debitage were recovered including one piece each of quartzite (1.3 g), mottled chalcedony (0.3 g), mottled chert (3.2 g), Montana Chert (0.7) and Swan River Chert (12.2 g). Green argillite is represented by 11 pieces at 135.8 g.

This assemblage is very small, consequently definite inference cannot be drawn. However comparison of material types between the tools and the debitage samples yields an interesting observation. The tools consist of only non-local materials, all from south and east, while the majority of the debitage sample is represented by green argillite, quartzite, mottled chalcedony and two of the nearer non-local sources, Swan River Chert and mottled chert. The tools appear to have been discarded, perhaps suggesting that the materials from the very distant sources were exhausted at the time the site was occupied.

OWP

The OWP occupation has the smallest assemblage with only one tool, a Top-of-the-World Chert projectile point, and nine pieces of debitage. No cores were found. The debitage is represented by two pieces each of black chert (0.3 g), green argillite (3.8 g) and one piece each of Avon Chert (0.3 g), Knife River Flint (1.3 g), grey-brown chalcedony (0.4 g), mottled chert (2.3 g) and Montana Chert (0.2 g). Despite this limited sample, a broad representation of material types is present with eight material types representing ten artifacts, six of which are non-local in origin. This again lends support for a varied toolkit with respect to material type.

Summary

Several patterns were observed from the OMRD Project dataset. The first of these is a longstanding pattern of non-selective lithic procurement and use, which is common across many of the occupations and sites. Even in the small assemblages a large number of toolstone types are present. Another pattern observed in this dataset concerns the varied representation of non-local and local toolstones with respect to inferred on-site knapping behaviour. This variation may reflect the practice of different technological strategies, namely, curation and expediency. These patterns are discussed further in the following chapter.

Chapter 6

DISCUSSION

Introduction

This chapter is divided into three sections. The first section discusses several possible patterns in the data with respect to questions of large-scale directional movement and change over time. The second section discusses the implications of all of the observed patterns with respect to interpretation of broad lithic utilisation patterns for the types of variables outlined in Chapter 3. The third section is concerned with the application of this data. This includes a consideration of potential sources of error as well as optimal utilisation of this type of data.

Broad Toolstone Utilisation Patterns

The previous chapter outlined patterns of lithic representation through a site by site comparison of different artifact categories. To further investigate these patterns, another approach utilising gross representation is undertaken here. In this approach a number of more specific questions are asked of the data. The first compares the observed results with Reeves' pattern model of change over time for southern Alberta. The second concerns the possible directional focus of past groups with respect to toolstone acquisition. The site pattern data presented below is organised by occupation from the Late Middle Prehistoric to Protohistoric time periods.

In southern Alberta archaeology, raw material data has most commonly been used to compare the presence and absence of different material types, with the object of defining various components of the cultural-historical sequence. The most common reference to patterns of use over time is the scheme developed by Reeves (1970, 1983, 1990). Reeves included different patterns of lithic use as defining characteristics in his cultural-historical scheme. Most of Reeves' (1970, 1983) discussions concern the Late Middle Prehistoric and the Late Prehistoric, which are the time periods most common in this data set. There has been very little discussion of the earlier McKean use of lithic raw material. The only broad inference which may be made is that a reliance on local lithics may characterise the McKean Phase, as the Pelican Lake use of exotics is often described as being greater than in earlier time periods (Reeves 1990). For the Pelican Lake Phase, Reeves noted a higher incidence of exotic material, especially obsidian, which is considered to be characteristic of Pelican Lake. Montana Cherts are also common. For the Besant Phase, local lithics were often used extensively. Some sites however, do show high incidence of Knife River Flint, and Avon Chert may also be present in high frequencies. Avonlea is often characterised by an almost total reliance on local materials. The Old Woman's Phase is also characterised by the use of local materials, particularly petrified wood, although Montana Chert may also be common. There has been very little discussion concerning Protohistoric lithic procurement and use patterns.

Although this scheme is widely accepted, no large-scale study has been undertaken to confirm or modify Reeves' hypotheses. Reeves (1970, 1983, 1990) utilised these patterns of lithic use, in part, to make very broad generalisations concerning various archaeological cultures. For example, he sees the increased use of exotics (mainly obsidian and Montana Chert) in Pelican Lake assemblages as evidence of more intensive long-distance trade at this time. High incidence of Knife River Flint in several Besant sites has also led Reeves to suggest that this may reflect an involved trade system with easterly cultures.

The broad temporal patterns offered by Reeves are often cited in the archaeological literature despite concerns by a number of authors that Reeves' (1970) original work was based on the limited database available at that time, and that his results should perhaps be treated as pioneering work (Brumley and Dau 1988; Vickers 1994). These authors suggest that these patterns should be tested and revised with additional data. This study offers a good opportunity to compare how closely the representations from the occupations at the OMRD Project compare to Reeves' expectations, given that the patterns are based upon gross representation. A comparison of the results from this analysis and those of Reeves will be presented below in chronological order of occupations.

The assemblages from all three sites with a McKean presence (DjPl-13, DjPm-228, and DjPl-11) are all very small. One cannot definitively describe any patterns of use with such limited samples. Given this, however, local materials do tend to dominate the McKean assemblages in this study. DjPl-13, for example, is dominated by quartzite and silicified siltstone. Quartzite is the best represented toolstone at DjPm-228, with other materials being present only in very small quantities. However, it is undifferentiated material, rather than quartzite, that plays the largest role at DjPl-11.

The Pelican Lake Phase is the best represented, both in terms of the sites chosen for this analysis, as well as the for the OMRD Project generally. Comparison of the Pelican Lake assemblages from the four sites at which they are present reveals no obvious pattern. At DjPl-13, local materials represent most of the tool and debitage sample, with quartzite, black chert and silicified siltstone as the most important. In the tool sample, for the non-local materials, Knife River Flint and Montana Chert are well-represented. These two materials, along with grey-brown chalcedony and mottled chert were also well-represented in the debitage sample. Undifferentiated material is well-represented throughout. Although obsidian is present, it is not well represented.

DjPm-44 displays a somewhat different pattern of material representation, where non-local material has a greater representation in the Pelican Lake assemblage than does local material. Knife River Flint, obsidian, Montana Chert, mottled chert and Avon Chert are predominant in the tool sample. In the debitage sample, mottled chert accounts for nearly 40% of the sample followed by obsidian, banded black chert, grey-brown chalcedony, Avon Chert, Montana Chert and Knife River Flint. Green argillite and quartzite are the best represented local materials. Core toolstone types are roughly similar to those of tools and debitage. Unlike the situation at DjPl-13, obsidian is well-represented in this Pelican Lake assemblage. Obsidian is also common in the Pelican Lake assemblage at DjPm-228, and is present in the tool, core and debitage samples. Overall, however, material representation differs from DjPm-44.

At DjPm-228, quartzite is by far the most common Pelican Lake material type. In the tool sample, after the peak of quartzite, non-local and local materials have a similar representation with green argillite, black chert and silicified siltstone highest for local materials, and obsidian, Avon Chert, Montana Chert and Top-of-the-World Chert highest for the non-local materials. In the debitage sample, however, the local materials comprise the largest proportion of the assemblage, with green argillite, quartzite and black chert having the highest representation. Obsidian, Avon Chert, Montana Chert and Knife River Flint are the best represented non-local toolstone types.

The Pelican Lake assemblage at DjPl-13 illustrates yet another pattern. Obsidian is present only in the form of finished tools. This notwithstanding, silicified siltstone and undifferentiated material are the best represented materials for tools. These are followed by Swan River Chert, and Top-of-the-World Chert which are also well-represented. The debitage assemblage is best-represented by local materials such as quartzite and silicified siltstone. Quartzite is present in the core and debitage assemblages, but not in the tool assemblage. The best represented non-local material is Swan River Chert.

All five sites have a Besant presence, although, three of these assemblages are very small. DjPl-13 has the largest Besant sample. While local lithics, quartzite, black chert and silicified siltstone are used extensively, so are non-local materials such as Knife River Flint and Avon Chert along with Montana Chert, grey-brown chalcedony and mottled chert. Undifferentiated material is also well-represented. At DjPm-44, green argillite dominates the assemblage as the most common material type for the tools, cores and debitage. As at DjPl-13, undifferentiated material is well-represented proportionally (16.9% of tools, 16.7 % by count and 26.7 % by weight of cores, 11.6 %

by count and 26.6 % by weight of debitage) in all artifact categories. The presence of several non-local materials, Knife River Flint, Montana Chert, Avon Chert, and banded black chert, is most strongly observed in the tool samples. It is difficult to draw inferences from the small Besant assemblages at the remaining sites. However, at DjPl-11, which has the next largest debitage assemblage, non-local materials such as mottled chert, Knife River Flint and Avon Chert dominate.

The Avonlea Phase is poorly represented in the sites analysed in this study, as well as throughout the entire OMRD Project. At DjPl-13, the supposedly characteristic reliance on local materials is not seen. Rather, the best represented material types in the tool sample are Knife River Flint, Montana Chert, grey-brown chalcedony and undifferentiated toolstones. As well, silicified siltstone is the only known local source represented in the core sample. It also is the best represented material in the debitage sample, followed by Swan River Chert and grey-brown chalcedony, Montana Chert and mottled chert. Limestone and grey-chert are also well-represented. The Avonlea sample size at DjPl-11 is very small with a total of 20 artifacts. Yet, despite the small sample, non-local material types are well-represented.

As with the Avonlea material, the 'characteristic' reliance on local materials, is not apparent in the OWP assemblages. At DjPl-13, there is similar proportional representation for local and non-local materials for the tools, as well as for the cores. Undifferentiated and black chert have the greatest representation in the debitage, followed by mottled chert, Montana Chert, and grey-brown chalcedony. A similar situation exists at DjPm-100, with the exception that undifferentiated material is not present at this site. Only 10 artifacts of the OWP were recovered from DjPl-13. However, eight material types are represented, six of these are non-local.

In the Protohistoric component at DjPm-44, green argillite and quartzite are the best represented materials for the tools, cores and debitage. The majority of the debitage assemblage also is represented by these two lithic types. Undifferentiated materials are well-represented in the tools. Montana Chert and obsidian, two non-local types present in the tool category, have very low representation in debitage. Basalt has the highest representation for non-local material. In contrast, basalt was not present at DjPm-100. Green argillite plays a considerably smaller role, with only a few pieces of debitage. In the tool assemblage, Swan River Chert, Knife River Flint, Montana Chert and grey-brown chalcedony are the most common types. Mottled chert is strongly represented in the debitage sample. Local materials, such as quartzite and petrified peat/wood are also well-represented. Except for Swan River Chert, other non-local materials are uncommon.

Owing to small sample sizes, it is difficult to compare the results of this study to Reeves' (1983, 1990) general statements concerning lithic use patterns over time. However, my results do not completely conform to Reeves' expected patterns. While a number of occupations do demonstrate the expected trends, for example, obsidian was common in the Pelican Lake assemblage at DjPm-228, the variation between occupations does not seem to support a general pattern for each time period.

The second question concerns the possibility of a directional focus of past groups for non-local toolstone acquisition. If the non-local toolstone types are dominated by sources from a particular area, it may indicate a bias in group movement or interaction in a particular direction. The investigation of a possible directional focus utilises only the largest assemblages from the OMRD Project data. These assemblages correspond to those having data presented in tables in the preceding chapter.

An initial suggestion of directional focus can be observed simply from the total list of material types provided by Brumley (1980). For example, none of the toolstone types which can be traced to a source is located any distance north of the study area. The greatest number of lithic material source locations are located to the south such as the Montana Cherts, Avon Chert, grey-brown chalcedony and red chert. Porcellanite and Knife River Flint are located to the southeast. Several toolstone types have a number of possible western and southwestern source locations. This could potentially bias the observations of directional representation. Basalt, quartz and obsidian, for example, can all be obtained both in British Columbia as well as various states. Obsidian, however, may be the least problematic of these toolstone types. In a provenance study of obsidian artifacts in archaeological sites in southwestern Alberta, most of the artifacts were sourced to Wyoming and Idaho (Godfrey-Smith and Magne 1988). Western sources include mottled chert and banded black chert which can be obtained in the front ranges of the Rocky Mountains. Kootenay Argillite and Top-of-the-World Chert are located further west in southeastern British Columbia.

In the OMRD Project assemblages, the most consistent direction for source location of dominant non-local toolstone types is from the south. This is perhaps not surprising given the relatively large number of lithic raw material sources located south of the study area. Montana Cherts, Avon Chert and grey-brown chalcedony are the dominant toolstone types in the following assemblages: the Pelican Lake components at DjPl-13, DjPm-44, DjPm-228; the Besant and Avonlea components at DjPl-13; the Old Woman's Project at DjPl-13 and DjPm-100; and Protohistoric components at DjPm-44 and DjPm-100. Obsidian is well-represented in the Pelican Lake components at DjPm-44 and DjPm-228. The far southeastern source of Knife River Flint is also well-represented in many of the assemblages. One site which does not conform to the pattern of dominant southern sources is DjPl-11. The two dominant sources at this site are Swan River Chert and Top-of-the-World Chert located far to the east and west, respectively.

The patterns investigated in this section further elucidate past toolstone use in the OMRD Project area. The next section is concerned with the interpretation of these patterns as well as those outlined in the previous chapter.

Implications of Toolstone Utilisation Patterns

Behavioral interpretation in lithic studies assumes that generalised past behaviours are reflected in flaked stone assemblages (Bradley and Giria 1996:23). Recognition of these behaviours in the archaeological record has proven to be one of the most difficult challenges in lithic analysis, and is still the subject of much debate. In toolstone studies, this has resulted in criticism that gross representation of material type for an assemblage provides insufficient support for broad-scale interpretations, such as seasonality and territoriality (Ingbar 1994). This study has examined material type representation in a number of different ways in an effort to utilise the data to best advantage. Rather than considering only gross representation by assemblage, lithic representation was also examined by artifact type, by inferred tool type within tools, as well as by count and by weight. Examination of different artifact categories allowed for broad inferences concerning the import of finished tools, as well as patterns of manufacture. Such an approach, combined with the use of gross representational patterns, provided a clearer picture of past lithic resource use than the sole reliance on one or the other would have.

The results presented in the last chapter suggest both similarities and differences in raw material usage at all levels. A number of general observations may be made concerning utilisation patterns which seem to be common to all sites and occupations. First, most occupations are represented by a large number of material types. This observation should be made with some degree of caution however, given that the gross number of material types represented may be linked to sample size, as the largest sample sizes always have the largest number of lithic types. Despite this however, a large number of material types were present even in occupations with very small sample sizes. Debitage samples, for example, typically represent nearly all of the suite of material types listed by Brumley (1988). As well, the number of material types present is just slightly less than the number of tools. Therefore, although many of the material types are represented by only one or two artifacts, a large number of material types are present at each site. This suggests that the lithic procurement pattern was not highly selective, and does not appear to focus on a single or even a small suite of material types. One possible inference from this pattern is that the procurement strategy was relatively opportunistic in that all toolstones which are available in a seasonal round and/or through contact with other groups were utilised. That this pattern is evident in all time periods represented by the OMRD Project dataset suggests it may be long-standing.

Another potentially long-standing pattern may be seen in terms of which material types are not present in the assemblages. There is a group of material types which tend to be absent or only present in low amounts at DjPl-13; green chert, porcellanite, quartz, basalt, Kootenay Argillite, and red argillite. There are a number of likely explanations for the scarcity of these material types. Exploitation of certain lithic resources may not be possible. Availability, for example, may be variable due to a number of factors, including location of source outside the region of seasonal rounds, lack of trade in the material, access to the material being blocked by other groups, or seasonal unavailability. Another explanation for the low occurrence of materials may simply be that they were not highly valued. Moreover, non-local materials may have been procured and utilised, but the presence of these types may become exhausted before the site in question was inhabited. Ingbar's (1994) model of source proportions and mobility patterns demonstrates how this is possible. In Ingbar's simulations, a group moves over a hypothetical landscape with three raw material sources. Even varying the speed of the group's movement (measured in tool depleting events), all three material types are very rarely present at the same time. A similar group of material types is also consistently scarce or absent for the rest of the occupations at DjPl-13. Although it would be difficult to identify which of the above noted factors might be responsible for the patterns observed in this study, they seem to have persisted over a long period of time.

While it is apparent that toolstone acquisition was not highly focussed on one or even a limited suite of lithic raw materials, there does appear to be a directional bias to non-local toolstone acquisition, as outlined in the previous section. The concentration on generally southern sources and the lack of northern sources in the dataset may be the result of a number of different factors. To begin with, few toolstone source areas in central and northern Alberta have been documented, other than a general indication of use of secondarily derived quartzites, pebble cherts and silicified siltstones. The few which have been defined, such as Beaver River Sandstone (Ives and Fenton 1983), were not observed in the OMRD Project data. It is possible that the scarceness of the lithic resources did not tempt Plains groups into this area for the purposes of toolstone procurement. It should be noted however, that very little archaeological work overall has been undertaken in both central and especially northern Alberta, including lithic resource studies. Another complicating factor is the difficulty in sourcing and distinguishing between secondary sources obtained in different locations.

A second factor which may help to explain the lack of northern sources and focus on southern toolstones concerns the different environmental conditions between these areas. The open grasslands of southern Alberta grade into aspen parkland, and eventually, boreal forest. As the subsistence of past Plains groups was dependant on the bison, the main population of which existed on the grasslands, it is possible that there was less opportunity for movement and toolstone acquisition into northern areas in the course of seasonal rounds. It has been suggested that bison herds often wintered in the foothill region to the north or along the aspen parkland border to the north (Vickers

1991). However, even if populations were in the latter area, seasonal complications such as snow cover would not have encouraged lithic raw material exploitation. In contrast, areas of some of the northern states, such as Montana and Wyoming, both have grassland environments and archaeologically similar cultures to those of southern Alberta. Proximity to mountainous and upland areas also provide numerous source areas for lithic raw material. Given this, it may be logical to suggest that the seasonal round and/or social interaction of past groups utilising the OMRD Project area would be likely to encompass an area which supports a similar lifestyle and with groups of people with similar cultures and subsistence strategies, in a resource rich area.

Similar environmental conditions are present east of the study area as well, with the extension of the Canadian Plains into southern Saskatchewan and southwestern Manitoba (Vickers 1986). Other than secondary deposits of Knife River Flint, the only toolstone observed in the OMRD Project data to the east is Swan River Chert. This material can be obtained from secondary sources from Manitoba, through southern Saskatchewan into southeastern Alberta. In fact, most of the sources in southern Saskatchewan, in particular, are secondarily derived from tills and gravels, making it difficult to pinpoint source location. This again introduces the potential for bias when attempting to determine a directional focus as sources from a particular direction, this case to the east, may not be recognized.

The mountains to the west of the OMRD Project area provide ample opportunity for toolstone acquisition. One raw material type whose source area is located directly west of the OMRD Project area is mottled chert. This toolstone is well-represented in most of the assemblages investigated for this study. The proximity of the source to the study area lends itself to the suggestion that availability played a large role in the representation of this toolstone.

The two western sources located in southeastern British Columbia, Kootenay Argillite and Top-of-the-World Chert, are present in many of the OMRD Project assemblages, but not usually in large quantities. The presence of these toolstones may reflect gift giving activity. It has been suggested that small quantities of distant sources could reflect a type of social interaction characterised by gift giving to friends or relatives in order to cultivate and cement social relationships. Such a tactic may be followed as a risk management strategy in an effort to increase resource sharing during times of stress (Driver 1993; Gould 1980; Hayden 1982; Jamieson 1984). Kootenay Argillite, in particular, is a good candidate for such an explanation. This toolstone is an inferior raw material for flintknapping due to its platey structure and tendency for step fracture (Choquette 1980). This suggests that values other than technological considerations were placed upon this toolstone. Driver (1993) offers a similar explanation for the presence of Kootenay Argillite in a site in the Crowsnest Pass area of southwestern Alberta. The presence of the very distant sources of Knife River Flint in the OMRD assemblages may also be an example of this type of activity.

As the general patterns of toolstone procurement for the OMRD Project data have been established, we now consider a comparison of specific utilisation patterns for different lithic raw material types. The common practice of comparing local and non-local sources is useful for such an examination. Although the precise definitions of local and non-local or exotic often differ, most researchers are interested in whether differences exist between representation of lithic resources which are immediately available and those located at some distance from the site in question. The presence of very distant sources of raw material is often assumed to reflect the fact that such material had a higher value placed upon it by past stone workers than did local material (Morrow and Jefferies 1989; Munson and Munson 1984). Such value may be demonstrated by the preferential use of different material types for different tool types. Alternatively, distant sources may have simply been exploited in the course of the seasonal round, and the distribution of material types may merely reflect the available material resources (Andrefsky 1994a). A discussion concerning the representation of lithic materials with respect to tool type is presented.

The differential representation of toolstones for different classes of tools may suggest preferential treatment of one or several material types, implying that different material types have had a higher or lower value placed upon them by past peoples. Distant raw material might be valued for social, ideological or aesthetic reasons (Gould 1980:141-159). For example, Clark (1985:185) noted that in Hopewellian sites, Knife River Flint, an exotic material, was found almost exclusively in burial mounds and in the form of large bifaces of probable ceremonial use. It was suggested that this particular raw material was considered too valuable for everyday use (Clark 1984:185). However, there is no evidence of this type of preferential material use in this study. Both local and non-local sources were used for all tool types and no one particular tool type appeared to be manufactured from a favoured material. This suggests a fairly non-selective use of lithic resources. Clearly, however, it cannot be stated that past stone tool makers and users did not place different values on various lithic resources. It simply can be observed that this pattern is not evident from the criteria utilised here. In the case of gift giving, it may be the acquisition or possession of a toolstone type, or the action of receiving it, which is important. This may not translate into special treatment visible in the archaeological record.

Technological considerations, such as the superior flaking qualities of particular materials, may also play a role. Ahler (1977:40-141) noted in his sample of sites from the Middle Missouri Subarea that coarser quartzite and silicified sediments were preferentially used for larger bifacial tools which required larger initial pieces of raw material (not available from the regional chert sources) and percussion thinning techniques. In the OMRD Project sample, tools have been manufactured from almost the full range of material types, with one notable exception. From the results, it is clear that limestone/dolomite as well as undifferentiated material are found exclusively in the less formal tool type classes including the core tools, MRST, and the ground stone tools. This suggests that technological considerations such as the general unsuitability of limestone/dolomite for controlled flaking, as well as the material requirements for ground stone tools played a significant role in determining how these material types were utilised. The noticeable presence of quartzite and silicified siltstone in the ground stone tool sample, both better suited than many of the cherts for the manufacture of these tools, tends to support this interpretation.

If the difference in source representation is examined for specific material types, some interesting patterns emerge. Most local sources have greater weight than count proportions, and generally are present with a much greater mass than non-local sources. The non-local sources, in contrast, tend to have much higher count than weight proportions, especially Knife River Flint and the Montana Cherts. Two non-local sources, Swan River Chert and particularly mottled chert, are exceptions to this pattern. In many of the assemblages such as those of the McKean, Pelican Lake, Besant, and OWP at DjPl-13 and all of those at DjPm-44, for example, one or both of these sources have higher weight than count proportions similar to the local sources.

This pattern, as well as the fact that both of these materials come from two of the least distant of the non-local sources, supports the above suggestion that the relatively large quantities of these toolstones in the OMRD Project assemblages is indicative of their ready availability. This in turn suggests, however, that the commonly used local\non-local designation is fairly arbitrary. The division into local/non-local is generally based on availability in the immediate vicinity of the site, with all other sources considered non-local. It is difficult, however, to estimate what past groups may have considered to be immediately available. As a result, this may obscure sources located at intermediate distances from the site, and may bias the examination of local/non-local sources. These results demonstrate the potential importance of examining each material type separately as well as within a broader designation. Given this, however, the best and most consistent evidence for manufacturing, particularly for the very early stages of reduction can be found in the locally available materials, especially quartzite. In contrast, toolstones from many of the distant sources, especially those from the south and east, appear to have been brought into the site in finished form. As well, the presence of many material types tends to be recorded by only a few pieces of debitage in the assemblage, suggesting that tools may have been maintained at the site and then removed to be curated as part of the current toolkit.

Both strategies of curation and expediency appear to be present in the OMRD Project assemblages. Two toolstones in particular, green argillite and undifferentiated material, conform closely to the expectations of an expedient technology. In most of the assemblages in which they are present, these toolstones appear to be have been manufactured, used and discarded at the site. As well, there is a tendency for them to be used as informal tools. In contrast, many of the distant, non-local toolstones such as the southern and western sources, frequently appear to be part of a curated assemblage. Transportation into the site in finished or nearly finished form and the possibility that these tools may have been maintained once transported, are common curational characteristics for many of the non-local toolstones.

The presence of both technological strategies in the OMRD Project datasets is interesting when compared with case studies discussed in the literature. Most discussions concerning curation and expediency, including Binford's (1973, 1977) early papers, attempt to associate these strategies with different lifeways and mobility patterns. Curation is often associated with highly mobile lifestyles as a strategy designed to mitigate incongruities between the location of tool use and toolstone source, as well as time stress caused by the exploitation of mobile and/or unpredictable resources, which may arise in the context of nomadism (Bamforth 1986; Binford 1979; Torrence 1983).

Expediency, in contrast, is often liked with increasing sedentism, as the great advantage of curation, portability, would be less useful for this lifestyle (Nelson 1991; Parry and Kelly 1987). These studies discuss curation and expediency on a broad-scale and there is an implied mutual exclusivity for these concepts in many of the papers. Others (i.e., Andrefsky 1994a) have argued that invoking involved explanations of mobility strategies without first considering the factors of raw material availability and quality, could lead to erroneous conclusions. Several studies do include the possibility of curation and expediency in one assemblage. For example, Morrow and Jefferies (1989) argue that valued material from more distant sources are curated in an effort to retain them as long as possible. Such a pattern is seen to some extent in the OMRD Project assemblages. The distant non-local material appear to have been transported between sites as part of a curated assemblage of finished tools. Many of the non-local tools, however, appear to have been made and used on-site, perhaps in response to immediate needs. The characteristics of expediency as wasteful of raw material, but a useful way to take advantage of small and poor-quality raw material (Parry and Kelly 1987), are well-suited to the relatively abundant, but less tractable toolstones located close to the sites in question.

Not all toolstones, in all assemblages, strictly adhere to the general patterns noted above. Non-local cores, for example, are observed in the sites and there is evidence for some on-site manufacture of these toolstones. The presence of the small workshop of banded black chert in the Protohistoric occupation at DjPm-44 provides an excellent example of this observation. There are also a number of lithic types which do not conform well to either strategy of curation or expediency. While there is evidence for on-site manufacture for several of the local toolstones, in some of the assemblages there is the suggestion the finished tools were transported away from site. A good example of this is the use of quartzite in the Pelican Lake assemblage at DjPl-11. In addition to this, with the exception of the previously mentioned bias towards informal tools for several of the toolstones, tool type does not seem to differ between most of the lithic types. Thus, for many of the toolstones examined here, the factor of tool design, a popularly discussed variable in the literature on curation and expediency (i.e., Bleed 1986; Nelson 1991; Torrence 1983), does not seem to be useful. While the general pattern between local and non-local toolstones noted above is apparent, a degree of variation between lithic types does exist.

This situation likely reflects the limitations of our use of the concepts of curation and expediency. Although Binford (1973, 1977) originally viewed these concepts on a continuum, they have become polarised in much of the subsequent literature. As a result, there has been a tendency to force a particular assemblage into a rigid category, a common problem in archaeological interpretation. A more realistic approach may be to not to try subsume variation as 'exceptions' to predicted patterns, but to explain it as reasonable expectations for living groups rather than archaeological constructs. Thus, it is not unrealistic to envision the past (seasonal) inhabitants of the Oldman River Valley curating a toolkit of distant lithic resources, perhaps valued for knapping quality and/or social or cultural reasons. Cores from distant sources may have been transported in order to maintain a supply of raw material. These groups perhaps exploited local resources, using the less tractable materials for large or informal tools, and discarding them at the site. Other local resources, which may be of slightly better quality, may be utilised to replace an exhausted part of a toolkit.

It is possible that the broad patterns in material representation noted above may be due in part to the seasonal availability of various sources. Such an explanation also takes advantage of the concept of curation. The Oldman River Valley appears to have been used for overwintering. Seasonal changes could affect the availability of lithic resources, as winter conditions, including snow cover and poor travelling conditions, may limit access to raw material. One would expect that supplies of non-local resources, obtained either on a seasonal round or through trade, were not available during the winter to the people who overwintered in the Oldman River Valley. Snow cover and frozen ground may also limit the availability of local sources. Under these conditions, the practice of material conservation may be expected. The archaeological manifestation of this behaviour may be the reuse and reworking of tools, exhaustion and discard of tools from more distant sources, and a greater reliance on local resources. Such an explanation has been invoked in the southern Alberta archaeological literature before. Van Dyke (1982:98) argues that the presence of non-classic projectile points at the Bow Bottom site (EfPm-104) may reflect seasonal variation in material abundance. The classic points would therefore represent spring\summer sites where access to materials was good, but with declining availability during the winter, tractable material would become exhausted and reworked.

Although some curational behaviour is evident from the assemblages from the

Oldman River Valley sites, seasonal availability is not necessarily the only explanation for this. However, a more conclusive interpretation would require a comparison of representational patterns for sites thought to have been occupied during different seasons. It would also be useful to compare the results from a more in-depth lithic analysis which could address such questions as whether or not the tools were heavily resharpened, if cores were exhausted when discarded, and provide a better understanding of what types of debitage are present in an assemblage. The varying representational patterns observed here for different toolstone types may simply reflect the opportunistic use of available material, which may not differ from summer sites. However, the possibility that a seasonal pattern in lithic use may exist indicates that further research into this area is necessary.

The category of undifferentiated material should be also discussed. Many of the occupations have fairly large quantities of this material, greater than what is normally desirable in a miscellaneous category. The fact that the undifferentiated material appears to be treated similarly across different occupations and sites suggests that a similar group of materials was included in the miscellaneous category for all sites. For example, the materials assigned to the undifferentiated category were present in fairly large pieces, as demonstrated by the difference between count and weight. Also, undifferentiated material is well-represented in the core samples. The pattern of representation for the undifferentiated material appears to be similar to that of the more locally available material such as quartzite. An in-depth examination of these materials from collections and an effort to discover their origin is required. For the purposes of this study, a more detailed description of which types of material were included in this category would have been useful for interpretation.

This section has thus far only considered patterns which are similar between both sites and occupations. While similar patterns were observed between occupations and sites, exceptions to these observations were also noted. DjPl-11, for example, did not display a predominance of southern sources. Clearly, a number of different factors are responsible for toolstone representation in the OMRD Project dataset. Reeves (1983, 1990) has suggested that different utilisation patterns may be characteristic of different archaeological cultures. This study has compared Reeves' patterns model for change over time in toolstone use in southern Alberta with the OMRD Project data. My results do not support Reeves' model, as the data do not invariably conform to the predicted representational pattern. In fact, at the site level, assemblages from DjPm-44 exhibit a considerably higher quantity of green argillite than do the assemblages from DjPl-13. It is possible that as a local source, green argillite may have been more immediately available at DjPm-44. Such a pattern is interesting as it crosscuts cultural-temporal affiliations. All of this suggests that Reeves' model is overly simplistic.

Overall, the OMRD Project data indicate that basic technological considerations concerned with the nature of the raw material itself, opportunistic use of available toolstone, a possible suggestion of social interaction through gift giving, and the use of a large number of lithic raw material types with a potential bias toward sources located in the south may have all been important factors in toolstone use and acquisition. The results have also highlighted, however, the tentative nature of many of these interpretations. The next section will evaluate this exercise and the usefulness of its results.

Evaluation of the application of the OMRD data

The focus of this thesis is to evaluate the research potential for previously recorded CRM data. Data from the OMRD Project was analysed as deemed appropriate in an effort to gain a better understanding of lithic raw material utilisation in this region. A number of divergent patterns were observed and possible explanations presented. However, there are clearly difficulties in the application of CRM data to questions of lithic raw material utilisation. There are two main weaknesses which contribute to this situation. The first concerns the categorisation and identification of raw materials, while the second involves the types of attributes recorded.

Material identification presents an important potential source of error in this study. As described in Chapter 4, Brumley's (1988) list of identifying characteristics is similar to standards used by other researchers. However, the actual catalogue of raw material types is problematic. The miscellaneous category labelled 'undifferentiated' for example, is too well-represented in most samples. As a miscellaneous category it plays a larger role than is desirable. Furthermore, a large proportion of many of the samples is represented by material types for which there are no descriptions whatsoever. This might be very misleading. For example, in a comparison between local and non-local materials, if most of the materials in the miscellaneous category are in fact local in origin, this might bias the results. The inclusion of an 'undifferentiated' category is unusual in a categorisation system which includes the possibility for purely descriptive categories. This suggests that a particular material type or types were consistently placed into the 'undifferentiated' category. Clearly there are deficiencies in current knowledge of material types and sources utilised in prehistoric southern Alberta.

Similar concerns apply for several of the other material types. The practice of including a number of possible source areas for a material type provides a realistic view of our present level of knowledge. However, it may also result in misleading patterns. This potential source of error is similar to that for the 'undifferentiated' category. The inclusion of multiple categories greatly increases the possibility of misrepresentation of a material type. For example, if one of the purely descriptive categories turned out to be a variety of Montana Chert, this toolstone would be under-represented. However, it should also be stated that the inclusion of multiple possibilities for a source area is infinitely preferable to arbitrarily assigning a source provenance to a material type. It does however, illustrate the need for a better understanding of source variation.

The focus of the previous section was on non-local materials. A number of potential sources of error also exist for local sources. The common practice of relying on general descriptions of the presence of various secondary sources, rather than intensively surveying the immediate area for the presence of locally available sources is cause for some concern. While it is helpful to know what secondary sources were generally available in southern Alberta, it is more useful to know what materials were readily available in the immediate vicinity of a site and in what quantity. My reliance on the general description provided by Brumley (1988), which distinguishes local from non-local sources in a somewhat arbitrary manner, could result in the fact that some sources labelled as 'local' may not actually have been located as close to the occupation areas as might be supposed.

The problem of replication of results between different researchers also may have been a skewing factor in the data used for this study. The material type scheme was designed by Brumley (1988) on the basis of his years of experience and knowledge. The actual identification of material types, however, was performed by another researcher. It is possible that despite Brumley's (1988) generation of a reference collection and a detailed written description, some discrepancies in material type identification might exist. The main lithic analyst for the campsites project indicated that the reference collection might have been more useful if a broader range of individual source variation, which she knew to exist, was included in the collection (Barb Neal, Personal Communication 1995).

The second concern highlighted by this study are the limitations posed by utilising data not recorded with the specific focus of the research question in mind. The attributes which were recorded were not always suitable for the types of analysis which I initially desired to undertake. Furthermore, the types of information which would have been useful for my specific research questions were not always recorded. In short, the resulting generalised dataset makes it difficult to answer some of the more specific questions generated from the literature. As well, the general interpretations obtained from this analysis may be somewhat ambiguous, as they are only one of a number of possible explanations and more detailed information would be required to address specific questions with certainty. This is especially relevant when attempting to infer which types of manufacturing activity took place. For example, although differences between weight and count proportions are likely to provide some indication of flake size, which in turn may be used to infer flintknapping activity, high variation in individual flake size might bias the results, particularly in the case of one disproportionately large flake in the sample. In this study, quartzite appears to possess a generally high weight to count proportion, suggesting a relatively larger flake size, from which one might infer earlier stages of reduction, larger initial pieces of material from which the flakes were struck, or simply the production of larger tool types. However, a detailed debitage analysis would be necessary in order to confirm this.

This study identified the types of information which can be obtained from OMRD data, given the limits imposed by the basic level of the dataset. This CRM data is useful for studies examining general trends and broad comparisons between sites and occupations. It may also be used to examine proposed trends based on purely representational data, such as Reeves' (1983, 1990) suggested scheme of change over time. Essentially descriptive in nature, these types of analysis offer little in the way to generate explanations for observed patterns. While CRM data provides a large database, the general level of recorded lithic information makes interpretation of observed trends difficult.

The CRM dataset is also very useful for generating hypotheses and suggestions for areas of future research. Weaknesses in the OMRD data in terms of raw material sourcing and characterization reflect a deficiency of knowledge throughout Alberta archaeology. In addition, general patterns found through the application of CRM data may be used to focus research, and outline specific questions for future studies.

On the basis of this study, it is clear that a more intensive analysis of the types of stone tool activities which were associated with different material types is required. The question of local and non-local groupings, including broad regional comparisons. between different types of sites would also contribute a broader perspective to the understanding of raw material utilisation. In conclusion, the CRM dataset is useful for examining lithic raw material utilisation patterns provided the limitations of using previously recorded data are taken into account. When addressing very specific research questions, however, it is necessary to consult the original collections and perform specific analyses.

Summary

Generally, there is a need for a more regional approach to raw material studies in southern Alberta and the northern Plains. There are difficulties in comparing results between sites without consistent reporting (a phenomenon common in this area). There are also difficulties in attempting to develop an overall picture from one site, or from several sites which one has studied personally. There is a serious need for work concerning actual material source identification, as well as for the results of archaeological work to be distributed, and for more widespread use of this material. The present view is that such a database is being amassed as a result of the CRM work, and that this might prove to be an extremely valuable source of information in the future.

However, a number of suggestions stem from this research which might improve upon the usefulness of the CRM database for addressing a variety of archaeological questions. Three main points arise from this evaluation of the application of CRM data to lithic raw material utilisation patterns. Firstly, CRM data provides access to large quantities of data which would be difficult and time-consuming for the individual researcher to analyse. Secondly, while only general patterns can be obtained from the OMRD Project with any degree of confidence, the use of CRM data provides a useful means of generating hypotheses and suggesting future research projects on more specific questions. Thirdly, it is clear from the results of this research, that for the purposes of addressing comparative questions, the researcher would need to examine the original collections in order to tailor the data to the specific questions of interest, rather than relying on the CRM database, as that data is limited in its applications.

Chapter 7

SUMMARY AND CONCLUSIONS

In his summary of Plains archaeology, Forbis (1982) pointed out that the almost exclusive programme of archaeological work undertaken in a CRM framework creates a tendency to focus on project-specific goals and generates very few research-oriented field projects. Duke (1991:7) also emphasizes the difficulty in the dissemination of information as many of the reports remain unpublished. In addition, the single medium for publishing used almost exclusively by Alberta archaeologists, the Monograph and Occasional Papers issued by the Archaeological Survey of Alberta, while commendable, suffers from a lack of critical peer review. It has the potential for "producing an archaeology that lacks a sustained external critique" (Duke 1991:7). This medium for publishing data on Alberta archaeology became defunct before the results of the OMRD Project could be published. Despite the obvious need for large-scale field research oriented projects, present financial realities render such a programme of research unlikely. Despite these realities, some large CRM databases have been compiled over the last 20 years. With the cuts to funding experienced in the last few years, the use of previously collected data to answer new research questions has become an attractive alternative to 'hands-on' field work.

This study has attempted to evaluate the potential application of a previously collected CRM dataset and research. As this study was based on only one, albeit large, CRM project, there is a possibility that the potential utility of these datasets may vary between projects. The five sites (DjPl-13, DjPm-44, DjPm-228, DjPm-100 and DjPl-11) selected from a large mitigation project in southwestern Alberta, the Oldman River Dam Project, were analysed in an attempt to better understand lithic raw material utilisation patterns. As a detailed technological analysis was not possible, given the manner in which this data were recorded, an examination of material representation for various factors was determined to be the best use of the existing dataset. In general, the results of this study reinforce the criticisms and discussions concerning the necessity of tailoring specific field and analytical strategies to answer specific questions.

Nonetheless, this study has been able to make a number of broad generalizations about utilisation patterns for the project area from the previously recorded data. Firstly, there appears to be a longstanding pattern of resource use which is not highly selective. That is, there does not appear to be a focus entirely on a small suite of lithic types, although a possible bias toward southern sources was observed. Secondly, a number of multiple, interactive factors are likely the cause of the variation seen in the assemblages rather than the previously offered single explanation of cultural preference. For example, technological considerations of material quality and desired tool type as well as material availability likely played a role. In addition, two technological strategies, curation and expediency, are observed in the assemblages. A number of toolstones, green argillite and undifferentiated material in particular, appear to have been used expediently. In contrast, many of the non-local toolstones seem to have been transported, and perhaps maintained, as part of a curated toolkit. The possibility of gift giving as an explanation for some of the distant sources was also presented. More specific interpretations gathered from this analysis are considered to be more speculative but, the general conclusion is that previous interpretations of lithic use patterns for southern Alberta are too simplistic and fail to account for the sorts of complexities that can be introduced by actual groups of living peoples (as opposed to static archaeological constraints).

Redman (1987:258) offers a good example of this type of argument:

> I believe that archaeologists can collect baseline information using the more-or-less standard data collecting formats that exist for a region. A problem orientation often emerges from such projects, but usually after the data are collected, during the analytical stage. This may work out in some cases, but is not reliable because key categories of data may be overlooked in the field and when they are delineated in the laboratory stage, it is too late. For baseline interpretive questions, however, this will seldom be a problem.

This study suggests that in order to generate results which can be confidently used as a definitive pattern or comparative study, the best approach for a researcher would be to undertake a project or analyse the artifacts previously collected by himself\herself. Nevertheless, for the suggestion that this type of analysis would be useful for determining general patterns, as well as generating hypotheses and suggestions for future research, the OMRD Project data was found to be very useful. The most obvious requirement for future research to come out of this study is for an in-depth source study of all the toolstone types found in archaeological contexts in Southern Alberta. The identification of source areas for unknown materials, as well as a better understanding of the range of variation for specific material types such as Montana Chert would be very useful. In addition, experimental techniques such as X-ray fluorescence might also be undertaken. Although such a project would be an immense study, it is unlikely that a thorough understanding of the prehistoric use of lithic material will be achieved without it.

Future work might also include the automatic survey of the immediate environs of a site for potential sources of lithic material. For example, it would have been useful to know whether or not green argillite was particularly abundant around DjPm-44.

The limited interpretive potential of utilising purely representative data has already been discussed in Chapter 3. Only very general observations and interpretations may be made from the data analysed in this study. However, this analysis was useful for pointing out areas in which more in-depth analytical techniques might be beneficial in future research. A strict application of Ahler's (1989a) mass analysis would be very beneficial in interpreting the differences in proportional representation between weight and count as well as in addressing specific questions concerning the types and stages of reduction by the debitage.

The application of individual flake analysis of production attributes might also be useful for addressing more specific technological questions than were possible in this study. This type of analysis may be useful in comparing utilisation patterns of different lithic types by distinguishing between maintenance and manufacturing debitage. An examination of use-wear patterns to identify utilised flakes in the debitage as well as pattern of use on the other tools might prove helpful. For example, it might be interesting to compare patterns of use between material types as well as discard patterns by examining wear on a tool and whether or not it shows signs of resharpening or rejuvenation.

In conclusion, it appears that the use of previously analysed data could play a role in future studies. The general utility of this type of dataset has been demonstrated by this study. The best use of such data would be in the preliminary stages of a research project in order to assess what types of information are potentially available and which datasets may warrant individual analysis. The generation of hypotheses could be another application of this data. In short, while limited in some respects, CRM data is a resource which should not be cursorily dismissed.

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Appendix 1

Raw Material Categories Defined by Brumley (1988)

GROUP: A-1 MATERIAL: Red Argillite
MATERIAL COLOUR: Primary colour: Dark Red (5R 3/1 - 3/4); Secondary colours: None
TEXTURE: Fine Grained
LUSTER: Vitreous
TRANSLUCENCY: Opaque
FRACTURE: Even
OTHER ATTRIBUTES: Generally single solid colour
QUIGG (1981) GROUP CATEGORY(S): 3A
SIMILAR LITHIC GROUPS: Essentially identical in colour to F-2 porcellanite but easily identifiable due to more vitreous luster and slightly coarser texture.
KNOWN SOURCES/COMMENT: Reddish argillites occur commonly in gravel deposits throughout southern Alberta and northern Montana. Large bedrock outcrops of argillite in the Rocky Mountains are probably the original sources of this material.

GROUP A-2 MATERIAL: Green Argillite
MATERIAL COLOUR: Light to Dark Gray, Light to Medium Greens (10 GY 7/1 to 10 GY 2.5/1 to 10 GY 3/2).
TEXTURE: Fine to Medium
LUSTER: Dull to Resinous
TRANSLUCENCY: Opaque
FRACTURE: Even to Uneven
QUIGG (1981) GROUP CATEGORY(S): 3B
SIMILAR LITHIC GROUPS: Fine grained quartzites (B-2) have more visible grains and more vitreous luster. Kootenay Argillite (A-3) is separated as a more fine grained, distinctively platy variant, often lighter in colour.
KNOWN SOURCES/COMMENTS: This group includes a range of specimens from fine grained to coarser more quarzitic - looking varieties. Knapping quality is generally good with step fracturing fairly common. Sources have been located in southeastern British Columbia, southwestern Alberta and northern Montana.

GROUP A-3 MATERIAL: Kootenay Argillite
MATERIAL COLOUR: Light Green (5 GY 6/1) to Gray (7.5 Y 6/2) .
TEXTURE: Very Fine Grained
LUSTER: Resinous
TRANSLUCENCY: Opaque
FRACTURE: Even
OTHER ATTRIBUTES: Material is very prone to step fracturing along bedding planes. Circular surface potlid fractures also common.
QUIGG (1981) GROUP CATEGORY(S): 3D
SIMILAR LITHIC GROUPS: A-2 tends to be coarser and darker coloured and doesn't show distinctive platy fracture.
KNOWN SOURCES/COMMENTS: Kootenay Argillite is thought to originate around the Kootenay Lakes of southeastern British Columbia.

GROUP B-1: MATERIAL: Coarse Quartzite
MATERIAL COLOUR: Primary: Medium - Light Gray (N6.5/), Medium Red (7.5 R 5/6; 3/4), Medium Yellow Red (7.5 YR 5/6), Light Yellow (2.5 Y 5/4), Medium Green (5 G 5/2, 7.5 G 2.5/2), Dark Green (10 G 5/1), Dark Blue Green (10 BG 8/1), Dark Red Purple (10 RP 3/2); Secondary: None
TEXTURE: Coarse to Very Coarse
LUSTER: Vitreous - Dull
TRANSLUCENCY: Opaque - Slightly Translucent
FRACTURE: Even - Uneven
OTHER ATTRIBUTES: While there are a wide variety of colours in all groups, individual specimens are generally of one colour.
QUIGG (1981) GROUP CATEGORY(S):
SIMILAR LITHIC GROUPS:
KNOWN SOURCES/COMMENTS: B-1 quartzites are available in a variety of glacial till and river ground sources throughout southern Alberta and northern Montana.

GROUP B-2 MATERIAL: Fine Quartzite
MATERIAL COLOUR: Primary: Light Gray (N 6.75/), Medium Gray (N 6.25), Dark Yellow Red (10 YR 3/1), Medium Green (5 G 3/1) and Medium Red Purple (5 RP 8/2). Secondary: Light to Dark Yellow Red (2.5 YR 4/8 - 10 YR 4/2).
TEXTURE: Medium - Fine Grained
LUSTER: Vitreous - Dull
TRANSLUCENCY: Opaque - Moderately Translucent
FRACTURE: Even
OTHER ATTRIBUTES: Some banding
SIMILAR LITHIC GROUPS: E-10 mottled chalcedony/quartzite.

GROUP: C - Undiff MATERIAL: Basalt
MATERIAL COLOUR: Dark Grey to Black (N 2.75/)
TEXTURE: Fine Grained to Coarse
LUSTER: Dull
TRANSLUCENCY: Opaque
FRACTURE: Even to Concoidal
OTHER ATTRIBUTES: Some is vesicular and contains small volcanic glass sherds.
QUIGGS (1981) GROUP CATEGORY(S): 6A
SIMILAR LITHIC GROUPS: Will be easily confused with E-11, black chert, but presence of vesicles will generally distinguish. May also resemble darker varieties of silicified siltstone.
KNOWN SOURCES/COMMENTS: Tertiary basalts could have been obtained from central Montana, Washington or British Columbia quarries (Loveseth 1980). Slightly coarser gray basalt comes from the Midvale basalt Quarry (Dort 1964; Bucy 1974; Loveseth 1980) of western Idaho.

GROUP: D-Undiff MATERIAL: Massive Quartz
MATERIAL COLOUR: Clear - White (N 8.75/ - N 9.5/) Occasional tinges of other colours such as Pink, Yellow, Black
TEXTURE: Vitreous
LUSTER: Vitreous
TRANSLUCENCY: Highly Translucent
FRACTURE: Uneven
QUIGG (1981) GROUP CATEGORY(S): 1A
KNOWN SOURCES/COMMENTS: Possible sources include quarries in southern British Columbia (Bussey 1977) and Montana (Reeves personal communication; Loveseth 1980). Similar materials have been widely observed in the form of unmodified cobbles in river gravels and glacial till deposits.

GROUP: E-1 MATERIAL: Brown Chalcedony
TEXTURE: Very fined grained
LUSTER: Vitreous
TRANSLUCENCY: Moderate to High
FRACTURE: Concoidal to Even
OTHER ATTRIBUTES: Several specimens have limited areas of milky white patina with unpatinated dark surface elsewhere on specimen. The white patina over the dark yellow-red surface give the specimens a bluish cast.
QUIGG (1981) GROUP CATEGORY(S): 5M
SIMILAR LITHIC GROUPS: E-2
KNOWN SOURCES/COMMENTS: This material is commonly referred to as Knife River Flint or brown chalcedony. Although the majority of E-1 specimens are probably

from the Knife River Quarry located in North Dakota, material from other sources but essentially identical to Knife River Flint are known to occur in other contexts and are undoubtedly partially encompassed here.
Although Knife River Flint is generally recognized as a petrified peat, specimens included here show no evidence of fossil plant material.

GROUP: E-2 MATERIAL: Patinated Brown Chalcedony
MATERIAL COLOUR: Primary colour: White (N 8.75/ - N 9.5/) with underlying Dark Yellow Red (5 YR 5/6) showing through in areas creating a "bluish" cast.
TEXTURE: Very Fine Grained
LUSTER: Predominantly Vitreous: More rarely Dull
TRANSLUCENCY: Opaque to Slightly Translucent
FRACTURE: Concoidal to Even
QUIGG (1981) CATEGORY(S): None
SIMILAR LITHIC GROUPS: E-1; E-3
KNOWN SOURCES/COMMENTS: Group E-2 specimens are largely to totally patinated with underlying dark-yellow red showing lightly throughout in 1) a small limited area or 2) where the specimen has been recently fractured. The material is believed to be a patinated variety of group E-1. Although the majority probably are "Knife River Flint", several specimens exhibit features more characteristic of what are referred to here as "Montana Cherts". In particular, one specimen has a vug partially infilled with drusy quartz which is characteristic of Montana Chert but not Knife River Flint.

GROUP E-3: MATERIAL: "Avon" Chert
MATERIAL COLOUR: Primary: White(N 8.75/ - N 9.5/) to Light Gray (N 6.75/ - N 8.25) patinated surface; Secondary: Medium Yellow Red (10 YR 9/2) in localized areas
TEXTURE: Very Fine Grained
LUSTER: Largely Dull; Rarely Vitreous
TRANSLUCENCY: Opaque
FRACTURE: Even
QUIGG (1981) GROUP CATEGORY(S): 5E Occasionally 5B
SIMILAR LITHIC GROUPS: E-2
KNOWN SOURCES/COMMENTS: Group E-3 consists of totally patinated specimens differentiated from E-2 specimens by the absence of a "bluish" tint. Several specimens show limited underlying surface referable to E-2 materials. A few specimens reflect colour and luster characteristics which the writer was taught were typical of classic "Avon Chert" from quarries near Missoula, Montana.

GROUP: E-4 MATERIAL: Opaque Yellow Chert
MATERIAL COLOR: Primary: Dark Yellow Red (2.5 YR 5/6) Medium Yellow Red (7.5 YR 7/8); Light Yellow Red (10 YR 7/6); Dark Gray to Black, Dark Yellow (5 Y 4/2)
TEXTURE: Very Fine Grained
LUSTER: Vitreous
TRANSLUCENCY: Opaque
FRACTURE: Concoidal to Even
OTHER ATTRIBUTES: Solid and mottled colors are both present; dendrites common. Irregular vugs with or without drusy quartz occasionally present. Sub parallel banding present on a few specimens.
QUIGG (1981) GROUP CATEGORY (S): 5I, 5K, 5L, 5N, 5P
KNOWN SOURCES/COMMENTS: This category encompasses the opaque varieties of what I am calling Montana Cherts. Although the color variation is broad, in a large collection of specimens transitional stages through the various color varieties can be found.

GROUP: E-5 MATERIAL: Patinated Yellow Chert/Chalcedony
MATERIAL COLOR: Primary: Medium to Light Yellow (5Y 8/8)
TEXTURE: Very Fine Grained
LUSTER: Vitreous
TRANSLUCENCY: Opaque
FRACTURE: Concoidal to Even
OTHER ATTRIBUTES: None
SIMILAR LITHIC GROUPS: E-3 & E-4
KNOWN SOURCES/COMMENTS: Group E-5 apparently reflects patinated varieties of "Montana Cherts". On a few specimens, where recent damage has broken through the patina, materials closely referable to Group E-4 are visible. This patinated group is discernable from E-2 in the absence of a "blue" cast. E-5 is similar to E-3 specimens but is distinctly more yellow.

GROUP: E-6 MATERIAL: Yellow Chalcedony
MATERIAL COLOR: Primary: Medium Yellow Red (10 YR 7/8); Light Yellow Red (2.5 YR 7/4)
TEXTURE: Fine Grained
LUSTER: Vitreous
TRANSLUCENCY: Slight to Moderate
FRACTURE: Concoidal to Even
OTHER ATTRIBUTES: Dendrites and banding common
SIMILAR LITHIC GROUPS: E-4, E-7
KNOWN SOURCES/COMMENTS: This is a slightly translucent variety of material

most of which is probably identifiable as "Montana Cherts". Color, texture and other characteristics are very similar to E-4 specimens with the exception that these materials are slightly to moderately translucent. E-7 are similar but do not have dendrites, are more translucent, clear, white, or dark gray in color.

GROUP: E-7 MATERIAL: White to Gray-brown Chalcedony

MATERIAL COLOR: Primary: White (N 8.75/-N9.5/), Clear, Dark Gray (N 2.75-N4.25), some Mottled Browns (5 YR 4/2)
TEXTURE: Very Fine Grained
LUSTER: Vitreous
TRANSLUCENCY: Slightly to Moderately Translucent
FRACTURE: Concoidal to Even
OTHER ATTRIBUTES: Banding, dendrites common. Percussion marks common on cortex surface.
SIMILAR LITHIC GROUPS: E-6
KNOWN SOURCES/COMMENTS: This material is similar to E-6 types but lacks the yellow color. Similar materials have been observed in "Montana Chert" quarry sources. As well, many of the specimens exhibit dendrites and banding characteristic of "Montana Agate". Similar materials also occur as lag gravels flanking the Little Snowies. Some of the specimens show the "sugary" texture typical of finer quality Etherington Chert from southern Alberta- the mottled dark gray and brown.

GROUP: E-8 MATERIAL: Red Chalcedony

MATERIAL COLOR: Primary: Dark Red (2.5 R 4/8), Medium Red (2.5 R 6/8). Secondary: Medium Yellow (10YR 8/8)
TEXTURE: Very Fine Grained
LUSTER: Vitreous
TRANSLUCENCY: Generally Opaque to Slightly Translucent
FRACTURE: Even to Concoidal
OTHER ATTRIBUTES: Dendrites common along with red and yellow mottling.
SIMILAR LITHIC GROUPS: E-9 is similar in that the primary color is red. E-9 is always opaque, however does not contain dendrites, and is generally solidred with little or no yellow mottling.
KNOWN SOURCES/COMMENTS: E-8 materials clearly appear to be a variety of Montana Chert, although some finer quality Etherington Chert specimens also fit this group.

GROUP: E-9 MATERIAL: Opaque Red Chert
MATERIAL COLOR: Primary: Dark Red (5 R 4/6). Secondary: None
TEXTURE: Very Fine Grained
LUSTER: Vitreous
TRANSLUCENCY: Opaque
FRACTURE: Even
OTHER ATTRIBUTES: No dendrites; mottling or banding limited or faint.
SIMILAR LITHIC GROUPS: Group E-9 is similar to E-8 in color. However, E-9 lacks dendrites, is always opaque, and contains little or no yellow mottling.
KNOWN SOURCES/ COMMENTS: E-9 materials may in part be a variety of Montana Chert. However, essentially identical varieties have been found near Grass Range in lag gravels, apparently derived from the Little Snowy Mountains.

GROUP: E-10 MATERIAL: Mottled Chalcedony/Quartzite
MATERIAL COLOR: Primary: Light Medium to Dark Yellow Red (2.5 YR 6/4, 7.5 YR 5/2, 10 YR 7/2;7/6; 6/6; 8/1) Secondary: Neutral Light and Medium Gray (N 4.75/-N 8.25/) and Red (10 R 5/10)
TEXTURE: Fine Grained
LUSTER: Vitreous to Dull
TRANSLUCENCY: Opaque
FRACTURE: Even to Concoidal
OTHER ATTRIBUTES: Banding in some specimens
QUIGG (1981) GROUP CATEGORY (S): None
SIMILAR LITHIC GROUPS: Similar to fine grained quartzites (B-2) but has more mottled colors, and grades into Chert-like texture. Some individual grains visible but most are not.

GROUP: E-11 MATERIAL: Black Chert
MATERIAL COLOR: Primary: Dark Gray (N 2.75/-N4.5/) to Dark Gray-Black (N 2.5/). Secondary: Some Medium Yellow Red (5 YR 7/2)
TEXTURE: Fine Grained
LUSTER: Dull to Resinous
TRANSLUCENCY: Opaque
FRACTURE: Even to Concoidal
OTHER ATTRIBUTES: Slight evidence of banding.
QUIGG (1981) GROUP CATEGORY (S): 5R
SIMILAR LITHIC GROUPS: Silicified siltstone (J-1) has duller luster, slightly coarser texture. Banded black Chert (E-19) is identical except for clearly defined banding.
KNOWN SOURCES/ COMMENTS: While the majority of specimens are probably chert, this groups also contains basalts, mudstones and siltstones which are virtually

indistinguishable in hand specimen. Some of these materials are derived from pebble sources and other are from formations such as the Banff Formation of the lower Mississippian.

GROUP: E-12 MATERIAL: Mottled Chert
MATERIAL COLOR: Heavily Mottled-mixture of Medium to Dark Grays (N 4/ to N 8/), Medium Red (5 R 3/4 to 6/4), Dark Yellow Red (10 YR 4/2 to 9/2), Dark Blue Green (10 BG 5/1 to 7/1), Medium Blue (7.5 B 4/4), Dark Blue (10 B 5/2) and Dark Red Purple (10 RP 4/4 to 5/2).
TEXTURE: Fine Grained to Medium
LUSTER: Vitreous to Dull
TRANSLUCENCY: Opaque to Slightly Translucent
FRACTURE: Even to Uneven
OTHER ATTRIBUTES: Wide range of colors in individual specimens. Many specimens have distinctive " sugary" texture- uneven breakage leaves small milky fish scale-like scars. Fossil remnants and drusy quartz replacement infillings are common (Loveseth 1980).
QUIGG (1981) GROUP CATEGORY (S): N/A
SIMILAR LITHIC GROUPS: Petrified peat (E-13) shows similar texture and fracture characteristics but tends to have less color mottling and contains remnant banding. Some specimens of "Swan River" Chert (E-15) have similar mottled colors but have more vitreous luster and more even fracture.
KNOWN SOURCES/COMMENTS: Many of the specimens belong to the material commonly called "Etherington". However, visually similar and indistinguishable, specimens are also derived from the Bear Paw Chert quarry (24BL1184) in the Bear Paw Mountains of northern Montana. Several "Etherington" quarry sites have been identified in the Livingstone Range (Loveseth 1976) and the name is derived from the Etherington members of the Rocky Mountain Formation. The material occurs as nodules or in thin beds (20-30 cm thick) in a limestone or dolomite matrix (Loveseth 1976, 1980).

GROUP: E-13 MATERIAL: Petrified Peat
MATERIAL COLOR: Primary: Medium (7.5 YR 3/2; 8/2) to Dark (10 YR 2.5/1) Yellow Red. Secondary: Mottled Dark Gray N 3.25/
TEXTURE: Fine grained
LUSTER: Vitreous to Dull
TRANSLUCENCY: Opaque
FRACTURE: Uneven
OTHER ATTRIBUTES: Clear evidence of banding and organic structure.
KNOWN SOURCES/COMMENTS: Relatively common in till and gravel deposits in the plains of northern Montana and southern Alberta and Saskatchewan.

GROUP: E-14 MATERIAL: Petrified Wood
MATERIAL COLOR: Primary: Medium (5 YR 8/2) to Dark (10 YR 2.5/1) Yellow Red. Secondary: Dark Gray N 3.5/ to N 7/ and Dark Red (5R 4/4) bands.
TEXTURE: Fine Grained
LUSTER: Vitreous to Dull
TRANSLUCENCY: Opaque to Slightly Translucent
FRACTURE: Even to Uneven
OTHER ATTRIBUTES: Clear banding tending to platy layers at replacement materials.
QUIGG (1981) GROUP CATERGORY (S): 4a, 4b
KNOWN SOURCES/ COMMENTS: Relatively common in till and gravel deposits throughout northern Montana and southern Alberta and Saskatchewan.

GROUP: E-15 MATERIAL: "Swan River" Chert
MATERIAL COLOR: Primary: White-Light Gray (N8.5/) to Medium Gray (N 4.75/ -N 6.25) as well as Dark red (10 R 6/6) to Medium Yellow (5 Y 9/2); Secondary; White (N 8.75/ - N 9.5/) and Medium Yellow red (5 YR 9/1).
TEXTURE: Fine to Very Fine Grained
LUSTER: Vitreous to Dull
TRANSLUCENCY: Slightly to Moderately Translucent
FRACTURE: Even to Uneven
OTHER ATTRIBUTES: Common microfossil inclusions
QUIGG (1981) GROUP CATEGORY (S): 5a, 5b
KNOWN SOURCES/COMMENTS: Sources of this material are known in outcrops from the Swan River valley in Manitoba, but it also occurs in gravel and glacial deposits throughout southern Alberta and Saskatchewan, possibly northern Montana.

GROUP: E-16 MATERIAL: Green Chert
MATERIAL COLOR: Primary: Medium-Dark Green (5 G 2.5/2-5/1), Dark Green Yellow (7.5 GY 5/2 -10 GY 5/2), Medium Yellow (7.5 Y 5/4); Secondary: None
TEXTURE: Fine Grained
LUSTER: Resinous to Dull
TRANSLUCENCY: Primarily Opaque
FRACTURE: Even
OTHER ATTRIBUTES: A distinct category due to its green color.
QUIGG (1981) GROUP CATEGORY (S): 5Q

GROUP: E-17 MATERIAL: Miscellaneous Cherts
MATERIAL COLOR: Varied, Predominantly Medium Gray (N 4.75/ - N 6.25/) Medium Yellow Reds (YR) and Red Purples. Many Mottled Specimens
TEXTURE: Fine Grained

LUSTER: Dull to Resinous
TRANSLUCENCY : Opaque to Slightly Translucent
FRACTURE: Even
OTHER ATTRIBUTES: A wide variety of specimens in this category. Each exhibit characteristics that preclude it from being included in other defined categories.

GROUP: E-18 MATERIAL: "Top of the World" Chert
MATERIAL COLOR: White, Light to Dark Gray (N2/ to N 9/) some with slight bluish tinge (10B 8/10). (Loveseth 1988)
TEXTURE: Very Fine Grained
LUSTER: Vitreous to Resinous
TRANSLUCENCY: Opaque to Moderately Translucent
FRACTURE: Concoidal to Even
OTHER ATTRIBUTES: Banded and speckled varieties are common. Microfossils, some completely silicified and others partially replaced by silicas are present in the matrix giving some of the chert a mottled effect (Loveseth 1980).
QUIGG (1981) GROUP CATEGORY(S): 50, 5P
SIMILAR LITHIC GROUPS: Some E-7 specimens similar but lack speckling and tend to have more yellow/brown cast.
KNOWN SOURCES/COMMENTS: Top of the World Chert is named after a high plateau located in the Rocky Mountains of southern British Columbia. Two quarries and several workshops are scattered across the Top of the World plateau at an elevation of 2, 134 m (Loveseth 1980). Potential tool size is limited to a maximum of 8-10 cm in dimension by the highly brecciated nature of the source lenses (Choquette 1981).

GROUP: E-19 MATERIAL: Banded Black Chert
MATERIAL COLOR: Primary: Dark Gray to Black (N 2.25 to N 4.5/). Secondary: Bands of Light to Dark Gray (N 4/ to N 7/); Dark Yellow Red (10 YR 8/2).
TEXTURE: Fine Grained
LUSTER: Dull to Resinous
TRANSLUCENCY: Opaque
FRACTURE: Even to Concoidal
OTHER ATTRIBUTES: Obvious banding, usually less than 1 mm in thickness.
QUIGG (1981) GROUP CATEGORY (S): 11A
SIMILAR LITHIC GROUPS: E-11, J-1
KNOWN SOURCES/COMMENTS: This material grades from a siliceous siltstone to a fairly good quality Chert. Commonly called "Banff Chert" after the lower Mississippian Banff Formation (Loveseth 1980). It is available in outcrops throughout the Rocky Mountains of southern Alberta and northern Montana and probably many other places.

GROUP: F-1 MATERIAL: Porcellanite
MATERIAL COLOR: Primary: Medium to Dark Gray (N4.5/); Secondary: Color Light Yellow (5 Y 8.5/ 4) or Black (N .175/-N 2.25)
TEXTURE: Very Fine Grained
LUSTER: Dull to Vitreous
TRANSLUCENCY: Opaque
FRACTURE: Concoidal
OTHER ATTRIBUTES: Vesicles common, sub parallel bedding or banding present in severed specimens.
QUIGG (1981) GROUP CATEGORY (S): 7B
SIMILAR LITHIC GROUPS: F-2, F-3
KNOWN SOURCES/COMMENTS: Materials in category F-1 are generally a single, solid color. However, occasional irregular inclusions or small segments of cortex will be present of another color. Small, round or irregular, vesicles are common in many specimens and easily discernable with a hand lens.

GROUP: F-2 MATERIAL: Porcellanite
MATERIAL COLOR: Primary: Predominantly Dark Red to Medium Red (10 R 4/4; 4/6; 5/6); Secondary Color: Light Red (5 R 3/2)
TEXTURE: Very Fine Grained
LUSTER: Vitreous to Dull
TRANSLUCENCY: Opaque
FRACTURE: Concoidal to Even
OTHER ATTRIBUTES: Generally single solid color.
QUIGG (1981) GROUP CATEGORY (S): 7C
SIMILAR LITHIC GROUPS: F-1
KNOWN SOURCES/COMMENTS: Generally more vitreous and with fewer vesicles than F-1. Also, evidence of banding or sub parallel bedding rare. Small pieces are easily confused with similarly colored and textured cherts. One fairly distinguishing characteristic seems to be luster, which is generally more dull in F-2 than in the cherts. As well, the cherts more often exhibit slight variation in color, while F-2 specimens are generally very color consistent across their surface.

GROUP: G-1 MATERIAL: Natural Glass - obsidian
MATERIAL COLOR: Bblack (N 1.75/ - N 2.25).
TEXTURE: Vitreous
LUSTER: Vitreous
TRANSLUCENCY: Opaque to Highly Translucent
FRACTURE: Concoidal
QUIGG (1981) GROUP CATEGORY (S): 8
SIMILAR LITHIC GROUPS: None. Very distinctive material. Only similar to other

groups of natural glass.

GROUP: Undiff MATERIAL: Limestone
MATERIAL COLOR: Light to Medium Gray (N 4.5/ to N9/).
TEXTURE: Fine to medium
LUSTER: Dull
TRANSLUCENCY: Opaque
FRACTURE: Even
OTHER ATTRIBUTES: Often has visible fossils. Reacts with dilute HCl.
SIMILAR LITHIC GROUPS; L-1, dolomite, differs from limestone by absence of reaction with Hcl.

GROUP: I-Undiff MATERIAL: Dolomite
TEXTURE: Fine to Medium
LUSTER: Dull
TRANSLUCENCY: Opaque
FRACTURE: Even
SIMILAR LITHIC GROUPS: H-1
KNOWN SOURCES/COMMENTS: Dolomite

GROUP: J-Undiff MATERIAL: Silicified Siltstone
MATERIAL COLOR: Primary: 1) Interior - Medium (N 4.75/- N 6.25/) to Dark (N 2.75/ - 4.25/) Gray; 2) Patinated Exterior- Dark Yellow Red (10 YR 5/2-10 YR 8/2) with occasional patches of Medium Red (5 R 3/4) and Medium Green (5 G 5/2); Secondary: None
TEXTURE: Fine Grained
LUSTER: Dull
TRANSLUCENCY: Opaque
FRACTURE: Even
OTHER ATTRIBUTES: Interior is a uniform color, exteriors show a range of colors. Microfossil inclusions and root bleached patination are common.
SIMILAR LITHIC GROUPS: Black Chert (E-11) and Banded Black Chert (E-19) are similar in basic color and are distinguished by slightly brighter luster.
KNOWN SOURCES/COMMENTS: This group probably also contains chert, basalts and mudstones which are virtually indistinguishable in hand specimen. The siltstones are known to occur in the Banff Formation throughout the Rocky Mountains of Alberta and Montana. A very high quality silicified siltstone quarry has been identified near Creston, British Columbia (Choquette 1974). Pebbles and cobbles of siltstone occur throughout the drainages of the Rocky Mountains.