An Overview of Vitrophyre Use in North Central Idaho:
12,000 Years of Rock Knockin' on the Lochsa

A Thesis
Presented in Partial Fulfillment of the Requirements for the
Degree of Masters of Arts
with a
Major in Anthropology
in the
College of Graduate Studies
University of Idaho
by
Jordan J. Thompson

Approved by:
Major Professor: Mark Warner, Ph.D.
Co-Committee Chair: Robert Lee Sappington, Ph.D.
Committee Member: Rachel Horowitz, Ph.D.
Department Administrator: Brian Wolf, Ph.D.

May 2022

Abstract

Archaeological investigations in the 1990s defined the Clearwater River region of the southern Columbia Plateau as a unique cultural and archaeological entity, though it remains poorly understood. The Nez Perce have occupied this portion of north central Idaho since time immemorial. Excavations throughout ancestral Nez Perce country have revealed vitrophyre in at least 19 key sites dating back 12,000 years. Vitrophyre is a natural igneous glass, formed of pyroclastic flow deposits containing large-grain phenocrysts of ash and pumice. Much like obsidian, vitrophyre creates sharp cutting edges for tool production and retains a chemical signature that can be traced to a geographical point of origin. A combination of geochemical analysis, lithic analysis, and experimentation have provided an overview of this understudied resource and its uses. By comparing two known vitrophyre sources with archaeological samples through an ecological foraging model, vitrophyre use reflects both embedded procurement strategies and territorial restrictions of different groups since the initial occupation of the Clearwater River region. The results of the analysis, in tandem with ethnographic data, suggest a strong connection of the inhabitants of the Clearwater River region with Salish groups of the Bitterroot and Plains regions to the east.

Acknowledgments

I express by deepest gratitude to the Nez Perce Tribal Executive Committee for sharing their cultural heritage with me and granting the permission to pursue this research project.

The completion of this thesis is owed to the support and dedication of my committee members. Without the legacy of Dr. Robert Lee Sappington’s work in the region, I would not have had such a solid foundation on which to build this research. Thank you to Dr. Rachel Horowitz at the Washington State University Lithics Laboratory for assisting me with my analysis and for continued mentorship and inspiration. Dr. Mark Warner’s support has kept this project on track and the goals within sight.

I acknowledge the support of the agencies and institution that have made this project possible including the Nez Perce-Clearwater and Bitterroot-Lolo National Forests, the Army Corps of Engineers, Leah Evans-Janke at the Alfred W. Bowers Laboratory, and Kristine Leier at the Nez Perce National Historic Park, for generously allowing me to include these collections in this research. A special thank you to Garrett Toombs for lending his expertise to the experimental component of this research.

Finally, I thank my friends and family for their support and encouragement throughout this journey. An especially heartfelt thank you goes to my dog Data, for her dutiful field work, energy, and companionship during the process, and reminding me to have fun.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Lithic artifacts in north central Idaho are dominated by chert, quartz, and fine-grained metamorphic river cobbles with occasional obsidian sourced from great distances. Since high-quality lithic material for stone tool production is scarce in this region, suitable local materials, such as vitrophyre, are an important resource. Vitrophyre occurs in small, but consistent quantities in the archaeological record across north central Idaho. Vitrophyre is an extrusive igneous glass with porphyritic inclusions that is a form of ignimbrite. Ignimbrites are pyroclastic flow deposits that contain large-grain phenocrysts of ash and pumice that become cemented (USGS 2021). As a highly rhyolitic formation, the viscous material cools rapidly and becomes glassy. Much like obsidian, this material fractures in predictable ways, creating sharp cutting edges for stone tools, and contains a unique chemical signature that can be linked to a geographical point of origin, or a parent source.

The Problem

Vitrophyre was first identified in an archaeological context in the Clearwater River drainage of the southern Columbia Plateau in 1977, used to produce everything from formal, temporally diagnostic projectile points to blanks and preforms, cores, and modified flakes (Knudson and Sappington 1977). Previous research has identified at least two local vitrophyre sources in the region, one along the Lochsa River in Idaho and another just across the Montana border, near Montana Creek (Keating et al. 1996c; Munger 1993; Skinner and Thatcher 2013s, 2013b). Vitrophyre has been noted in many subsequent archaeological reports within the region yet remains understudied as a material resource in the Clearwater River region.

In 1994, Robert Lee Sappington identified the Clearwater River region as a unique cultural and archaeological entity; however, there has been little research devoted to understanding the connection between sites in the region since then. While there is a significant amount of ethnographic data, the lifeways of the distant past remain poorly understood. As the only local material that can be geochemically sourced, a closer examination of vitrophyre artifacts and their geographic origin can help to draw connection between sites within Clearwater drainage to make inferences about mobility, land and resource usage, seasonality, trade, and can be useful in understanding the lives and decisions of the people that lived in the region over the last 12,000 years.

The Objective

This thesis provides an overview of vitrophyre as a lithic resource in the Clearwater River region through a multipoint analysis and offers a characterization of the material through time and across space. A combination of lithic attribute analysis, geochemical analysis, and experimentation are applied to establish an overview of this understudied resource and its uses in an archaeological context.

1. Lithic analysis**:** The analysis of tools and debitage is used to reconstruct patterns of lithic technology and human behavior to extrapolate regional and temporal patterns in vitrophyre use and distribution.
2. Geochemical analysis: By comparing the chemical composition of vitrophyre sources at two known locations with artifacts from the archaeological record, we can explore how material is distributed temporally and geographically.
3. Experimental analysis: Experimental replication and analysis with raw vitrophyre samples was conducted to better understand the material character and quality of vitrophyre.

The Research Area

The research area is comprised of the southeastern portion of the Columbia Plateau, which extends from the Bitterroot Divide to where the Clearwater River merges with the Snake River and includes several major tributaries; the North Fork, the Lochsa, the Middle Fork, the Selway, and the South Fork. The Nez Perce, or *Nimiipuu* – meaning "The Real People" (Slickpoo and Walker 1973:1), have had an established presence in the Clearwater River region as long as people have occupied the river valley, at least 12,000 years, demonstrated through oral history, ethnographic documentation, and archaeological evidence. Today, the Nez Perce Reservation spans roughly 77,000 acres within Lewis, Nez Perce, and Idaho Counties (nezperce.org 2021).

A sample of 19 archaeological sites within the Clearwater River region known to contain vitrophyre artifacts were examined during this research. The sites represent an example of deep time occupations, ranging from 12,000 to 200 years before present (BP), including permanent winter villages, hunting and fishing camps, upland base camps, and lithic production areas that are geographically dispersed among the Clearwater tributaries.

Theoretical Framework

Lithic studies that draw on a cultural ecology approach provide a useful framework for thinking about artifact assemblages as functional materials that reflect some aspects of subsistence, settlement, and mobility over time. Building on these perspectives, this research expands the breadth of interpretation of material culture by incorporating concepts of perception, social networks, and indigenous place names into an ecological foraging model. This approach not only addresses how people interacted with their environments, but also how they interpreted these materials and landscapes.

Organization

The remainder of this thesis is organized into seven chapters. Chapter 2 begins with a physical description of the Clearwater River region and its place in the southern Columbia Plateau. A brief history of the paleoclimate for the confirmed time of human occupation in the southern Columbia Plateau (16,000 BP to present) is given. The chapter goes on to cover the geology of the region, focusing on lithic materials available for toolstone. Finally, a detailed description of vitrophyre is provided, along with a background of archaeological documentation.

Chapter 3 covers the cultural setting and previous archaeology of the region. Situating the research area within the southern Columbia Plateau, the chapter begins with an overview of the cultural groups in the region and their connections to one another. Next, a review of ethnographic documentation and archaeological resources notes what is known about Nez Perce subsistence and settlement patterns. This archaeological data is the foundation for the regional cultural chronology as defined by Leonhardy and Rice (1970) and refined by Sappington (1994). Finally, a description of each archaeological site referenced in the study provides a background for analysis and interpretation.

Chapter 4 builds the theoretical template used for analysis and interpretation. First, how interpretations are derived for lithic tools and debitage analysis. Second, how provenience studies outline the interpretation of geochemical data. The rest of the chapter discusses how cultural ecology and indigenous social networks in the region inform the interpretation of data for this research.

Chapter 5 explains the methods of field and laboratory work including lithic analysis and portable x-ray fluorescence (pXRF), followed by methodological limitations. Chapter 6 presents the data and results of both the lithic and pXRF analysis and discusses the distribution of vitrophyre through time and across space. Chapter 7 introduces the experimental component and provides a synthesized characterization of vitrophyre as a lithic resource. Finally, Chapter 8 discusses the results and interpretations of the study and offers recommendations for future work.

Chapter 2: Biophysical Environment

The research area is situated in the southern Columbia Plateau which represents a diverse biophysical environment (Figure 2.1). It is important to note how the variability in climate, topography, geology, vegetation, and fauna across this region would have impacted the lives of people living in the region and represented ecological niche boundaries between groups. This section will define the parameters of the research area, provide a physical description of it, and summarize the paleoclimate through the time of occupation defined in the study, 12,000–200 BP. Because this research focuses on lithic resources, a more detailed account of the local geology and available lithic materials is given. Finally, vitrophyre is examined as geologic and archaeological material.

Figure 2.1 The southern Columbia Plateau, depicting original Nez Perce territory (shaded green) and the present-day reservation (shaded dark green). Adapted from the Columbia River Inter-Tribal Fish Commission (https://critfc.org/member-tribes-overview/nez-perce-tribe/).

The Southern Columbia Plateau

The southern Columbia Plateau consists of a large basin bound by gradually rising mountains on all sides. The Clearwater, Snake, and Columbia Rivers cut through the rolling hills of the basin creating steep valley drainages and narrow alpine zones to the east, formed in the Bitterroot and Northern Rocky Mountain Ranges. The research area is comprised of two physiographic provinces including the Northern Rocky Maintains on the eastern boundary and the Columbia Plateau to the west where the Clearwater River merges with the Snake River (Stapp et al. 1984:3; Figure 2.2).

Snow is channeled into the primary tributaries, the North Fork, the Lochsa, the Middle Fork, the Selway, and the South Fork Rivers that drain west into the Clearwater River and into the Plateau region. West of Lewiston, Idaho, the Clearwater flows into the Snake River heading toward the coast. The Clearwater drainage basin covers 9645 square miles (mi) and contains more than 156 kilometers (km) (97 mi) of river (Nez Perce Tribal Wildlife Division 2003). The topographically diverse landscape ranges in elevation from 225 meters (m) (740 feet [ft]) at the mouth of the Clearwater to 2700 m (8800 ft) in the peaks of the Bitterroot Mountains (Stapp et al. 1984:3).

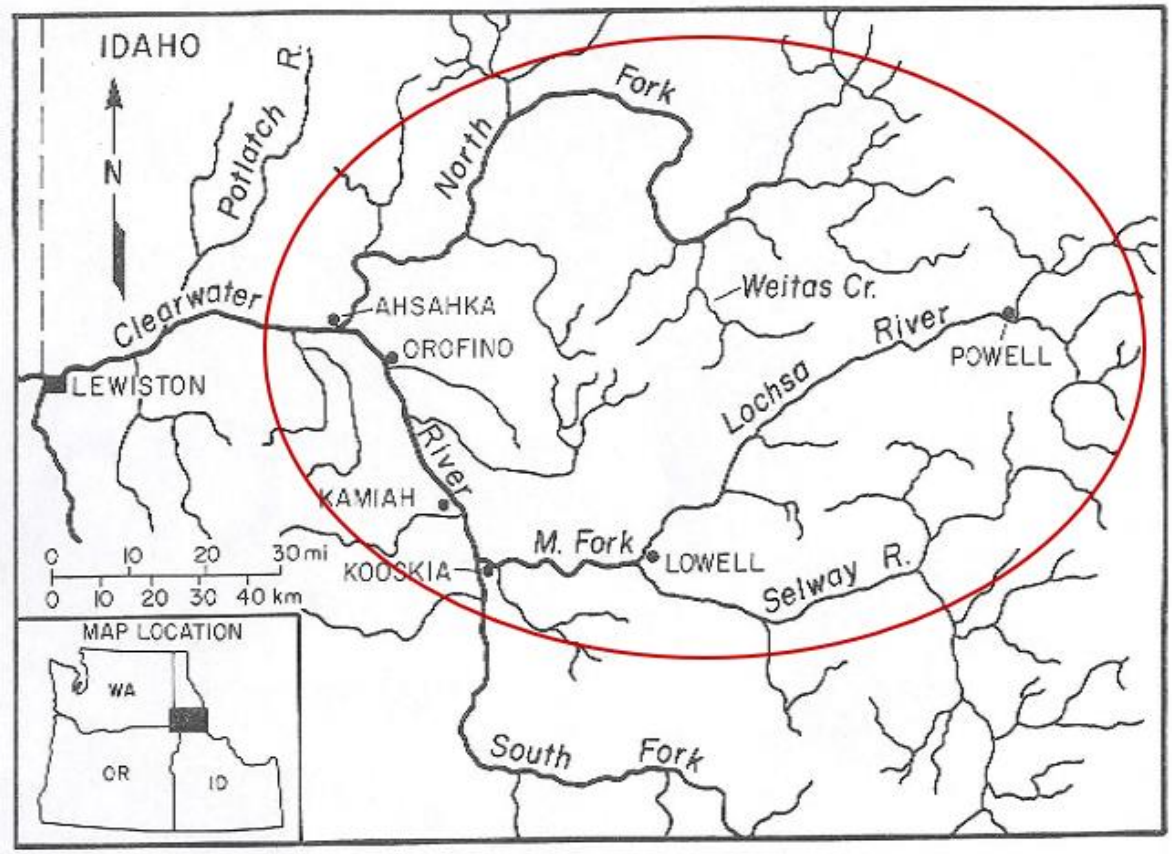


Figure 2.2 Map of the research area in the Clearwater River region.

Paleoclimate

In both the Clearwater and Bitterroot regions, people would have made extensive use of the uplands in the late summer with low montane zone base camps and winter occupations along the river valley floors (Munger 1993:48). To provide context about the research area, a brief overview of the environmental setting will be discussed, more extensive descriptions of each element can be found elsewhere (Beiswenger 1991; Brunelle et al. 2005; Chadez 2017; Chatters 1995; Davis 2001; Dyke 2005; Mehringer et al. 1977; Stone and Fritz 2006; Walker and Pellatt 2008; Whitlock et al. 2008).

The earliest radiocarbon dated archaeological site in west central Idaho, Cooper's Ferry, located along the Salmon River, suggests that people have occupied this part of the southern Columbia River basin for at least 16,000 years (Davis et al. 2019). The Cooper's Ferry site is a village known ethnographically to the Nez Perce as *Nipéhe*. While there is no tangible evidence of people in the Clearwater region at this time, there were most certainly people adjacent to the region and the local climate would have been hospitable enough for human habitation. Prior to 13,000 BP, the climate would have been influenced by massive ice sheets covering much of northern North America, creating a dry, steppe tundra in the habitable surrounding regions. After this point the climate begins to warm with increasingly wet conditions, gradually developing moraine dammed lakes, alpine meadows, and pine and fir forests, opening more hospitable land.

In the Clearwater River region, a series of radiocarbon dates and lithic assemblages at the Hatwai site (10NP143) have suggested occupations in this part of the Plateau at least as early as 12,430–12,890 BP (Sappington 1994:111). By the early Holocene, 11,000 BP or so, pollen and isotope indicates major climatic shifts, expanding subalpine forest in the mountainous regions, possibly facilitating human occupation in the upland regions of Idaho and Montana (Dyke 2005; Mehringer et al. 1977). Fossil pollen, plant macrofossils, and macroscopic charcoal at four montane and subalpine lakes in the Bitterroot region show continued warming and drying conditions throughout the Holocene (Burnelle et al. 2005). As the conditions continued to warm in the Northwest, drier interior forests and steppe terrain had replaced the subalpine forests in north central Idaho, the Northern Rockies, and eastern Washington by 6000 BP.

Despite the elevation and mountainous valley terrain, the climate is primarily impacted by weather conditions from the Pacific. In the middle Holocene, or Early Precontact period, fossil diatom flora records reveal periods of pervasive and cyclic drought in the Northern Rockies related to Pacific Decadal Oscillations (PDO), an El Niño-like phenomenon caused by shifting sea-surface temperatures (Stone and Fitz 2006). A variety of isotope, charcoal, and lake core data indicate that the Late Precontact period was increasingly dry with decreased winter precipitation and frequent fires interrupted by occasional periods of increased moisture (Mehringer et al. 1977; Prentiss et al. 2005; Whitlock et al. 2008). Near the end of the Altithermal, 2500–1500 BP, the reestablishment of whitebark pine forests may have been the driver of a systematic use of alpine regions in western Montana (Munger 1993:48). By 1700 BP, rainfall patterns in the Columbia Basin resemble modern conditions (Burnelle et al. 2005). Currently the western side of the Northern Rocky Mountains and the Bitterroot Range receives nearly three times the precipitation than the east due to winter snow that blows in from the Gulf of Alaska and Pacific Ocean while receiving less summer rain, creating hot-dry summers and cool-moist winters (Burnelle et al. 2005).

The Clearwater region is incredibly biodiverse and rich with edible plants. It is home to more than 340 species of terrestrial wildlife and supports a population of culturally important plant and aquatic species (discussed further in Chapter 3). Regional vegetation consists of shrub steppe and grasslands at the low elevation center of the basin that progress into coniferous subalpine forests at the mountainous boundaries. Productive, moisture-retaining ash and loess sediments and a mild, moist winter provide the basis for the conifer-dominated subalpine forests consisting of subalpine fir (*Abies lasiocarpa*), grand fir (*Abies grandis*), Engelmann spruce (*Picea engelmannii*), mountain hemlock (*Tsuga mertensiana*), lodgepole pine (*Pinus contorta*), whitebark pine (*Pinus albicaulis*), and Douglas fir (*Pseudotsuga menziesii*).

Geology of North Central Idaho

The majority of the research area lies within the Idaho-Bitterroot Batholith geologic zone which is bordered by the Belt Super Group to the north and the Columbia Plateau geologic zone to the west. The eastern portion of the Idaho-Bitterroot Batholith province is a Cretaceous, deep-rock granite made up of intrusive igneous rock. Magma beneath the earth’s crust, formed by subduction melting, rises to the surface as basaltic andesite magma and cooling into medium grained, felsic granodiorite, and tonalite (Alt and Hyndman 1989; Hyndman 1989). Approximately 150 million years ago, the Pacific Ocean tectonic plate crashed into what is now the Idaho-Montana border, creating the oregonous region of the Rocky Mountains. The granite formations are chemically and minerally homogeneous near the Lochsa River but are cut by numerous swarms of synplutonic complexes of basaltic andesite, andesite, rhyolite, quartz diorite, quartz monzonite, gabbro, and pegmatite dikes, metamorphosed gneiss, and serpentine to the northeast and southwest (idahogeology,org 2021).

Stream and glacial erosion create deep gravel outwashes and glacial till deposits in the valleys between high elevation mountain ridges to the east. At lower elevations to the west, glacial till and sediment collect in long narrow riparian areas forming stream bottoms, terraces, and alluvial fans upon which many Nez Perce villages are built (USFS 2014). Between the mountain ridges and valley bottoms, the rolling foothills and plateaus contain ancient silty, alluvium and Palouse loess periodically interrupted by thousands of years of volcanic activity from Pacific Rim volcanoes, represented in various layers of ash, over the top of a series of basalt flows (USFS 2014). These tephra layers can be useful in stratigraphically dating archaeological sites. Mount Mazama, a particularly significant eruption approximately 6900 years ago, blanketed much of the Northwest in a distinct layer of ash. The presence of Mazama ash on archaeological sites in the region is often used to denote the separation of Early and Late Cascade phase occupations.

Volcanic activity in the Northwest has additional significance to early tool makers, as they can provide lithic raw materials. While there are no sources of obsidian available locally in north central Idaho, regional ignimbrites can be found at multiple locations. In the Clearwater River, regional ignimbrites may be the result of the Lewis and Clark Fault Zone, located just north of the Idaho-Bitterroot Batholiths. Studies of similar fault zones in other regions show the formation of ignimbrites related to transtensional shearing and deformation caused by compression and friction associated with strike-slip fault zones (Bennett 2009). Both the Lochsa and the Montana Creek vitrophyre sources are interestingly situated adjacent to several hot springs associated with tectonic subduction activity along the Bitterroot Range which may relate to the presence of vitrophyre.

In the Bitterroot region, the Rhodes Peak Caldera, remnants of a collapsed volcano formed in the Lolo Batholith, is thought to be the source of vitrophyre in the western Montana region (Munger 1993:8). Welded rhyolitic ignimbrites in the Central Snake River Plain, south of the research area, are thought to be the product of the Yellowstone hotspot (Ellis et al. 2014:431). The presence of homogenous crystal populations and phenocryst composition in the same deposit strongly suggests distinct magma batches during an eruption event in the Snake River region (Ellis et al. 2014:431).

In addition to vitrophyre, local geology offers a variety of alternative lithic materials that have been used for toolstone. It is important to consider the material character and availability of these materials when interpreting procurement-based decision making though an ecological framework.

Regional Toolstone

Though ideal knapping material is rare in north central Idaho, several sources of raw lithic materials are available. Gravel beds along the river corridor offer a wide assortment of secondarily deposited materials transported in by the river systems including metamorphic cobbles. Columbia River Basalt and rhyolite flows were deposited across a large area of the Clearwater River valley from Lewiston down to Riggins. Basalt, a fine-grained crystalline igneous material, was utilized heavily as toolstone during the Cascade phase in the lower Snake River region (Leonhardy and Rice 1970:9).

These basalt flows also provide vacuous spaces such as faults, fractures, and gas bubbles, that allow the formation of hydrothermally precipitated silica materials known as cryptocrystalline (Grisham 2015:29). These materials are known generically as chert, but includes opals, agate, chalcedony, and jasper which can be found opportunistically across the region and tends to dominate the flaked tool assemblages in the region. A source known as "Kamiah Chert" that occurs west of Kooskia, has been noted in many archaeological sites in the region (Sappington and Carley 1987).

Argillite, a metamorphosed sedimentary rock formed of shale and siltstone, is frequently used for toolstone in the region (Andrefsky 1998:58). It occurs in abundance near the Middle Fork, along the Selway, and Lower Lochsa Rivers (Danner 2017; Munger 1993; Sappington 1991:39).

Quartz, formed through uplift of igneous intrusions into silica rich bedrock, is hard with natural cleavage that tends to shatter, making it difficult to knap, has been identified for tool use in the region (Grisham 2015:31). Numerous sources of quartz crystal occur in the region including a source near Craig Mountain west of Cottonwood, Idaho, another at the confluence of Fish Creek and the Lochsa River, another west of the North Fork and Clearwater River confluence, and another is said to be located along the Middle Fork of the Clearwater (Broncheau-McFarland 1992:19; Grisham 2015; Sappington 1988, 1996).

Obsidian, a form of natural igneous glass, is among the most optimal materials for flaked tool production due to its homogenous composition that fractures conchoidally and creates very sharp edges, said to be sharper than surgical steel. No obsidian is available locally in north central Idaho; however, Sappington (1981, 1982, 1984) identified and characterized several sources including the Timber Butte of southern Idaho and Owyhee Mountains sources in southern Oregon, as well as many others across the Pacific Northwest and western United States that would have been available to people in the Clearwater River region though trade and migration. Several obsidian sources are located within 75–275 miles off the research area. Obsidian could have been acquired through trade, though ethnographically, the Nez Perce prized obsidian and traveled great distances to obtain their material directly from the source (Sappington 1984:25). Sappington's (1984:25) investigation of obsidian quarries in southern Idaho showed a lack of evidence for production on site, confirming a direct procurement strategy.

Vitrophyre

Vitrophyre has been identified archaeologically in small but consistent quantities across the region. Vitrophyre is an extrusive igneous glass with porphyritic inclusions that is a form of ignimbrite – or a welded tuff. Ignimbrites are formed of a pyroclastic flow expelled from rhyolitic stratovolcanoes that contains large-grain phenocrysts of ash and pumice that become cemented (USGS 2021). During a volcanic eruption, micro-glass ash particles, pumice, rock, and gas combine into a hot, dense slurry. Heat and compaction cause the larger particles to become welded into a fine-grain, glassy matrix (Allaby and Park 2017). As an ash flow, an eruption can deposit pyroclastics thousands of square miles, however, the higher rhyolite content in vitrophyre will usually form viscous lava that will not travel as far and cools rapidly in place (Sappington 1981). When igneous material cools rapidly, having little time to form large crystals, the texture becomes smooth and glassy which allows it to fracture in predictable ways, obeying conchoidal fracture mechanics. These fracture mechanics are what makes the material easy to control through the knapping process. Vitrophyre is often found in situ in bedded veins or as rounded cobbles within secondary alluvial deposits (Figure 2.3).

Figure 2.3 Example of ignimbrite collected from Montana Creek Location, showing bedded deposits and inclusions (September 2021).

Though vitrophyre is primarily silicone dioxide (SiO_2), 65–85%, as a volcanic product, expelled from compositionally variable reservoirs, it also contains a distinct chemical signature (Ellis et al. 2014). While this can cause chemical heterogeneity among batches, products that are richer in low-temperature cumulates such as quartz, K-feldspars, and/or biotite can melt extensively leading to microsettling or phase separation and the formation of gradationally zoned ignimbrites. These processes may explain variation in pigment and phenocryst populations throughout a single deposition while retaining chemical homogeneity (Ellis et al. 2014:432-433). The formation of gradational zones may also present issues in sourcing, as batches may have chemical variation across smaller geographic ranges within a single source.

Vitrophyre forms a thick, irregular vesicular pumice-like cortex and contains granules of impurities, seams, and other material flaws that can disrupt the force of percussion when detaching flakes during the manufacturing process (Figure 2.4). Vitrophyre from a single source can have a range of visual characteristics with various types and sizes of inclusions and can present in a range of colors (see Chapter 5 for more images).

Figure 2.4 Examples of phenocryst in multiple vitrophyre samples.

The Lochsa source was first reported by the Clearwater National Forest (10IH2500) along the ridge of Sherman Peak (Armstrong 1994, 2006; Keating et al. 1996; Figure 2.5). Over the next few decades vitrophyre was reported at several sites in the Clearwater River region. An extensive multiyear excavation by the University of Idaho Archaeological Field School of a large upland base camp site at the Kelly Fork Work Center (10CW34) between 2010 and 2012 produced a preliminary investigation of obsidian and vitrophyre at the site. Craig E. Skinner and Jennifer J. Thatcher (2013a), of the Northwest Research Obsidian Studies Laboratory, conducted a provenience study of 48 artifacts from 10CW34 using x-ray fluorescence. Their results were the first evidence that vitrophyre artifacts could have been brought in from three to five chemically distinct sources. Skinner and Thatcher (2013b) also conducted a supplementary provenience analysis of 11 vitrophyre artifacts from another four archaeological sites within the research area that show all but one was made from Lochsa vitrophyre.

The Montana Creek vitrophyre source (24MN198), originally named the Fish Creek quarry, was identified by Munger (1993) during a survey of upland camps in the Bitterroot National Forest (Figure 2.5). The source is located along a mountain ridge overlooking Fish Creek. At the location, Munger noted evidence of several dug pits at the crest of the slope with little evidence for onsite reduction (Munger 1993:42). The nodules observed were small and chunky, leading Munger to believe that larger, higher quality subsurface pieces had been removed from the site at some point in the past. Several hunting camp sites were identified during the survey, most of which contained vitrophyre, both as curated and expedient tools. In 2015, the Lolo National Forest revisited the vitrophyre quarry and created an official site record (24MN198) (Schlader 2015). Schlader (2015) described the location as isolated and minimally impacted.

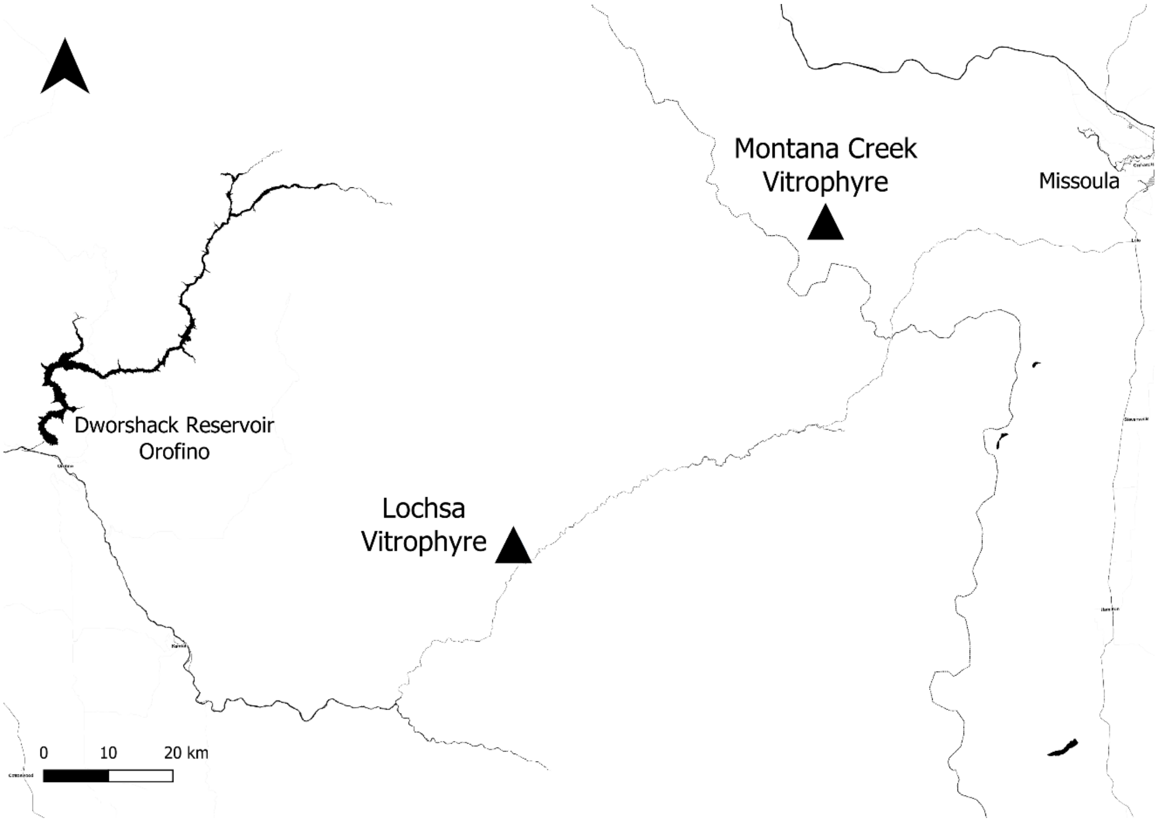


Figure 2.5 Map of known vitrophyre sources examined in the study.

Summary

The Nez Perce and surrounding groups became well adapted to the distinctive and dynamic mountain valley terrain and seasonality of the Plateau by at least 12,000 BP. The region furnished a variety of resources including abundant lithic material to work with. Chert and, to a lesser degree, argillite are the most highly favored materials for flaked tools in the Clearwater River. Among the lesser utilized material, vitrophyre comprises a small but consistent portion of the archaeological record, about 1 to 3 percent. Two known vitrophyre sources, located 70 km (44 mi) apart, have been identified by previous surveys. These sources provide the basis for this research.

Chapter 3: Cultural Setting and Previous Archaeology

Groups occupying the Columbia Plateau speak related languages, have a shared Paleoindian ancestry, and cultural and economic cross over among groups (Aikens 1978; Ames et al. 2010; Jones 2003). People have continuously occupied the Plateau as hunter-gatherers for over 12,000 years, establishing semi-permanent winter villages in the canyons along major river systems and following a seasonal subsistence cycle. Some of the major tribal groups in the region include the Nez Perce Tribe, the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation (Umatilla, Walla Walla, and Cayuse), the Confederated Tribes of the Warm Springs Reservation of Oregon, The Spokane Tribe of Indians, the Coeur d'Alene Tribe, the Palus, and the Confederated Salish and Kootenai Tribes, among others (Chalfant 1974; Slickpoo and Walker 1973:9; Walker 1998).

Several of these groups are linguistically related as part of the Penutian Language family, and they frequently intermarried (Josephy 2007:15). The Nez Perce are part of the Sahaptin language grouping, a descendant of the Penutian superfamily, and would have intermarried with the other Sahaptin speaking groups such as the Yakama, Umatilla, Warm Springs, and Cayuse (Walker 1998:420). Intermarriage with Salish speaking groups such as the Colville, Okanagan, Sinkaietk, Coeur d'Alene, Salish, and Spokane as well as some Great Basin groups also occurred (Anastasio 1985:148). Northern and southern Nez Perce country was subdivided by dialect with the northern groups oriented toward a Great Plains lifestyle (Slickpoo and Walker 1973:29). Despite this interconnectedness, Plateau hunter-gather communities within the region developed considerable diversity in settlement patterns, subsistence strategies, and social organizations (Ames and Marshall 1980; Anastasio 1985; Prentiss 2005; Sappington 1994; Walker 1998). Environmental and ecological diversity in these territories contributes to the cultural diversity and underlies their intergroup dynamic (Anastasio 1985:117).

Since at least 12,000 years ago the Nez Perce have occupied north central Idaho, routinely traveling as far as the Northwest Coast, the Western Plains, and the northern Great Basin (Josephy 2007:2; Longstaff 2013:50; Slickpoo and Walker 1973:24; Figure 3.1).

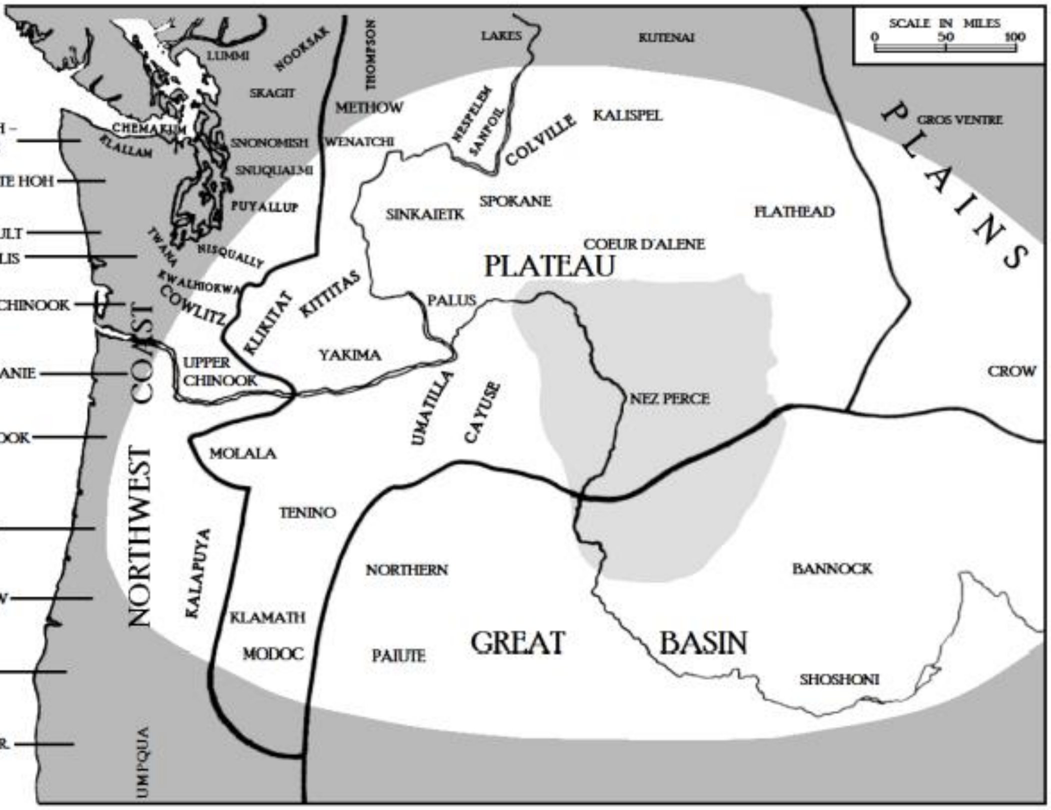


Figure 3.1 Map of Northwest cultural areas with Nez Perce territory (Shaded gray at center) and the regional extent of Nez Perce travel (in white) (Adapted from Longstaff 2013:51, Figure 35).

While indigenous groups of North America did not observe legal or geographical limitations, certain groups dominated geographic regions, although the boundaries were fluid. It should be noted that at the eastern boundary of the research area, the Salish (often documented ethnographically as the “Flathead”) occupied the Bitterroot Divide and the Lochsa River region (Figure 3.2). Both groups would have likely had the territory in common, particularly after the acquisition of horses during the protohistoric period, around 500 BP (Chalfant 1974:108; Munger 1993:11). Ethnographically, a large network of well-traveled routes connected the southern Plateau socially and economically.

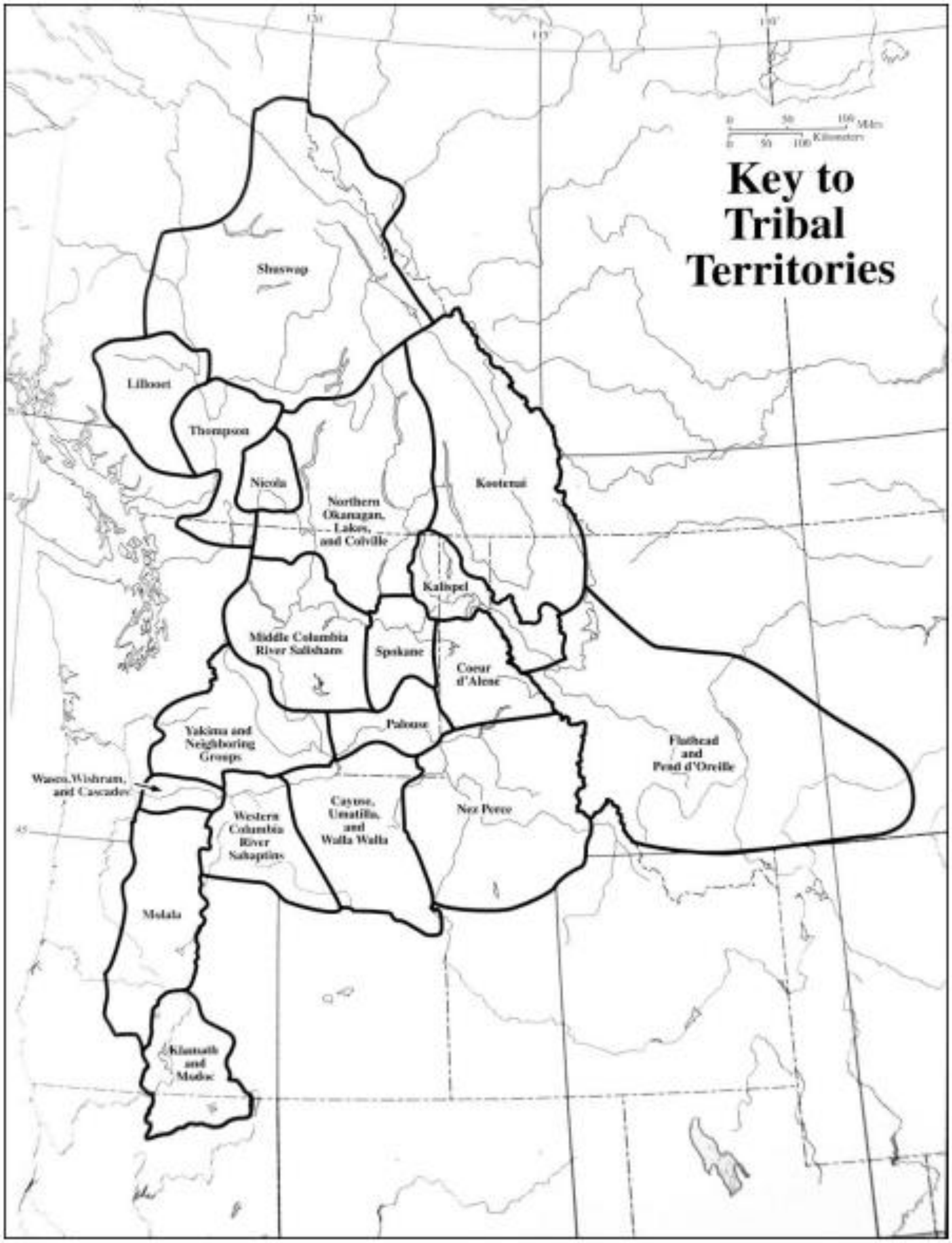


Figure 3.2 Map of tribal territories of the Columbia Plateau (adapted from Walker 1998:ix).

The Lolo, Nee Me Poo, and Wise'isskit trails, positioned along high elevation mountain ridges, were advantageous lookout points and spiritually significant locations that facilitated group interactions across the research area and beyond. The section of the Lolo trail that intersects the research area extends 150 miles from Weippe to Lolo Pass and was well established by the arrival of Lewis and Clark's Corp of Discovery (Broncheau-McFarland 1992:13). The trail system was a major component of the ancestral Nez Perce lifeway, even appearing in some of their origin stories. At least 45 archaeological sites are located along the Nee Me Poo trail including camps, burials, lithic scatters, fishing stations, rock cairns, and peeled trees (Broncheau-McFarland 1992:116). The location of the trail represents an important spiritual place. Rock cairns along the ridge tops represent *Tam-loy* or *Tam-loy yiic max*, meaning "wherein one left a memorial to oneself and found one's old self," a practice in which individuals return to a marked location of significance and place a new stone and recite a prayer or song (Broncheau-McFarland 1992:86).

The Wise'isskit trail, meaning "camping trail," established by at least 8000 BP, was a favored route to southeast prior to the acquisition of horses due to the selection of campsites located one day's walking distance from one another (Schacher 2004:4-5). The trail, also known as the Southern Nez Perce Trail, follows the divide between the Clearwater and Salmon Rivers from present day Grangeville through the mountains into southern Bitterroot Valley in Montana. The Nez Perce used this trail to enter Montana to hunt and trade with tribes in the plain's region, most prominently the Salish people.

These trail systems were regarded as an open highway for intertribal travel, and resident tribes would host traveling tribes crossing through territories, even among enemy groups (Anastasio 1985:175; Shawley 1977:7). The Nez Perce were well connected with tribes in the Yakama and Willamette Valleys, including the Walla Walla, the Palus, and Cayuse, with whom they frequently socialized, fished, and traded (Josephy 2007:15). The Nez Perce would also cross the Bitterroot Mountains along the Lolo or Wise'isskit trails in large parties with the Salish and the Kootenai to hunt buffalo in the spring (Josephy 2007:15; Schacher 2004). The Salish and the Nez Perce would routinely gather in the upper Clearwater during late spring salmon runs (Chalfant 1974:87). Because of their unique location and access to diverse resources, the Nez Perce were optimally positioned economically and politically, eventually becoming one of the most influential groups in the Plateau region.

The Nez Perce are tied to the landscape of the Clearwater River region through their creation story, centered around a landform known as the "Heart of the Monster." They have no migration story and have not been reported to have ever lived anywhere other than north central Idaho. According to their creation story, in the time before people, a great monster was at work consuming the earth and all its creatures. After being swallowed by *Ills-wase-tsit*, the beast, Coyote tore the beast limb to limb from the inside out, tossing the remnants to all corners of the land, freeing the animals, and creating all the people of the world from the flesh of the beast. After recognizing that he had not placed any people in the Clearwater Valley, Coyote washed the blood of the monster's heart from his hands, sprinkling it across the land. From the blood, the *Nimiipuu* emerged, and Coyote said, "they will be few, but they will be strong." The heart and liver of the monster now lives outside modern-day Kamiah, Idaho (Josephy 2007:1; Kirchhoff Smith and Drown 2013; Sappington and Carley 1995:11-12; Stout 2003).

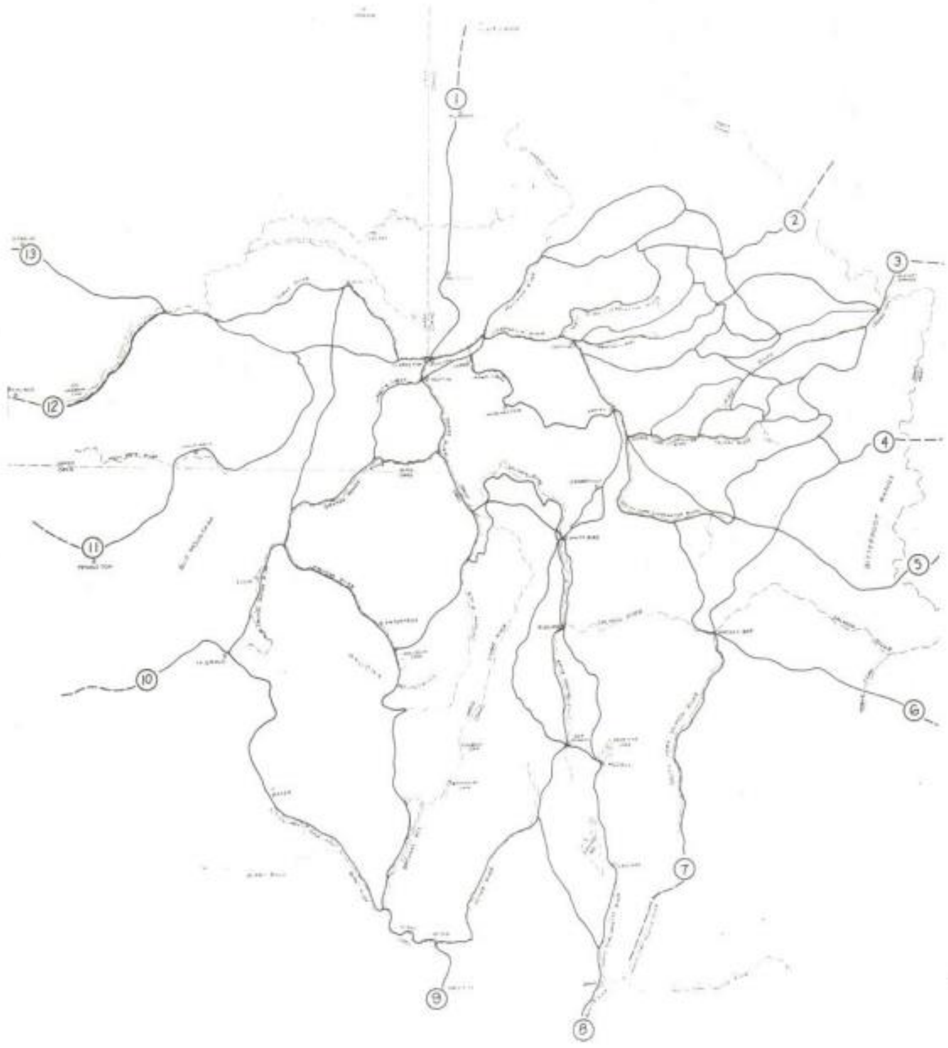


Figure 3.3 Map of Nez Perce territory trail system where 3 references the north passage into the Bitterroots via the Lolo trail and 5 references the southern passage into the Bitterroots via the Wise'isskit tail (adapted from Shawley 1984:6. Map1).

Regional Chronological Sequence

Archaeological investigations of the Clearwater River region have delineated five major cultural periods (Ames and Marshall 1980; Bense 1972; Leonhardy and Rice 1970; Rice 1972; Sappington

1994, 1996). The Early Precontact, the Middle Precontact, the Late Precontact, the Protohistoric, and the Historic period, each characterized by distinct material cultural and patterns of subsistence (Sappington 1994; Figure 3.4). In the Bitterroot region, there is no accepted chronology. Chronologies applied to the region often follow either the Northwestern Plains sequence or Leonhardy and Rice's (1970) chronology developed in the Lower Snake River of southern Idaho (Munger 1993:14). Radiocarbon dates and lithic assemblages from the archaeological sites included in this study show occupations spanning from the Early Precontact into the Historic period.

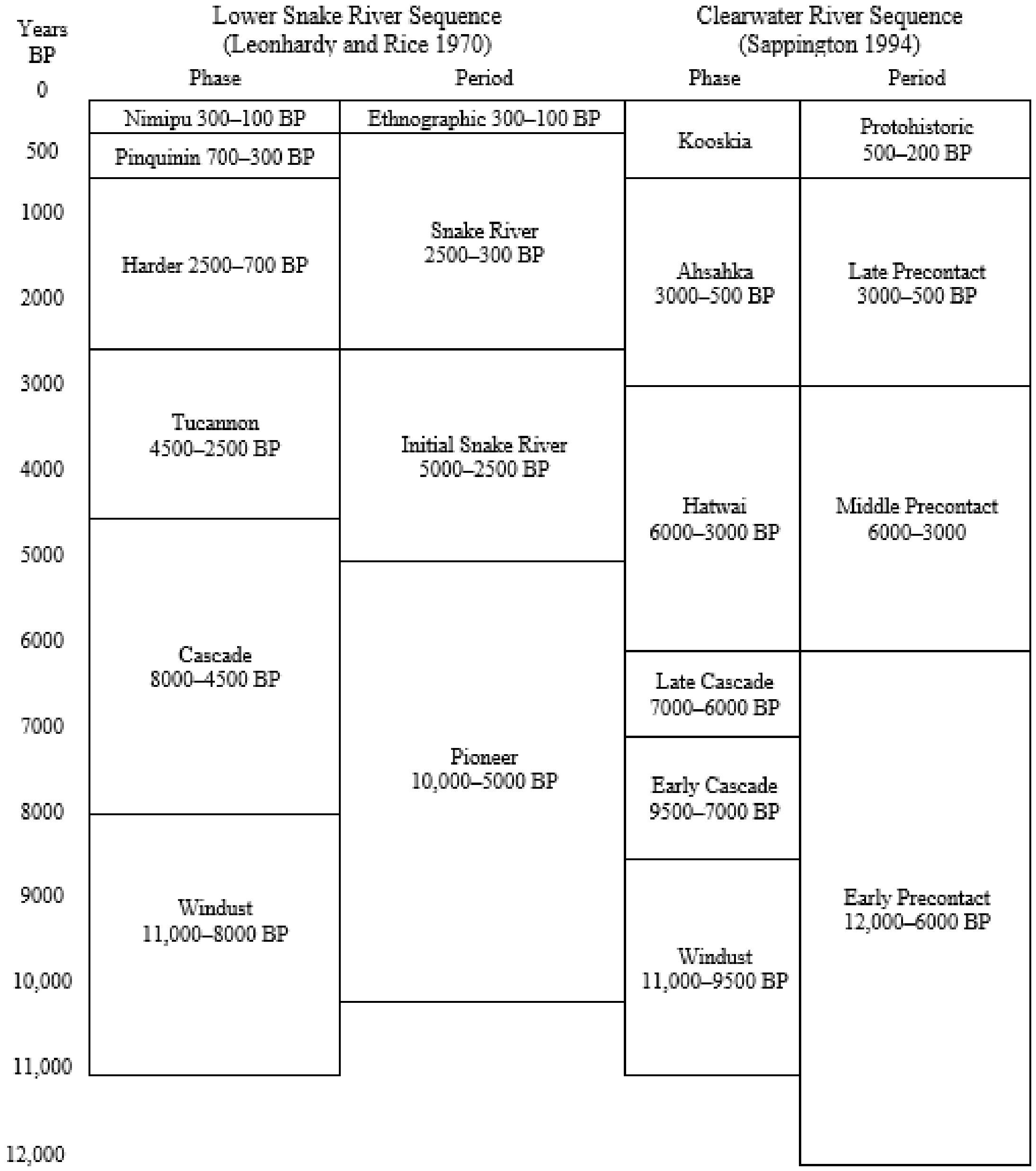


Figure 3.4 Diagram of regional cultural chronology sequence for the lower Snake River (Leonhardy and Rice 1970) and Clearwater River region (Sappington 1994), adapted from Longstaff (2013).

Early Precontact (12,000–6000 BP): This was a period of residential mobility in which a few small communities would relocate seasonally to be near productive resources, practicing seasonal "mapping on foraging" (Binford 1980) with opportunistic hunting. The broad economy focused primarily on upland resources and plant use. Habitation sites were set in open areas near major streams and consisted of many small, ephemeral camps that left behind only traces of hearth features and occupational surfaces. Generally, technology was uniform with expedient tools that show evidence of maintenance and reworking (Sappington 1996:145). Windust tool technology, representing the earliest known occupations in the Clearwater region, developed prior to 12,000 BP and continuing into 8000 BP, at which point stone technology transitioned into the Cascade phase. The Windust and Cascade tools were originally identified in the lower Snake River by Leonhardy and Rice (1970) and appear nearly identical to those found within the Clearwater sites at Hatwai (10IH143), Weitas Creek (10CW30), and Beaver Flat (10IH871) (Sappington 1994:188). In the Bitterroot Mountain region, projectile points are subdivided into the Llano, Folsom, and Plano (Munger 1993:15).

Middle Precontact (6000–3000 BP): As a period of both environmental and cultural transition, the archaeological record remains poorly understood. Economic activities continued to focus on hunting and increased plant processing with limited evidence of fishing, shifting toward a "logistical collecting" strategy (Binford 1980). The characteristic subsistence strategy is defined by Prentiss et al. (2005) as "Classic Collector," wherein residential settlements were places in ecotones with optimal access to a variety of resource patches associated with field camps and procurement sites that included small, linearly oriented, oval pit houses, specialized use areas, and some cache pits (Prentiss et al. 2005). By 4400 BP, possibly as early as 5100 BP, archaeological evidence shows year-round subterranean dwellings near forest boundaries (Ames and Marshall 1980). These changes in settlement are the key element to identifying Middle Precontact sites. The identification of lithic tools is based on the most extensive archaeological investigation in the region dating to the Middle Precontact – Hatwai (10NP143), originally identified by Leonhardy and Rice (1970). The addition of edge-ground cobbles marks the separation between Middle Precontact and Early Precontact sites (Sappington 1994:189).

Late Precontact (3000–500 BP): Archaeological evidence shows gradual population growth, with small group or single-family pit house villages developing along major river systems and increased evidence of processing and storage. Villages were arranged in circular formations with subterranean floors and split pole frames covered in grass and brush mats. The Nez Perce utilized a salmon-oriented, delayed-return economy adapted to the seasonality of the Plateau area. To the east, the Salish did not have the same access to salmon resources and relied heavily upon communal hunting of bison and antelope (Munger 1993: 11). Lithic tool kits shifted toward reliable and easily replaceable tool systems including diverse and delicate projectile points associated with the Harder (Leonhardy and Rice 1970) or Ahsahka phase (Sappington 1994) and the transition to the bow and arrow. In the Bitterroot Mountain region projectile points resemble Northwest Plains Avonlea styles (Munger 1993:15). A sharp increase in reliance on plant processing, particularly of root vegetables, is suggested by the presence of digging sticks, ground stone, and woodworking wedges (Josephy 2007:5; Sappington 1996). The period is also marked by increased diversity of material types used in lithic manufacturing throughout the region (Sappington 1996:323).

Protohistoric Period (500–250 BP): Economic activities resembled those of the Late Precontact with hunting and fishing activities well represented and evidence for minimal plant processing noted though the Historic period. The tool assemblages are associated with the late Harder subphase (Leonhardy and Rice 1970) and the Kooskia phase (Sappington 1994), including a wide variety of small projectile points. Fewer sites are found, likely due to the acquisition of the horse and increased contact with European settlers that resulted in devastating population decline due to disease and conflict as well as considerable changes in lifeways and territories (Sappington 1994:371).

Euromerican fur trappers and missionaries first arrived in the region in the early 1800s and by the mid-1800s prospectors and homesteaders flooded the area, seeking gold and silver and pursuing land offered by the Homestead Act of 1862, which spurred western development of the region (USFS 2001). After a series of treaties continued to reduce Nez Perce territory, the landscape became managed by a patchwork of private and federal entities. Today much of the traditional land of the Nez Perce is owned by federal agencies and managed by the United States Forest Service as the Nez Perce-Clearwater National Forest (USDA 2001). Many domestic, land management, Civilian Conservation Corps, recreational, and other historic developments occurred in the region that will not be discussed in this thesis as the focus is on lifeways prior to European contact.

Cultural Setting

In addition to oral traditions, ethnography, and historical documentation, archaeological investigations corroborate the connection of the Nez Perce to the landscape. Ethnographic accounts begin as far back as 1805 with the Lewis and Clark Corps of Discovery and Alice Fletcher in 1891 (Sappington and Carley 1995). Continued interest in the region through the 1990s provides much of the documented oral and ethnographic history of the region (Schwede 1966, 1970; Slickpoo and Walker 1973; Chalfant 1974; Curtis et al. 1970, 1997; Shawley 1977; Chance and Chance 1987; Walker 1998; Stout 2003).

Settlement and Seasonality

Ethnographic accounts describe historic Nez Perce settlements as villages, *tew?yeni-kes*, or camps, *wi-se-s* (Schwede 1970:129). Villages are often located along important trail routes where trails cross or where important streams meet. Schwede (1970) found that 98% of villages are located below 762 m (2500 ft) and 82% of are located along seventh and eighth order streams. Camps are more widely distributed, with 77% located below 1067 m (3500 ft), though some were noted at elevations as high as 1980 m (6500 ft). Schwede also reported that 75% of villages are located near fishing resources while 48% of camps are located near root or game resources (1970:133).

The Nez Perce traditionally followed seasonal game and plants, utilizing lower canyons resources during the winter and upland resources in the fall and summer (Slickpoo and Walker 1973:30). In the spring and summer, families and bands would break off to upland campsites, constructing temporary grass and dirt-mat covered teepee-like tent structures, located along small streams and tributaries, modeled after the plains style (Walker 1998; Stout 2003). At upland camps some groups would gather root crops such as camas (*Camassia quamash*), bitterroot (*Lewisia rediviva*), wild onion (*Allium* sp.), and wild carrot (*Daucus pusillus*) as well as service berry (*Amelanchier* sp.), hawthorn berries (*Crataegus* sp.), huckleberries (*Vaccininum* sp.), chokecherries (*Prunus virginiana*), pine nuts (*Pinus* sp.), and black moss (*Tilladsia usneoides*).

During the late summer and early fall hunting of large game such as elk (*Cervus canadensis*), deer (*Cervidea* sp.), moose (*Alces alces*), mountain sheep (*Ovis canadensis*), goat (*Capra aegagrus hircus*), back bear (*Ursus americanus*), and grizzly bear (*Ursus arctos horribilis*) were of greater prominence (Slickpoo and Walker 1973). Small game and birds including rabbits (*Sylvilagus nuttalli*), squirrel (*Sciuridae* sp.), marmot (*Marmota* sp.), ducks (*Anas* sp.), and grouse (*Tetraonini* sp.) were hunted throughout the year (Walker 1998).

In the early spring large game were occasionally hunted, but the focus was on fish gathering and processing. The abundance of anadromous fish continues to be one of the most important staples of Nez Perce subsistence and economy. Chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch),* and sockeye salmon (*Oncorhynchus nerka*), as well as steelhead trout (*Oncorhynchus mykiss*), west slope cutthroat trout (*Oncorhynchus clarki lewisi*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), sucker (*Hypostomus plecostomus*), whitefish (*Coregonus clupeaformis*), sturgeon (*Acipenseridea*), and lampreys (*Petromyzontiformes* sp.) were historically harvested by the Nez Perce (Nez Perce Tribe 2003). Fish were then sun dried and smoked to store for winter consumption or traveling (Slickpoo and Walker 1973:35).

By November, people moved back to their winter villages and settled in until early spring when the cycle began again. Villages supported the greatest populations, 30–40 individuals, during the winter when families and bands would come together, though some were occupied year-round (Ames and Marshall 1980; Sappington 1994). Multiple families lived in lean-to longhouses constructed of pole-frames over oblong shaped depressions covered with woven mats of sagebrush or grass and packed with earth (Josephy 2007:9). Villages typically consisted of five to six long houses as well as hemispherical sweathouses, menstrual huts, and hot bath structures (Slickpoo and Walker 1973:32; Walker 1998: 427). During the winter, villagers relied heavily on stored goods from the rest of the year's harvest and socialized in large village gatherings (Figure 3.4).

Figure 3.5 Artist depiction of Nez Perce village at Canoe Camp, Lapwai Creek, Idaho (Nakia Williamson).

Political Organization and Ontology

The Nez Perce were organized in several bands, each setting up villages at the confluence of lateral feeder streams along the Clearwater River tributaries. Villages were led by a single headman, usually hereditarily filled by the eldest active man in the village, who solved domestic issues and spoke for the village when interacting with other tribes and bands (Walker 1998:425). The Nez Perce bands did not officially become a tribe with a single chief until after 1830 in response to Euromerican force (Stout 2003; Walker 1998). Bands would occasionally unite for important matters including large hunting or gathering expeditions or during conflict, though individual village autonomy was a priority and independence was highly valued (Josephy 2007:9).

The Nez Perce belief system is based in the ideology that all living things are connected and have spirits (Josephy 2007:17; Slickpoo and Walker 1973; Stout 2003). Each person is spiritually linked to nature through guardian spirits, or *wyakin*, which are acquired through sacred experience around the onset of puberty (Sappington and Carley 1995:14; Slickpoo and Walker 1973:57). Contact with these spirits could be made through dreams and visions at sacred spaces and locations (Josephy 2007; Walker 1998:425-427). The Nez Perce participated in ceremonial and social activities that included dancing, singing, games, races, and gambling.

Archaeological Work in the Region

Professional archaeological investigation in the region began in the 1960s and 1970s. Testing was initiated by Earl H. Swanson Jr. through Idaho State University (Stapp et al. 1984:10); however, most of the archaeological work has been conducted as reconnaissance in advance of highway improvements *(*Sappington and Carley 1987), construction of the Dworshak Reservoir and other dams *(*Gaarder 1968), or for various facilities projects such as hatcheries (Sappington 1991), gravel pits (Knudson and Sappington 1977), and recreation sites (Benson et al. 1979). Investigation of the Hatwai site (10NP143) near Lewiston provides much of the foundation for defining the cultural phases of the Clearwater River region as the most extensively researched site in the area (Ames and Marshall 1980; Sappington 1995). Selective development in the region most certainly biases the archaeological record, favoring low elevation sites along river access and underrepresenting high altitude or mountainous sites. Much of the study area is currently managed by the U.S. Forest Service; however, the patch work of tribal, private, and Park Service land make compiling a comprehensive inventory of previous research convoluted.

Due to the lack of archaeological work in the region, the Snake River cultural sequence had been applied to the Clearwater River region due to proximity and cultural connections until Sappington (1994) provided a detailed cultural sequence unique to the region.

Archaeological Sites in the Study

Vitrophyre is found in the archaeological record across the region in small but consistent quantities. A total of 19 archaeological sites known to contain vitrophyre artifacts within the Clearwater River region were examined (Figure 3.5; Table 3.1). These sites represent a sample of deep time occupations, ranging from 12,000 to 200 BP, that are geographically dispersed among the Clearwater tributaries. Each site involves some level of excavation, many have associated radiocarbon dates, and they represent variation in site types. This examination is not meant to be exhaustive; rather, it offers a representative sample in which to initially identify pattens in the archaeological record and test the utility of this methodology. This section will describe each site individually to provide a background based in the original archaeological reports and any subsequent research relevant to the study.

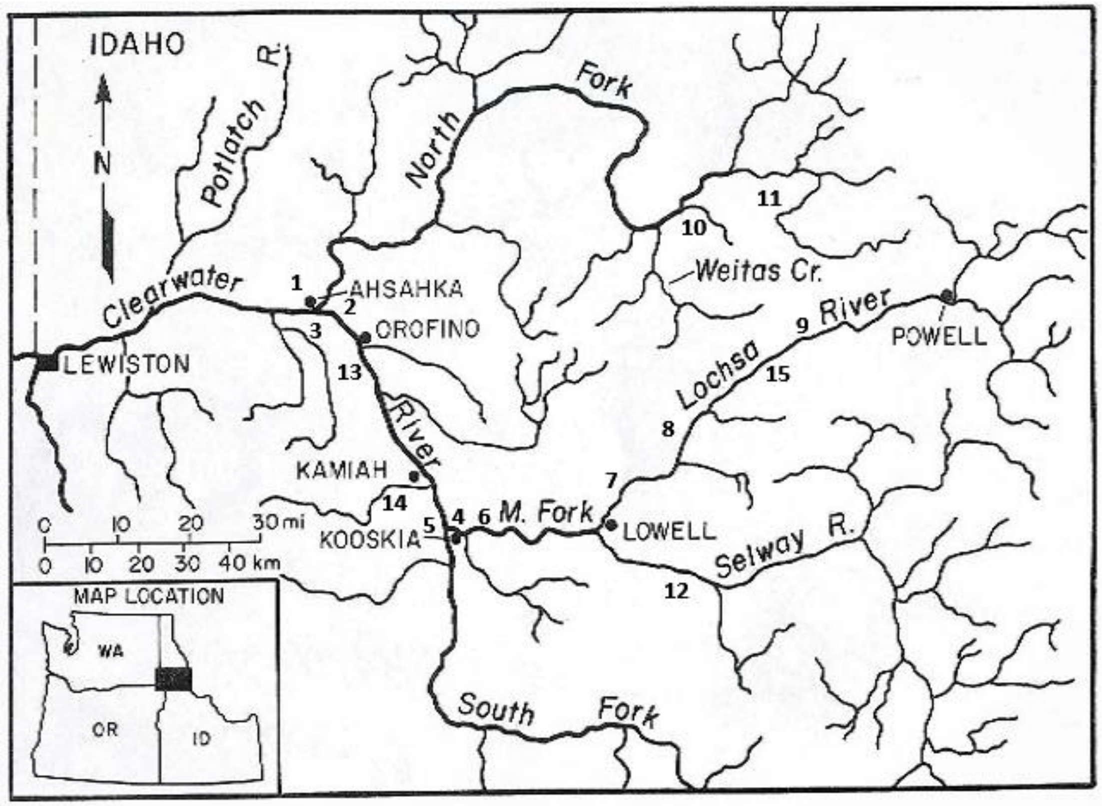


Figure 3.6 Location of selected archaeological sites in the Clearwater River region where vitrophyre artifacts have been recovered: (1) Clearwater Fish Hatchery (10CW4); (2) Ahsahka Sportsmen's Access (10CW5); (3) Canoe Camp (10CW25); (4) Kooskia Bridge (10IH1395); (5) *Kam'-nak-ka* (10IH820); (6) *Tuhkaytahs'speh* (10IH1009); (7) Pete King Creek (10IH453); (8) Beaver Flat (10IH871); (9) Wilderness Gateway sites (10IH798 and 10IH879); (10) Weitas Creek (10CW30); (11) Kelly Forks Work Center (10CW34 and 10CW92); (12) O'Hara Bar (10IH1948) and Rackliff (10IH2737); (13) Middle Clearwater sites (10LE34, 10LE102); (14) Ginger Flats (BT6). Map adapted from Sappington 1994.

Table 3.1 Archaeological Sites Selected for Study

Trinomial	Site Name	Type	Cultural Sequence	Date Range
10CW4	Clearwater Fish Hatchery	Hunting or Fishing Camp	Middle to Late Precontact	(3200–1170 BP)
10CW5	Ahsahka Sportsman's Access	Winter Village	Middle Precontact to Protohistoric	(3210–280 BP)
10CW25	Canoe Camp	Winter Village	Late Precontact	(666–250 BP)
10CW30	Weitas Creek	Upland Hunting Camp	Early to Middle Precontact	(12,000–4500 BP)
10CW34	Kelly Forks Work Center	Upland Base Camp	Early to Late Precontact	(12,000–500 BP)
10CW92	Kelly Creek	Hunting or Fishing Village	Late Precontact	(700–300 BP)
10IH453	Pete King	Late-Summer Base Camp	Late Precontact to Protohistoric	(2925–260 BP)
10IH798	Boulder Flat Terrace	Base Camp	Unknown	Unknown
10IH820	*Kam'-nak-ka*	Winter Village	Middle Precontact to Protohistoric	(4500–660 BP)
10IH871	Beaver Flat	Lithic Production Area	Middle Precontact	(5570–3415 BP)
10IH879	Sherman Creek	Lithic Production Area	Middle Precontact	(4500–2500 BP)
10IH1009	*Tukaytah'speh*	Hunting Camp	Middle to Late Precontact	(3700–660 BP)
10IH1395	Kooskia Bridge	Permanent Village	Late Precontact to Protohistoric	(700–290 BP)
10IH1948	O'Hara Bar	Seasonal Village or	Late Precontact	(550–300 BP)
10IH2737	Rackliff	Seasonal Hunting Camp	Early Precontact to Late Precontact	(12,000–2000 BP)
10LE34	US-12 Highway	Base Camp - Hunting and Processing	Early to Late Precontact	(12,000–500 BP)
10LE102	US-12 Highway	Base Camp - Hunting and Processing	Early Precontact to Protohistoric	(12,000–200 BP)
10LE75	Kittle Rock Shelter	Rock Shelter	Early to Late Precontact	(12,000–1000 BP)
BT6	Ginger Flats	Upland base Camp	Middle Precontact	(6000–3000 BP)

10CW4 Clearwater Fish Hatchery

Located downstream on the west bank of the North Fork at the confluence of the Clearwater River the site was first noted by Lewis and Clarks Corps of Discovery in 1805, while staying at the camp in September and October after crafting canoes upstream (Sappington 1991). The site was originally recorded in 1961 but testing in 1987 did not identify significant cultural material (Sappington 1988, 1991). After a backhoe trench revealed the multicomponent site during construction of the fish hatchery for the Corps of Engineers, it was partially excavated in 1988–1989 by the University of Idaho (Sappington 1991, 2020). Known ethnographically as *Acqa?a'ywawi,* 'referring to sheer canyon walls' (Schwede 1966:32), several trails converge just up steam of the site, near Orofino (Shawley 1977).

Excavation revealed six occupations at the site with radiocarbon dates ranging from 3200 to 200 BP. A pit house feature with abundant lithic material and a cooking and processing activity area, dating to 1500–1200 BP, indicates the presence of a camp with an emphasis on fishing and hunting technology.

The lithic assemblage from the 1990 excavation is dominated by chert (97%), with basalt, granite, vitrophyre, quartz, and argillite each comprising less than 1% of the assemblage.

10CW5 Ahsahka Sportsman's Access

The site is located on a gravel bar at the confluence of the North Fork on the north bank of the Clearwater River. Limited testing in 1967 was conducted in preparation for the Dworshak National Fish Hatchery by Idaho State University (Gaarder 1968; Sappington 1987, 1990). Two decades later the University of Idaho tested the location of a proposed boat ramp for the Lower Snake River Fish and Wildlife Compensation Plan, and the site was subsequently excavated (Sappington 1987, 1990).

Fletcher, and others (Schwede 1966; Spinden 1974; Walker 1978), documented a major winter village at this location called *Atskaaiwawipu* meaning "the river mouth people." The village was estimated to have population between 30 to 200 individuals. Excavation revealed a house floor feature and a significant amount of lithic material representing a range of reduction stages for tool manufacture and maintenance, particularly hunting tools such as arrow points. Density and lack of diversity in the archaeological material is consistent with long-term, continued occupation of a winter village. The lithic assemblage is dominated by chert (92%) with obsidian, argillite, and basalt comprising roughly 2% each, metamorphic rock comprising less than 1%, and vitrophyre at just 0.1% of the debitage.

10CW25 Canoe Camp

Located on the south bank of the Clearwater River, west of Orofino, the Corps of Discovery stayed at this site to build canoes before continuing to the Pacific Ocean in 1805 (Sappington 2020). Between 1986 and 1993, the University of Idaho and the Nez Perce Tribal Cultural Resource Program conducted a series of tests and excavations prior to development by the National Park Service (Sappington and Wegars 1988; Sappington 1990, 1994).

Excavation revealed one Late Precontact house floor and several house floor features including fire-modified rock and an abundance of lithic materials. Vitrophyre comprises an insignificant percentage of the lithic material excavated at this site, with chert, basalt, and argillite being most common.

10CW30 Weitas Creek

Located along the North Fork of the Clearwater River at the mouth of Weitas Creek, this site was originally tested by Idaho State University Museum in 1970 and excavated as part of a field school in 1972 (Keeler 1973). Chronology of the site was originally divided into four broad occupations ranging from the Early Precontact to the Middle Precontact Periods with the most intensive occupation during the Late Cascade subphase (6500–5000 BP) (Keeler 1973). The density of Windust and Cascade points in this assemblage make the site regionally significant in both time and space.

Extensive excavation revealed high-quality heat-treated chert lithics and a few net sinkers but almost no materials suggesting plant processing or butchering activities. The lack of features further indicates the site was used as an upland hunting camp during the Early Precontact period. Though the excavation was unable to obtain radiocarbon dates, it revealed several thousand-years of reoccurring occupations (Keeler 1973:3). A diversification of cultural material over time indicates cultural stability and a constant rate of seasonal occupation.

10CW34 Kelly Forks

Located along an alluvial terrace at the confluence of Kelly Creek and the North Fork of the Clearwater River, limited testing of the site by the U.S. Forest Service in the 1970s and 1980s indicated the presence of a significant archaeological site. Upon U.S. Forest Service development plans, intensive investigation was conducted by the University of Idaho between 2010 and 2012 (Longstaff 2013). Cultural material at the site suggests an important upland hunting, fishing, game processing, and tool manufacturing camp with a wide network of trade and resource procurement.

The site is chronologically organized into five stratigraphic zones and shows regular occupation for roughly 13,000 years with the most extensive occupation between 9000 to 6000 BP, declining after 6000 BP and resurging in the Late Prehistoric period. The lithic assemblage contains a base fragment of a Windust point made of vitrophyre, indicating the use of vitrophyre as far back as 12,000 to 8000 years ago. The lithic assemblage is predominantly comprised of chert (76%), but also includes significant amounts of metamorphic rock (44%), basalt (21%), quartz (14%), vitrophyre (13%), and lesser amounts of granite (3%), obsidian (1.5%), argillite (1%), and a few metamorphic quartz and sandstone items.

10CW92 Kelly Creek

Located on a long, alluvial terrace on the south bank of Kelly Creek, near the confluence of Moose Creek, this site was discovered and excavated during testing for the construction of a gravel pit on behalf of the Clearwater National Forest engineers by the University of Idaho (Knudson and Sappington 1977). The excavation of two test pits revealed a moderate amount of lithic material and a rock-ring hearth feature. Though there is no ethnographic record of a village, the lithic assemblage indicates multiple occupations of a seasonal hunting or fishing camp or village.

The lithic assemblage contained seven tools and 42 debitage flakes. One vitrophyre point and six debitage flakes, recorded as ignimbrite, were recovered. Other materials included chalcedony, chert, basalt, and obsidian in minimal quantities.

10IH453 Pete King Creek

This site was originally recorded as a house pit village in 1966, known ethnographically as *'Aat'pipseh'*, referring to "large old bones," perhaps mammoth fossils (Chance and Chance 1987:129; Schwede 1970:29). Located on a low alluvium flood plain terrace along the Lochsa River, several major ethnographic trails converge at this location (Shawley 1977). A historic cabin was recorded at the site in 1980, and several years later, the precontact component was excavated by the University of Idaho in preparation for Highway 12 improvements in 1988 (Sappington and Carley 1989).

Excavations in 1986 and 1988 revealed 10 features. This site was likely a late summer base camp, indicated by evidence of hunting tool repair activity, and processing of large game such as elk, deer, and bear. The lithic assemblage is comprised primarily of chert (59%), argillite (26%), granitic rock (8%), vitrophyre (5%), and small amounts of obsidian, quartz, and basalt (less than 1% each).

10IH798 Wilderness Gateway – Boulder Flat Terrace

The Wilderness Gateway Recreation Area was extensively investigated by the University of Idaho for development of the area by the U.S. Forest Service in 1978 (Benson et al. 1979). The site is located along the Lochsa River, across from the mouth of Boulder Creek. Intense disturbance of the site and stratigraphy make dating or determining site function difficult. Though this site was nearly destroyed by earlier highway construction, excavation revealed a limited number of vitrophyre artifacts, primarily debitage, utilized flakes, and cores.

10IH820 Kam'-nak-ka

The site is situated at the confluence of Clear Creek and the Middle Fork of the Clearwater River. *Kam'-nak-ka*, "fiber out of which nets are made" (Sappington and Carley 1995:208), was discovered in 1993 during a survey for the Kooskia National Fish Hatchery through subsurface testing and was excavated as part of the data recovery process for the installation of a pipeline in 1996 by the University of Idaho (Sappington 1997). Ethnographic data states that there was a large camp of 160 individuals associated with the "Looking Glass" band (Sappington 1997). The village was destroyed by U.S. soldiers in 1877, but the area was resettled by the Nez Perce in the late 1890s. The area was a hub of activity, with several camps and villages in the Stites region and major trail routes linking northern and southern Nez Perce territories (Shawley 1977).

Excavation revealed faunal remains, a probable house feature, and a copious amount of ground stone, lithic tools, and debitage of an assortment of material types procured from a varying distance. Stratigraphic information identified four occupations spanning from the Late Cascade to the Protohistoric period. Faunal data at the site suggests a fall or early winter occupation. The lithic assemblage is primarily basalt tools (60%), and more than 30,000 debitage flakes. By count, the assemblage is dominated by chert (21%), opals (19%), and chalcedony (16%) with small quantities of obsidian (4%), vitrophyre (3%), argillite (2%), and metamorphic rock (1%).

10IH871 Beaver Flat

Located on a low alluvium flood plain terrace along the Lochsa River, this site was discovered during initial testing for Highway 12 improvements and was subsequently excavated by the University of Idaho (Sappington and Carley 1989). Extensive excavation revealed a historic cabin and an intensely occupied lithic production area.

The presence of a Windust phase projectile point below a layer of Mazama ash dated the initial occupation between 12,000 and 8000 BP. Lithic material at the site is nearly 85% vitrophyre. Debitage at the site also included chert (10%), basalt (3%), metamorphic tock (3%), and very few granitic, quartz, and argillite flakes.

10IH879 Wilderness Gateway – Sherman Creek

The site is located on an upper terrace of the Lochsa River, on an alluvial fan adjacent to a small creek east of the Boulder Creek confluence. As part of the Wilderness Gateway Recreation Area, this site was extensively investigated by the University of Idaho for continued development of the area by the U.S. Forest Service in 1978 (Benson et al. 1979: 34-41).

Excavation revealed a modest amount of lithic materials characteristic of the late Cascade or Hatwai phase into the Ahsahka phase. The Wilderness Gateway complex including 10IH747, 10IH798, 10IH 799, 10IH800, and 10IH879 represents a 7000-year occupation with intense occupation between 6500 and 5000 BP.

10IH1009 Tuhkaytahs'peh

Tuhkaytahs'peh, "going uphill or a place where one comes out of a fording place", refers to the presence of a nearby trail (Sappington and Carley 1995:208). Located 2 km (1.25 mi) up the Middle Fork of the Clearwater, the village was originally identified by Alice Fletcher in 1891 and officially recorded as an archaeological site in 1980 by the Clearwater National Forest Archaeologist. This village was known as a good place to acquire ground stone for camas processing and to throw nets for fishing (Sappington and Carley 1995:208). Located near *Kam'-nak-ka* north of Stites, the site would have lent access to the southern Nez Perce territory through a system of major trails (Shawley 1977). The site was tested by the University of Idaho after inadvertent disturbance in 1990 (Sappington 1991) and fully excavated in 1992–1993 (Sappington 1994).

Excavation revealed substantial amounts of flaked and ground stone tools, faunal remains, bone tools, fire cracked rock, and partially exposed features below the surface with a historic component in the upper four levels. Features at the site include two house pit depressions and several hearths. An abundance of corner notched points and late-development fishing technology indicate a hunting camp that dates to the Middle Precontact (3700 BP), with a second occupation in the Late Precontact period (660 BP). The lithic assemblage is primarily chert (31%) and opal (23%) with argillite (13%), basalt (11%), obsidian (5%), chalcedony (6%), jasper (6%), vitrophyre (3%), and small amount of metamorphic material (1%).

10IH1395 Kooskia Bridge

This site is located on the north bank of the Middle Fork of the Clearwater, opposite the mouth of the South Fork. Alice Fletcher made note of two villages in this vicinity named *Tsy-was-'poo* and *Tuke'?ywewi*. Site 10IH1395 is thought to represent the village of *Tuke'?ywewi*, "buffalo hump," a permanent village of the Kamiah band that was known as the leader village of the region (Sappington and Carley 1995:206; Sappington 2020). Test trenches excavated by the Idaho Transportation Department at the planned site of the Kooskia Bridge replacement revealed cultural material in 1982 (Sappington and Carley 1983). A significant multicomponent site was later exposed during the 1985 University of Idaho excavation (Sappington and Carley 1987).

Excavation revealed a significant amount of lithic and bone material as well as several features including multiple hearth ovens, several house pit features, and a lithic manufacturing and games processing area. These features are consistent with the longer-term occupation of a winter village. The lithic assemblage is comprised of primarily chert (86%), obsidian (6%), argillite (5%), basalt (2%), and very small quantities of metamorphic and vitrophyre material.

10IH1948 O'Hara Bar

This site, named after historic prospector Pat O'Hara, was initially excavated for campground and recreation improvements (Knudson et al. 1977). It is located on an alluvial terrace along the Selway River, several miles upriver of the Lochsa River confluence. Excavation of three test pits conducted by the University of Idaho revealed a small camp or seasonal village, including house pit features and activity areas (Sappington 1994:216). The lithic assemblage is dominated by argillite (50%) with small quantities of vitrophyre (5%), and a few obsidian flakes. The primary site function revolves around the manufacturing of new tools noted in the lack of worn edges. The site is on a major trail route, surrounded by multiple ethnographically known camp sites, and was known ethnographically to be a significant fishery (Shawley 1977).

10IH2737 Rackliff

The site was first identified by the U.S. Forest Service during a 1999 survey for the Selway Corridor Recreation Project, situated on a north bank alluvial fan located approximately eight miles upstream of the Lochsa River confluence (Armstrong 2006). After subsurface testing revealed buried cultural material, several more shovel tests were laid out across the site and formally excavated between 1999 and 2003.

Excavation revealed a historic component in the top two levels, representing decades of recreational use, as well as precontact lithic material. Residue analysis conducted at the Laboratory of Archaeological Science at California State University, Bakersfield, identified cactus proteins on one biface tool. However, most of the lithic material appears oriented toward hunting tool maintenance and retouching rather than plant processing or fishing. No features and very few faunal remains were observed during excavation. The presence of Mazama ash above Windust and Early Cascade subphase lithic tools indicate that initial occupation of the site is well within the Early Precontact, at least 6700–12,000 BP. Lithic material at the site is dominated by chert (69%) and argillite (18%) with some quartz (7%), obsidian (3%), and small amounts of metamorphic rock (2%) and vitrophyre (0.6%).

10LE34 US Highway 12

10LE34 and 10LE102 were identified in 2001 during preliminary testing for a highway passing lane project. Located along the west bank of the Middle Fork, several ethnographic trails converge in this location, and at least two campsites were known to exist in (Shawley 1977). They were again tested in 2002 by the Nez Perce Tribe Cultural Resource Program, initiating a data recovery excavation by the University of Idaho and tribal members in 2004 (Sappington 2008, 2010).

Excavation of 34 units in 10LE34, *lolonima'puh* named after the adjacent Lolo Creek, revealed numerous stone tools, including a Cascade point, indicating Late Precontact or earlier occupation and radiocarbon dates the site into the Historic period. A potential house pit feature and evidence of extensive plant and animal processing indicate a base camp. Residue analysis of lithic tools (Sappington 2008) revealed the presence of proteins including rabbit, rat, deer, sheep, bovine (bison), guinea pig (interpreted as beaver, porcupine, marmot, or squirrel), pine, and aster.

The majority of stone at the site is comprised of granitic, metamorphic, and quartzite, with vitrophyre, chert, and obsidian comprising the smallest portions of the assemblage. With just 10 artifacts weighing a combined 0.75 g, vitrophyre makes up less than 1% of the assemblage, but slightly more than chert and obsidian.

10LE102 US Highway 12

Excavation of seven data recovery units at 10LE102, *piik'un taxsawxt* named after the phenomena of echoing sounds at the site, revealed evidence of hunting and processing of medium to large game. A stemmed Windust point suggests an occupation as early as 12,000 BP, however radiocarbon dates could only confirm occupation from 2000 to 200 BP. Residue analysis of lithic tools included deer, rabbit, and rat (Sappington 2008). Chert comprised the majority of the lithic assemblage (81%), with basalt and obsidian occurring at less than 2% each, and vitrophyre comprising just 0.7 grams (g).

10LE75 Kittle Rock Shelter

This site was first noted by locals in the early 1970s but was not officially recorded until 1993 when it was named after Lauren Kittle who brought attention to the site. Excavation of a test trench was conducted by students at the University of Idaho through funding from the landowners, the Flying B Ranch (Herbel 2001; Sappington 2008, 2010). A single Cascade point is associated with a radiocarbon dated of 7330 ± 40 BP. Though the lithic assemblage was small, two vitrophyre modified flakes were collected, and residue analysis of other lithics indicated processing of deer.

BT6 Ginger Flats

During a survey intended to discover unrecorded precontact sites along the Lochsa River, limited testing resulted in several sites along the corridor being recorded (Danner 2017). Site BT6 is located on an alluvial terrace just 2–4 m (6.5–13 ft) above the flood plain. Many subsurface tests revealed a heavily utilized butchering and processing camp. Several diagnostic projectile points date to the Early and Middle prehistoric (10,000–3000 BP). The lithic assemblage also includes chalcedony, argillite, cryptocrystalline, and flaked cobbled tools in addition to vitrophyre (Danner 2017:68-80).

Summary

This brief summary of archaeological sites within the study area demonstrates the geographic and temporal range in which vitrophyre is found. Radiocarbon dated sites range from 6500 to 200 BP but are attributed to as far back as 12,000 BP or more, at elevations ranging from 300 m (984 ft) to the west and 830 m (2723 ft) to the east. A combination of site types including permanent winter villages (n=4), upland base camps (n=4), hunting and processing sites (n=5), lithic production areas (n=2), and general base camps or rock shelters (n=4) illustrates how vitrophyre was used at various locations and during different activities.

Chapter 4: Lithics and Geochemical Analysis

Lithic Studies

The study of stone tools has a long history. Since at least the 1600s, people have been collecting and studying the craftsmanship of this early technology. Despite this curiosity, lithics remained understudied in archaeology until the 1960s. Experimental work by Crabtree, and others (Andrefsky 1994, 1998, 2001; Callahan 1979; Flenniken 1978; Walker 1994) has inspired further investigation of lithic materials, which have become increasingly important to understanding the archaeological record and past human behavior.

Lithic debitage has been the focus of archaeological studies since the 1970s, as manufacturing debris varies by methods of manufacturing and the character of the raw material (Whittaker 1994). Debitage analysis is the systematic study of unmodified chipped, or knapped, stone artifacts that are not cores or tools (Sullivan and Rozen 1985:755). Some of the variables that are commonly considered in debitage analysis include size, count, weight, shape, production method, tool type, or percent of cortex (Andrefsky 2001). The analysis of debitage is used to reconstruct patterns of lithic technology and human behavior such as site function, regional influences on technology, and variability of technology within or among sites.

There are three current approaches to debitage analysis: aggregate or mass analysis, typological analysis, and attribute analysis. Aggregate analysis examines the entire collection, quickly categorizing based on size, weight, and relative proportions. This approach is good for understanding the debitage and identifying reduction stages; however, it doesn’t convey a lot of information about the tools produced or behaviors at the site.

Typological analysis takes a closer look at a sample of individual flakes or tools and sorts them into typological categories such as application load (type of tool used in manufacturing), technological type (focusing on where the flake was removed from the core or tool – a thinning flake on a biface vs a notching flake on a projectile point), and cortex (considers the amount of cortex as a proxy for stages of production). Typologies are based on a combination of attributes that are assumed to define the technological origins of an artifact. However, multiple reduction techniques can produce similar attribute combinations and, likewise, the same reduction technique can produce different sets of attributes depending on several variables. Some researchers argue that these approaches make assumptions about the sequence of flake removal and do not consider variability in size, shape, or nature of available material, nor does it consider the intensity of reduction or stylistic and functional choices of the knapper (Clay 1976:303; Sullivan and Rozen 1985:756).

Attribute analysis is a method that measures and describes multiple dimensions of variability in debitage form that can then be analyzed individually or in combination (Andrefsky 2001; Clay 1976:304). This approach is intended to be a set of standardized observations that considers each tool or piece of debitage as a complex component, recognizing the significance of variability of individual attributes, that can later be used to assign a typological category (Clay 1976:304). A combination of attribute and typological approaches was selected for this research to investigate how vitrophyre was being transported and used at individual locations and between sites in the region.

Technological Organization, Settlement, and Subsistence

Early lithic studies focused on how settlement strategies, resource procurement, and activities impacted stone tool organization, illustrating a direct relationship between effort expended during tool production and settlement strategies. These early studies suggested that generally, more sedentary groups utilized informal or expedient tools, while more mobile populations are associated with formal tools (Andrefsky 1994:21; Binford 1979; Gould and Sagger 1985; Parry and Kelly 1987). Andrefsky (1994:22) defines formal tools as those that require extra effort in production, compared to informal tools, which are thought to require little to no effort in their production. “Formal tools” are flexible, transportable, designed to be rejuvenated, prepared in advance, and used for various functions, i.e., bifaces, cores, and retouched flakes (Bamforth 1986). “Informal tools” are generally unstandardized, expediently made in anticipation of use, with a relatively short life cycle, and discarded according to the needs of the moment (Adrefskey 1994:22; Bamforth 1986).

Archaeologists often assume that formal and informal tool use are a function of subsistence and settlement organization (e.g., Andrefsky 1994; Bamforth 1986:39; Nelson 1991). The nature of raw material acquisition will impact the form and patterning of debitage in the archaeological record, reflecting mobility in reduction method and quarrying behaviors. A quarry is a raw material source where toolstone is acquired and preliminarily worked (Beck et al. 2002:482). The distance to a source, activities performed, and other factors will influence the lithic assemblage at any site. For example, cobble testing and initial reduction generally occur at the quarry location to ensure material quality, with all stages of production represented (Beck et al. 2002; Erekson et al. 2007:586). The size of debitage flakes decreases as distance from the source increases. Discarded tools are disproportionally of exotic materials as new material is acquired and exhausted tools are abandoned (Ereksen 2007:586). Workshop sites will also include debitage, manufacturing tools (hammerstones and flaked chisels etc.), and utilized and discarded tools (Ereksen 2007; Gramly 1980).

These theoretical frameworks have formed the basis for lithic interpretations. Over the last few decades, technological advancements have expanded the study of lithics. Modern development such as geochemical sourcing allows researchers to address a new set of inquiries about where an object was procured, who made it, and how it moves around the landscape.

Provenience Studies

Sourcing, or provenience, studies investigate the origin point of the materials used to create an object or artifact, usually through trace element, or geochemical, analysis. These studies involve a classification technique in which artifacts are sorted into compositional types based on ratios of chemical elements of known geologic specimens to identify their geographical origin, or parent source. Some common methods include x-ray fluorescence (XRF), neutron activation analysis (NAA), and atomic absorption spectrometry (AAS), which characterize the chemical composition of the material (DeFrancesco 2008; Frahm 2012; Luedtke 1979). Portable x-ray fluorescence is discussed further in Chapter 5.

Using geochemical analysis for lithic procurement and provenience information allows researchers to integrate source data into the broader theoretical inferences of past human behavior based on culturally modified and transported materials. The ability to determine the geographic origin of an artifact can allow researchers to reconstruct mobility patterns, local economy, territory and resource patch ownership or access, trade and social networks between groups over time, and to some extent the symbolic value or cultural preference of material goods. Historically, archaeological investigation of lithic material often assumed that materials are local and rarely considered variations in material or examined the relationship between material types across multiple sites. As an important component of early survival, toolstone acquisition should be considered with the same significance as any other important subsistence resource. A multisite analysis of vitrophyre in the Clearwater River region has unique potential to contribute to our understanding of past lifeways in this understudied region.

Geochemical analysis has been accepted as a legitimate method for investigating archaeological use of obsidian for decades. X-ray fluorescence and emissions spectrometry have been used in archaeological investigation since the 1960s, proven effective on obsidian and other igneous materials, providing insight into quarry and procurement activities, organizational strategies, trade and social networks, etc. (De Francesco et al. 2008; Frahm 2014; Glascock 2020:37; Hayden 1997; Adams and MacDonald 2015; Reimer 2018; Reimer and Hamilton 2015; Sappington 1984).

This relatively new method has contributed to our understanding of procurement behavior, questioning earlier assumptions. For example, a regional XRF investigation of obsidian sources in southern Idaho concluded that a variety of obsidian sources were utilized over the past 10,000 years (Sappington 1984). The study indicated that tool production occurred primarily at the site of use, rather than at the source area. Previous work assumed that obsidian was being obtained from Yellowstone or central Oregon, dismissing local sources as inadequate for toolstone due to the size and shape of available nodules. A similar investigation of these relatively unknown vitrophyre sources may help to clarify local patterns of resource use in the region.

An Ecological Approach to Lithic Procurement

As an integral part of early survival, the acquisition, use, and distribution of lithic resources should be considered in relation to the physical surroundings. Similar to other subsistence resource, local lithic materials would have been considered a nonrenewable resource that requires time and energy to procure and process, but also involved a profound knowledge of the landscape. Ethnographic and archaeological studies have long looked at factors influencing raw material procurement from the theoretical orientations of landscape and cultural ecology. Those theories rely on settlement and subsistence strategies, landscapes, and raw material quality for interpretation that assume optimizing and economizing behaviors during resource collection. Central place foraging models, derived from a human behavioral ecology approach normally applied to plant and animal resources, have been used to describe and explain the relationship between the effort expended at a lithic quarry and the distance from that quarry to foraging or residential sites (Beck et al. 2002:495, Beck 2008:760).

Binford (1979) identified two basic strategies for procurement: direct and embedded. Direct strategies make an explicit task of obtaining raw material with no other tasks involved, generally at a cost, while embedded strategies organize and schedule procurement activities simultaneously with other subsistence tasks, thereby reducing the cost of material procurement (Adams and MacDonald 2015:209; Binford 1979:259-260). For example, when fishing is slow, some members of the group will go to a nearby lithic source to reduce and prepare cores while watching for game (Binford 1980). Embedded strategies seem to be the most common, because they involve an efficient use of overall task management when moving across the landscape, particularly among mobile groups.

Subsistence activities, which include lithic procurement, are related to settlement and mobility patterns, and optimizing behavior is expected to be reflected in the distribution of lithic materials. When the distance between a resource patch or lithic source and a residential base is great, more intense reduction will be carried out at the quarry than if the residential base were positioned closer to the quarry (Beck et al. 2002). A residential site assemblage will contain bifaces at later stages of reduction than its associated quarry (Beck et al. 2002). As distance from procurement sites increases, stone tools are expected to exhibit greater and greater degrees of processing (Beck 2008:760). However, lithic processing and transportation costs and benefits can be difficult to quantify for several reasons. First, the utility and optimal transportation load of toolstone is subjective. For example, when is a utilized flake to be considered “waste material?” Second, even among more formal tools, there is variability in procurement, maintenance, and discard behavior. Lastly, the model does not adequately recognize variability in material quality or availability of alternative resources.

Over the decades several studies have suggested that opportunity for procuring high quality toolstone may impact decision making during regular subsistence tasks (Adams and MacDonald 2015; Andrefsky 1994; Bamforth 1986; Gould 1980; Gould and Saggers 1985; Sappington 1981). This means that people travel great distances and go out of their way for certain materials, thus influencing the patterns observed in the archaeological record that contradict theses optimizing models. Adams and MacDonald (2015), for example, utilize the Wilsons Attractiveness Equation, which ranks lithic quality through a series of metrics including the extent of the source, size of available material, overall scarcity, difficulty of terrain, and cost of extraction to give a score of attractiveness to a raw material source to demonstrate that groups did preferentially choose more difficult travel routes in pursuit of higher quality material.

In central and southern Idaho, Sappington (1981) identified five obsidian sources at the Givens Hot Spring site (10LE1698). The most local source, Owyhee obsidian, which is considered to be of poorer quality, was nearly absent from the archaeological record. This suggests that proximity and ease of access may not be among the highest priorities for procurement (Sappington 1981:31). Instead, the availability and quality of raw material are more significant than settlement or subsistence practice. However, exchange, resource ownership, social relationships, and ideology can offer access to quality, nonlocal material, which can affect these predictions and impact patterns observed in the archaeological record.

Ethnographic evidence proposes that people went to considerable effort when traveling to adjacent sacred sites, materially superior lithic sources, or other specialty resources. The Nez Perce were known to travel great distances to acquire high quality obsidian and preferred to collect it themselves rather than through trade (Sappington 1981). However, in addition to material quality, social relationships may be another important factor influencing how and where material is procured. Gould and Saggers (1985:123) argue that a social mechanism is required to reduce risk during long-distance travel for nonlocal resources. If groups are traveling great distances for a specific resource, there are likely additional motivations for travel such as secondary resources or maintaining long-distance social relationship. Considering these studies, a controlled effort should be made to assess technological characteristics of a material before assuming the degree to which material procurement is structured by subsistence or quality alone (Gould and Saggers 1985:124).

Ecology, Perception, and Social Networks

While ecologically based theories are useful in evaluating assemblage variability relating to quarry and transportation behavior, they are missing human components that contribute to patterns and variability. To understand the decision-making process of early inhabitants of the Clearwater River region, it is necessary to understand the engagement between people and their environment (Gibson 1979) through landscape ecology and indigenous approaches.

A landscape ecology approach investigates how an organism is distributed within its environment, how it perceives its surroundings, how individual activity spheres are used, and how these parameters are affected by the structure of the landscape itself (Kempf 2020:4). Perception has evolved as a survival mechanism for humans to extract information from their environments to make decisions and take action. Landscape Affordance Theory, based on Gibson's ecological approach to perception, is a conceptual framework that describes how societal decision-making is controlled by the ecosystem's functionality, the human perception, experience, memory, tradition, and the individual configuration of landscape components (Gibson 1979; Kempf 2020). Affordances are what the environment offers, provides, or furnishes that have both objective and subjective properties. Affordances are stable, though perception is contextually dependent. As Kempf (2020:1) argues, "Certain parts of the environment are perceived differently than others, which leads to mental and eventually physical categorization of the available space." To truly understand patterns in the archaeological record, it is imperative that cultural practices and indigenous perspectives be incorporated into the interpretations.

One way to interpret how landscapes are perceived and categorized is to consider indigenous place names. Place names carry with them many forms of knowledge that can signify indigenous ontology, social relationship, or landscape utility. Hunn (1996) showed that an ethnosemantic quantitative analysis of Sahaptin language place names correlated to population density in eastern Washington. A place name can indicate social or spiritual meaning; the significance of places, times, or events; cultural protocols; and relationships with the land and material themselves (Reimer 2018:14). Hunn argued that a cognitive anthropological approach could draw parallels between naming patterns and underlying universal geographic parameters (1996:6) that also highlights the ecological niche of local groups (1996:19). Because landscapes are embedded in cultural identity, language, and history, when pieces of the landscape, such as vitrophyre artifacts, are found at great distances or in certain patterns of distribution, it represents cultural meaning (Reimer 2018:5).

Ecology and economy are closely integrated into the social network of the Plateau region. In the southern Columbia Plateau, Anastasio (1985) describes two types of interaction: ecological and intertribal. The natural environment, or ecological niche, of each group works as a spatial framework for intergroup relationships (Anastasio 1985). The landscape itself is physically and mentally categorized based on social boundaries. Though the region was not united by an overall social or political structure, the consensual and reciprocal relationship among groups creates the mechanisms for intergroup relations based on a shared set of norms, values, and beliefs (Anastasio 1985) that depended on the perception of physical, social, and political boundaries. Highly mobile and centrally located, the Nez Perce were among the primary transporters of information and trade goods throughout the region (Slickpoo and Walker 1973:24).

When acquired through trade, lithics are often found as preforms or finished tools. Debitage from these materials are represented as late-stage reduction or retouching. These patterns can be complicated by the choice of tool kit carried. The Nez Perce often traveled through difficult terrain and were known to take the most direct routes. Trails tended to take the shortest, straightest line to a destination, not diverting in the presence of mountains or elevation changes (Broncheau-McFarland 1992:85), thereby necessitating a compact and efficient tool kit that included formally curated tools (Bamforth 1986).

Discussion

Early lithic studies provide a useful way to think about artifact assemblages as functional materials that reflect some aspects of subsistence, settlement, and mobility. Sourcing studies allow a fine-grain investigation of when, where, and how materials move around the landscape that both confirm and contradict these ecological models. Examined through an ecological scope, lithic and provenience studies provide insight into deeper inquiries about how people made decisions in the past while interacting with their environmental surroundings.

Building on these perspectives grounded in technological organization and cultural ecology, this research expands the breadth of interpretation of material culture by incorporating ethnographic and indigenous perspectives. Considering how a landscape is perceived and categorized based on both ecological and social conditions more directly addresses the psychology of societal decision making in the past that examines multiple influencing factors. Further, this approach helps to avoid overly deterministic interpretations that minimize indigenous ideology and variations in group identity that tend to homogenize human experiences in the past. Integrating indigenous place names that point to identity, place, and social networks into the interpretation of data can foster a richer and more nuanced understanding of how people not only used and interacted with their environments but also how these environments and the resources were interpreted ore mentally categorized.

Chapter 5: Methods

Raw Material Collection

Preparations for the field work began with obtaining research permits from the Nez Perce Tribal Executive Committee and the U.S. Forest Service. In July of 2021, the Nez Perce Tribal Executive Committee authorized the "Research Permit" and the U.S. Department of Agriculture, Forest Service issued a "Permit for Archaeological Investigations," effective in the Clearwater River Basin on the Nez Perce-Clearwater, and the Lolo-Bitterroot National Forests in Idaho and Montana.

The goals of fieldwork were to locate and define each vitrophyre source and collect raw material samples with which to characterize the chemical composition of each source. Investigation consisted of pedestrian survey and surface inspection. Several photographs were taken, and samples were collected from a roughly 1.5 m radius of the recorded GPS coordinates.

Montana Creek Source

Field work began at the Lolo National Forest to locate the Montana Creek vitrophyre source. Utilizing topographic maps, GPS coordinates, and written directions from the 24MN198 site form, myself and another archaeologist hiked to a peak situated between Montana Creek to the north and Cache Creek to the south, both connecting to Fish Creek to the west (Schlader 2015). Much of the hike follows a decommissioned Forest Service Road; vitrophyre was noted eroding from road cuts at several points along the way. At about 1000 m upslope of Montana Creek, on the north side of the peak, pockets of vitrophyre nodules were observed at the surface or exposed in root spalls where samples collection began (Figures 5.1 and 5.2).

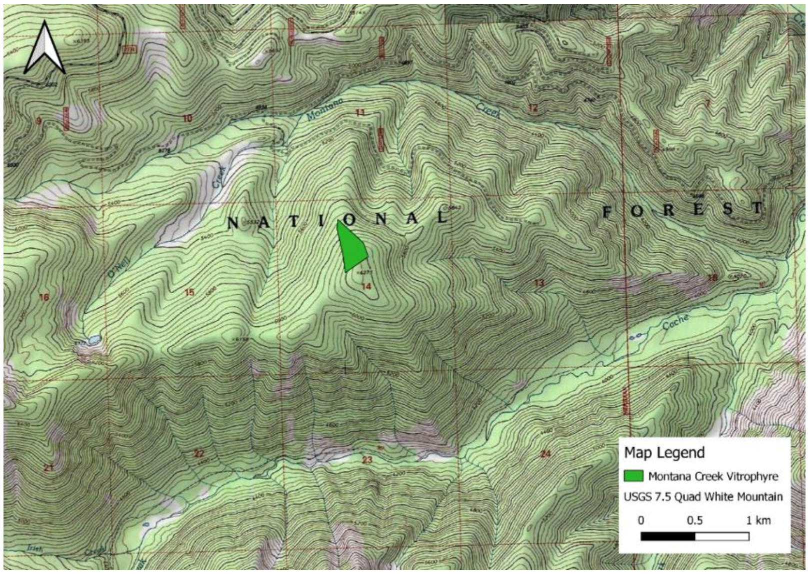


Figure 5.1 Topographic map of Montana Creek vitrophyre outcrop (shaded green).

Nodules measured 3–15 cm and exhibited weathering with degraded quality including erosional seams and fracture planes (Figure 5.3). A few larger specimens, found semisubsurface, measured up to 35 cm in length and 15–20 cm in width but only 7–10 cm in thickness (Figure 5.4). The peak and much of the north slope were surveyed, observing vitrophyre concentrations along an eroding vein exposed at the north slope at approximately 1895 m in elevation.

Samples (n=53) were collected from three locations for geochemical analysis (Table 5.1). Location A and B are located along an exposed vein, about 1900 m elevation, where the highest concentrations were noted. Location C is located approximately 290 m south, downslope of the exposed vein, where nodules were observed at the surface at regular, but less frequent concentrations.

Table 5.1 Montana Creek Vitrophyre Collected Samples

Location	**UTMs**	**Samples**
A	674921 E, 5185560 N	11
B	674953 E, 5185602 N	21
C	675405 E, 5187578 N	21
Total		53

Figure 5.2 Overview of Montana Creek vitrophyre outcrop, facing north (September 2021).

Figure 5.3 Montana Creek vitrophyre surface exposure (September 2021).

Figure 5.4 Largest observed nodule of Montana Creek vitrophyre (September 2022).

While local resources were not directly observed during the survey, game and other upland plant resources such as bear grass, huckleberry, and whitebark pine likely would have brought people to the location. Vitrophyre was difficult to locate due to the density of vegetation on the slope, but the configuration of vegetation may have been different in the past due to modern climate and forest management practices.

Lochsa Source

Myself and another archaeologist traveled to the Nez Perce Clearwater National Forest to locate the Lochsa vitrophyre source. Utilizing topographic maps and GPS coordinates provided by the site forms and the Nez Perce-Clearwater National Forest, the crew began hiking at the confluence of Fish Creek and the Lochsa, surveying the south slope of Sherman Peak. At about 1300 m in elevation, several vitrophyre nodules were exposed at the surface of a small level clearing, measuring roughly 100 m^2, with minimal vegetation (Figures 5.5 and 5.6).

The majority of these nodules were small, only 5–10 cm in diameter on average (Figure 5.7). The total area of surface exposure was more limited than the Montana Creek source, however this may have been due to vegetation. Further survey of the slope and ridgeline is recommended to better understand the distribution and exposure for potential outcrop locations. Samples (n=26) from two locations were collected at the Lochsa source for chemical characterization (Table 5.2).

Table 5.2 Lochsa Vitrophyre Collected Samples

Location	**UTMs**	**Samples**
X	627325 E, 5135309 N	21
Y	627369 E, 5135398 N	5
Total		26

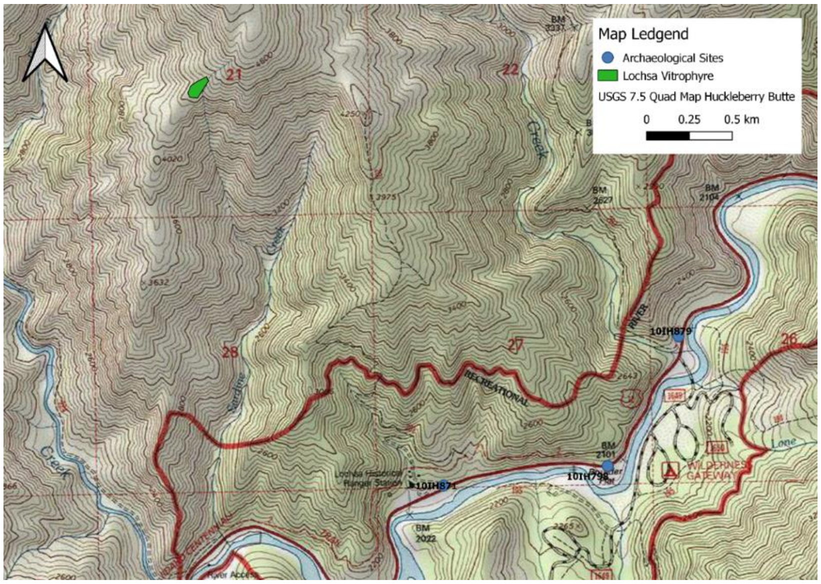


Figure 5.5 Topographic map of Lochsa vitrophyre outcrop (shaded green).

Figure 5.6 Overview of Lochsa vitrophyre outcrop facing west (September 2021).

Figure 5.7 Lochsa vitrophyre surface exposure (September 2021).

During the survey, evidence of deer and elk were observed which may have been the original motivation for travel along these ridges. Other resources in the area that may have drawn people to the location include huckleberry or bear grass. Both the Nee Me Poo and Lolo Trails cross the ridgelines less than 10 km north of the source, making Sherman Peak easily accessible to traveler.

Evidence of potential human modification was noted by the presence of several flakes, a possible worked vitrophyre core, and a potential metamorphic river cobble hammerstone (Figure 5.8).

Figure 5.8 Possible hammerstone observed at Lochsa vitrophyre outcrop (September 2021).

Laboratory Methods

Laboratory analysis of artifacts was conducted at the Alfred W. Bowers' Laboratory of Anthropology at the University of Idaho, Moscow, Idaho. Many of the archaeological assemblages examined in this study are currently curated at the Alfred W. Bowers Federal Repository and were accessed with support from the Nez Perce Tribe and the U.S. Forest Service. The Walla Walla District U.S. Army Corps of Engineers approved a "Research Request Form" to access the Ahsahka (10CW5) assemblage, also curated at the Alfred W. Bowers Repository. Another site, Canoe Camp (10CW25), is curated at the Nez Perce National Historic Park in Lapwai, Idaho. With the support of the National Park Service and their cultural resource staff, an "Artifact Loan Agreement," allowed items from this site to be included in the study as well. The Ginger Flats site (BT6) is in care of the U.S. Forest Service, housed at the Kooskia facility of the Nez Perce-Clearwater National Forest which was also incorporated into the research with an "Artifact Loan Agreement."

Raw material characterization often begins with a comparison of visual characterizations. Identification of texture, color, or size and type of phenocryst inclusions can be conducted though observation or with a magnification lens. However, as noted, vitrophyre can vary considerably in color, sheen, or the size, type, and concentration of phenocrysts within a single finger-length nodule, let alone over a large gradation of deposition.

Lochsa Source

Material from the Lochsa source present a range of characteristics (Figure 5.9). Color ranges from an opaque black (N 2.5), with very few small inclusions to an opaque light olive gray, (5Y 6/2), with some very course angular inclusions, to a more translucent dark greenish gray (5G 4/1) with many very fine to course 3 mm rounded inclusions. More occasionally they can range from to an iridescent opaque grayish green (5G5/2) with 1 mm rounded inclusions, to an opaque yellowish red (5YR 5/6) with black speckled banding, or pale yellow (2.5Y 8/4) with black striations (Globe Program 2005).

Figure 5.9 Examples of Lochsa vitrophyre projectile points and preforms from the Clearwater River region. Left to right: 10CW30 (1662.123), 10IH820 (21.7/3.5), 10IH820 (21.2/2.13), 10IH1009 (1.4.0), 10CW30 (1662.250.01), 10CW30 (1662.214.02).

Montana Creek Source

Montana Creek vitrophyre appeared to be equally variable in character (Figure 5.10). Color can transition abruptly from an opaque light gray (5Y 7/2) with 1–3 mm rectangular inclusions to a very translucent olive gray (5Y 5/2) with many tiny inclusions (Globe 2005). More occasionally, they range from an opaque dark gray (10YR 4/1) with sparse 4 mm angular inclusions, to opaque brown (7.5YR 5/4) with very few tiny black inclusions, or a dull, opaque black (N 2.5) with minimal visible inclusions.

Figure 5.10 Examples of Montana Creek vitrophyre bifaces from the Clearwater River region. Left to right: 10CW30 (1662.355.01), 10IH453 (27.2.14), 10CW30 (1662.011.03), 10IH820 (26.9/4.1), 10CW92 (11.3), 10CW30 (1662.250.01).

Lithic Analysis

The vitrophyre artifacts for 18 sites (n=3539) were analyzed including cores and tools (n=149) and debitage (n=3390). Of these flakes, only whole flakes (n=1815) were fully analyzed in the attribute analysis. An analysis of eight attributes were considered for the debitage including length, width, thickness, mass, manufacturing technology, number of dorsal flake scars, termination type, and percentage of cortex. For tools and cores information including form and stage of production, length, width, thickness, mass, cutting edge, haft length, neck width, base width, portion of tool recovered, breakage pattern, shape of cross section at the tip and base, and type and precent of retouching or use wear were recorded where applicable.

Formal Tool and Core Analysis

For this analysis formal tool artifacts have been categorized based on size, form, and technological type as defined in Leonhardy and Rice (1970) and refined by Sappington (1994). Other tool technologies have been defined based on a four-stage sequence of reduction; core, blank, percussion biface thinning, and pressure bifacial thinning (Sappington 1991).

Lithic cores are nodules of raw material that constitute the initial selection and early stages of reduction. Cores may retain a significant amount of cortex or may be worked in a number of ways, illustrating material testing, blade and flake production, or preparation for transportation that range in size with variable flake scar patterning or as raw nodules. Modified flakes are debitage flakes that exhibit signs of additional working, usually as pressure flaking either unifacially or bifacially along only the margins but are less stylized and not shaped into recognizable tools. Retouching along the margins removes irregularities and strengthens the cutting edge. Retouching was noted as either less than 50% or greater than 50% of the margin as wells as either unifacially or bifacially retouched.

Preforms are considered nodules that have been bifacially worked, primarily decorticated, and shaped into roughly oval or triangular shapes with somewhat worked margins to be further shaped at a later time. Blanks have been worked beyond that of a preform, becoming more symmetrical, thinner, with controlled pressure flaking, more closely resembling the tools final form. Point preforms are further worked, but do not include hafting elements. Projectile points can be identified by the presence of hafting features such as notching on the sides, corners, or base with a distinct stem or base. Additional information was recorded about their fragmentation, including breakage patterns and portion of projectile point recovered. Points were classified based on the refined typologies for the region defined by Sappington (1994), but Leonhardy and Rice’s (1970) typologies have been included as they are often referenced in archaeological reports.

Early Precontact Lithic Technology Phases

Windust phase (12,000–9500 BP): Lithic tool kits were durable and well developed, consisting of shouldered and stemmed projectile points, a variety of cobble tools, large lanceolate or oval knives, and numerous modified flakes (Leonhardy and Rice 1970; Sappington 1996). Windust style projectile points are rare in the region and only a few are from excavated contexts. Even fewer are associated with radiocarbon dates, though the Hatwai site (10NP143) offers a calibrated radiocarbon date of 12,750–10,000 BP. These tools typically have short blades with shoulders of varying prominence, convex margins with ground, straight to contracting stems as the hafting element and straight or slightly convex bases (Sappington 1994:13-15).

Cascade phase (10,000–4500 BP): Among the most widespread technology in the region, lithic tools are characterized by lanceolate projectile points, edge ground cobbles, well-made lanceolate and triangular knives, end scrapers, and modified flakes (Leonhardy and Rice 1970; Sappington 1996). They occur in tandem with the end of the Windust phase and are difficult to separate. In the Bitterroot Mountains Cascade points are large, unfluted, lanceolate projectile points (Munger 1993:15).

> Early Cascade phase (10,000–6000 BP): This subphase predates Mazama ash.
>
> Late Cascade phase (6000–3000 BP): This subphase postdates Mazama ash and includes large side notched projectile points.

Middle Precontact Lithic Technology Phases

Hatwai phase (6000–3000 BP): In the Clearwater region, lithic tools at this time are temporally congruent with the late Cascade phase, which are minimally represented in the region, and are morphologically similar to the Tucannon phase identified by Leonhardy and Rice (1970). Projectile points include large stemmed or corner notched points. There is minimal evidence for fishing technologies and evidence for plant processing appears restricted to edge-ground cobbles and a few mortars and pestles (Sappington 1994, 1996).

Tucannon phase (4500–2500 BP): Lithic assemblages are not considered to be an evolution of the Cascade phase, but an independently developed technology that is unique to the Lower Snake River region. Tools appear to be worked less intensely and include short blades with shoulders of varying prominence, stemmed points with contracting stems, points notched low on the side or at the corners with expanding stem and short barbs, small scrappers, few modified cobble spalls, pounding stones, net sinkers, hopper mortar base, and pestles (Leonhardy and Rice 1970; Sappington 1994, 1996). Arrow points in the Bitterroot Region include Avonlea side-notched, Desert side-notched, and Columbia Valley corner-notched points (Munger 1993:16).

Late Precontact Lithic Technology Phases

Ahsahka phase (3000–500 BP): Lithics include a rich variety of projectile point styles including corner, side, and base notched as well as stemmed points with small corner notched points being most common. Projectile point styles appear highly diverse, reflecting individual style rather than strict cultural parameters. Tri-notched and Desert side notched style, points begin to appear in the very late Ahsahka pahse, 700 BP, continuing into the Protohistoric. The diversity of raw material used is also characteristic of this phase.

Harder phase (2500–700 BP): Characterized by a transition from atlatls to bows and arrows, lithics include scrappers, knives, utilized spalls, net sinkers, hopper mortars, and pestles (Leonhardy and Rice 1970; Sappington 1994, 1996).

> Early Harder subphase (2500–700 BP): Includes large corner and basal notched projectile points and small side-notched points.
>
> Late Harder subphase (also known as the *Piqu'nin* or *Nimipu* phase 700–250 BP): Small, well-crafted corner and basal notched points with a variety of scrapers, lanceolate and pentagonal knives, spalls, net sinkers, hopper mortar base, and pestle (Leonhardy and Rice 1970).

Protohistoric Lithic Technology Phases

Kooskia phase (500–250 BP): Characterized by the presence of a wide variety of small, triangular projectile points including side, corner, and base notches. This phase represents some of the latest ancestral routine use of lithic material technology.

Debitage Analysis

Debitage was categorized primarily by flake technology, though a number of other attributes were also measured to evaluate the quality and character of the material including degree to which it has been worked (quantified by the number of dorsal flakes scars), amount of cortex present, and the termination type of each complete flake. The weight of each flake was determined using a standard digital scale, though many flakes are too small to register on the scale. Length, width, and thickness were measured using standard digital calipers. Cutting edge length was determined by using a string to contour the length of prepared cutting edge and then measured with digital calipers.

Flake technology refers to the method of reduction such as hard hammer, soft hammer, or pressure flaking. Each flaking technology leaves evidence of characteristic attributes on the flake that can be used to identify the tools used in the manufacturing process. Hard hammer flakes are the result of applied percussion force at less than 90° angles and have a pronounced point of percussion, erailleur scars, and are curved. Soft hammer flakes result from applied percussion at greater than 90° angles, often with a platform lip and diffused bulb of percussion. Pressure flakes are the result of applied pressure at greater than 90° angles, producing longer, thinner flakes with steep platforms angles.

To evaluate the degree to which the material is worked, dorsal flake scars were counted and categorized into four groups: 1) Not worked, no scars present, 2) Somewhat worked, 1–3 scars visible, 3) Moderately worked, 4–10 scars visible, and 4) Highly worked, more than 10 scars visible.

A high degree of cortex, or exterior rind developed through weathering, tends to suggest early-stage reduction or proximity to the original quarry source (Andrefsky 2001:11). The presence of cortex was noted as a percentage based on five groupings: 1) No cortex, 2) 1–25%, 3) 26–50%, 4) 51–75%, and 5) 76–100% cortex present.

Termination of each complete flake was identified and categorized into seven types: 1) Feathered, 2) Step, 3) Hinge 4) Overshoot, and 5) Material flaw. Termination refers to the distal end or edge of the flake that is produced. How a flake terminates is often the result of angle and force of percussion.

Geochemical Sourcing

Now more accessible and affordable than ever, Portable X-ray Fluorescence (pXRF) has gained interest and support among the archaeology community and has become a prominent tool of interpretation. Portable x-ray fluorescence refers to the handheld instrument, similar in size to a handheld drill, intended to be rugged and mobile for field use or mounted on a tabletop surface in a portable laboratory as opposed to sending materials away to an outside laboratory or for destructive analysis. This method is mobile, expedient, non-destructive, and relatively inexpensive.

Geochemical sourcing is a classification technique in which artifacts are sorted by chemical composition to their geographic origin, known as the parent source. Classification refers to the ordering of material into groups based on the geological relationship. This classification system is then used to assign artifact "types." Types are designated by conducting a statistical analysis of trace elements in various material samples (artifacts from each of the 19 archaeological sites) and sorting material by compositional characterization as compared to control samples (the Lochsa and Montana Creek sources samples collected during field work).

X-ray florescence works by causing secondary x-rays to be emitted from a material that has been bombarded with high-energy primary gamma rays from the instrument. When the sample is blasted with the rays, the electrons in the atoms of the sample are displaced. The distance and energy between displaced electron orbits are unique to each element. The instrument measures the distance of displacement and amount of energy emitted to identify the quantity and proportion of elemental concentrations in a given sample. To characterize unique sources, the analysis focus' on a handful of trace elements. Detected elements and their relative concentration ratios are then analyzed by statistical software that provides a display of results, including proportions in parts per million and standard error, that are then statistically analyzed to create clusters based on the chemical composition.

Vitrophyre is composed of primarily silicate minerals (SiO_2) and thus it is the trace elements that make geographically distinct materials chemically unique. Trace elements occur at less than 1% of the composition. For vitrophyre, these trace elements differ between sources by orders of magnitude that reflect the composition of parent material surrounding the eruption foci, variable thermodynamic properties at work in original formation, and by the ease with which certain elements can transform during the crystallization process. Light-ion lithophile elements (Rb, Sr, Ba, and Th) are too large to fit within the crystalline structure of the solid phase, while high-field strength elements (Zr, and Nb, Hf) have ionic charges that are too high to replace other ions in the solid phase (Glascock 2020). The concentration of these incompatible elements is therefore the most suitable for geochemical analysis and the best indicators of geographic origin.

Craig E. Skinner and Jennifer J. Thatcher (2013a) of the Northwest Research Obsidian Studies Laboratory, were the first to conduct a provenience study of vitrophyre in the region which included

48 vitrophyre artifacts from 10CW34 using x-ray fluorescence. Their results indicated that there could be anywhere from three to five chemically distinct vitrophyre sources in addition to the Lochsa and Montana Creek sources. A supplementary provenience analysis of 11 vitrophyre artifacts from four archaeological sites within the research area included 10CW30 (n=1), 10IH453 (n=3), 10IH1009 (n=6), and 10IH27237 (n=1) (Skinner and Thatcher 2013b). Nondestructive trace element analysis was completed using a Thermo NORAN QuanX-EC energy dispersive X-ray fluorescence (EDXRF) spectrometer. Using Sr/Zr ratios in parts per million, Skinner and Thatcher assigned all but one artifact to the Lochsa source. This initial testing sparked the interest to further investigate the presence of various vitrophyre sources at more archaeological sites in the region.

pXRF Method

Analysis was conducted over several weeks at the Washington State University Lithics Laboratory, in Pullman, Washington, using a portable Bruker Tracer 5g instrument, with the standard MURR/Bruker obsidian calibration. The calibration runs 50 kgv, 35 microamps, a 3 mm colimeter, with a three-metal filter of Cu 100 um, Ti 25 um, and AL 300 um. The MURR/Bruker obsidian calibration was developed by Glascock and Ferguson in 2012. The analysis compared 40 different solid obsidian source samples through three analytical methods including neutron activation analysis (NAA), microwave digestion inductively coupled plasma mass spectrometry (MD-ICP-MS), and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). More information about sample preparation and the analysis can be found in Glascock and Ferguson (2012). However, their results for all three methods were highly consistent with differences between techniques not exceeding 5%. Glascock and Ferguson recommended a list of 40 useful elements based on the NAA and MD-ICP-MS methods that would form the basis of the MURR/Bruker obsidian calibration used in this study. The calibration collects ratio data of Iron (Fe), Niobium (Nb), Rubidium (Rb), Strontium (Sr), Thorium (Th), Yttrium (Y), Zinc (Zn), and Zirconium (Zr) in parts per million.

For each test, the instrument was set on a mount and samples were processed with a run time of 120 seconds per sample. Artifacts were placed in front of the instrument beam with the cleanest, smoothest surface covering the entire window to ensure minimization of x-ray scatter. These data were then entered into a Statistical Package for Social Science (SPSS) program and analyzed with a hierarchical cluster and K-means analysis. Results of any x-ray fluorescence analysis can vary from machine to machine, thus the measurements from the previous analysis are not directly comparable with the measurements from this analysis.

Prior to x-ray analysis, all raw material samples were washed and air-dried to avoid contamination of outside elements from soil. All raw samples adhered to the minimum recommended sample size requirements, > 10 mm diameter and 3 mm thickness. Artifacts were not washed prior to testing. An effort was made to adhere to minimum sample size requirements, covering the entire instrument window, however minimum thickness was not always possible, which may lead to some issues with concentrations of light elements for thinner samples. Initial tests of the raw samples revealed effective clustering of Nb, Rb, Sr, Zr and, Zn ratios, determining that the standard MURR/Burke calibration would be sufficient for chemically characterizing the material (Figure 5.11).

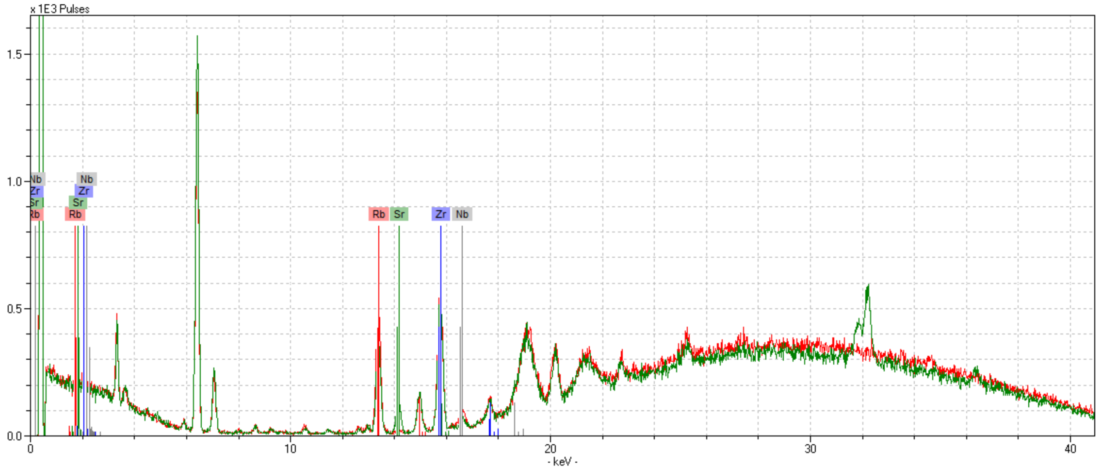


Figure 5.11 Element spectrum image of vitrophyre samples (Lochsa in red and Montana Creek in green) with elements highlighted (Rb, Sr, Zr, and Nb).

Samples of the Lochsa (n=26) and the Montana Creek (n=53) sources were characterized using the pXRF to determine whether these sources are geographically homogenous and chemically distinct from one another (Figure 5.12). The data were then arranged into a scatterplot to determine compositional clusters. Results of the initial analysis suggested that the two known sources are indeed chemically distinct from one another. Ratios of Sr/Rb, Sr/Zr, Sr/Zn, Sr/Nb, and Nb/Zr were selected as having the most impact on chemical characterization and provided the tightest clustering. While samples from each source were gathered from different areas, analyses showed that these sources were geochemically similar among the sampled area, thus these different collection areas were not considered when assigning source signatures.

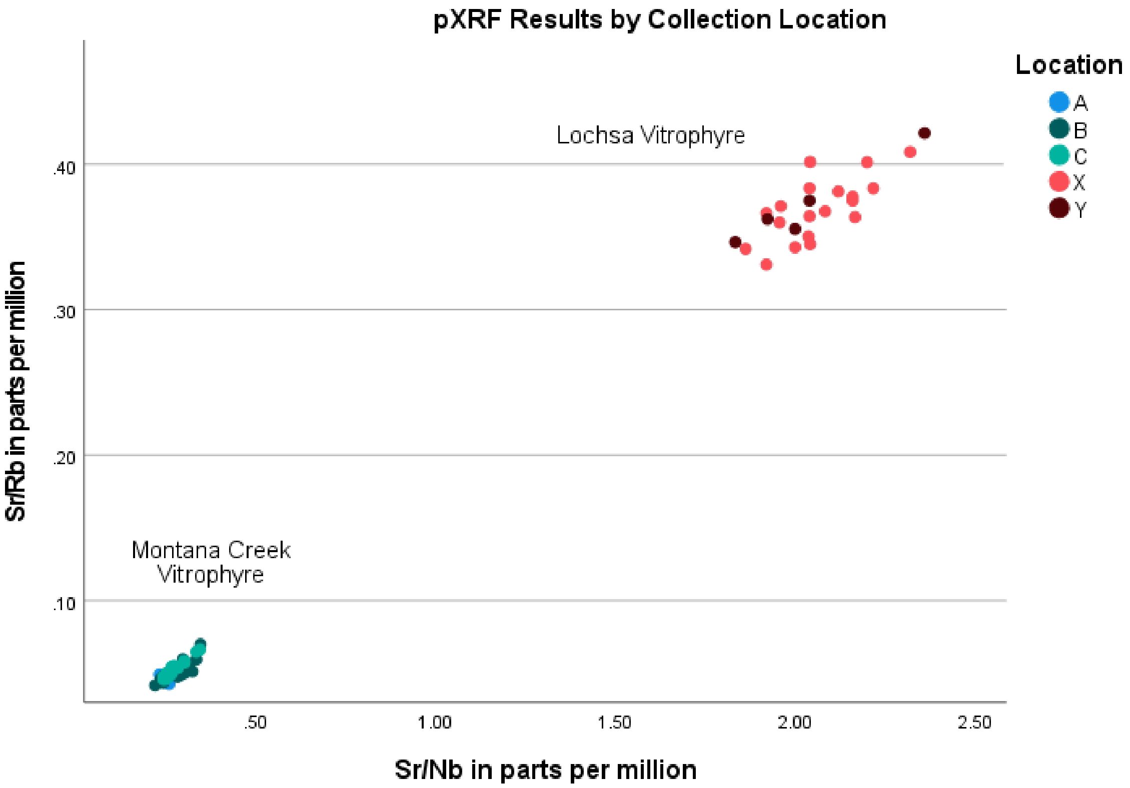


Figure 5.12 Scatterplot of pXRF results by collection location showing chemical homogeneity among source location.

Artifacts (n=394) from 15 sites, including tools, cores, and modified flakes (n=76) and debitage flakes (n=218) were analyzed. Any tool large enough to meet the minimum requirements of the instrument was analyzed. A stratified sample of debitage flakes that met the minimum diameter requirements to cover the window of the pXRF instrument were selected from each site. An effort was made to include a range of the smallest to largest sized flakes, with a range from 0–100% cortex, from multiple test units and depths. The goal was to include a 20% sample of the debitage for pXRF analysis. Due to the sample size of each site and minimum size requirements actual sample sized ranged from 5% to 100%.

A hierarchical cluster analysis determined the presence of four chemically distinct sources. Next, a K-means cluster analysis assigned artifacts into these four classes: Lochsa, Montana Creek, Unknown, and a single outlier (Figures 5.13 and 5.14). The outlying artifact created its own cluster which was removed from the interpretation until further chemical characterization can be done. Results show the artifacts (n=394) were distributed among the Lochsa source 93% (n=340), the Montana Creek source 22% (n=33), and the unknown source 5% (n=20).

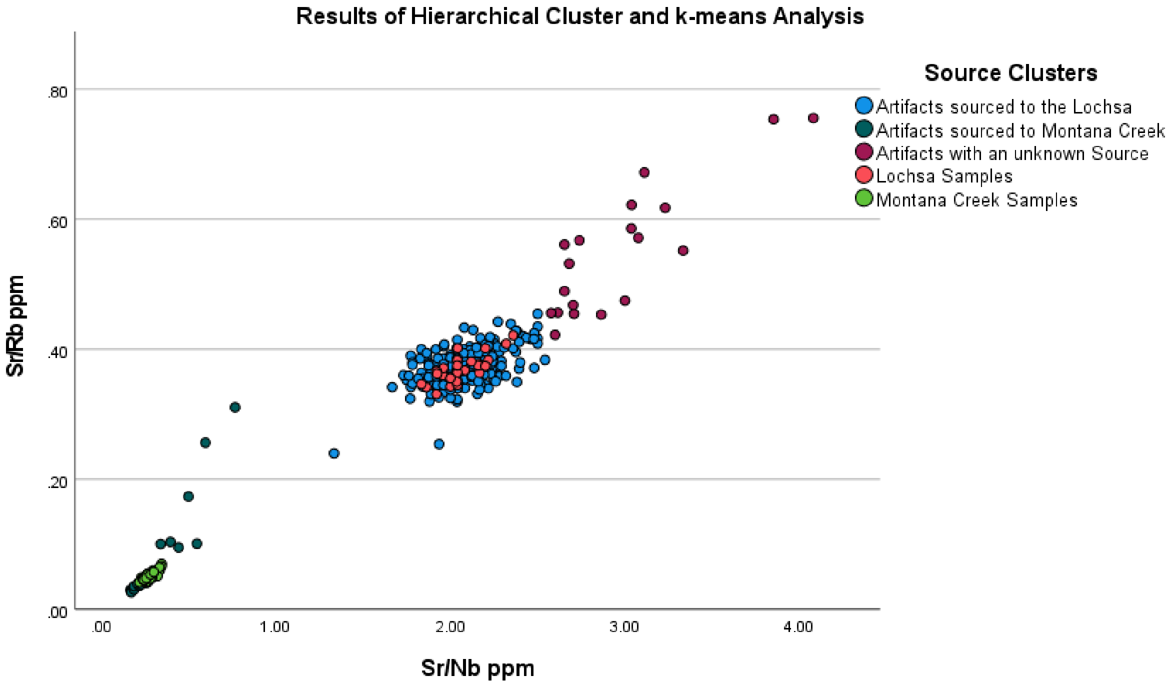


Figure 5.13 Scatterplot of vitrophyre samples and analyzed artifacts classified by the hierarchical and K-mean analysis.

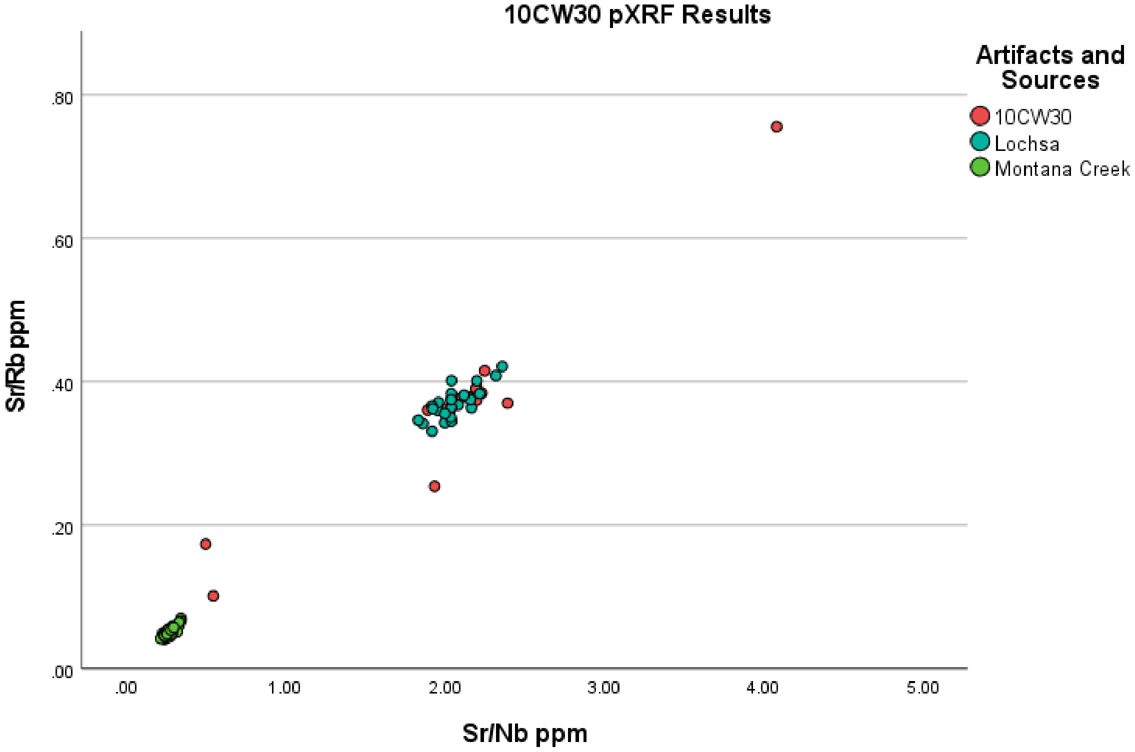


Figure 5.14 Example scatterplot of lithic distribution at a single site (10CW30).

Characterizing Unidentified Sources

Results of the analysis classified vitrophyre artifacts (n=21) from seven sites into an unknown class (Table 5.1). The materials (n=21) from the class were examined for a physical characterization (Figure 5.15). These items generally present as a translucent, very dark olive gray (5Y 3/1) with several large angular inclusions and many tiny, speckled inclusions (Globe 2005), but also showed moderate variation with a range of thin to rough cortex. Based on the examination, the unknown source was subdivided into three groups (Figure 5.16).

Table 5.3 Unidentified Vitrophyre pXRF Results by Site

Site	**Group A**		**Group B**		**Group C**	
	Tools	**Debitage**	**Tools**	**Debitage**	**Tools**	**Debitage**
10CW4				1		
10CW30		1				
10IH798				1	1 Core 1 Biface Preform	
10IH820				1	1 Point Preform 1 Core	1
10IH871				1	1 Modified Flake	6
10IH879				1		1
10IH1009	1 Biface Preform			1		
Total	1	1		6	5	8

Figure 5.15 Examples of vitrophyre from the Clearwater River region classified to an unknown source. Left to right: 10IH820 (21.1/1.15), 10IH871 (3.7.1), 10IH1009 (F4.5.6.7a), 10IH798 (6.0.3a), 10IH820 (26.5/3.62).

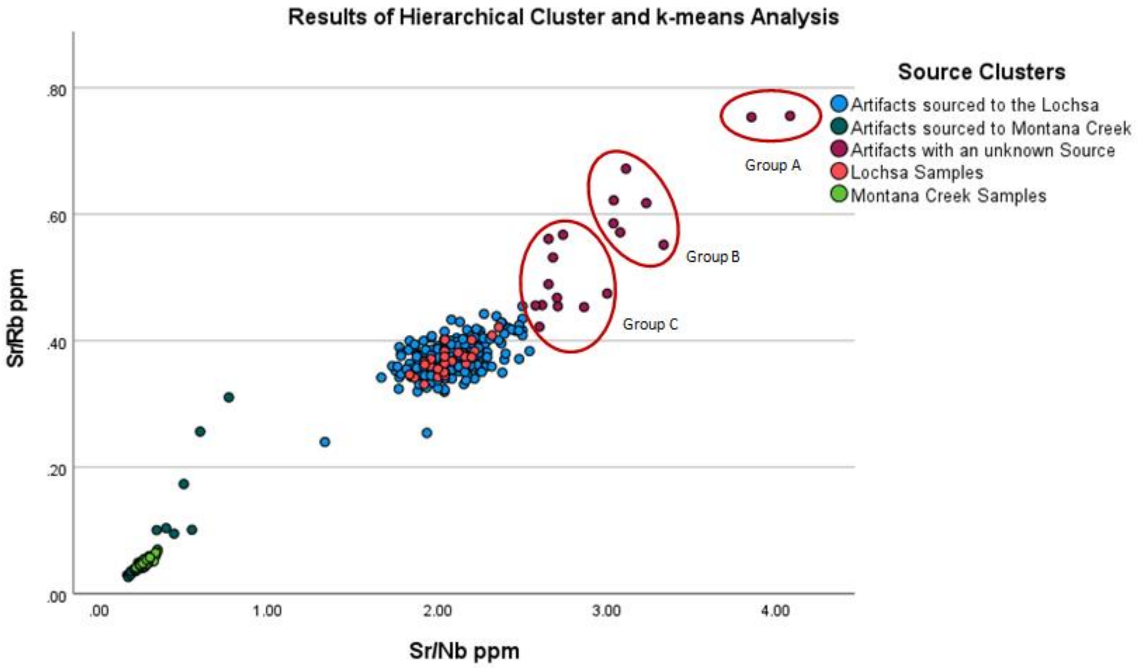


Figure 5.16 Scatterplot depicting potential subgrouping within the unknown classification.

Group A distinctly clusters together but independently from the unknown clusters. These items may represent an unidentified source coming from the southern end of the research area, possibly along the Selway or South Fork of the Clearwater River, that are represented as a formal tool and follow an inverted pattern of distribution compared to the Montana Creek source artifacts. Group B contains only debitage, including a few that are suspected to be near the instrument limitation. It is possible that these flakes represent a source of vitrophyre from a greater distance. Items from Group C are distributed primarily around the Sherman Creek lithic production area. These items could represent a chemical gradation of the Lochsa vitrophyre or they could be from a more distant source discarded in favor of new Lochsa material. The presence of cores, a bifacial preform, and a projectile with a production error support these items as a chemical gradient of the Lochsa vitrophyre.

Method Limitations

While this study has successfully classified vitrophyre, the potential limitations of the study must be noted. First, the right combination of trace elements is required to adequately characterize a material and often the creation of unique calibrations are required for new materials. Errors can occur due to the matrix effect, in which inter-element interactions causes excitation of elements with low atomic numbers causing artificially high readings of low atomic elements and lower readings of high atomic elements (Glascock 2020). This is of particular concern with vitrophyre due to the large-grained phenocryst inclusions in vitrophyre. The window of the instrument used in this study has a diameter of 3 mm, an effort was made to place to the most homogenous surface in the path of its view and a camera on the lens was used to avoid placing any large phenocrysts in the way of the x-rays. Clear clustering across the samples suggests this was not a significant issue for this assemblage.

Second, variability in surface roughness and sample size (surface area, thickness, mass etc.) can be a factor in pXRF readings. Ideal samples have surfaces that are clean, flat, and uniform with a minimum thickness of 3 mm necessary for absorbing x-rays and returning sufficient data to the spectrometer. Several sites within this study consist almost entirely of small debitage leading to the tiny artifact conundrum which can cause distortions in the pXRF reading due to the calibration curve. Glascock and others have successfully used ratios of incompatible elements (such as Sr/Rb, Y/Zr, Nb/Zr) to address this problem since ratios of adjacent elements are less distorted by the calibration curve and can reveal more distinct clusters, especially when samples are chemically similar (Glascock 2020). The distortion effect of tiny artifacts may have influenced the scattered reading in Group B of the unknown class of artifacts. Furthermore, the size limitations of the instrument window present bias in the representation of late-stage reduction and pressure flakes. Ereksen et al. (2007:586) demonstrate, through geochemical analysis of microdebitage, that small flakes and tools tend to have greater source diversity and are generally found farther from their original source. There may have been more representation of Group A if it were possible to test smaller artifacts and microdebitage.

Finally, erosion and river action can secondarily deposit vitrophyre along the riverbeds and alluvial terraces where many Nez Perce villages were located. We cannot be sure that any vitrophyre artifact was originally acquires from the parent source area or collected from a secondary source based on geochemical analysis alone. Together with experimental and lithic analysis, patterns may emerge that can clarify some of these concerns.

Chapter 6: Data and Results

Lithic Analysis Results

Vitrophyre artifacts (n=3539) from 18 archaeological sites were analyzed including tools and cores (n=149) and debitage flakes (n=3390) (Tables 6.1 and 6.2). One site (10IH2737) could not be relocated for analysis; however, Armstrong (2006) provides data for interpretation. Of the debitage, many were fragments, shatter, or otherwise undiagnostic. Analysis was focused on whole flakes (n=1815). Shatter comprised 5% (n=170) of the debitage, roughly 250 grams (g).

Table 6.1 Vitrophyre Artifacts

		Count (percent)
Tools		
	Projectile Points	29 (19%)
	Stemmed	4 (14%)
	Side Notched	6 (21%)
	Corner Notched	15 (51%)
	Uncategorized fragments	4 (14%)
	Point Preforms	14 (9%)
	Bifaces	10 (7%)
	Biface Preforms	15 (12%)
	Biface Blanks	5 (3%)
	Unifaces	3 (2%)
	Perforators	3 (>1%)
	Modified Flakes	33 (22%)
	Cores	37 (25%)
Debitage		3390 (96%)
	Shatter	170 (5%)
	Whole Flakes	1815 (54%)

Table 6.2 Vitrophyre Cores

Range (Average)	Length (mm)	Width (mm)	Thickness (mm)	Mass (g)
Cores	14-65 (34.9)	7-50 (30.6)	3-39 (13.3)	0.2-55.5 (18.2)

The collection of vitrophyre artifact in this assemblage represent a range of forms including tools, preforms, cores, and debitage at all stages of reduction across multiple locations and site types. Broad patterns in the region suggest vitrophyre is used most often as expedient modified flakes (22%, n=33), or as projectile points (19%, n=29), being transported as preforms and blanks. A breakdown of the distribution of vitrophyre at each site is described below.

Results of Lithic Analysis by Site

10CW4 Clearwater Fish Hatchery

Vitrophyre artifacts include two projectile point preforms and debitage (n=123). Debitage includes shatter (n=8) and whole flakes (n=82) (Table 6.3). One preform was found on the house pit floor with a radiocarbon date of approximately 1250 BP. Another preform was found in a stratum with no associated radiocarbon dates but which likely dates to later in the Late Precontact period as well, at least prior to 500 BP. Vitrophyre debitage associated with radiocarbon dates of 2000–1200 BP and in more recent levels that had no radiocarbon dates but likely predate the Protohistoric period.

Table 6.3 10CW4 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication or Secondary	10 (13%)	No Cortex	71 (86%)
Thinning	26 (32%)	1-25%	3 (4%)
Pressure	42 (51%)	26-50%	2 (2%)
Hard Hammer	1 (1%)	51-75%	3 (4%)
Soft Hammer	2 (2%)	75-100%	3 (4%)

The small percentage of early-stage reduction and the presence of projectile preforms suggest that vitrophyre was being brought into the site preliminarily worked for transportation with onsite activities emphasizing thinning and late-stage reduction of hunting tools. This is not surprising, given that 10CW4 is located nearly over 75 linear km from the closest known vitrophyre source.

10CW5 Ahsahka Sportsman's Access

Vitrophyre artifacts include corner notched projectile points (n=2) and one point fragment that are characteristic of the Ahsahka phase. Vitrophyre debitage could not be located to include in the analysis. However, the insignificant amount noted in the report (0.1%), suggests that vitrophyre was being brought into the site preliminarily worked or as finished tools and onsite activities were limited to only late-stage reduction or tool maintenance during winter months. Found near 10CW4, 10CW5 is located over 75 km from the nearest known source.

10CW25 Canoe Camp

Only one vitrophyre artifact was analyzed, a single corner notched projectile point that is characteristic of the Ahsahka phase. According to the excavation report, there should have been two debitage flakes as well (Sappington and Wegars 1988). After spot checking the curated collection from 1988 and the materials excavated from successive excavation, no other vitrophyre artifacts could be located. Similar to other sites in the Ahsahka area, the insignificant amount of vitrophyre debitage suggests that vitrophyre was being brought into the site preliminarily worked or as finished tools and onsite activities were likely limited to tool maintenance during slow winter months.

10CW30 Weitas Creek

Vitrophyre artifacts include tools (n=14) and debitage (n=31) (Tables 6.4 and 6.5). Projectile points included side notched points (n=3) which are characteristic of the Ahsahka phase, not originally noted by Keeler (1973), and lanceolate style bifaces (n=3) characteristic of the Cascade phase.

Table 6.4 10CW30 Tools

Material	Count (Percent)
Projectile Points	5 (36%)
Bifaces	3 (21%)
Biface Preforms	3 (21%)
Modified Flakes	3 (21%)

Table 6.5 10 CW30 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication or Secondary	1 (4%)	No Cortex	18 (78%)
Thinning	7 (30%)	1-25%	4 (17%)
Pressure	8 (35%)	26-50%	1(4%)
Soft Hammer	7 (30%)	51-100%	

The high number of tools suggest that vitrophyre was brought into the site preliminarily worked into preforms or tools, then further worked into finished hunting tools and used as expedient tools to process game or other resource. Debitage at the site also reflects late-stage reduction and tool maintenance.

10CW34 Kelly Forks

Vitrophyre artifacts include tools (n=21) and debitage (n=354), including shatter (n=17) and whole flakes (n=165) (Tables 6.6 and 6.7). The two small side notched projectile points are characteristic of the Ahsahka phase. The presence of a Goshen and Avonlea stye projectile point at the site indicates a connection with Plains groups occupying the Bitterroot region in the Early Precontact period.

Table 6.6 10CW34 Tools

Material	Count (Percent)
Projectile Points	2 (10%)
Point Preform	1 (5%)
Perforators	3 (14%)
Bifaces	1 (5%)
Biface Preforms	1 (5%)
Biface Blanks	1 (5%)
Modified Flakes	10 (48%)

Table 6.7 10CW34 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Pressure	27 (16%)	No Cortex	18 (83%)
Soft Hammer	117 (70%)	1-25%	4 (8%)
Hard Hammer	21 (13%)	26-50%	1 (4%)
		51-75%	2 (6%)

Similar to 10CW30, the high number of tools suggest that vitrophyre was brought into the site preliminarily worked into preforms or tools, further worked into finished hunting tools and used for expedient game processing. The majority of late-stage reduction debitage with no cortex or retouching points to tool manufacture and maintenance.

10CW92 Kelly Creek

Vitrophyre includes a single corner notched projectile point characteristic of the Ahsahka phase and debitage (n=2) including a single soft hammer flake exhibiting no cortex. This site is located adjacent to 10CW34 and similarly reflects the transportation of finished tools into the site with minimal onsite working of the material.

10IH453 Pete King Creek

Vitrophyre artifacts include tools (n=7) and debitage (n=126) (Tables 6.8 and 6.9). Debitage includes shatter (n=12) and whole flakes (n=68). Projectile points include a side notched point (n=1), corner notched points (n=2), and a stemmed point (n=1) characteristic of the Ahsahka phase. One modified flake and nine debitage flakes found in a feature with a radiocarbon date of 1750 BP supports the categorization of the Ahsahka phase.

Table 6.8 10IH453 Tools

Material	Count (Percent)
Projectile Points	4 (57%)
Point Preforms	1 (14%)
Modified Flakes	1 (14%)

Table 6.9 10IH453 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication	2 (3%)	No Cortex	59 (88%)
Thinning	4 (6%)	1-25%	6 (9%)
Pressure	41 (33%)	26-50%	1(1%)
Soft Hammer	11 (16%)	51-75%	
Hard Hammer	9 (13%)	76-100%	2 (3%)

The number of projectile points and preforms in combination with later stage debitage exhibiting no cortex suggest that vitrophyre was being brought in as finished tools or preforms and were being used for hunting and processing tools.

10IH798 Boulder Flat Terrace

Vitrophyre artifacts include tools (n=15) and debitage (n=119) (Table 6.10). The debitage includes shatter (n=4) and whole flakes (n=48) (Table 6.11).

Table 6.10 10IH798 Tools

Material	Count (Percent)
Bifaces	1 (7%)
Biface Preforms	2 (13%)
Modified Flakes	2 (13%)
Cores	9 (60%)

Table 6.11 10IH798 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Pressure	1 (2%)	No Cortex	21 (44%)
Soft Hammer	36 (75%)	1-25%	16 (33%)
Hard Hammer	11 (23%)	26-50%	6 (13%)
		51-75%	2 (4%)
		76-100%	3 (6%)

The high number of cores and lack of finished tools indicated that raw materials were being brought in to be preliminarily reduced, likely for transport else were, suggesting a closer proximity to the source. Later stage reduction flakes with 56% showing some degree of cortex further supports this.

10IH820 Kam'-nak-ka

Vitrophyre artifacts include tools (n=27) and debitage (n=716) (Table 6.12). Debitage includes shatter (n=10) and whole flakes (n=279) (Table 6.13). Vitrophyre is found in every stratum, dating from the Late Cascade to the Kooskia phases.

Table 6.12 10IH820 Tools

Material	Count (Percent)
Projectile Points	8 (30%)
Point Preforms	7 (26%)
Bifaces	1 (4%)
Biface Preforms	2 (7%)
Biface Blank	2 (7%)
Modified Flakes	3 (20%)
Cores	9 (60%)

Table 6.13 10IH820 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication	2 (<1%)	No Cortex	213 (16%)
Thinning	6 (2%)	1-25%	79 (28%)
Pressure	59 (21%)	26-50%	25 (9%)
Soft Hammer	193 (69%)	51-75%	10 (4%)
Hard Hammer	19 (7%)	76-100%	17 (6%)

As one of the most stratigraphically defined sites in this study, 10IH820 provides a unique opportunity to analyze the distribution of vitrophyre through time. Unit 24, which includes a radiocarbon dated feature in stratum 2 (500–300 BP), demonstrate this distribution through time (Table 6.14). The analysis of unit 24 shows that while vitrophyre was used by people throughout the entire occupation of the site, it was utilized most heavily during the Ahsahka (3000–500 BP) and Hatwai (6000–3000 BP) phases. In each phase, vitrophyre makes up an insignificant percentage of the tools as compared to other materials at 10IH820 which may reflect the proximity to the Kamiah Chert source to the east.

Table 6.14 Vitrophyre Distribution Through Time: 10IH820, Unit 24

		Vitrophyre			Unit 24 Totals	
Strata	**Phase**	**Tool Type**	**(Count/Percent)**	**Debitage**	**Flaked Tools**	**Debitage**
1–2	**Kooskia**	Stemmed Point Preform Blank	3 (> 0.01%)	74 (3%)	124	2304
3	**Ahsahka**	Modified Flake Uniface	2 (> 0.01%)	136 (7%)	61	1893
4	**Hatwai**	Core	1 (> 0.01%)	26 (5%)	13	525
5	**Late Cascade**			5 (2%)	6	203

The variety of tools indicate that raw materials were being brought in as cores and worked into preforms or finished tools, likely for transport and later use. The low degree of cortex may suggest that cores were tested for quality and preliminarily reduced at a workshop before being transported. This pattern is consistent with the Nez Perce practice of obtaining local, or semi-local materials from small geographic gathering ranges, particularly through the Late Precontact, during the winter months and preparing tools for summer subsistence activities. Additionally, the proximity of 10IH820 to Sherman Creek, the location of multiple vitrophyre production areas, may corroborate the creek bed as a potential procurement location from a secondary deposition.

10IH871 Beaver Flat

Vitrophyre artifacts include tools (n=21) and debitage (n=1348) (Table 6.15). Debitage includes shatter (n=39) and whole flakes (n=379) (Table 6.16).

Table 6.15 10IH871 Tools

Material	Count (Percent)
Bifaces	1 (5%)
Biface Preforms	2 (10%)
Blanks	1 (5%)
Unifaces	1 (5%)
Modified Flakes	3 (14%)
Cores	11 (52%)

Table 6.16 10IH871 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication or Secondary	116 (30%)	No Cortex	169 (45%)
Thinning	157 (41%)	1-25%	84 (22%)
Pressure	54 (14%)	26-50%	32 (8%)
Soft Hammer	34 (9%)	51-75%	23 (6%)
Hard Hammer	14 (4%)	76-100%	71 (19%)

The variety of preforms indicate that raw materials were brought in as cores and worked into preforms or finished tools on site, likely for transport and later use. The high percent of cores (52%), many of which were noted as being tabular in shape, indicates a close proximity to the source. A range of debitage types with a significant amount of early-stage reduction and cortex and lack of other materials, such as ground stone, suggest that procurement and preparation of raw materials were the main objective at this site. The lack of place names or ethnographically known trails in this location and the early date of the site (near the end of the Early Precontact and early Middle Precontact, roughly 8000–4000 BP), point to vitrophyre as an important resource for early inhabitants of the Upper Lochsa.

10IH879 Sherman Creek

Vitrophyre artifacts include tools (n=15) and debitage (n=215) (Table 6.17). Debitage includes shatter (n=14) and whole flakes (n=122) (Table 6.18). Tools include a corner notched point (n=1) characteristic of the Ahsahka phase and bifaces more characteristic of the Hatwai phase.

Table 6.17 10IH879 Tools

Material	Count (Percent)
Projectile Points	1 (7%)
Bifaces	1 (7%)
Biface Preforms	2 (13%)
Modified Flakes	2 (13%)
Cores	10 (67%)

Table 6.18 10IH879 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication or Secondary	9 (7%)	No Cortex	72 (80%)
Thinning	9 (7%)	1-25%	11 (11%)
Pressure	3 (2%)	26-50%	8 (7%)
Soft Hammer	93 (76%)	51-75%	11 (11%)
Hard Hammer	6 (5%)	76-100%	20 (16%)

The configuration of finished tool, preforms, and large number of cores, similar to 10IH871, indicates a vitrophyre lithic production area intensely exploited during the Middle and Late Precontact periods. The distribution of debitage represents all stages of reduction. Groups were likely stopping buy to pick up raw materials and prepare them for transportation and later use. Sherman Creek flows right through this site and likely transports vitrophyre cobbles from the source at the crest of Sherman Peak, depositing them in the creek bed below. Further testing of the 10IH879 location, the Sherman Creek trail and peak, and upland camp sites may reveal more insight about the source and workshop.

10IH1009 Tuhkaytahs'peh

Vitrophyre artifacts include tools (n=18) and debitage (n=970) (Table 6.19). Debitage includes shatter (n=69) and whole flakes (n=548) (Table 6.20). Tools include corner notched projectile points (n=2) that are characteristic of the Ahsahka phase. Over a dozen debitage flakes were associated with a probable pit house feature that dates to the Ahsahka phase. Another pit house floor feature, radiocarbon dated to 3400 BP or the Hatwai phase, contains several vitrophyre tools including a core, a uniface, a point base fragment, a blank, and debitage flakes (n=60).

Table 6.19 10IH1009 Tools

Material	Count (Percent)
Projectile Points	2 (11%)
Point Preforms	3 (17%)
Biface Preforms	3 (17%)
Biface Blanks	3 (17%)
Unifaces	2 (11%)
Modified Flakes	3 (17%)
Cores	2 (11%)

Table 6.20 10IH1009 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication or Secondary	23 (3%)	No Cortex	417 (76%)
Thinning	67 (7%)	1-25%	76 (14%)
Pressure	288 (30%)	26-50%	18 (3%)
Soft Hammer	155 (16%)	51-75%	13 (2%)
Hard Hammer	13 (1%)	76-100%	24 (4%)

The variety of tool forms represented at this site and the amount of debitage indicate that vitrophyre was brought in as cores and worked into preforms or finished tools, likely for hunting and processing tools. The high percentage of late-stage reduction strategies and the low degree of cortex represented in the debitage indicates that cores were preliminarily reduced at the site of the source or an adjacent production area before being transported to the site. Vitrophyre distribution between the Ahsahka phase and Hatwai phase pit houses suggests a more intense use of vitrophyre in the Middle Precontact versus the Late Precontact.

10IH1395 Kooskia Bridge

Vitrophyre artifacts include a corner notched projectile point (n=1) characteristic of the Ahsahka phase and debitage (n=45). Debitage includes shatter (n=2) and whole flakes (n=29) (Table 6.21). The projectile point and two debitage flakes were found in a house pit floor with a radiocarbon date of 700 BP. Additional vitrophyre debitage was associated with another probable house pit floor with a radiocarbon date of 300 BP, representing some of the latest traditional use of lithic materials during the Kooskia phase.

Table 6.21 10IH1395 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Pressure	15 (52%)	No Cortex	25 (86%)
Soft Hammer	13 (45%)	1-25%	1 (3%)
Hard Hammer	1 (3%)	26-50%	1 (3%)
		51-75%	2 (7%)

The minimal representation of vitrophyre suggests that it was not an important resource, which may be due to its proximity to the Kamiah Chert source. The later date of the site (the Protohistoric and Historic era), when upland resources, such as vitrophyre, were not as intensively utilized may also explain the limited representation of vitrophyre. Vitrophyre was likely brough in as preforms or finished tools, and reduction was limited to finial reduction and tool maintenance evident through the high number of pressure flakes and flakes with no cortex.

10IH1948 O'Hara Bar

Vitrophyre artifacts include a biface (n=1) and debitage (n=9). Debitage includes whole flakes (n=7) (Table 6.22).

Table 6.22 10IH1948 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Pressure	1 (14%)	No Cortex	5 (71%)
Soft Hammer	5 (71%)	1-25%	2 (29%)
Hard Hammer	1 (14 %)		

Minimal late-stage reduction debitage and a single biface suggest that vitrophyre was brought into the site as preforms or finished tools, and reduction activities were associated with tool manufacturing or maintenance.

10IH2737 Rackliff

This assemblage could not be located for laboratory analysis; therefore, interpretations are based on Armstrong (2006). According to Armstrong (2006), vitrophyre debitage flakes (n=27) were noted in the top 10 levels of various units and test probes. Debitage was generally described as prominently late-stage reduction with some bifacial thinning flakes and only two primary or secondary flakes. No vitrophyre pressure flakes were noted. Site activities were described as oriented toward tool maintenance. One vitrophyre projectile point, described as a Windust phase, was noted below Mazama ash. This is a particularly important site for vitrophyre because it demonstrates the use of vitrophyre as early as the Windust phase, indicating use at least 10,000–7000 years ago.

10LE34 and 10LE102 Highway 12

Vitrophyre between these sites is comprised of only debitage (n=15) including shatter (n=1) and whole flakes (n=8) (Table 6.23).

Table 6.23 10LE34 and 10LE102 Debitage Analysis

Type	Count (Percent)	**Cortex**	Count (Percent)
Decortication	1 (13%)	No Cortex	5 (63%)
Pressure	2 (25%)	1-25%	1 (13%)
Soft Hammer	5 (63 %)	76-100%	1(13%)

With no tools and minimal late stage debitage represented at this site, vitrophyre was likely brought in as finished tools and onsite reduction was probably limited to tool maintenance at these base camps.

10LE75 Kittle Rock Shelter

Vitrophyre artifact include only modified flakes (n=2). This rock shelter site dates to the Early to Late Precontact, indicating that vitrophyre was procured and transported by very early inhabitants of the region. Materials were likely transported in curated tools kits including robust vitrophyre flakes that exhibit retouched edges. They may have been brought in and cached as modified flakes or removed from a larger biface for expedient use. However, there is minimal evidence for large vitrophyre biface cores at this or any other site.

BT6 Ginger Flats

Vitrophyre artifacts include a biface preform (n=1). Several vitrophyre flakes were noted during testing but were not collected. This limited information suggests that vitrophyre was transported along the Lochsa and utilized at several hunting camps through the Middle Precontact.

Summary

Results of the analysis indicate that generally vitrophyre is procured as raw nodules and cores, further reduced at lithic production areas for transportation as points or preforms. Several base camp sites show evidence for the use of vitrophyre as expedient tools and modified flakes for processing. At the farthest reaches, vitrophyre appears as finished projectile points with reduction activity limited to tool maintenance. This pattern indicates a central place foraging strategy wherein, artifacts farther from the source are more highly worked and debitage is smaller with later stage reduction such as the assemblages near Ahsahka (10CW4, 10CW5, and 10CW25). On the other hand, artifacts at residential and base camp sites much closer to the sources (such as 10CW30, 10IH453,10IH820, and 10IH1009), include more bifaces and preforms with all stages of reduction are represented.

Geochemical Results

Artifacts (n=395) from 15 archaeological sites were analyzed with pXRF, including tools, cores, and modified flakes (n=77), and debitage flakes (n=218). Due to instrument failure, two sites (10CW5 and 10CW34) could not be included in the pXRF laboratory analysis. The Rackcliff site (10IH2737) could not be located and no material from 10LE102 met the minimum size requirements for pXRF analysis. However, information from previous XRF analysis by Skinner and Thatcher (2013a, 2013b) and Longstaff (2013) is included into the interpretations for sites 10CW34 and 10IH2737.

Geochemical analysis of these artifacts tells us what ratios of the two known vitrophyre sources are present at each site and indicated the presence of any additional unidentified sources. Once the artifacts were sourced, patterns emerged signifying the movement of lithic material across the landscape that can be used to make connections and inferences about other mobility, subsistence, or social patterns of the people that carried these artifacts. Results from laboratory analysis show that tested artifacts (n=395) were distributed among the Lochsa source (n=340, 86%), the Montana Creek Source (n=34, 9%), and what is termed here as an “unknown source” (n=20, 5%) (Table 6.24).

The hierarchical analysis and subsequent K-means analysis assigned artifacts to sources based on the best fit relative to trace element ratios selected as variables. While some artifacts were classified as a single unknown source, due to the small sample size, this classification may represent multiple sources that are more related to one another than to the two known sources. Future research should work to identify and collect a larger source sample of vitrophyre in the region in order to tease out the number and character of unknown sources. Several artifacts classified as either the Lochsa or

Montana Creek sources appear to fall outside the original clusters of the source samples. Samples collected from both sources were geographically limited, so classifications outside the sample cluster may represent a geographical and chemical gradient of the same source, or an unidentified source that is more chemically similar to one of the known sources. Based on these results, there could be as many as five unidentified sources (discussed in more detail in Chapter 5).

Table 6.24 Vitrophyre Assemblage pXRF Results

Source, Count (Precent)	**Lochsa**	**Montana Creek**	**Unknown**
Tools	58 (17%)	13 (38%)	6 (20%)
Projectile Points	9 (16%)	7 (54%)	
Point Preforms	3 (5%)		1 (17%)
Blanks	5 (9%)		
Bifaces	5 (9%)	2 (15%)	
Biface Preforms	10 (18%)		2 (33%)
Unifaces	1 (2%)		
Modified Flakes	16 (28%)	3 (23%)	1 (17%)
Cores	17 (29%)	1 (8%)	2 (33%)
Debitage	183 (45%)	21 (64%)	14 (70%)
Total	340 (86%)	34 (6%)	20 (5%)

Not surprisingly, vitrophyre in the region is predominantly from the local Lochsa source. Situated roughly at the center of the research area, along a major tributary and near major trails, this location would have been crossed many times over the many thousands of years that people occupied the region. Results of the lithic analysis show that generally, Montana Creek materials are being transported into the Clearwater region as finished tools, indicating some distance from the original source or the possibility of trade or intergroup interactions. A significant trail route, the Lolo Trail, crosses the over the Bitterroots and through Nez Perce country just north of Sherman Peak, the location of the Lochsa vitrophyre.

The relative proportion of vitrophyre sources represented at the site and artifact form (tools, preforms, cores, or debitage) can provide clarification about how these two vitrophyre sources were being used and transported across the landscape. A description of vitrophyre sources by site is described below (Table 6.25).

Table 6.25 Vitrophyre pXRF Results by Site

Site	Lochsa	Montana Creek	Unknown
10CW4	9 (82%)	1 (9%)	1 (9%)
10CW25	1 (100%)		
10CW30	12 (50%)	10 (42%)	2 (8%)
10CW34*	9 (60%)	3 (20%)	3 (20%)
10CW92		1 (100%)	
10IH453	16 (94%)	1 (6%)	
10IH798	39 (93%)	1 (2%)	2 (5%)
10IH820	41 (76%)	10 (21%)	3 (6%)
10IH871	108 (91%)	2 (2%)	8 (7%)
10IH879	56 (94%)	2 (3%)	2 (3%)
10IH1009	54 (94%)	1 (2%)	2 (4%)
10IH1395	2 (66%)	1 (33%)	
10IH1948	1 (50%)	1 (50%)	
10IH2737*		1 (100%)	
10LE34	1 (100%)		
10LE75		2 (100%)	
BT6	1 (100%)		

*Results derived from Longstaff (2013:373-.375, Appendix 5) and Skinner and Thatcher (2013a, 2013b).

Results of Geochemical Analysis by Site

10CW4 Clearwater Fish Hatchery

An 8% sample (n=11) was analyzed with the pXRF. The sample includes the distal fragment of a point preform (50% of the vitrophyre tools) and an 8% sample of the debitage flakes (n=10). The analysis showed that 91% of vitrophyre at the site belongs to the Lochsa source, including the point preform fragment (n=1) and debitage flakes (n=8). The preform fragment was found in a feature radiocarbon dated to 1500–1200 BP. The Montana Creek and the unknown source were represented by a single debitage flake each indicating that other sources may have been brought through as finished tools or blanks, but Lochsa was the primary vitrophyre source being utilized.

10CW5 Ahsahka Sportsman's Access

Unable to be analyzed due to technological failure of the instrument during the research process.

10CW25 Canoe Camp

The single serrated, corner notched, Ahsahka phase projectile point from this site was assigned to the Lochsa source (100% of the vitrophyre sample), indicating that Lochsa vitrophyre was being brought to the site in relatively minimal quantities compared to other materials.

10CW30 Weitas Creek

A 57% sample (n=24) of the artifacts were analyzed by pXRF, including all tools that met the minimum requirements for analysis (n=12, 85% of the tools), inflating the sample size, and debitage (n=10, a 48% sample of the debitage) (Table 6.26). Artifacts are distributed among the Lochsa (50%), Montana Creek (42%), and the unknown source (8%).

Table 6.26 10CW30 pXRF Results

Artifacts (Count)	**Lochsa**	**Montana Creek**	**Unknown**
Tools	5	6	1
Projectile Points		4	1
Bifaces	1	1	
Biface Preforms	2		
Modified Flakes	1	1	
Cores	1		
Debitage	7	4	1

These results show that both the Lochsa and Montana Creek sources were being brought to this hunting camp as finished tools and preforms in roughly even proportions. The unknown source is represented as a single debitage flake which may indicate greater distance from the source.

Cascade phase projectile points, bifaces, and preforms manufactured from of both Lochsa (n=3) and Montana Creek (n=1) vitrophyre indicate that both sources were being utilized during the Early Precontact, with the Lochsa source being more dominant. Hatwai phase modified flakes and debitage, interpreted by Keeler (1973) are represented in equal quantities of Lochsa and Montana Creek Vitrophyre, demonstrating that both sources were being extensively utilized in during the Middle Precontact. The presence of two Ahsahka phase projectile point from the Montana Creek source and one from an unidentified source illustrates continued use of Montana Creek vitrophyre into the Late Precontact.

10CW34 Kelly Forks

This site was not able to be analyzed with the pXRF in our laboratory due to technological failure of the instrument during testing. The results of a 2013 XRF analysis will be discussed in lieu of original results, which cannot be considered directly comparable due to the nature of the methodology discussed in the previous section. According to the sample of vitrophyre artifacts (n=15) tested by Skinner (2013) for Longstaff (2013), artifacts are distributed among the Lochsa source (n=9, 60%), the Montana Creek Source (n=3, 20%), and an unknown source (n=3, 20%). Longstaff (2013) reported that at least one flake of the unknown source was associated with a radiocarbon dated feature (6560–6400 BP) in Area A (Figure 6.1).

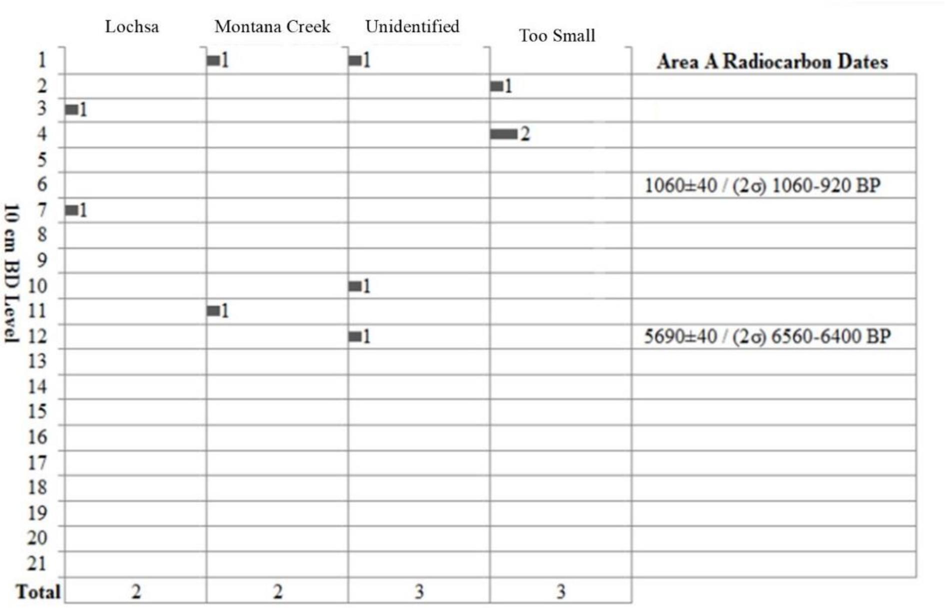


Figure 6.1 Stratigraphic distribution of vitrophyre from Area A at 10CW34 (adapted from Longstaff 2013:378, Figure 224).

Located just 45 km west of the Montana Creek Source, it is somewhat surprising that the Montana Creek source is not more prevalent. While the presence of Goshen technology suggests a connection between groups, the separation of sources may suggest separation of territory and resources or anonymity between groups. These results are likely skewed by the small sample size and should be further investigated, particularly since there are many more vitrophyre artifacts from this site.

10CW92 Kelly Creek

A 50% sample (n=1) of vitrophyre was analyzed with the pXRF. A single projectile point indicates that people were coming to this location with finished tools from the Montana Creek source, possibly as part of a curated hunting tool kit.

10IH453 Pete King Creek

A 12% sample (n=17) was analyzed with the pXRF including 43% of the tools (n=3) and 11% of the debitage (n=14) (Table 6.27). Generally, artifacts from 10IH453 are distributed among the Lochsa (94%) and the Montana Creek (6%) sources.

Table 6.27 10IH453 pXRF Results

Artifacts (Count)	**Lochsa**	**Montana Creek**
Tools	2	1
Projectile Points		1
Modified Flakes	2	
Debitage	12	

Results indicate that finished tools were brought into the site from the Montana Creek source. Vitrophyre is presented at the site as modified flakes, likely used to process game at this hunting camp. Several projectile points from the assemblage could not be located for pXRF analysis, but it is clear that both Lochsa and Montana Creek vitrophyre were being utilized at this site though Lochsa vitrophyre was being worked on site while Montana Creek artifacts came in their final forms.

10IH798 Boulder Flat Terrace

A 32% sample (n=42) was analyzed with the pXRF including 100% of the tools (n=13) and 24% of the debitage (n=29) (Table 6.28). Artifacts from 10IH798 are distributed among the Lochsa (93%), the Montana Creek (2%), and the unknown source (5%).

Table 6.28 10IH798 pXRF Results

Artifacts (Count)	**Lochsa**	**Montana Creek**	**Unknown**
Tools	13	1	1
Bifaces	1		
Biface Preforms	2		1
Modified Flakes	4		
Cores	6	1	
Debitage	2		1

These results show that all three sources were brought into the base camp as cores or preforms to be worked into hunting tools. It is not surprising that the Lochsa source comprises the majority of the tools, since the site is located adjacent to the source.

10IH820 Kam'-nak-ka

A 7% sample (n=54) was analyzed with the pXRF including 65% of the tools (n=17) and 5% of the debitage (n=37) (Table 6.29). Much of the debitage at the site is too small for the limitations of the instrument. Artifacts are distributed among the Lochsa (76%), the Montana Creek (21%), and the unknown source (6%).

Table 6.29 10IH820 pXRF Results

Artifacts (Count)	**Lochsa**	**Montana Creek**	**Unknown**
Tools	15	1	2
Projectile Points	7		1
Point Preforms			
Biface Preforms	1		
Blank	2		
Modified Flakes	3		
Cores	2	1	1
Debitage	26	9	1

Results show that all three sources were brought into the site as cores, likely to be worked into tools over the winter months for use in summer activities. The higher percentage of Lochsa tools and debitage indicate a closer proximity to the source, while the Montana Creek and unknown sources were likely transported greater distances. Interestingly, the Lolo and Nee Me Poo trails cross right through this site which connects the northern portion and southern portion of the research area that seem to be exhibiting the highest concentrations of Montana Creek source. *Kam'-nak-ka* was located near several villages known ethnographically to be an economic hub for trade and access other local resources.

10IH871 Beaver Flat

A 9% sample (n=118) was analyzed with the pXRF including 82% of the tools (n=9) and 8% of the debitage (n=109) (Table 6.30). Artifacts are distributed among the Lochsa (91%), the Montana Creek (2%), and the unknown source (7%).

Table 6.30 10IH871 pXRF Results

Artifacts (Count)	**Lochsa**	**Montana Creek**	**Unknown**
Tools	8		1
Bifaces	1		
Biface Preforms	1		
Blank	2		
Unifaces	1		
Modified Flakes	3		1
Debitage	93	2	6

The high percentage of early-stage tools manufactured of Lochsa vitrophyre show the close proximity to the sources at this lithic production area. Though the other sources are not represented as discarded tools, these results show that people were carrying other materials with them while occupying this camp, possibly refurbishing tools during hunting expeditions.

10IH879 Sherman Creek

A 26% sample (n=60) was analyzed with the pXRF including 92% of the tools (n=12) and 22% of the debitage (n=48) (Table 6.31). Artifacts are distributed among the Lochsa (94%), the Montana Creek (3%), and the unknown source (3%).

Table 6.31 10IH879 pXRF Results

Artifacts (Count)	**Lochsa**	**Montana Creek**	**Unknown**
Tools	13		
Bifaces	1		
Biface Preforms	2		
Modified Flakes	2		
Cores	8		
Debitage	47	2	3

The high percentage of early-stage tools and cores manufactured of Lochsa vitrophyre show the close proximity to the sources at this lithic workshop. Though people were carrying other materials from both the Montana Creek and potentially another source, perhaps as finished tools needing retouching for hunting activities while stopped to replenish raw materials.

10IH1009 Tuhkaytahs'peh

A 6% sample (n=57) was analyzed with the pXRF including 60% of the tools (n=9) and 5% of the debitage (n=48) (Table 6.32). Much of the debitage was too small for the limitations of the instrument. Artifacts are distributed among the Lochsa (94%), the Montana Creek (2%), and the unknown class (4%).

Table 6.32 10IH1009 pXRF Results

Artifacts (Count)	**Lochsa**	**Montana Creek**	**Unknown**
Tools	7		
Point Preforms	2		
Biface Preforms	2		1
Blanks	1		
Modified Flakes	2		
Core			1
Debitage	47	1	

Results indicate that the Lochsa source was brought to the site in all forms and worked into hunting tools on site. Some Montana Creek materials may have been brought in and retouched on site, but in minimal quantities. The unknown source, represented as a core and preform, indicates a possible source located near the South Fork or Selway Rivers being transported north. The less worked core indicates a closer proximity to the unknown source than say site 10CW30 which has only one projectile point and a piece of debitage or other sites that contain only debitage from the unidentified source.

10IH1395 Kooskia Bridge

A 7% sample (n=3) was analyzed with pXRF including 100% of the tools (n=1) and 4% of the debitage (n=2). Vitrophyre debitage is minimal and many were too small to analyze. Of this limited sample, one projectile point and one debitage flake were of Lochsa vitrophyre (66%). The Montana Creek source (33%) was represented by one debitage flake. Both sources were being brough into the site, likely as finished tools but vitrophyre was not an important resource. This may reflect the proximity to the Kamiah Chert source, or the later occupation of the site compared to the surrounding sites that do exhibit more vitrophyre.

10IH1945 O'Hara Bar

A 20% sample (n=2) was analyzed with pXRF including 100% of the tools (n=1) and 11% of the debitage (n=1). Debitage at the site is minimal, of this limited sample, one biface fragment (50% of the sample) is from the Lochsa source and one debitage flake (50%) is from the Montana Creek source. This suggests that both sources were brought into the site, likely as finished tool that were retouched or maintained while stopping to acquire argillite from a nearby source or during hunting and gathering expeditions.

10IH2737 Rackliff

The original Armstrong (2006) report submitted several pieces of obsidian and the vitrophyre Windust point for geochemical analysis to the Geochemical Research Laboratory in California (Figure 6.2). The vitrophyre artifact did not match any known samples at that time. Later, Skinner and Thatcher (2013b) classified the point as Montana Creek.

Figure 6.2 Windust projectile point, made of Montana Creek vitrophyre, found at 10IH2737 (Skinner 2013b).

10LE34 Highway 12

A 13% sample (n=1) was analyzed with pXRF including 100% of the debitage (n=1) from the Lochsa source. Vitrophyre only consist of only debitage flake. This limited data indicates that people were crossing the Middle Fork with Lochsa vitrophyre during hunting and processing expeditions, as early as 2000 BP, if not earlier.

10LE75 Kittle Rock Shelter

A 100% sample (n=2) was analyzed with pXRF including modified flakes (n=2) from the Montana Creek source. The artifacts indicates that Montana Creek vitrophyre was worked and transported beyond the Middle Fork as early as 8000 BP to 1200 BP.

BT6 Ginger Flats

A 100% sample (n=1) was analyzed with the pXRF including a biface preform (n=1) of Lochsa vitrophyre from a butchering camp dating to the Middle Precontact.

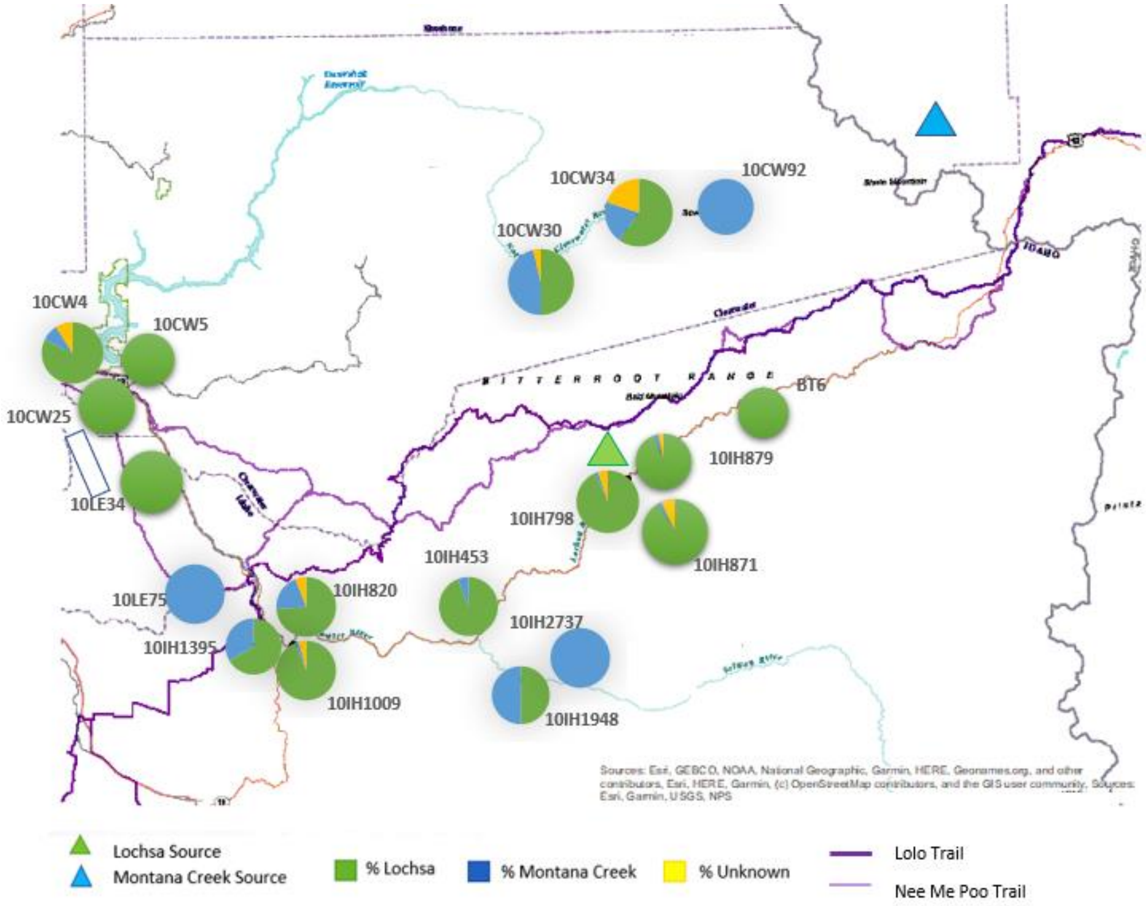
Summary

These results indicate that the assemblages are primarily Lochsa vitrophyre. Of the sites analyzed, 87% are predominantly Lochsa vitrophyre. However, it is clear that Montana Creek vitrophyre was broadly utilized as well, if not more infrequently. Only four of the sites (21%) did not include Montana Creek vitrophyre. Two sites (10LE75 and 10IH2737) located 100–120 km west of the source contained 100% Montana Creek vitrophyre, illustrating a patterning in the distribution of Montana Creek vitrophyre that is different than the local vitrophyre.

Vitrophyre Use Across Space

It appears that the Nee Me Poo, Wise’isskit, and Lolo trails contribute to the distribution of Montana Creek and the unknown vitrophyre in the region which may reflect the movement of neighboring groups through Nez Perce territory (Figure 6.3). The Lolo trail was known as *Nak sone mah*, meaning ‘the path to salmon’ (Sappington 1995:182-183) and as *Wah-winto-lech-it*, referencing ‘buffalo country to the east’ (Schwede 1970:102). The highest concentrations of Montana Creek vitrophyre were found at the sites closest to the source, along the North Fork of the Clearwater River, or near Kooskia, Idaho. Kooskia was known ethnographically as a place for surrounding groups to gather hemp and camas and was the location of a large trade market (Sappington and Carley 1995:206). The Wise’isskit, or Southern Nex Perce Trail, connects the southern Bitterroot Valley to the northern Nez Perce territory just south of Kooskia where it crosses the South Fork of the Clearwater River. The distribution of material may reflect seasonal rounds connecting these trail systems.

According to *Kew-kew'-yah*, or 'Billy' Williams a Nez Perce elder that helped Alice Fletcher develop ethnographic maps of the region, Craig Mountain served as a physical and social division point for the region in which some groups lived to the west, the '*Pu-nim'-moo'* meaning people of the Snake River, or to the east, *Na-ki-ma* 'the other side' (Sappington and Carley 1995:189). The *Na-ki-ma* group occupied the Clearwater River drainage. *Kew-kew'-yah* noted several villages in the Kooskia area including *Tuke'?ywewi* (10IH1395) the leader village of the *Tsy-was-'poo* group which controlled much of the *Na-ki-ma* area, including access to Camas Prairie, and intercepted visitors from the east and south (Sappington and Carley 1995:208).



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Sources: Esri, Garmin, USGS, NPS

Figure 6.3 Map of vitrophyre source distribution, represented as pie charts for each site, including major ethnographic trails.

The disproportionate concentration of Montana Creek vitrophyre along the Selway and South Fork near the Kooskia area may be due to non-local groups such as the Salish traveling to this ecological and social hub and spending time hunting and gathering in the area. The connection between groups in Kooskia is further indicated by the density of place names of Salish origin in the area that denote landmarks, trails, and camps such as *pasaso.nam* referring to a trail to Kamiah (Schwede 1970:56), *q'ulpleqelése* referring to fish traps near Kooskia (Schwede 1970:22), *Tsuhho'lohxkun* referencing a ridgeline southeast of Kooskia (Chance and Chance 1987:134), and *cipunépu* a Salish camp located in Lawyer Creek Canyon which may reference 10LE75, a site which includes only Montana Creek vitrophyre (Schwede 1970:66). The *Sel'whuh* (Selway River) and *Lok'suh* (Lochsa River) are both Salish terms referencing the people who lived there (Chand and Chance 1987:92-93). *Kew-kew'-yah* also noted a village, *Ne'hu-lat-poe*, said to be the oldest Nez Perce village near a passage to the Bitterroots. The two groups have a long history of interconnection that appear to be confirmed though the distribution of Montana Creek vitrophyre.

Vitrophyre Use Over Time

Vitrophyre appears in all chronological periods of the Clearwater River region. The presence of Windust and Cascade phase tools of both Lochsa and Montana Creek vitrophyre, supported by radiocarbon dates, indicate both sources were being used and transported though the region as long as people have occupied the Clearwater River drainage. The distribution of vitrophyre use over time models the overall regional occupation and subsistence patterns described in previous archaeological work, with the highest concentrations during the Middle and Late Precontact (Table 6.33).

Table 6.33 Distribution of Vitrophyre Across Time

Site	Early Precontact	Middle Precontact	Late Precontact	Protohistoric	Historic
10CW4			X	X	
10CW5			X		
10CW25			X		
10CW30	X	X	X		
10CW34	X	X	X		
10CW92			X	X	
10IH453			X	X	X
10IH798					
10IH820	X	X	X	X	
10IH871	X	X			
10IH879		X	X		
10IH1009		X	X		
10IH1395			X	X	
10IH1948			X	X	
10IH2737	X	X	X		
10LE34			X	X	X
10LE104			X		
10LE75		X			
BT6		X			

Vitrophyre use is infrequent, but widely distributed, in the Early Precontact (Figure 6.4). This pattern coincides with the high mobility and broad range foraging patterns of the Early Precontact that focused on upland resources. These sites are exclusively upland base camps with the exception of a lithic production area at Beaver Flats near the Lochsa source. During the Middle and Late Precontact, vitrophyre use becomes relatively more intensified, reflecting population growth and denser occupation of people with smaller geographic gathering ranges (Figures 6.5 and 6.6). There is a stark increase in the number of village sites by the Late Precontact, particularly near Ahsahka and Kooskia to the west, and with it a general increase in cultural material density.

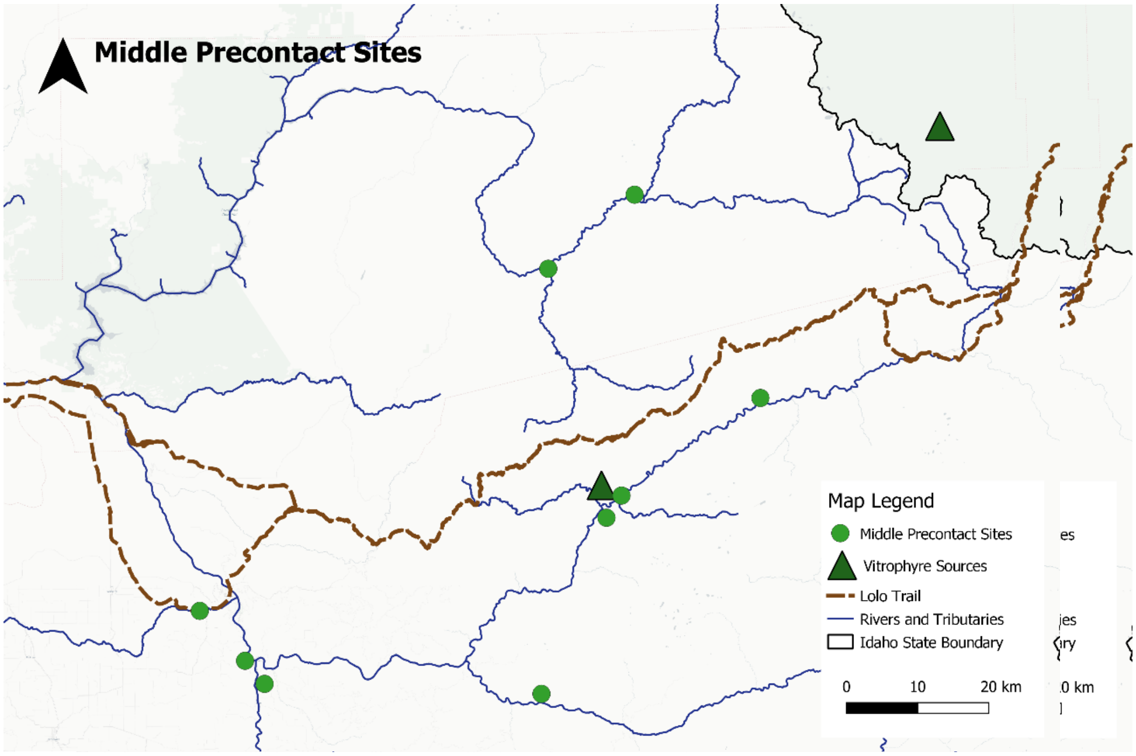


Figure 6.4 Map of Early Precontact sites in the study.

Figure 6.5 Map of Middle Precontact sites in the study.

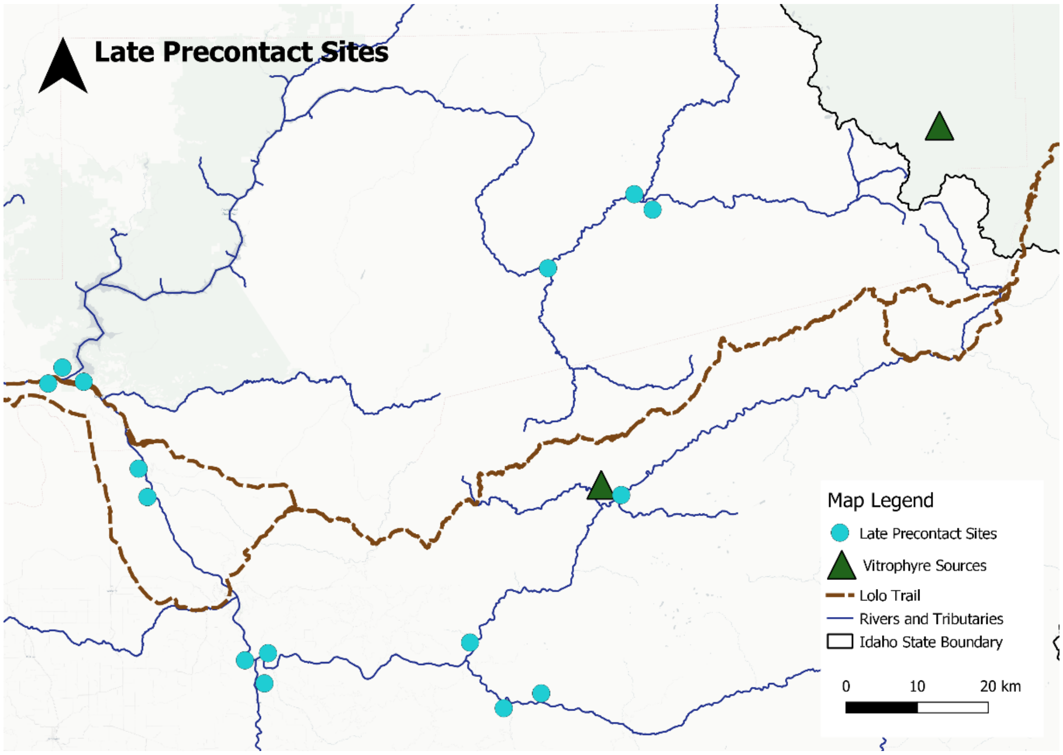


Figure 6.6 Map of Late Precontact sites in the study.

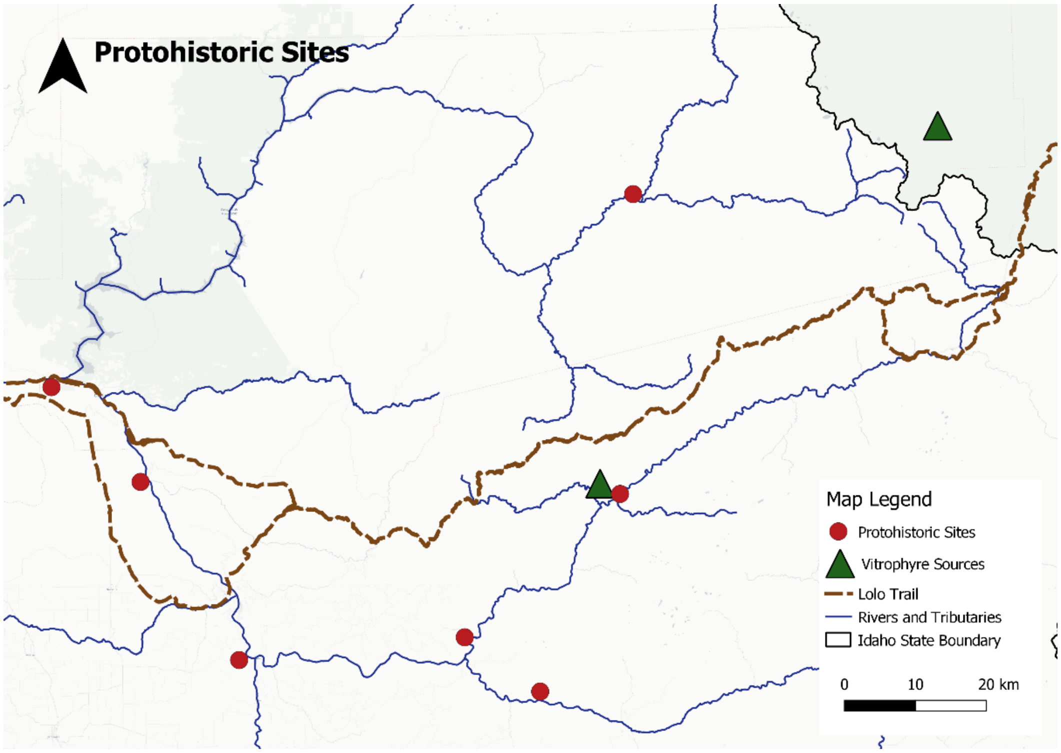


Figure 6.7 Map of Protohistoric sites in the study.

Vitrophyre use begins to drop off in the Protohistoric, becoming nearly nonexistent by the Historic period (Figure 6.7). This pattern reflects a decrease in residential sites due to changes in travel, subsistence, and settlement practices that favored denser concentrations in villages that focused on salmon fishing. By the Historic period, increased interactions with Euromericans would have considerably changed Nez Perce lifeways. Population declines due to devastating disease and conflict, more limited activity spheres, and greater mobility after the acquisition of horse's manifests as fewer residential sites. Furthermore, the introduction of Euromerican materials such as glass and guns would have been adopted resulting in less reliance on lithic materials. While there was not enough data at this time to address chronological variation between Montana Creek and Lochsa vitrophyre, the consistent use of both sources into the Protohistoric and even the Historic period indicates that despite cultural changes, local and semi-local vitrophyre remained a part of the Nez Perce lifeway in some capacity.

Chapter 7: An Experiment in Rock Knockin'

The unassuming appearance of vitrophyre, displaying a thick, irregular cortex with material flaws, large phenocrysts, inclusions, and inconsistencies, leave doubts about the quality of the material as a lithic resource. Quality, the ease with which the stone can be shaped by the knapping process, is one of the most important attributes for predicting lithic distribution (Andrefsky 1994). Ideal knapping materials have a homogenous, micro-crystalline structure, meaning that the material is internally consistent and free of impurities and inclusions, flaws and cracks, or cleavage planes. An experiment was conducted to evaluate the knappablility of vitrophyre collected from the source locations and characterize its overall quality.

An experienced knapper, Garrett Toombs, selected several raw samples collected during field work. Toombs was first asked to conceptualize the tool he hoped to produce, creating a sketch of the tool relative to the size of the nodule, work the material, and describe the process as the material took form (Figure 7.1A). This was Toombs' first encounter with vitrophyre, after a few minutes of general experimentation with a nodule of vitrophyre, the experiment began.

The average nodule samples collected are comparable to those found in the archaeological record (Table 7.1). Munger (1993) surmised that vitrophyre was procured in the past by digging below the surface. It is possible that higher quality, less weathered vitrophyre can be found subsurface. The archaeological record suggests that higher quality material may be available but not likely as pieces much larger than what was observed in the field, less than 15 cm.

Table 7.1 Vitrophyre Nodules and Cores

Range (Average) (mm)	Length	Width	Thickness
Lochsa Samples	18-66 (36.8)	17-41 (26.5)	4-26 (13.5)
Montana Creek Samples	29-159 (76)	18-68 (36.8)	7-39 (20.2)
Archaeological Cores	14-65 (34)	7-50 (30.6)	3-39 (13.3)

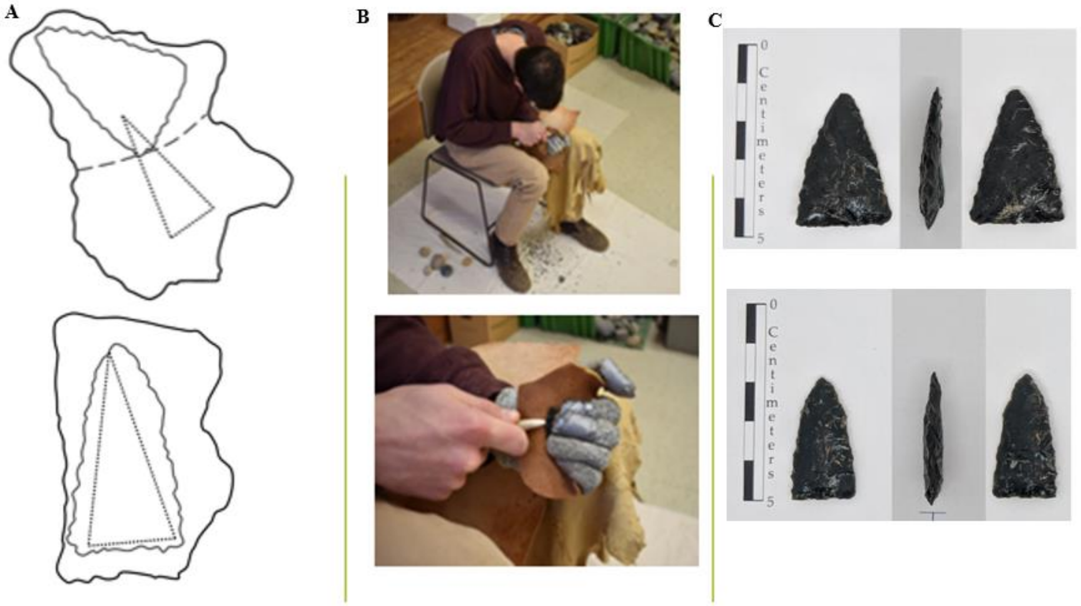


Figure 7.1 Knapping experiment. A. Sketch of raw nodules with intended biface shape and actual biface shape depicted. B. Toombs during the knapping process. C. Biface replicas.

Out of six total tested nodules, Toombs was able to produce two bifaces (Table 7.2). The other four nodules were discarded almost immediately due to material flaws, internal seams, and fractures, so significant the piece could no longer be worked. After testing several nodules with quartzite and sandstone hammer stones, pressure flaking with white tailed deer tines was favored for its ability to maintain accuracy and control with such small pieces. As Toombs worked, he switched back and forth between hard hammer and pressure flaking several times during the reduction process (Figure 7.1B). The two successful replications were 20-32% larger, by area, than projected measurements (Figure 7.1C). When compared to the whole assemblage, the experimental bifaces produced were equivalent to the complete projectile points (n=10) from the assemblage (Table 7.3).

Table 7.2 Experimental Results

	Length (mm)	Width (mm)	Thickness (mm)	Mass (g)
Raw Nodule 2	60.2	46.7	8.5	26.2
Projectile Point 1	32.4	22.6	5.3	3.5
Percent of Reduction	46%	52%	39%	87%
Raw Nodule 6	33.2	27.4	8	11.4
Projectile Point 2	28.9	15.6	4.4	1.8
Percent of Reduction	13%	62%	45%	84%

Table 7.3 Vitrophyre Projectile Points from the Archaeological Record

Range (Average)	Length (mm)	Width (mm)	Thickness (mm)	Mass (g)
Projectile Points	15-37 (29.9)	14-34 (18)	4-22 (4.9)	0.8-2.9 (2.7)
Bifaces	9-51 (31)	15-38 (28.1)	7-11 (8.7)	0.4-11.4 (6.3)

During the biface replication, debitage from the experiment was collected for analysis. The debitage was passed though nested screens to classify debitage by size and then the size classes were weighed, expressed as a percentage of the total debitage. According to this experimental analysis, only 4–49% of the debitage, by mass, produced from biface manufacturing would be captured by the ¼ -inch mesh which is often the standard practice in archaeological excavations (Table 7.4). Even with a 4 mm screen (about ⅛ in) only 65–31% of the debitage from the experiment was captured. A significant amount of the mass (16–31%) was microdebitage (less than 4 mm) which would be nearly indetectable archaeologically. Given that early-stage reduction of vitrophyre cores is often accomplished through techniques thought of as late-stage reduction (i.e., pressure flaking), vitrophyre in the archaeological record is likely severely underrepresented by standard screening practices, even more so than other lithic materials, due to the small size of the cobbles and the production of small debitage from these cobbles.

Table 7.4 Experimental Debitage Aggregate Analysis

Mesh Size Debitage (%, g)	¼ in	4 mm	2 mm	1mm	>1mm	Total Mass
Projectile Point 1	49% (11.3)	16% (3.6)	17% (3.9)	9% (2)	7% (1.5)	22.9 g
Debitage Count	10	53	381	~600	Dust	
Projectile Point 2	4% (0.4)	27% (2.5)	38% (3.6)	14% (1.3)	17 % (1.6)	9.4 g
Debitage Count	3	39	327	~800	Dust	

According to an experimental study by Don Crabtree (1967), when vitrophyre is found as alluvium the exterior surface of the material is rounded and weakened from battering stress, becoming more brittle and susceptible to edge crushing. Nodules from this context are less consistent and require more material to be removed, making them less desirable for tool manufacturing. Toombs described vitrophyre from the primary sources as being stronger and less brittle than obsidian, resisting crushing along the edges, and despite material flaws did retain contestant fracture mechanics suggesting that it may have been worthwhile to procure material at the source than from a secondary deposit. More significantly, the experiment illustrates that when a nodule is found to be high quality, the material is analogous to obsidian, which could explain people's willingness to regularly acquire nodules and carry high quality pieces over great distances. However, the character of the material did limit the potential shape of the tools to small, chunky points.

Vitrophyre is often found in relatively thin, tabular nodules. Raw nodules collected from the sources had an average thickness of about 15 mm. Biface manufacturing can be an extremely wasteful use of raw material particularly where suitable material is rare or occurs in small nodules such as vitrophyre (Sappington 1984:31; Beck et al. 2002:490). During the experiment, Toombs reduced core thickness by 39–45% and most of the flakes produced would not have been suitable for modification and use as expedient tools, illustrating that vitrophyre is not well suited for biface of core production due to the character of the material. The archaeological assemblage confirms minimal evidence for large biface or prepared blade cores and several biface and projectile point even retained some cortex. This many indicate the raw vitrophyre has always been found in relatively small, tabular nodules.

For Toombs, the seams and inclusions did not present a significant problem in point production, but would have hindered the production of large bifaces, even given enough material, as large, thinning flakes can be difficult to produce due to nodule shape and inclusions. Discarding two-thirds of the tested cobbles in the experiment for material flaws highlights the unpredictability of the material and variability in quality. Because of the nature of vitrophyre, traditional stage reduction analysis is difficult to apply. Late-stage reduction may exhibit a high degree of cortex and various technological types may be used at various interchanging stages of production. For example, pressure flaking during initial core reduction, or late-stage flakes retaining excessive cortex.

This experiment helps to explain the form and patterning of vitrophyre in the archaeological record as well as the motivation for acquiring it. While the material is extremely variable, there is a consistent probability of finding high quality material that is comparable to obsidian. Thus, people would have made a point of incorporating this resource into their seasonal routines that indicate long-term relationships with these source locations. Consistently available chert and argillite are the foundation of lithic material in the region, but when high quality vitrophyre was acquired, it was maintained and transported throughout the region.

The material characteristics of vitrophyre might deter a knapper from making an explicit task of collecting raw nodule. Yet, vitrophyre was modified and transported by people 125 km or more for over 12,000 years because when high a high-quality nodule is secured, it can be comparable to obsidian, considered to be the most ideal knapping material.

Chapter 8: People Are Materialistic, But Vitrophyre is Opportunistic

Discussion

This study, intended to test the feasibility and overall utility of pXRF analysis for vitrophyre artifacts, provides an overview of vitrophyre use in the Clearwater River region. Based on these initial results, vitrophyre is indeed amenable to this methodological approach and deserves further investigation. Returning to the theoretical frameworks discussed previously, we can interpret these data through a cultural landscape ecology approach that employs foraging models to discuss vitrophyre distribution.

Vitrophyre may not have been the most ideal knapping material, worth a great deal of effort to procure, but would have made for suitable toolstone, nonetheless. The replication experiment demonstrates that it is possible to reproduce bifaces similar to those found in the assemblages with the size and quality of nodules available at these two sources today, confirming that vitrophyre has always been found in small, tabular nodules and likely not in much better quality. Vitrophyre was never quarried in classic sense, with direct and repeated use with intense reduction onsite and discarding of exhausted tools in favor of fresh raw materials. Because of the material character of vitrophyre, a high degree of reduction at a quarry location before transportation is not always possible or necessary, making traditional stage reduction analysis difficult to apply.

Instead, these data point to opportunistic, or embedded, procurement during other subsistence tasks that drew people near a productive resource location, such as hunting or berry gathering in uplands areas. Rather than being reduced at the quarry site, vitrophyre was initially procured as raw nodules or cores and transported to nearby camps or lithic production areas for further reduction. We can surmise that since early tool makers made use of this resource, they were intimately familiar with the landscape and the resources it furnished very early on. Geochemical analysis gives us the opportunity to discuss how materials from these two known sources moved around the landscape relative to time and location.

While other materials such as chert make up a more significant portion of the lithic assemblage, as the only local material that can be geochemically source, vitrophyre offers an exclusive opportunity to study the movement of local and semi-local material. The relative distribution of vitrophyre sources in the region could illustrate a seasonal travel pattern or relative anonymity between groups that reflect perceptions of group territory or resources, and communal use of travel routes, camps, and resources. Ethnographic data, including place names, reinforce the connection between the Nez Perce and the Salish that may explain the distribution of vitrophyre in the region.

Lochsa Vitrophyre

Vitrophyre throughout the region is predominantly from the local Lochsa source and is present in all regional chronological sequences from the Early Precontact to the Historic period. Lochsa vitrophyre use models the more general settlement and subsistence patterns of the region defined through previous archaeological work. Early Precontact vitrophyre procurement followed an opportunistic, or “mapping on,” resource procurement strategy where resource collection was integrated into highly mobile seasonal rounds. As people spent more time in the region and become more familiar with the resources available, vitrophyre procurement followed a more “logistical” strategy during the Middle and Late Precontact periods. People would have made a point of returning to productive resource patches or lithic sources to acquire new material during other tasks – picking up cores, carrying them for miles, and using them sparingly to produce projectile points or expedient tools when high quality cores were encountered.

By the Protohistoric period, the acquisition of horses and a more intense focus on a salmon oriented delayed-return economy drastically impacted travel, subsistence, and settlement patterns that favored denser concentrations in lower elevation villages. Further reinforcing the interpretation that vitrophyre was procured opportunistically during upland tasks. The marked decrease in vitrophyre use during the Protohistoric and Historic periods probably reflects a larger disruption of Nez Perce cultural practices due to increased interactions with Euromericans. By the Historic period, more limited activity spheres, the introduction of Euromerican materials such as glass and guns, and devastating population decline due to disease and conflict greatly impacted the Nez Perce lifeways reflected in the archaeological record. However, the presence of vitrophyre at Historic era sites indicate a persistent connection to the local landscape and cultural practices.

Montana Creek Vitrophyre

Montana Creek vitrophyre was used just as broadly though time and across space in the Clearwater River region, but always secondarily to Lochsa vitrophyre. These artifacts are more often transported into the region as finished tools or preforms. Montana Creek vitrophyre is no doubt widespread in Salish country, but its presence in the Clearwater River region may be attributed to the vast range of Nez Perce seasonal rounds or a connection to cultural groups of the Bitterroot region through trade or resource sharing. The Lolo and other trails in the region, which connect to the Bitterroot region to the east, may help to explain the distribution of Montana Creek vitrophyre within the region. The presence of a Montana Creek vitrophyre Windust phase projectile point juxtaposes with Goshen or Plano Lancelot style projectile point from the plains area, both of which date to about 11,000 BP, at Kelly Forks (10CW34) indicates a connection with groups of the Bitterroot region.

Conclusion

This study has successfully provided a preliminary overview of an understudied lithic resource in the Clearwater River region. From these results, several large themes about vitrophyre use in north central Idaho have become evident:

1. It is clear that both the Lochsa and Montana Creek sources were broadly used as a supplement to chert, since the initial occupation of the Clearwater River region 12,000 or more years ago.

2. Lochsa toolstone was opportunistically procured and embedded into seasonal hunting and gathering activities at upland locations following a central place foraging model.

3. The distribution of vitrophyre use through time models the overall settlement and subsistence pattern of the region. The use of the material, which requires deep knowledge of the landscape and the quality of the material, confirms the long occupation of the peoples in the region and their extensive landscape knowledge.

4. The ubiquitous distribution of Lochsa vitrophyre in the region, which quickly drops off near the western edges of Nez Perce territory, suggests that this was a secondary regional resource. However, the presence of Montana Creek vitrophyre indicates a solid and consistent connection with Salish territory to the east, either through travel and resource sharing or social connection and trade.

5. The trail network including the Lolo, Nee Me Poo, and Wise'isskit trails appears to be the most influential factor in the distribution of material across the region, representing a connection between the Nez Perce and the Salish.

Sourcing of understudied, local vitrophyre can provide contributions to understanding the behaviors, decisions, and patterns of resource use in the past. This research can be a useful jumping-off point in understanding how we can reconceptualize physical, social, and political boundaries when addressing resource management in modern society.

Future Directions

The initial results of this study have been very promising. Although the feasibility of pXRF analysis with vitrophyre has proven to be successful there is still ample opportunity to improve the methodology and expand on the investigation of regional use of vitrophyre in north central Idaho and other regions. Several possible areas of future analysis are outlined below.

1. Conducting a larger scale survey of the known sources to refine the chemical and physical characterization of vitrophyre in the region would improve the results and interpretations of pXRF analysis. Additionally, survey in search of yet unidentified vitrophyre sources will add data and could resolve some of the issues with material that was unable to be sufficiently classified to the sources in this study by providing a greater understanding of variation in the geochemical signature between sources. Testing along the ridgeline and the lithic workshops near Sherman Creek may reveal more information about the procurement of local vitrophyre.

2. Though the MURR/Bruker obsidian calibration proved to be sufficient for analysis, another way to refine the methodology would be to create unique calibration designed for vitrophyre from this region. Since there is minimal research regarding vitrophyre in the archaeological record in general, there is a great deal of work to be done to refine the methodology and characterize variability between sources. Sourcing of nonlocal vitrophyre could aide in developing a unique calibration.

3. Adding to the ecological models with controlled experimentation to evaluate the quality of the material relative to the procurement effort could contribute to the interpretation of vitrophyre use and provide insight into this poorly understood in the archaeological record. For example, employing the Wilsons Attractiveness Equation (Adams and MacDonald 2015) or other aspects of the Central Place Foraging Model (Beck et al. 2002) would contribute quantitative data for assessing material quality and effort expended.

4. Expanding the research to include the archaeology of western Montana to investigate the relationship between the known sources could reveal more about the extent of Nez Perce land use and provide deeper insights into the social relationships with the people of the Bitterroot region and how resources and travel routes were used simultaneously by multiple groups.

5. Finally, taking an ethnoarcheological or linguistic approach, incorporating interviews with Nez Perce and Salish tribal members to encompass indigenous perspectives on place names, landscapes categorizations, resource uses, and social relationships would enrich the interpretation of the archaeological record.

References Cited

Adams, Jacob S. and Douglas H. MacDonald

2015 Differential Selection of Lithic Raw Materials by Prehistoric Hunter-Gatherers in the Upper Yellowstone River Valley, Montana/Wyoming. In *2015 Toolstone Geography of the Pacific Northwest*, edited by Terry L. Ozbun and Ron L. Adams. Archaeology Press, Simon Fraser University, Burnaby, BC, Canada.

Aikens, Melvin C.

1978 The Far West. In *Ancient Native Americans*, edited by Jesse D. Jennings. W.H. Freeman and Company, San Francisco.

Allaby, Michael and Chris Park

2017 Ignimbrite. *A Dictionary of Environmental and Conservation* Third Edition, Oxford University Press. Online. Accessed March 8, 2021 from https://www-oxfordreference-com.uidaho.idm.oclc.org/view/10.1093/acref/9780191826320.001.0001/acref-9780191826320-e-3937.

Alt, David D. and Donald W. Hyndman

1989 Central Idaho, In *Roadside Geology of Idaho*, Mountain Press Publishing Company, Missoula.

Ames, Kenneth M. and Allan G. Marshall

1981 Villages, Demography, and Subsistence Intensification on the Southern Columbia Plateau. *North American Archaeologist* 2:25-52.

Ames, Kenneth M., Kristen A. Fuld, and Sara Davis

1981 Darts and Arrow Points on the Columbia Plateau of Western North America. *American Antiquity* 75(2):287-325.

Anastasio, Angelo

1985 The Southern Plateau: An Ecological Analysis of Intergroup Relations. Second Edition, revised from *Northwest Anthropological Research Notes*, 1972: 6(2):109-229.

Andrefsky, William Jr.

1994 Raw-Material Availability and the Organization of Technology. *American Antiquity*, 59(1):21-34.

1998 *Lithics: Macroscopic Approaches to Analyses*. Cambridge University Press, New York, NY.

2001 *Lithic Debitage: Context, Form, Meaning*. University of Utah Press, Salt Lake City

Armstrong, Steve

1994 Archaeological Site Inventory Form: 10IH2260, U.S. Forest Service, Nez Perce-Clearwater National Forest, Kamiah, Idaho.

2006 *The Rackliff Site (10-IH-2737): Result of Investigation for 1999-2003*. U.S. Forest Service, Nez Perce-Clearwater National Forest, Kamiah, Idaho.

Bamforth, Douglas B.

1986 Technological Efficiency and Tool Curation. *American Antiquity* 51(1):35-50.

Beck, Charlotte, Amanda K. Taylor, George T. Jones, Cynthia M. Fadem, Caitlyn R. Cook, and Sara A. Millward

2002 Rocks Are Heavy: Transport Cost and Paleoarchaic Quarry Behavior in the Great Basin. *Journal of Anthropological Archaeology* 21:481-507.

Beck, Kelly

2008 Transportation Distance and Debitage Assemblage Diversity: An Application of the Field Processing Model to Southern Utah Toolstone Procurement Sites. *American Antiquity* 73(4):759-780.

Beiswenger, Jane M.

1991 Late Quaternary Vegetational History of Grays Lake, Idaho. *Ecological Monographs*, 61(2):165-182.

Brunelle, Andrea, Cathy Whitlock, Patrick Bartlein and Kurt Kipfmueller

2005 Holocene fire and vegetation along environmental gradients in the Northern Rocky Mountains. *Quaternary Science Reviews*, 24:2281-2300.

Bennett, Scott Edmund Kelsey

2009 Transtensional Rifting in the Late Proto-Gulf of California Near Bahia Kino, Sonora, Mexico. Master's thesis, Department of Geological Sciences, University of North Carolina, Chapel Hill.

Bense, Judith A.

1972 The Cascade Phase: A Study in the Effect of Altithermal on a Cultural System. Unpublished Ph. D. dissertation, Department of Anthropology, Washington State University, Pullman.

Benson, Michael P., Ruthann Knudson, Thomas Dechert, and Richard C. Waldbauer

1979 Archaeological Investigation of the Cultural Resource of the Wilderness Gateway Recreation Area Clearwater National Forest, Idaho. *University of Idaho Anthropological Research Manuscript*, No. 56, Moscow.

Binford, Lewis R.

1973 Interassemblage Variability in the Mousterian and the "Functional" Argument. In *The Explanation of Culture Change: Models in Prehistory*, edited by Colin Renfrow pp. 227- 254. London: Duckworth.

1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35(3):255-272.

Broncheau-McFarland, Sandra

1992 Tsoop-Nit-Pa-Lu and a Corridor of Change: Evolution of an Ancient Travel Route Nee-Me-Poo Trail. Master's thesis, Department of Anthropology, University of Idaho, Moscow.

Brunelle, Andrea, Cathy Whitlock, Patrick Bartlein and Kurt Kipfmueller

2005 Holocene fire and vegetation along environmental gradients in the Northern Rocky Mountains. *Quaternary Science Reviews* 24:2281-2300.

Callahan Errett

1979 The Basics of Biface Knapping in the Eastern Fluted Point Tradition: A Manual for Flintknappers and Lithic Analysts. *Archaeology of Eastern North America* 7(1):1-180.

Clay, R. Berle

1976 Typological Classification, Attribute Analysis, and Lithic Variability. *Journal of Archaeology* 3(3):303-311.

Chadez, Jenifer

2017 *The Holocene Occurrence and Exploitation of Mammals in the Clearwater and Lower Snake River Region of Idaho*. Masters thesis, Department of Anthropology, Idaho State University, Moscow.

Chatters, James C.

1995 *Population Growth, Climatic Cooling, and the Development of Collector Strategies on the Southern Plateau, Western North America*. Journal of World Prehistory, 9(3):341-400.

Chalfant, Stuart A.

1974 Aboriginal Territory of the Nez Perce Indians. In *Nez Perce Indians*, edited by David Agee Horr, Garland Publishing Company, New York, 25-163.

Crabtree, Donald E.

1967 Notes on Experiments In Flintknapping: 3, The Flintknapper's Raw Materials, *Tebiwa: The Journal of Idaho State University Museum, Pocatello* 1(10):8-25.

Curtis, Edward S., Frederick Webb Hodge, Theodore Roosevelt, and Pierpont J. Morgan

1970 *The North American Indian: being a series of volumes picturing and describing the Indians of the United States and Alaska*. Johnson Reprint.

Danner, Bryce

2017 An Overview of the Pre-Contact Archaeology of the Lochsa River, North-Central Idaho. Master's thesis, Department of Anthropology, University of Idaho, Moscow.

Davis, Loren G.

2001 *The Coevolution of Early Hunter-Gatherer Culture and Riparian Ecosystems in the Southern Columbia*. Doctoral dissertation, Department of Anthropology and Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton.

Davis, Loren G., Alex Nyers, and Lorena Beccerra-Valdivia

2019 Late Upper Paleolithic Occupation at Cooper's Ferry, Idaho, USA, ~16,000 Years Ago. *Science* 365:891-897.

De Francesco, A.M., G.M. Crisci, and M. Bocci

2008 Non-destructive analytic Method Using XRF for Determination of Provenience of Archaeological Obsidians from the Mediterranean Area: A Comparison with Traditional XRF Methods. *Archaeometry* 50(2): 337-350.

Dyke, Arthur S.

2005 *Late Quaternary Vegetation History of Northern North America Based on Pollen, Macrofossil, and Faunal Remains*. Géographie physique et Quaternaire, 59(2-3):211-262.

Eereksen Jelmer W., Jeffery R. Fergusin, Michael D. Glascock, Craig E. Skinner, and Sharon Waechter

2007 Reduction Strategies and Geochemical Characterization of Lithic Assemblages: A Comparison of Three Case Studies from Western North America. *American Antiquity* 72(3):585-597.

Ellis, Ben S. Olivier Bachmann, and John A. Wolff

2014 Cumulate Fragments in Silicic Ignimbrites: The Case of the Snake River Plain. *Geology* 42(5): 431–434

Frahm, Ellery

2012 Validity of "Off-the-Shelf" Handheld Portable XRF for Sourcing Near Eastern Obsidian Chip Debris. *Journal of Archaeological Science* 40(2): 1080–1092

2014 Characterizing obsidian sources with portable XRF: accuracy, reproducibility, and field relationships in a case study from Armenia. *Journal of Archaeological Science* 49(1): 105-125.

Gaarder, Lorin R.

1968 A Report on the Archaeological Testing of Site 10-CW-5, Clearwater River, North-Central Idaho. *Tebiwa*, 11(1):60-70.

Gibson, James J.

1979 The Theory of Affordances, in *The Ecological Approach to Visual Perception*, Psychology Press, New York.

Glascock, Michael D.

2020 A Systems Approach to Geochemical Sourcing of Obsidian Artifacts. *Scientific Culture* 6(2):35-47.

Glascock, Michael D. and Jeffery R. Ferguson

2012 Report on the Analysis of Obsidian Source Samples by Multiple Analytical Methods, *Archaeometry Laboratory Report*, University of Missouri-Columbia.

Globe Program

2005 *A Pocket Guide for the Identification of Soil Colors,* Second Edition.

Gould, Richard A., and Sherry Saggers

1985 Lithic Procurement in Central Australia: A Closer Look at Binford's Idea of Embeddedness in Archaeology. *American Antiquity* 50(1), 117–136.

Gramly, Richard M.

1980 Raw Materials Source Ares and “Curated” Tool Assemblages. *Society for American Archaeology* 823-832.

Grisham, Abram

2015 Prehistoric Use of Quartz Crystal Lithic Material in the Clearwater River Basin, North-Central Idaho: A Replicatie Study in Manufacture and Use-Ware Analysis. Master’s thesis, Department of Anthropology and Sociology, University of Idaho, Moscow.

Herbel, Brian

2001 The Prehistory of Lawyer Canyon as Evidenced by Recent Investigations at Kittle Rockshelter, Near Kamiah, Idaho. Master’s thesis, Department of Anthropology and Sociology, University of Idaho, Moscow.

Hunn, Eugene

1996 Columbia Plateau Indian Place Names: What Can They Tech Us? *Journal of Linguistic Anthropology*, 6(1):3–26.

Hyndman, Donald W.

1989 Formation of the Northern Idaho Batholith and Related Mylonite of the Western Idaho Suture Zone. *In Guidebook to the Geology of Northern and Western Idaho and Surrounding Area*, edited by V.E. Chamberlain, R.M. Breckenridge, and Bill Bonnichsen. Idaho Geological Survey Bulletin 28:51-64.

Idaho Geologic Survey

2021 Interactive Geologica Map. Electronic document, https://www.idahogeology.org/WebMap/, accessed December 2021.

Jones, Peter N.

2003 American Indian Cultural Affiliations and Cultural Continuity in the plateau and Great Basin Culture Regions of the American West. Master's thesis, department of Human Science, Saybrook Graduate School, San Francisco.

Josephy Jr., Alvin M.

2007 *Nez Perce Country*, University of Nebraska Press, Lincoln.

Keating, Lin., Sandra McFarland, and Doug Carr

1996a Archaeological Site Inventory Form: 10IH2469, U.S. Forest Service, Nez Perce-Clearwater National Forest, Kamiah, Idaho.

1996b Archaeological Site Inventory Form: 10IH2497, U.S. Forest Service, Nez Perce-Clearwater National Forest, Kamiah, Idaho.

1996c Archaeological Site Inventory Form: 10IH2499, U.S. Forest Service, Nez Perce-Clearwater National Forest, Kamiah, Idaho.

1996d Archaeological Site Inventory Form: 10IH2500, U.S. Forest Service, Nez Perce-Clearwater National Forest, Kamiah, Idaho.

Keeler Robert

1973 An Upland Hunting Camp on the North Fork of the Clearwater River, North-Central Idaho. Master's thesis, Department of Anthropology, Idaho State University, Pocatello.

Kempf, Michael

2020 From Landscape Affordance to Landscape Connectivity: Conceptualizing and Archaeology of Human Ecology. *Archaeological and Anthropological Sciences*, 12(174):1-12.

Kirchhoff Smith, Jan and Stephen R. Drown

2013 Interpreting the landscape, a Nez Perce perspective: lessons from the cultural landscape. Master's Thesis Department of Anthropology and Sociology, University of Idaho, Moscow.

Knudson, Ruthann

1977 Archaeological investigation of the O'Hara Bar campground, Nez Perce National Forest, Idaho. *University of Idaho Anthropological Research Manuscript*, No.34, Moscow.

Knudson, Ruthann and Robert Lee Sappington

1977 Archaeological Investigation of the Proposed Kelly Creek Gravel Source Clearwater National Forest, Idaho. *University of Idaho Anthropological Research Manuscript*, No.41, Moscow.

Leonhardy, Frank C. and David G. Rice

1970 A Proposed Culture Typology for the Lower Snake River Region: Southeastern Washington. *Northwest Anthropological Research Notes* 4(1):1-29.

Longstaff, Laura

2013 Archaeological Investigation at the Kelly Forks Work Center Site (10CW34): Clearwater River National Forest, North-Central Idaho. Master's thesis, Department of Anthropology. University of Idaho, Moscow.

Magne, Martin P.R.

2001 Debitage Analysis as a Scientific Tool for Archaeological Knowledge. In *Lithic Debitage: Context, Form, Meaning*, edited by William Andrefsky Jr. University of Utah Press, Salt Lake City.

Mehringer, Peter J. Jr., Stephen F. Arno, and Kenneth L. Petersen

1977 Post Glacial History of Lost Trail Pass Bog, Bitterroot Mountains, Montana. *Arctic and Alpine Research* 9(4):345-368.

Munger, Ben

1993 Whitebark Pine: A Prehistoric Food Source at Timberline in the Bitterroot Mountains of Montana. Master's thesis, Department of Anthropology, University of California, Santa Barbra.

Natural Resource Conservation Services

2020 *Soil Survey of the Clearwater Area, Idaho*. Natural Resource Conservation Services Annual Report.

Nelson, Margaret C.

1991 The Study of Technological Organization. *Archaeological Method and Theory* 3(1):57-100.

Nez Perce Tribe

2021 Nez Perce Tribal History. Electronic document, https://nezperce.org/, accessed December, 2021.

Nez Perce Tribal Wildlife Division

2003 *Clearwater Subbasin Assessment*, Washington State University Center for Environmental Education, 1-463.

Prentiss, William C., James C. Chatters, Michael Lenert, David S. Clarke and Robert C. O'Boyle

2005 The Archaeology of the Plateau of Northwestern North America During the Late Prehistoric Period (3500-200 BP): Evolution of Hunting and Gathering Societies. *Journal of World Prehistory* 19(1):47-118.

Reimer, Rudy

2018 The Social Importance of Volcanic Peaks for the Indigenous Peoples of British Columbia. *Journal of Northwest Anthropology* 52(1):4-35.

Reimer, Rudy and Tyrone Hamilton

2015 Implications Between Technological Organization and Portable X-Ray Fluorescence Analysis on Lithic Material Use at Two Rockshelter Sites on the Southern Northwest Coast. In *2015 Toolstone Geography of the Pacific Northwest*, edited by Terry L. Ozbun and Ron L. Adams. Archaeology Press, Simon Fraser University, Burnaby, BC, Canada.

Sappington, Robert Lee

1981 Progress Report on the Obsidian and Vitrophyre Sourcing Project. *Idaho Archaeologist* 4(4):4-14.

1982 Additional; Obsidian and Vitrophyre Source Descriptions from Idaho and Adjacent Areas. *Idaho Archaeologist* 5(1):4-8.

1990 Archaeological Investigation at the Ahsahka Sportsmen's Access Site (10-CW-5). *University of Idaho Anthropological Reports*, No. 90, Moscow.

1991 Archaeological Investigation at the Clearwater Fish Hatchery Site (10-CW-4). *University of Idaho Anthropological Reports*, No. 85-2, Moscow.

1994 The Prehistory of the Clearwater River Region, North Central, Idaho. *University of Idaho Anthropological Reports*, No. 95, Moscow.

1996 Clearwater River Region. *Northwest Anthropological Research Notes* 30(1):116-166.

2020 Residential Structures in the Clearwater River Region, North Central Idaho. In *Of Housepits and Homes: Twenty-First Century Perspectives on Houses and Settlements in the Columbia-Fraser Plateau*, edited by Molly Carnery, James W. Brown, and Dakota E. Wallen 19:154-177.

Sappington, Robert Lee and Caroline D. Carley

1987 Archaeological Investigation at Kooskia Bridge Site (10-IH-1395), Middle Fork, Clearwater River, North Central Idaho. *University of Idaho Anthropological Research Manuscript*, Letter Report No. 87, Moscow.

1989 Archaeological Investigation at the Beaver Flat and Pete King Creek Sites, Lochsa River, North Central Idaho. *University of Idaho Anthropological Research Manuscript*, Letter Report No. 89, Moscow.

1995 Alice Cunningham Fletcher's "Ethnographic Gleanings Among the Nez Perce", *Northwest Anthropological Research Notes* 29(1):1-50.

Sappington, Robert Lee and Priscilla Wegars

1988 Results of Archaeological Test Excavation at Canoe Camp, Nez Perce National Historic Park, Near Orofino, Idaho. *University of Idaho Anthropological Research Manuscript*, Letter Report 88-18, Moscow.

Schacher, Cindy L.

2004 *The Southern Nez Perce Trail Wise'isskit*, USFS Nez Perce National Forest, Montana, p. 1-14.

Schlader, Ron

2015 Site Monitoring Form: 24MN198, Montana Site Steward Program, USFS Lolo-Bitterroot National Forest, Montana.

Schwede, Madge L.

1970 The Relationship of Aboriginal Nez Perce Settlement Patterns to Physical Environment and to Generalized Distribution of Food Resources. *Northwest Anthropological Research Notes* 4(2):129-136.

Shawley, Stephen D.

1977 Nez Perce Trails. *Idaho State University Anthropological Research Manuscript*, No. 44, Pocatello.

Skinner, Craig E. and Jennifer J. Thatcher

2013a X-Ray Fluorescence Analysis of Artifact Obsidian from 10-CW-34. *Northwest Research Obsidian Studies Laboratory*, Report No. 2013-07. Corvallis, Oregon.

2013b X-Ray Fluorescence Analysis of Artifact Obsidian from 10-CW-30, 10-IH-453, 10-IH-1009, and 10-IH-2737. *Northwest Research Obsidian Studies Laboratory,* Report No. 2013-07. Corvallis, Oregon.

Slickpoo, A.P., and D.E. Walker Jr.

1973 *Noon Nee-Mee-Poo (We, The Nez Perce).* Nez Perce Tribe of Idaho, Lapwai.

Spinden, H. J.

1974 *The Nez Percé Indians*. Kraus Reprint Corp.

Stapp, Darby, Edgar Bryan, and Diana Rigg

1984 The 1978 Clearwater River Survey, *University of Idaho Anthropological Research Manuscripts*, No. 82, Moscow.

Stone, Jeffery R. and Sherilyn C. Fritz

2006 Multidecadal drought and Holocene climate instability in the Rocky Mountains. *Geology* 34(5):409-412.

Stout, Mary A.

2003 *Native American Peoples: Nez Perce*, Gareth Stevens Publishing, Milwaukee, WI.

Sullivan, Alan P. and Kenneth C. Rosen

1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50(4):755-779.

USFS Nez Perce-Clearwater National Forest

2014 Vitrophyre. *USGS Geology*. Online, Accessed March 8, 2021, from https://mrdata.usgs.gov/geology/state/sgmc-lith.php?code=3.1.2.

USGS

2021 Air, Soil, and Water Resources and Quality, in the *Nez Perce-Clearwater National Forests Forest Plan Assessment*. Pg 2.1-2.76.

Walker, Deward E., Jr.

1998 Nez Perce, in Plateau, *Handbook of North American Indians,* Volume 12. Smithsonian Institution, Washington, D.C.

Walker, Ian R. and Marlow G. Pellatt

2008 *Climate Change and Ecosystem Response in the Northern Columbia River Basin – A Paleoenvironmental Perspective*. Environmental Review, 16:113-140.

Whitlock, Cathy, Jennifer Marlon, Christy Briles, Andera Burnelle, Collin Long and Patrick Bartlein

2008 Long-term Relations Among Fire, Fuel, and Climate in the North-western US Based on Lake-sediment Studies. *International Journal of Wildland Fire* 17: 72-83.

Whittaker, John C.

1994 *Flintknapping: Making and Understanding Stone Tools*. University of Texas Press, Austin, TX.

Williamson, Nakia

2021 *Canoe Camp*, Nez Perce National Historic Park, post card.