In Pursuit of the Quarry: Exploring Lithic Exchange on the Interior Plateau of British Columbia

by

Cameron J. Pollock

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Name: **Cameron J Pollock**

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Examining Committee:

Chair: Christina Giovas
Assistant Professor

Rudolf Reimer
Senior Supervisor
Associate Professor

George Nicholas
Supervisor
Professor

Jesse Morin
External Examiner
Independent Heritage Consulant and Archaeologist
K'omoks First Nation and Tsleil-Waututh Nation

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Abstract

This thesis represents an exploratory provenance study to map the spatial distribution of lithics from the Arrowstone Hills lithic source, located near Cache Creek BC, across the Southern Interior Plateau. Using X-Ray Fluorescence analysis, an elemental signature for this source was generated, against which lithic artifacts from archaeological sites located across the Plateau were compared. The Arrowstone Hills source was also compared to five other lithic sources on the Plateau and Northwest Coast. It was determined that the Arrowstone Hills source is part of a geological complex that includes at least three other nearby lithic sources possessing a similar elemental signature, named here the Kamloops Fine-Grained Volcanic complex. Furthermore, it was determined that lithics from this complex are ubiquitous across the Plateau, and were likely moved through exchange networks. Cultural factors such as kin relationships, resource rights, and territorial sovereignty likely influenced how these networks operated at different times throughout the past.

Keywords: X-Ray Fluorescence; Fine-Grained Volcanics; Toolstone; Exchange; Canadian Plateau.

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Chapter 1.

Introduction

Archaeological research, ethnographic records, and First Nations cultural knowledge provide multiple lines of evidence that large-scale exchange networks existed in the Interior Plateau of British Columbia for thousands of years (Connolly et al. 2015; Hayden and Schulting 1997:52; Ignace and Ignace 2017:107). These sources provide an opportunity to examine how Plateau exchange networks functioned in terms of the processes and social relationships by which they were governed, as well as specifics about goods that were exchanged and the parties involved (Bruchert and Greenough 2016; Hayden and Schulting 1997; Ignace and Ignace 2017; Magne 1983; Richards 1987; Rorabaugh and McNabb 2014). These networks were operated and maintained in an organized manner, with different types of exchange occurring depending on the parties involved (Hayden and Schulting 1997:52–53; Ignace and Ignace 2017:220). Cultural protocols focusing on access rights to resources, based in familial relationships and status as the member of a given First Nation, influenced how exchange occurred (Ignace and Ignace 2017:220). Such lithic items as preforms or finished goods were among the items exchanged across these networks (Hayden and Schulting 1997; Ignace and Ignace 2017:220; Kristensen et al. 2016; Morin 2015; Teit 1900:260–262). While historically recorded cultural protocols cannot be accurately projected back in time, they do provide an idea of how culture and economy may have intersected in the ancient past.

Despite the wealth of archaeological, ethnographic, and Indigenous knowledge about networks and systems of exchange across the Plateau, there is a shortage of quantitative data to support and expand on what is known about the exchange and distribution of finished or raw materials (Bruchert and Greenough 2016:97). Lithic materials are frequently the focus of research seeking to explore exchange as they preserve well, are generally ubiquitous in the archaeological record, and can often be assigned to specific origins (Springer et al. 2018:45). However, in British Columbia much of the research focusing on the procurement or exchange of lithics has utilized visual comparisons of lithic artifacts to source materials (Reimer 2018a). Assigning a source locale to an artifact based solely on visual techniques is often unreliable, and inferences drawn from the results of such research may therefore be based on inaccurate or misleading data (Goffer 1983:1198–1199; Reimer 2018a:499). However, studies focusing on lithic procurement and exchange in the Pacific Northwest employing more reliable, quantitative methods such as X-Ray Fluorescence (XRF) analysis (Reimer 2018a, 2018b), geochemical and petrographic analysis (Bruchert and Greenough 2016), or infrared-spectrometry (Morin 2015, 2016) have greatly expanded our understanding of patterns of exchange and interaction throughout the region.

Arrowstone Hills is near Cache Creek BC, as well as the modern and historic borders of two large Plateau First Nations, the Secwepemc and Nlaka'pamux, who were regularly and highly involved in Plateau exchange networks (Ignace and Ignace 2017:105–110, 220–224). Lithics from this source are abundant and of high quality; they have a very fine matrix grain size, high glass content, low rate of phenocryst occurrence, and millimetre-scale flow planes, making them a highly suitable toolstone (Bruchert and Greenough 2016:114; Greenough et al. 2004:712; Mallory-Greenough et al. 2002:51). Commonly used visual identification traits indicate that Arrowstone Hills lithic materials may be indistinguishable from other dacitic lithic materials. Figure 1 illustrates the approximate locations of lithic sources with visually similar materials.

Given the Arrowstone Hills source's abundant, high-quality material, long history of intense utilization, and location within the territory of major participants in Plateau exchange networks, it is an ideal candidate for a provenance study seeking to explore lithic distribution across the Plateau. The goals of this thesis is to contribute to our understanding of lithic acquisition and exchange on the Plateau by demonstrating the movement of materials from known origins to multiple locations, focusing primarily on materials from the Arrowstone Hills lithic source.

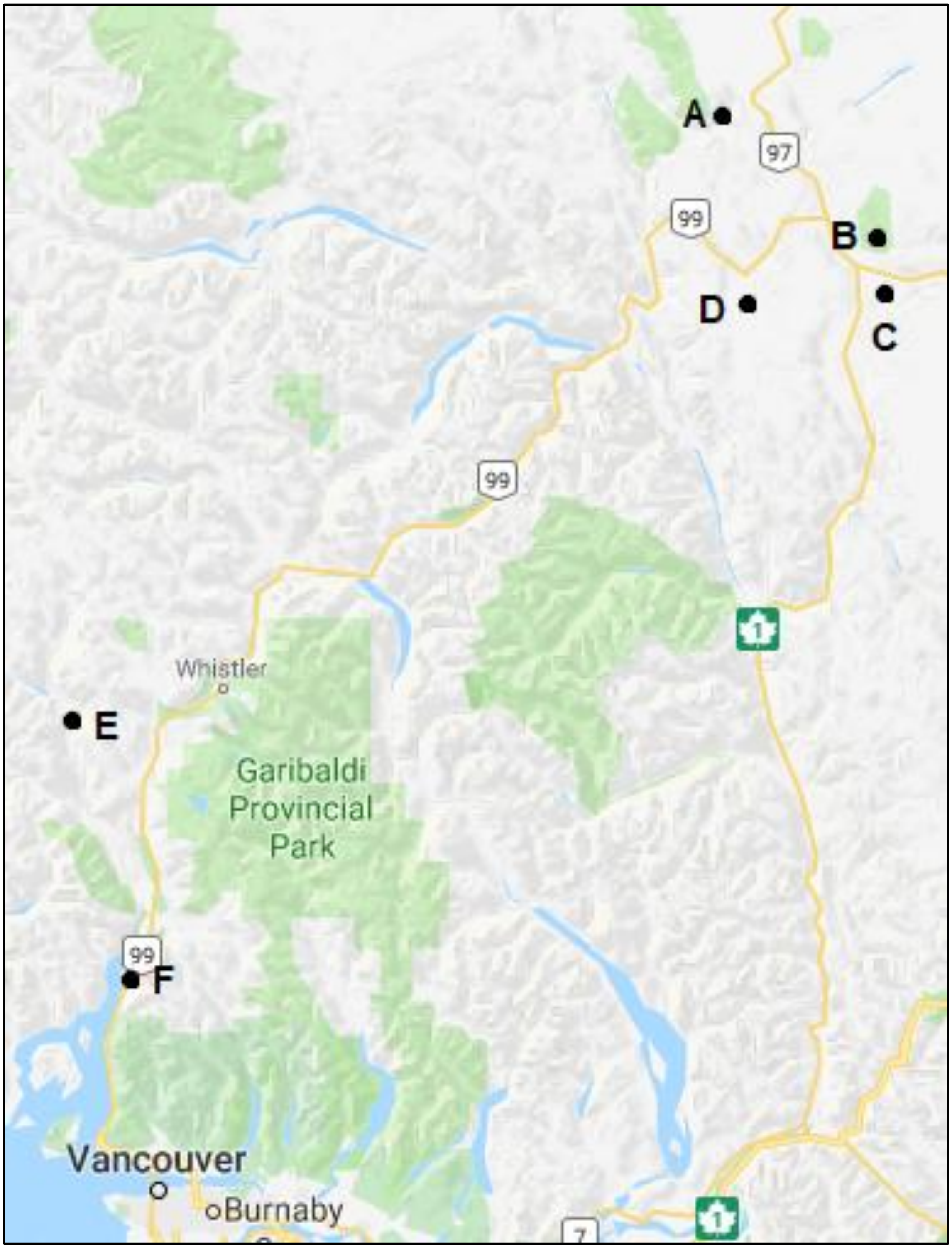

Figure 1: **Approximate locations of all lithic sources included in this research. A: Maiden Creek; B: Arrowstone Hills; C: Cache Creek; D: Hat Creek; E: Turbid Creek; F: Watts Point.**

Image: Google 2018

The study area is limited to the southern Interior Plateau of British Columbia, a portion of the larger Plateau area. The larger Plateau is defined as the region drained by the Columbia and Fraser rivers, and bordered by the Great Basin, Subarctic, Northwest Coast, and Plains culture areas to the south, north, west, and east, respectively (Walker 1998:1). The Plateau culture area includes the Interior Salishan and Sahaptian peoples, as well as certain Athapaskan, Kootenai, and Cayuse outliers (Walker 1998:1). The area covered by this research is bounded on the west by the Coastal and Cascade mountain ranges, on the east by the Rocky Mountains, to the south by the Canadian-United States border, and to the north by the gradation into central British Columbia's subarctic forests around Quesnel, near the 53rd Parallel (Prentiss and Kujit 2004:x–xi).

Samples were analyzed from archaeological sites that lie within the historic territories of the Secwepemc, Nlaka'pamux, Stl'atl'imx, Nicola, Okanagan, and Ktunaxa First Nations; these territories are illustrated in Figure 2. In terms of geography and as a cultural region, the southern limit of the study area is an entirely artificial one, but is convenient for the purposes of the project, as gaining access to materials in the United States would impose additional challenges. Henceforth, the southern Interior Plateau of British Columbia is referred to simply as the Plateau in this thesis.

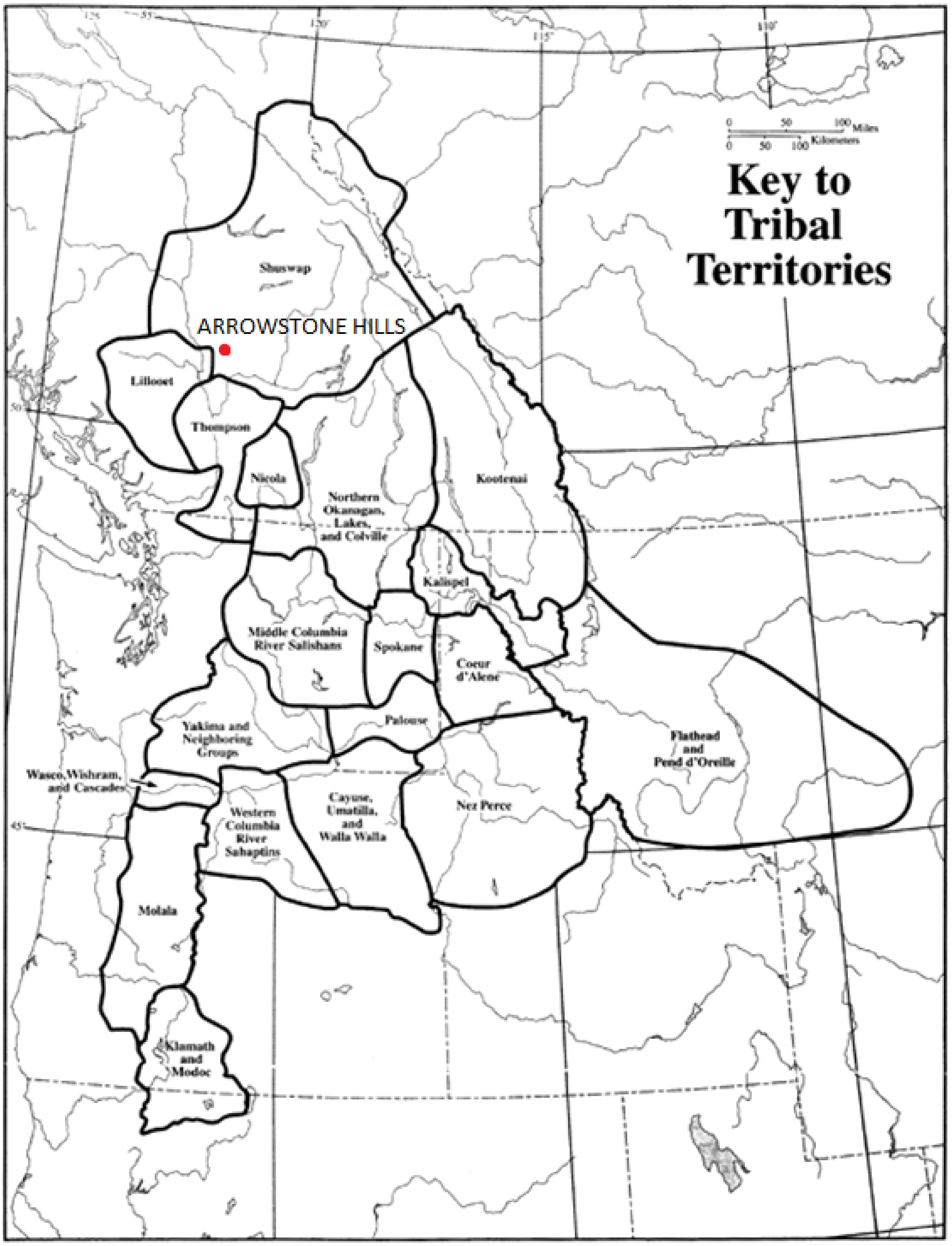

Figure 2: **Map of Major Plateau First Nations territories, with approximate location of Arrowstone Hills.**

Image: Handbook of North American Indians, Vol. 12: Plateau, 1998.

Research Objectives and Design

The primary objective of this research was to generate quantitative data that would permit me to explore the distribution of lithics through Plateau exchange networks. This was accomplished through an exploratory lithic provenance study focusing primarily on the Arrowstone Hills lithic source near Cache Creek, British Columbia, but also including other known and recorded sources. I employed XRF analysis to answer the following questions:

1) What is the geochemical signature of the Arrowstone Hills source, and can it be used to differentiate this source from others?

2) What is the distribution of Arrowstone Hills materials across the Plateau?

The results of this project include a geochemical signature for the Arrowstone Hills source, and a map of archaeological sites across the Plateau where materials from this source have been identified. The distribution of these materials is discussed regarding Plateau First Nations', specifically Secwepemc, cultural protocols relating to exchange, resource access rights, territorial boundaries, and kinship systems. These cultural protocols were employed to inform hypotheses explaining how Arrowstone lithics were distributed across the plateau. Linking First Nations knowledge —"that rich body of oral history, stories, environmental awareness, technological expertise, and landscape memory" (Nicholas 2006:352) — with ethnographic information and quantitative data about exchange on the Plateau provides a multi-faceted understanding of exchange systems on the Plateau. Additionally, this helps to affirm Indigenous Knowledge and demonstrate its validity with quantifiable data, as an example of how Western and Indigenous ways of knowing can be complementary (See Nicholas and Markey 2015).

There were two main aspects to the provenance study. The first was to confidently establish an elemental signature for the Arrowstone Hills lithic source. This allowed it to be compared to and differentiated from similar materials using XRF via rare earth and trace elemental analysis. The second was to explore the spatial distribution of lithic materials from this source across the British Columbia Plateau. This was accomplished by an XRF comparison of artifacts found at sites across the region to reference data from the lithic sources. XRF analysis was employed in this research as it has been demonstrated to be a reliable and effective tool for fine-grained volcanic (FGV) lithic research (Gauthier and Burke 2011; Liritzis and Zacharias 2011; Newlander et al. 2015; Palumbo et al. 2015; Reimer 2018a and b; Scharlotta and Quach 2015). It is a rapid, precise, user-friendly technique that is non-destructive, and requries little to no sample preparation (Goodale et al. 2012:882; Liritzis and Zacharias 2011:109–111; Shackley 2011:8–9). Given these characteristics, it is an ideal choice for research focusing on the analysis of large numbers of fine-grained volcanic artifacts.

Source Characterization. The first objective of this project was to generate an elemental signature for the Arrowstone Hills source. Previous provenance analyses involving the Arrowstone Hills source have been undertaken (Commisso 1997:45; Reimer and Hamilton 2015; Reimer 2018) but sample sizes have generally been small, meaning that they may not represent the range of variability of the material. Sampling this source more extensively would establish a greater understanding of the elemental variability therein. This was accomplished by analyzing archaeological and geological materials from locations across the Arrowstone Hills area. XRF analysis was employed to measure the amount of rare earth and trace elements present in these lithic materials. The results were used in statistical analysis to determine whether or not the Arrowstone Hills is distinguishable from other sources in the Plateau and Northwest Coast. The locations of these sources are illustrated in Figure 1.

Exchange Networks. Once an elemental signature for the Arrowstone Hills was generated, it then would serve as a point of reference against which to compare lithic artifacts from a variety of archaeological contexts across the Plateau. After determining if Arrowstone materials were present at sites across the study area a map of locations where Arrowstone lithics are present would be generated. This would provide a means to assess the distribution of this material the study area, and serve as a starting point for exploration of the exchange networks that likely resulted in the patterns of distribution.

Thesis Structure

In this chapter I introduced the objectives of this research, discussing how generating a geochemical fingerprint for the Arrowstone Hills lithic source enables the exploration of the distribution of its materials across the Plateau. Additionally, I introduced the study area, and why the Arrowstone Hills are suitable for a research project exploring Plateau lithic exchange.

Chapter 2 provides background information for the Arrowstone Hills, with respect to its geology, its use by Indigenous people, and what previous archaeological research has been undertaken about this source. I begin by describing the geological area and its formational history, as well as the properties of the lithic materials themselves. I then detail the general culture history of the Plateau, and identify trends in lithic material exchange and acquisition throughout the occupational history of the region. I present a review of archaeological evidence for the use of this source, in addition to a summary of the relevant work in lithic provenance work in the area. Finally, I review ethnographic descriptions of the acquisition, use, and exchange of lithic materials on the Plateau, with special reference to the Arrowstone Hills, and briefly introduce a few informative lithic analysis projects from the Plateau.

Chapter 3 describes the methods used in this research. The basic principles of XRF analysis are described, including its strengths and weaknesses, and ways to mitigate the latter. The instrumental procedures and settings utilized during the XRF analysis are presented, as are the statistical methods employed. Finally, I summarize the sampling strategy for the source characterization and provenance study portions of the research, in addition to the sample selection criteria.

Chapter 4 presents the results of this research. The outcome of the source characterization, including comparison to other Fine-Grained Volcanic (FGV) lithic sources is expanded upon. Additionally, the findings of the provenance study are illustrated, demonstrating where lithics from Arrowstone Hills and other sources have been identified at archaeological sites across the Plateau.

Chapter 5 provides a general summary of the XRF results and spatial patterning of Arrowstone Hills lithics at archaeological sites across the study area. There is also discussion of how lithic exchange and acquisition can be recognized in the archaeological record. Furthermore, it explores how these lithics could have been dispersed to locations across the Plateau. It moves on to discuss how Plateau First Nations' cultural systems might have influenced and organized the access to and exchange of Arrowstone Hills materials. Finally, it argues what the most likely means of acquisition and exchange were for Arrowstone Hills and Kamloops Fine-Grained Volcanic Complex (KFGVC) materials across the Plateau.

Chapter 6 summarizes the findings of this thesis, drawing conclusions about lithic exchange on the Plateau and the cultural factors that likely influenced it. A brief discussion of potential implications that this research may have on other lithic provenance studies in British Columbia is also included. Finally, future research directions are proposed, and suggestions made about how to expand on this study.

Chapter 2.

Geological and Cultural Background of the Arrowstone Hills

This chapter describes the geological history of the Arrowstone Hills and the physical properties of its materials. I discuss how these physical properties relate to the suitability of the materials for use as raw material for stone tool production. Next, I summarize the cultural history of the Plateau, divided into the Early, Middle, and Late periods, with special focus on patterns of lithic acquisition and use for each period. Further, I discuss archaeological evidence for the use of the Arrowstone Hills as a source of toolstone, and provide a brief review of related archaeological research. I review ethnographic descriptions of lithic acquisition, use, and exchange by Plateau First Nations peoples, including specific references to the Arrowstone Hills as recorded by ethnographers. Finally, I briefly summarize some important, regional lithic analysis projects from the Plateau.

Geological History

Arrowstone Hills belongs to a suite of mid-Eocene-age volcanic rocks known as the Kamloops Group, which underlie much of the Plateau (Commisso 1997:43–45; Ewing 1981:1472–1473). It was formed between 55 and 46 million years ago (MYA) during a period of regional volcanism related to the cessation of tectonic subduction, the formation of a slab gap beneath central British Columbia, and the formation of a shield volcano (Bordet et al. 2014:56; Breitsprecher 2002:125–131; Reimer and Hamilton 2015:62–63). Figure 3 illustrates various Eocene-age rock complexes found on the British Columbia Plateau; the most relevant are the extrusive complexes, including the Arrowstone Hills, which were caused by this slab-gap volcanism. This period of volcanism was characterized by an initially intense pulse, with silicic magmas erupting first, and gradually transitioning to more dacitic and andesitic flows (Bordet et al. 2014:74). Situated between the Bonaparte and Deadman Rivers, north of the Thompson River (Figures 4 and 5), the Arrowstone Hills are part of this larger geological complex of volcanic flows that extend over thousands of square kilometers, and are up to 850 m thick (Read 2000:21).

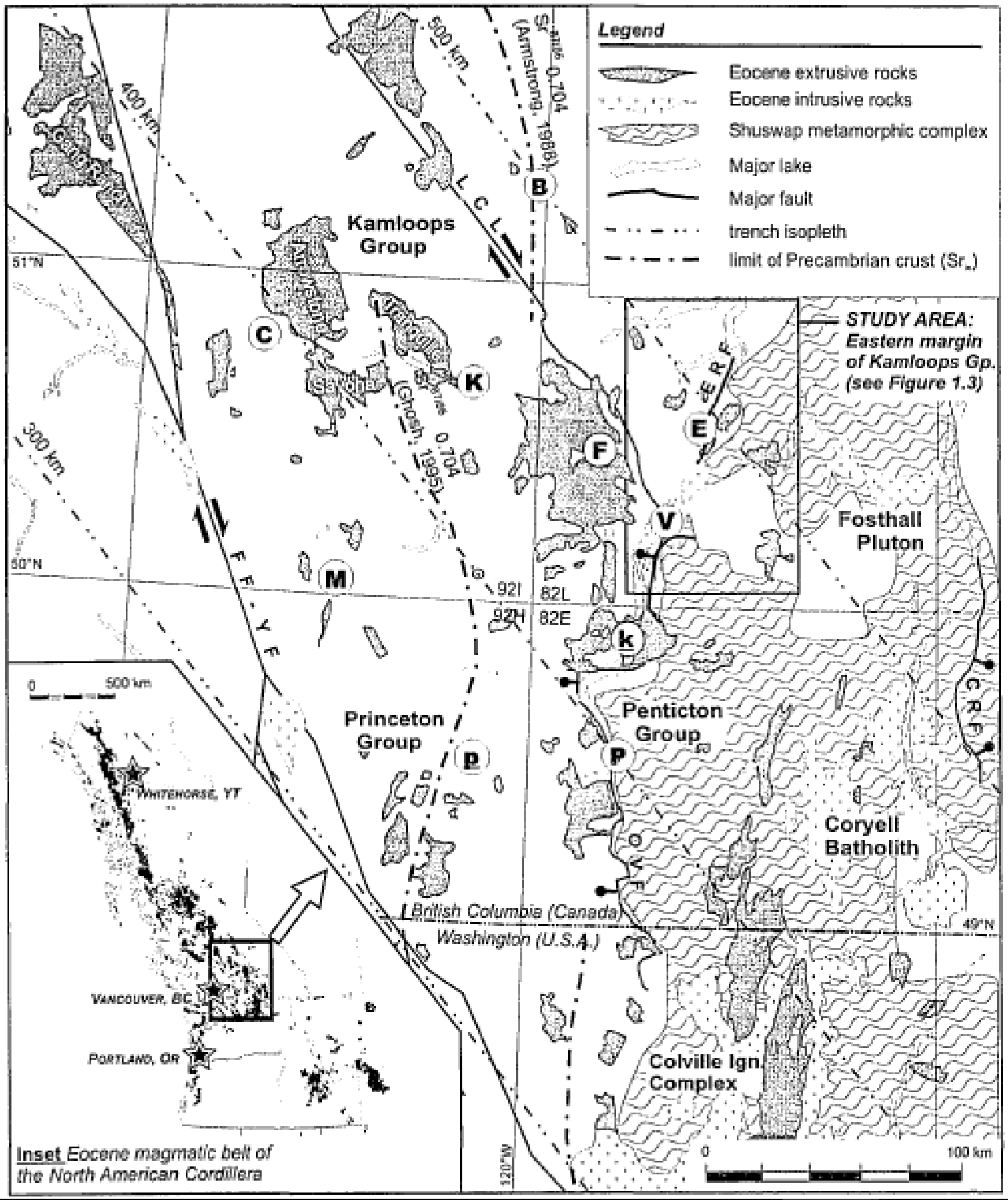

Figure 3: **Map of Eocene-era volcanic complexes on the British Columbia/Columbia Plateau. The Arrowstone Hills are labelled as C.**

Image: Breitsprecher 2002.

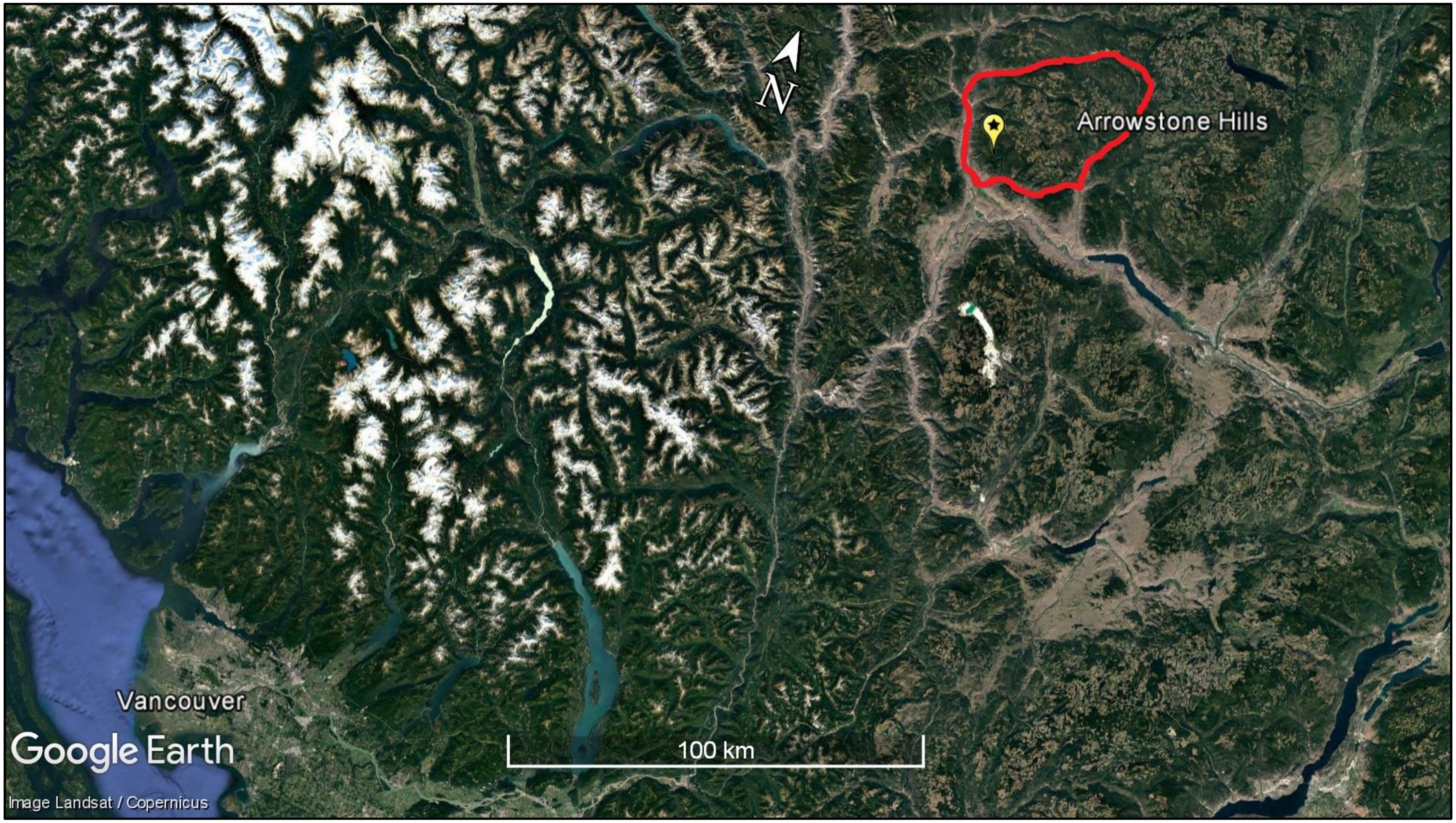

Figure 4: The Arrowstone Hills, outlined in red, in the context of southern British Columbia.

Image: Google 2018

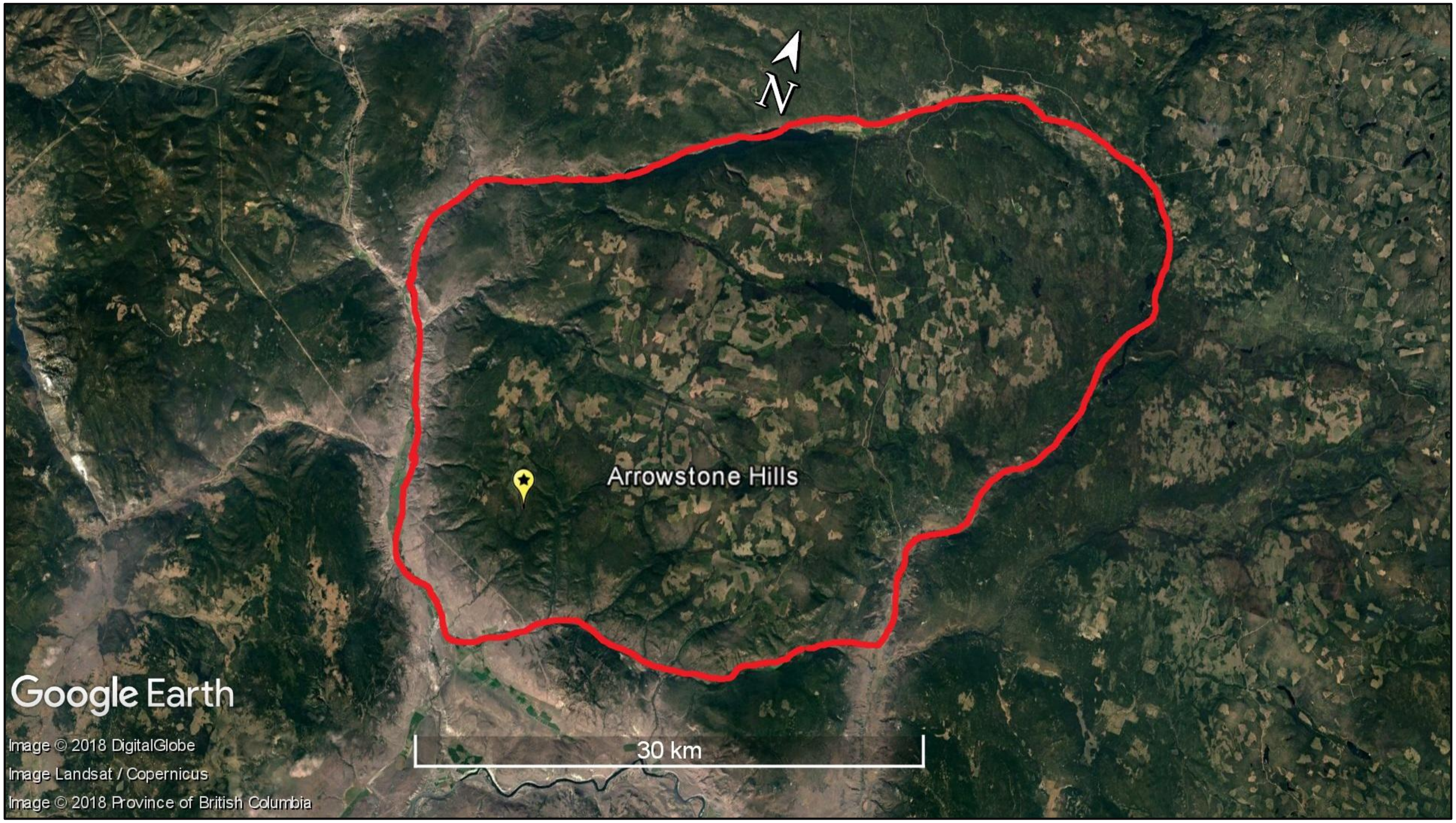

Figure 5: The Arrowstone Hills drainage, outlined in red.

Image: Google 2018

Many of the flows and materials found in the Arrowstone Hills can be identified as belonging to the dacite/rhyolite/trachydacite rock family, clustering around the dividing boundary between the different types (Austin 2007:19–21; Bakewell and Irving 1994:30–31; Commisso 1997:49; Greenough et al. 2004:712–713; Mallory-Greenough et al. 2002:51; Reimer 2018:504–505). Figure 6 illustrates the relative proportions of alkali and silica in the Arrowstone Hills, Turbid Creek, and Watts Point lithic sources, to classify them as particular rock type. Dacite, rhyolite, trachydacite, and to a lesser extent, andesite, all possess qualities that make them particularly suitable for use in stone tool manufacture.

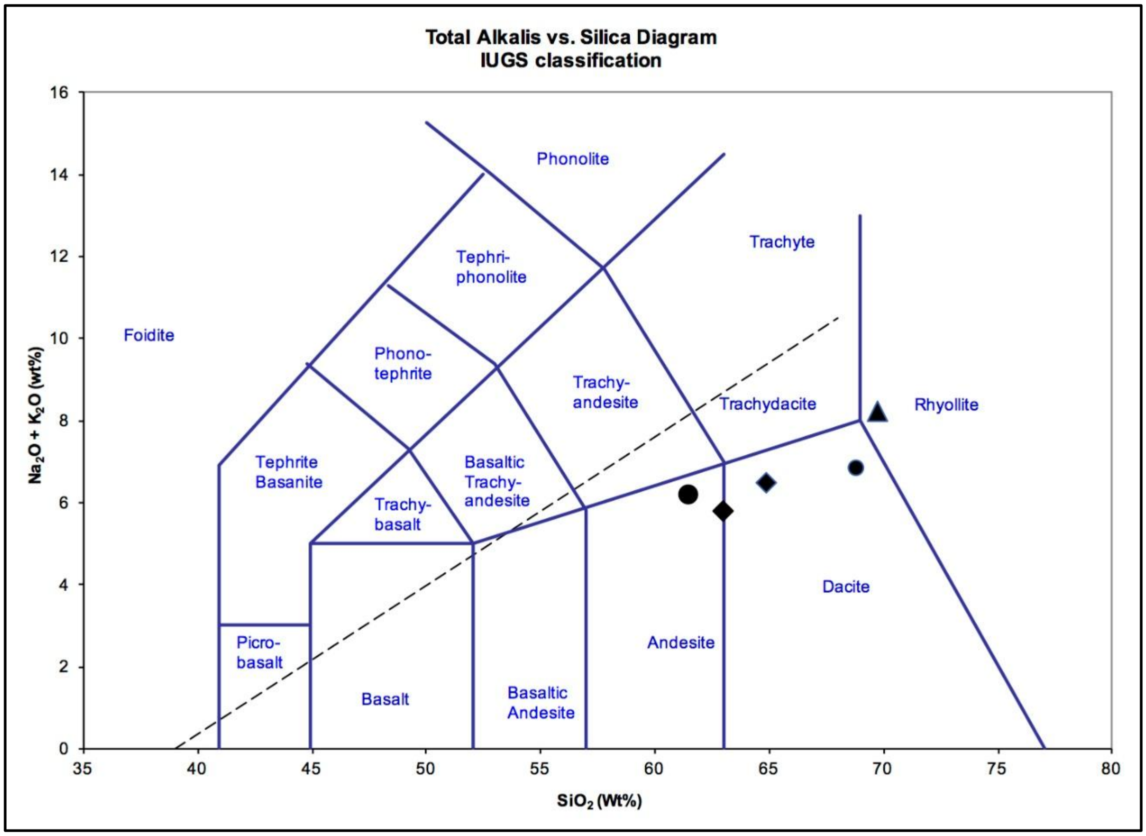

Figure 6*:* **Major oxide geochemical composition, and definitions of rock types. The Arrowstone Hills source is represented by the triangle, while two other British Columbia dacite sources, Watts Point and Turbid Creek, are represented by diamonds and circles, respectively.**

Image: Reimer 2018a.

The four physical properties that influence the suitability of a particular rock type as a raw material for tool production are flow planes, matrix grain size, glass content, and rate of phenocryst occurrence (Mallory-Greenough et al. 2002:49). *Flow planes* refer to lamellar banding that may occur in volcanic rocks because of their formational process, and which may influence the regularity and directionality with which flakes can be struck off a cobble (Rousseau 2015:32). *Matrix grain size* refers to the size of the individual minerals that constitute the rock itself, and is related to the degree of crystallinity. A material with a low matrix grain size typically fractures more evenly, and retains a sharper edge. *Glass content* refers to the level of silica in a material, which also influences how readily it fractures, and the sharpness of the edge (Mallory-Greenough et al. 2002:49). Finally, the *rate of phenocryst occurrence* refers to the frequency with which larger crystalline inclusions occur in a material. Materials with higher rates of phenocryst occurrence are more likely to fracture irregularly, and are thus less suitable for tool manufacture (Mallory-Greenough 2002:49).

The Arrowstone materials generally have a very fine matrix grain size, high glass content, low rate of phenocryst occurrence, and millimetre-scale flow planes, making them highly suitable as a toolstone (Bruchert and Greenough 2016:114; Greenough et al. 2004:712; Mallory-Greenough et al. 2002:51; Table 1). Compared to similar lithic sources, Arrowstone materials have fewer microphenocryst inclusions and a smaller matrix grain size (Greenough et al. 2004:712). Bedrock and cobble samples occasionally differ at the Arrowstone Hills, with flow banding and gas bubble inclusions sometimes found in bedrock (Mallory-Greenough et al. 2002:44). However, it appears that vesicular bedrock was not used as a toolstone, likely because of poor workability (Bruchert and Greenough 2016:113). In addition, Arrowstone Hills materials display a much higher degree of toughness that other materials such as obsidian, and are highly workable (Bruchert and Greenough 2016:114). While these materials can be highly suitable as a toolstone, morphological variability between clasts results in inconsistency in their suitability Table 1 compares materials from the Arrowstone Hills lithic source, as well as the five other lithic sources included in this research, summarizing their physical properties and illustrating that they possess nearly identical visual characteristics.

Table 1 **Comparison of Visual Characteristics for six British Columbia Fine-Grained Volcanic Sources (Adapted from Reimer 2018).**

Property	Arrowstone Hills	Cache Creek	Maiden Creek	Hat Creek	Watts Point	Turbid Creek
Munsell Colour	10 YR 2/1	10 YR 2/1	10 YR 2/1	10 YR 2/1	10 YR 2/1 to 3/1	10 YR 2/1
Crystal Structure	Fine	Fine	Fine	Fine	Fine to Med	Fine
Cleavage	Little	Little	Little	Little	Little to tabular	Little
Fracture	Conchoidal	Conchoidal	Conchoidal	Conchoidal	Conchoidal	Conchoidal
Hardness	6	6	6	6	6	6
Luster	Glassy	Glassy	Glassy	Glassy	Glassy	Glassy

Cultural History

The archaeological record of the Canadian Plateau is divided into the Early Period (11,000 BP – 7,500 BP), Middle Period (7,500 BP – 5,400 BP), and Late Period (5,400 BP – 250 BP), as defined by subsistence and habitation patterns, and technological developments (Chatters and Pokotylo 1998:73; Prentiss and Kujit 2004; Rousseau 2015; Stryd and Rousseau 1996). Here I present a brief description of each period, followed by a summary of what is known about lithic use patterns for each.

Early Period

The initial peopling of the Plateau is generally agreed to have occurred around 11,000 – 7,500 years ago, despite a lack of well excavated and dated archaeological sites from before 8,500 years ago (Butler and Campbell 2004:340–341; Stryd and Rousseau 1996:179). The Early period is characterized by small, mobile, egalitarian hunter-gatherer groups (Chatters and Prentiss 2005:52–55). Subsistence strategies were generalized, with reliance on multiple resources ranging from small to large game, fish, and also wild plant resources (Prentiss and Kujit 2004:xi; Rousseau 2004:4–6).

Lithic Acquisition in the Early Period. Lithic material acquisition during this period would likely have initially been on an encounter basis, and the highly mobile lifestyle practiced by many groups may have led to materials collected in one area being transported and deposited elsewhere, often across great distances (Chatters and

Prentiss 2005:52–55; Rousseau 2015:42–53). Lithic tools found at sites across the Plateau from this period have been recognized as stylistically and technically similar to tools from other, early technological traditions from adjoining regions (Rousseau 2008; Stryd and Rousseau 1996:180). Knowledge about the location of suitable toolstone sources increased as familiarity with the area grew. There is no evidence for actual quarrying activities from this period; indeed, any evidence for lithic acquisition from this period is sparse, aside from the existence of stone tools (Rousseau 2015:42–43). Future research may reveal more, but for the present, the high mobility and low population levels that characterize the Early Period support the presumption of low-intensity use of primary and secondary lithic sources, likely on an encounter basis, though potential exists for dedicated visits to primary, secondary, and tertiary sources.

Middle Period. The Middle Period spanned the time between 7,500-5,400 years ago. It saw a gradual shift from the mobile, hunter-gatherer strategy of the Early Period to a greater degree of sedentism around 5,000 BP, though not until after 3,500 BP in northern regions of the Plateau (Prentiss and Kujit 2004:xi; Rousseau 2004:11–12). Population densities were low at the beginning of this period, as evidenced by generally small, low-density occupation sites (Rousseau 2004:8). Populations increased slowly and steadily increased over time, anticipating the major population increases of the Late Period (Rousseau 2004:8). This was accompanied by an equally gradual change to a collector-oriented subsistence pattern revolving around planned, seasonal harvests of salmon and plant resources, stored for future use (Prentiss and Kujit 2004:xi–xii; Richards and Rousseau 1987:21–22; Rousseau 2004:11–13). One significant factor that led to the adoption of salmon as a key resource was the incursion of Coast Salish peoples into the Plateau from the Coast about 5,000 years ago, at the end of the Middle Period (Lawhead and Stryd 1985; Stryd and Rousseau 1996:198–200). They brought with them highly effective fishing technology that enabled Plateau peoples to successfully exploit this resource (Rousseau 2004:12).

Lithic Acquisition in the Middle Period. There is evidence of dedicated, planned visits to specific toolstone sources from this time, with direct acquisition of toolstone being common (Rousseau 2004:11; Rousseau 2015:44). This is based on numerous, large, primary reduction assemblages found at sites located near major lithic sources such as Arrowstone Hills, Cache Creek, Maiden Creek, and Pennask Lake dated to this period (Leaming 1971; Richards 1988; Rousseau 2015:43–44). Figure 7 illustrates the density of lithic reduction materials at one such site at the Arrowstone Hills. Additionally, there is some evidence for the exchange of lithic materials across the region: XRF studies of obsidian from BC Plateau sites have found materials originating from Anaheim Peak, British Columbia, and from Whitewater Ridge and Glass Buttes, Oregon (Blake 2004; Carlson 1994:311; Connolly et al. 2015; Rousseau 2015:44). If low volumes of obsidian from distant locales were being exchanged at this time, it stands to reason that the exchange of local fine-grained volcanic materials was likely also taking place.

Late Period. The Late period, defined as the time between 5,400-250 years ago, saw a widespread implementation and entrenchment of the salmon-centric collection and storage strategy that gradually developed in the Middle Period (Chatters and Prentiss 2005: 52; Prentiss and Kujit 2004:xii; Rousseau 2004:13–16). After about 2,000 BP, indicators of complex lifeways such as differentiated social status, increasingly dense, sedentary populations, and long-distance exchange of goods proliferate in the archaeological record, though this may have occurred earlier at certain locations (Hayden and Schulting 1997**;** Prentiss and Kujit 2004:xii; Rousseau 2004:13–20). The increase in population size and degree of seasonal sedentism is marked by the emergence of numerous, large villages across the Plateau at this time in many locations (Hayden 1997; Rousseau 2004:15). Participation in long-distance exchange networks can be seen archaeologically by the distribution of items not local to the Plateau, such as dentalium shell beads from coastal regions (Bruchert and Greenough 2016:101; Hayden 1997:256; Rousseau 2004:15). This is further supported by ethnographic accounts that describe trade between the Plateau and elsewhere that brought in non-local goods and materials, such as yew-wood and stone pestles from the Lower Fraser (Dawson 1891:11, 17), abalone and dentalium shells (Teit 1900:260–262), fish oil, and slaves from the coast (Teit 1906:232–233), and buffalo hides from the plains (Teit 1909:536).

Lithic Acquisition in the Late Period. The above-mentioned trade networks likely facilitated an increase in the exchange of fine-grained volcanic toolstone materials across the Plateau (Choquette 1981); sites from this period often have lithic assemblages that are between 70-90% fine-grained volcanics (Rousseau 2015:44–45). The quality of lithics used during this period seems to fluctuate. Initially, most toolstone was of medium quality, but increasing quantities of higher-quality materials appeared towards the middle of the late period (Richards and Rousseau 1987:28–44; Rousseau 2004:15).

Figure 7: **Materials eroding from a site partially bisected by a road. All dark-coloured materials are primary reduction waste or smaller, unused pebbles and cobbles.**

Near the end of this period an increase in the number of sites with lesser quality fine-grained volcanic materials, and higher incidences of lithic curation and recycling seem to indicate reduced proliferation of higher quality toolstone (Rousseau 2015:44–46). Throughout this entire period, however, fine-grained volcanic raw materials appear to have been the preferred, and most common, stone used for tool production on the Canadian Plateau (Austin 2007; Hayden et al. 2000; Richards 1988; Rousseau 2000, 2015).

Archaeological Evidence for Use of the Arrowstone Hills

Arrowstone Hills has several known areas of intensive quarrying activities, identified by Bruce Ball during an archaeological assessment of the source in the mid-1990s (Ball 1997). These are probably best described as "hot-spots" on a landscape of continuous lithic acquisition and extraction, similarly to what Fladmark (1984:149) described at the Mt. Edziza obsidian complex. These "hot-spots" are where intensive lithic extraction and reduction activities were undertaken, and likely represent areas where dense concentrations of suitable raw materials occurred. Figure 8 gives an idea of the size of one lithic extraction feature at one location in the Arrowstone Hills. While the size of the extraction features can vary, they are frequently around 1 meter in diameter.

Figure 8: J.R. Williams sitting on the edge of cultural depression 29 (CD 29) at site EfRh-135. The depth of the quarrying feature is approximately 1 meter.

Image: Matrix Research 2012.

The largest recorded concentration of these quarrying features at the Arrowstone Hills source has 115 such depressions, as illustrated by Figure 9. The extent and intensity of suficial debitage make it nearly impossible to take a step without treading on flakes or finding a finished tool or perform; one such tool is illustrated in Figure 10.

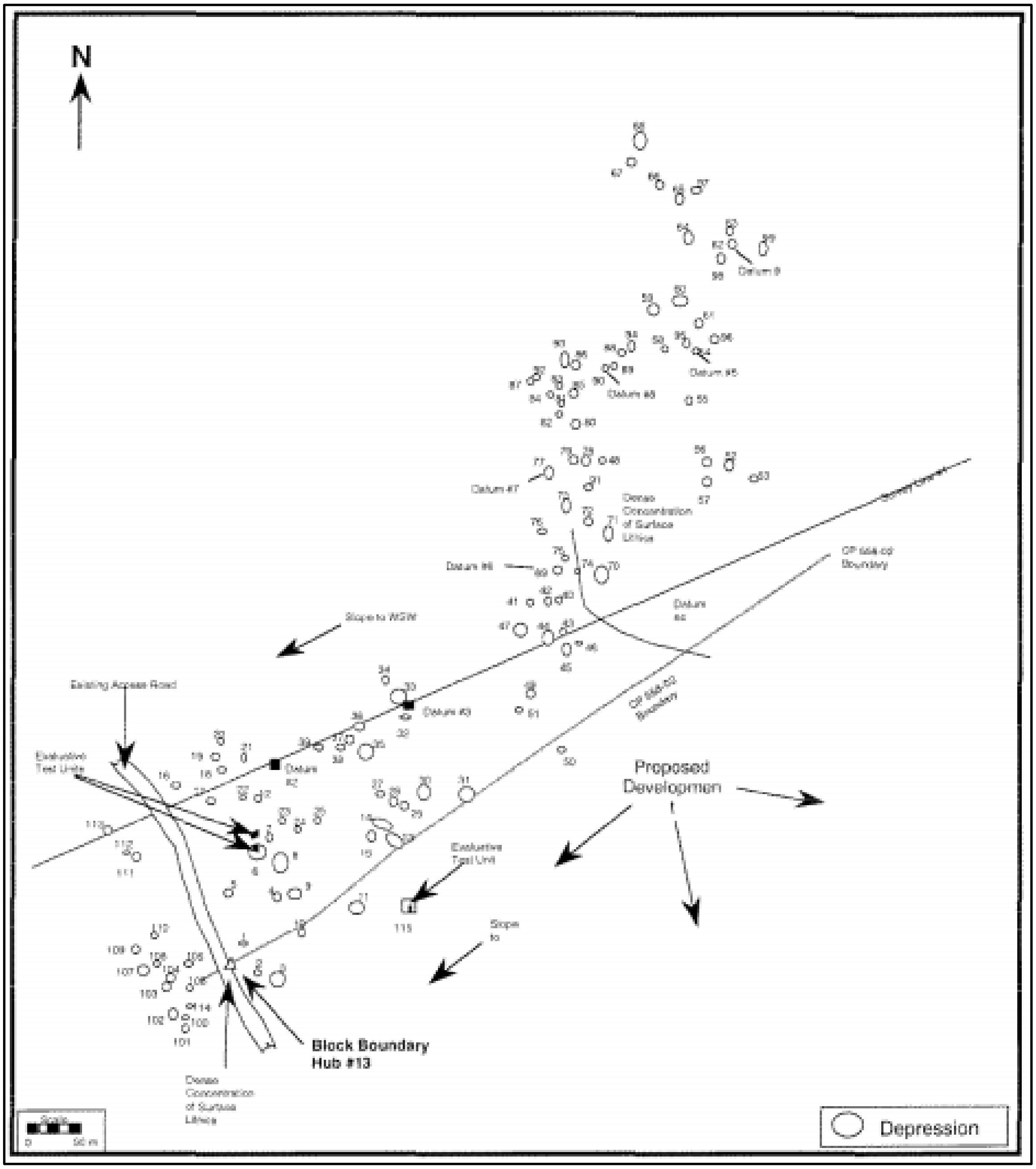

Figure 9: Site map of EfRh-38, showing 115 recorded lithic quarrying features.

Image: Ball 1997.

Figure 10: A biface, found during preliminary field reconnaissance.

The intensity of use varies across this source, from small debitage scatters to massive areas covered by mining pits, with artifacts and flakes numbering in the tens of thousands; Figures 11 and 12 illustrate the density of the material, and intensity of the reduction activities (Ball 1997:10–45). Deposits from quarrying activities are more than 2m deep in some areas, and extend below the water table in others (Ball 1997:24). Further observations of stratigraphic profiles in existing test units at the source revealed consistently massive amounts of debitage across the observable vertical profile. The number and extent of quarry sites, and the intensity of extraction activities there suggest long-term, repeated use of the Arrowstone Hills as an important toolstone source. These lithics are incredibly abundant; despite its intense exploitation, there are likely "still millions of…clasts that remain buried throughout the Arrowstone Hills" (Rousseau 2015:32). It is equally likely that millions of fine-grained volcanic clasts were removed over the history of this source's use, and were distributed and exchanged all over the British Columbia Plateau.

Figure 11: Lithic flakes, pebbles, and debitage eroding out of a road cut in the Arrowstone Hills.

Other researchers have attributed lithic materials recovered during research at sites across the Plateau and the Northwest Coast to the Arrowstone Hills, based on both visual analysis (Hayden et al. 2000; Rousseau 2015) and more quantitative techniques (Bruchert and Greenough 2016: Morin 2015; Reimer 2018a; Reimer and Hamilton 2015). However as previously discussed, those studies that rely solely on visual analysis of materials to attribute them to a source can be problematic or unreliable (Goffer 1983:1198–1199; Reimer 2018a:499).

Figure 12: Lithic scatter at an extraction and reduction area at the Arrowstone Hills; debitage density at this site was typical of quarrying and reduction areas.

Ethnographic Descriptions of Lithic Use and Exchange on the Plateau

Ethnographies provide relevant information for the use and exchange of lithics on the Plateau, including references to the Arrowstone Hills. The most useful are those produced by George Dawson (1891), Alexander Teit (1898, 1900, 1906, 1909), and Adrien-Gabriel Morice (1893). Their accounts provide descriptions of the lifeways of Plateau peoples from the post-contact period. They also specifically detail the manufacture, use, and exchange of lithic tools, as well as ideational cultural aspects that reference or revolve around lithics, and the value placed on them.

The Arrowstone Hills are referenced as an important source of lithic raw material for the Secwepemc and Nlaka'pamux First Nations. The northern divisions of the Nlaka'pamux obtained much of their raw toolstone "at a certain place north of the Thompson river" (Teit 1900:241). Teit is not specific in this instance about the location, but in another publication (Teit 1909:591) states explicitly that the Secwepemc obtained lithic materials from "the Arrow-stone Range, north of the Bonaparte River." He further states that "large roughly chipped arrow-stone were found scattered over the surface in many places;" this description likely refers to the numerous lithic extraction and reduction areas found in the Arrowstone Hills, or perhaps the Cache Creek area. Dawson (1891:35) also described how "particularly abundant" raw toolstone was in the "Arrow-stone Hills and the upper part of Cache Creek," and states that among all the lithic materials employed by the Secwepemc, that this was the "most commonly used."

The value placed on high-quality lithic materials, including those from the Arrowstone Hills, was expressly identified by Dawson (1891:35) who noted that Arrowstone Hills lithics were "pre-eminently important." This is supported by descriptions of control over access to raw material sources (Ignace and Ignace 2017:309, 317; Morice 1893:65). Preferred sources of raw materials occurred naturally in only limited areas on the landscape, and access to them was restricted. Sources of good quality material were "jealously guarded against any person, even of the same tribe, whose right to a share in their contents was not fully established" (Morice 1893:65). Oral accounts often referenced intruders coming into the territory of other nations with the goal of invading resources grounds, and who had to be repelled (Ignace and Ignace 2017:309, 317). Teit (1909:546) recorded that a Sekani group "would send active young men far down the river…to gather arrowstone" from Secwepemc lands as it did not occur naturally in their territory. While Teit may not have referenced Arrowstone Hills materials here specifically, competition or conflict over quarrying areas is indicative of the importance held by high-quality lithic materials, and the level of effort expended to obtain them. Such incursions necessitated the safeguarding of territorial boundaries and resource areas, such as quarry sites. This sometimes escalated to violence; for example, Teit (1909:546) recorded that people had been killed over such transgressions. Such accounts suggest that access to lithic resources was controlled, and that they were held as a valuable commodity.

The exchange of raw materials and finished tools between Plateau and coastal First Nations is also referenced in these documents. Teit (1900:183) notes that the Nlaka'pamux of the lower Fraser often imported finished stone mauls or hand-hammers from the Stl'atl'imx. Raw materials such as dentalium shells, nephrite jade, different types of wood, hides, furs, cedar and hemp bark, and feathers were among the items exchanged between the Secwepemc, Nlaka'pamux, Stl'atl'imx, and other local groups, as well as with coastal First Nations (Dawson 1891:11,17; Teit 1900:260–262, 1906:232–233, 1909:531–539). None of the ethnographic accounts specifically mentions lithic raw materials other than nephrite as having been exchanged. However, given the high frequency of fine-grained volcanic raw materials at archaeological sites across the Plateau (Rousseau 2015:44–45), the intensity of use of the Arrowstone Hills as a source of toolstone, evidence for controlled access to preferred quarry areas, and records of the value and importance placed on such lithic materials, it is likely that they were exchanged. Their absence in ethnographic descriptions of trade items may be explained by the ethnographers' focus on the exchange of, to them, more interesting items, such as hide robes, tents, canoes, salmon, snowshoes, pelts, and pipes. Alternatively, it is possible that such materials were not frequently exchanged, but the results of this research seem to demonstrate otherwise.

Plateau Lithic Use Beyond the Arrowstone Hills

Beyond the Arrowstone Hills, analyses of lithic assemblages at regional and site-specific levels have greatly expanded our understanding of the lithic reduction strategies and technological organization that occurred through time on the Plateau. These include studies at Keatley Creek (Hayden et al. 2000), Bridge River (Prentiss 2017), in the

Chilcotin (Magne 1983), and the Hat Creek area (Pokotylo 1978). Results from these works have helped illustrate the variety of lithic strategies that were employed at different sites, and helped to form interpretations about the primary activities undertaken at those sites. They are also informative about how inhabitants at a particular location planned their lithic use, and offer hypotheses about material procurement and use. Overall, fine-grained volcanic materials proved to be the primary toolstone employed at Plateau sites. These materials were reduced using a variety of strategies resulting in both expedient and formal tools, with varying levels of concern about economic use of the materials depending on their level of availability. While informative, the primary focus of these studies is the technological patterning of lithic use. This thesis focuses primarily on culturally-influenced patterning of lithic distribution through exchange, and so does not discuss them in depth.

Summary

This chapter presented the background information necessary to contextualize this research. The geological history of the Arrowstone Hills was described, with focus on the formational processes that created the hills. I discussed the general culture history of the Plateau, with special focus on lithic acquisition and use for the Early, Middle, and Late periods. I reviewed archaeological evidence for the use of the Arrowstone Hills, describing the scope and nature of lithic extraction activities at this source. Further, I reviewed ethnographic data about lithic acquisition, use, and exchange on the Plateau, with specific references to the Arrowstone Hills. Finally, I briefly described some important Plateau lithic analysis projects. The geology and formational history of the Arrowstone Hills resulted in a source of high quality toolstone that was heavily exploited by the people of British Columbia's Plateau for millennia. Patterns of lithic acquisition and use at the Arrowstone Hills and other sources shifted in conjunction with changing cultural trends on the Plateau. It is evident from the archaeological and ethnographic evidence that the Arrowstone Hills were an important source of toolstone throughout the ancient past.

Chapter 3.

Methods and Methodology

This chapter describes the means and strategy by which this research was carried out. It begins by outlining why XRF was selected as the primary analytical method, and details the basic principles, strengths, and limitations of this technique. Continuing on, it illustrates the use of XRF in archaeology, with special attention to its applicability to lithic source characterization and provenance studies. Finally, I explain the specific processes applied in this project, including sampling selection and strategy, analytical and statistical methods, and information about the samples themselves. XRF analysis was selected as the primary analytical method for this research as it has been demonstrated to be a reliable and effective tool for fine-grained volcanic lithic research (Newlander et al. 2015; Palumbo et al. 2015; Reimer 2018a, 2018b; Scharlotta and Quach 2015).

Principles of XRF Analysis

XRF analysis is an analytical technique that can detect and measure the presence and concentration of elements in a sample. XRF analysis has been employed for commercial elemental analysis since the 1950s, but the technique has seen use since the 1910s (Shackley 2011:7–8). The instrument produces a beam of high energy photons by means of radio-isotope x-ray tubes, which is directed at a sample to excite the electrons of the compositional elements and induce the emission of radiation (Liritzis and Zacharias 2011:110; Lundblad et al. 2008:2). Ionized electrons then detach from the inner shell of an atom, and are replaced by an outer shell electron; because these inner shell electrons are tightly bonded, they release energy when they detach, which is known as fluorescent radiation (Shackley 2011:16). The amount of fluorescent radiation emitted depends on fixed, known energy differences between electron shells, which are characteristic to each particular element; therefore, the fluorescent x-rays can be measured and used to detect the abundances of elements in a sample (Liritzis and Zacharias 2011:110; Lundblad et al. 2008:2; Shackley 2011:16). These data can be compared between unidentified samples and known reference materials to obtain a probabilistic match. It is preferable to analyze the higher energy elements, which are more easily excited and therefore more easily measured, providing higher counts and more reliable statistics (Grave et al. 2012:1676). The elements most often measured and used for characterizations are K, Ca, Ti, Mn, Fe, Zn, As, Rb, Sr, Zr, Ba, Hg, and Pb; lower energy elements are less desirable to measure, as beyond a certain depth into the sample they are difficult to excite with radiation, which can result in issues related to low counts, detection, and the skewing of results (Grave et al. 2012:1676; Liritzis and Zacharias 2011:117).

Strengths and Weaknesses of XRF Analysis. XRF analysis has many strengths, hence its widespread application in archaeology and elsewhere. These include rapid analysis of 20+ elements; good analytical precision; portability and ease of use; non-destructive analysis; user friendly software that can be linked to GIS; little necessary sample preparation and; cost effectiveness (Goodale et al. 2012:882; Liritzis and Zacharias 2011:109–111; Shackley 2011:8–9). However, there are also several weaknesses that must be acknowledged and mitigated. First, while XRF instruments can generate compositional groups with reliability, they sometimes lack accuracy compared to more powerful technologies, and can mischaracterize certain elements (Freeland 2013:46–47; Goodale et al. 2012:875–882). Accuracy and precision are affected by numerous factors, but if controlled for by calibration, generally do not cause erroneous interpretations, or affect the ability of XRF to attribute artifacts to sources (Freeland 2013:46–47). Accuracy and precision can vary according to the capabilities of different instruments (Shackley 2011:25–32). Inter-instrument variability can be problematic when comparing results from different studies, potentially causing misleading conclusions, but when a study employs only one kind of instrument, the results are usually more than adequate (Goodale et al. 2012:880). Analytical drift has been observed in XRF instruments in several different studies, and can affect the reproducibility of results over time (Freeland 2013:53; Goodale et al. 2012:881–882; Lundblad et al. 2008:5,10). This is highly problematic, but can be mitigated to a degree by keeping analytical conditions consistent, and selecting stable elements for analysis (Lundblad et al. 2008:5,10). When these weaknesses are properly mitigated, XRF is a powerful, reliable analytical tool that has a wide applicability, especially in archaeology.

In archaeology, XRF is frequently applied for two main reasons; 1) to understand technological aspects of artifacts such as compositional analysis; and 2) to identify or estimate source areas, usually involved with exploring exchange networks (Freeland

2013:14). The latter application is frequently used for lithic analysis (Grave et al. 2012; Liritzis and Zacharias 2011; Nazaroff et al. 2010; Palumbo et al. 2015; Scharlotta and Quach 2015), but also for the study of such materials as pigments, metals, glass, and ceramics (Freeland 2013; Williams-Thorpe 2008). Lithic and other raw material analysis usually takes one of two forms — source characterization or artifact provenance analysis — with the former being a necessary step to achieve the latter.

Source Characterization

Source characterization is "an essential step in identifying relationships between artifacts and sources," and involves qualifying or quantifying the compositional attributes of materials (Freeland 2013:17). When using XRF elemental analysis, it can involve establishing the relative or absolute concentrations of elements in samples from a source (Freeland 2013:17). If characterizing a source using elemental analysis, it is crucial to understand the level of elemental variability that may exist within a source (Lundblad et al. 2008:2). This is important as it allows the researcher to determine if separate sources overlap in terms of their elemental fingerprints, and take that into consideration. In other words, it must be determined if there are elements in the source material that vary more *between* sources than *within* the source. Otherwise it may be impossible to differentiate between multiple sources (Commisso 1999:44), a principle known as the "provenance postulate" (Glascock and Neff 2003:1521).

Adequate sampling must thus be undertaken for source characterization, such that it provides an accurate representation of the source material (Shackley 2008:197–199). The question of how large a sample population must be to characterize a source is a recurring one. Reviewing relevant literature (Glascock 2011; Hughes 1994; Johnson 2011; Jones et al. 1997; Kuzmin et al. 2002; Millhauser et al. 2015; Phillips and Speakman 2009) reveals that there is no standard as to what constitutes a sufficient sample size. However, there is some consensus that extensive sampling of primary and secondary source deposits, paying attention to different flows or volcanic vents, will allow one to "be more confident that geochemical variability does or does not exist" (Hughes 1994:263). There is a tendency towards large sample populations to achieve representativeness, which can be helpful, but it may be prohibitively expensive to assemble (Shackley 2008:201). The optimal representative sample population would contain materials from the primary, and all secondary deposits at a source, though there is no “magic number” of samples (Shackley 2008:202).

Provenance Analysis.

Once a source has been adequately characterized, it becomes a reference point against which artifacts can be compared, forming the basis of provenance studies, such as this research. The comparison of artifacts to potential origin points often referred to as sourcing. Sourcing is when a sample is characterized and determined to fall within the expected range of variation of a source (Freeland 2013:17). It is important, however, to dispel the inaccurate perception that materials can be positively matched to their origin point based on chemical or elemental analysis (Shackley 2008:196–197). Shackley (2008:196–197) argues that nothing is ever definitively "sourced," but that materials are only characterized as a "probable fit to a known source." The probabilistic nature of lithic sourcing results is frequently under-evaluated by archaeologists, who do not investigate or evaluate the role of statistics in assigning materials a source (Shackley 2008:196–197).

Sourcing studies have employed a variety of techniques that range from the highly technological, including XRF analysis, neutron activation analysis (NAA), and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), to visual techniques such as macroscopic visual analysis (MVA) or individual attribute analysis (IAA) (Bruchert and Greenough 2016:101; Glascock 2011:161). Provenance studies can be highly informative about the acquisition or exchange of raw materials and finished goods; this can in turn help answer questions about social and technological organization, and cultural interaction (Jones et al. 1997:929; Weiming et al. 2010:1670).

Analytical Procedures

The analytical procedures utilized in this research project were based on protocols and best practices established by numerous researchers and studies employing XRF analysis to study fine-grained volcanic materials (Liritzis and Zacharias 2011; Palumbo et al. 2015; Reimer 2018a and b; Williams-Thorpe 2008). These procedures pertained to instrument settings (Goodale et al. 2012; Newlander et al. 2015), sample selection

(Gauthier and Burke 2011), instrument-sample interaction (Scharlotta and Quach 2015), calibration processes (Reimer 2018a and b), and statistical analysis (Shackley 2011).

The instrument used for this project was a Bruker AXS Tracer III-V+ portable energy dispersive XRF (EDXRF) spectrometer. It uses a rhodium tube to emit X-rays, with a peltier-cooled silicon PIN diode detector operating at 40 kilovolts, and 15 microamps. For this analysis, it operated from external power sources only, as opposed to battery power, ensuring steady power supply. This instrument has been demonstrated to be analytically stable through previous and ongoing experimental testing by Dr. Rudolf Reimer, my senior supervisor. Previous testing of NIST 278 (obsidian powder) and PER-1 (Peruvian rhyolite powder) developed by the Geological Survey of Canada, both analyzed consecutively 20 times for 200 seconds, revealed that the six key elements utilized in this research –Fe, Rb, Sr, Y, Zr, and Nb– can be used to determine geochemical groups (Reimer 2018:501). In addition, 50 analyses were performed by Dr. Reimer over the past five years on the same sample of obsidian as an internal standard to detect instrumental drift; none has been discovered (Reimer 2018:501).

The instrument can accept different filters to target specific elements for analysis. In this study, it was equipped with a 6mm copper, 1mm titanium, and 12mm aluminum filter, allowing for analysis of elements ranging between manganese to molybdenum on the periodic table. The specific elements targeted were iron (Fe), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). These elements are on the higher end of the X-Ray spectrum, and are more easily excited and measured, providing higher counts and more reliable statistics (Grave et al. 2012:1676). This group of elements is also widely recognized as being applicable for the characterization of fine-grained volcanic rocks (Coffman and Rasic 2015; Dillian 2014; Reimer 2018a; Reimer and Hamilton 2015).

Analyses of source materials and artifactual samples were run for 200 seconds per sample to ensure sufficient sample stimulation, so that enough radiation was emitted for an accurate measurement (Newlander et al. 2015:535). An optimal beam exposure time can be between 40 to 60 seconds; while increasing count times does reduce error, exposure beyond 180 seconds has little effect (Newlander et al. 2015:536–544). At all times during use, the instrument was mounted on a stand on a steady, flat surface to maintain a secure position. Samples were selected based on physical dimensions; all were at least large enough to fully cover the beam emitting window, and were at least 5mm thick. This helped ensure both adequate absorption of X-rays and reduction of scattering effects (Lundblad et al. 2008:2; Newlander et al. 2015:535; Shackley 2011:9–10). The flattest portion of the sample was analyzed each time to reduce differential absorption of X-rays by air between the sample and the emitter window (Liritzis and Zacharias 2011:132–136; Lundblad et al. 2008:2; Williams-Thorpe 2008:181). Only clean surfaces were analyzed; any dirt or other materials were removed. In addition, surfaces with catalogue numbers were avoided during analysis. Weathered portions were avoided, as weathering can impact the elemental composition of a sample through chemical alteration (Gauthier and Burke 2011:269; Goodale et al. 2012:882; Liritzis and Zacharias 2011:132–136).

The program used for the analysis, S1PXRF, was developed by the company Bruker. It is designed to allow the user to visually examine the spectrographic readings in real time, and review them afterwards. All X-ray counts were converted to parts per million (ppm) through S1CalProcess, a Microsoft Excel macro also developed by Bruker. This process uses rhodium Compton backscatter and a database of established values from 40 obsidian and fine-grained volcanic lithic sources from around the world (Reimer 2018a:501). S1CalProcess was developed at the University of Missouri Nuclear Reactor to quantitatively calibrate the results of analyses like the ones undertaken in this research (Reimer 2018a:501). This was accomplished by comparing the instrument's results to known and established values for manganese (Mn), iron (Fe), zinc (Zn), gallium (Ga), thorium (Th), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb) (Reimer 2018a:501).

The results were imported into the statistical program JMP13. Using such multivariate approaches as principal component analysis and elemental biplots, data for the Arrowstone Hills, Maiden Creek, Cache Creek, and Hat Creek sources were analyzed to determine which elements were most useful to differentiate these sources. Principle component analysis is a powerful method that allows complex multivariate data to be represented as a two- or three-dimensional picture (Baxter 1994; 48). This facilitates data exploration and identification of groups; in archaeological applications, principal component analysis is most often used to determine groups based on their chemical composition (Baxter 1994:48). This method essentially reduces the data to their most distinguishing aspects; it is especially useful in identifying specific elements that, by themselves, may be used to describe the most significant compositional differences between lithic source groups (Glascock et al. 1998: 29). My review of the analysis determined that a biplot of rubidium (Rb) and strontium (Sr) provided the greatest differentiation between source materials. The results were further compared to existing source data from the Arrowstone Hills, and to two fine-grained volcanic sources in Howe Sound, British Columbia: Watts Point and Turbid Creek (See Reimer 2018a). Sources were grouped with 95% confidence ellipses to establish an elemental signature for the Arrowstone Hills. Samples from artifacts from sites across the Plateau were subsequently analyzed using the same procedures. They were compared to these sources; if a sample fell within the 95% confidence interval for a source, it was considered statistically likely to have originated from that source.

Sampling Strategy

First Objective: Source Characterization. Sampling for this project was designed to provide adequate data to complete this research's primary objectives. The first objective was to determine the geochemical signature of the Arrowstone Hills source, and if it could be differentiated from other fine-grained volcanic sources in British Columbia using XRF analysis. The information required to complete this was geochemical data from the Arrowstone Hills, and the other fine-grained volcanic sources included in this research. This geochemical data was either obtained by myself, or from previously completed research. As previously discussed, there is little agreement about what constitutes an adequate sample size for source characterization. I followed Shackley's general recommendations to sample all primary and secondary deposits, with a minimum of five samples from each location (Shackley 2008:202).

Given the size of the Arrowstone Hills source and the extent of both archaeological and geological deposits, it was impossible to collect materials from every primary and secondary deposit at that source. Furthermore, access to the Arrowstone Hills source was severely limited by forest fires during the 2017 field season, and it was not safe or practical to collect samples. In addition, to fully determine if the Arrowstone Hills could be distinguished from other fine-grained volcanic lithic sources would have required full source characterizations for each other source that was compared. This extended well beyond the scope of what could be reasonably expected to be accomplished in an MA thesis. As such, sampling was almost entirely restricted to existing collections of artifacts and geological samples, with a small number collected during my fieldwork. Since it was not possible to sample every deposit at every source, or every archaeological site on the Plateau, I sought to obtain as many samples as I could, from as many deposits and sites that were available.

For the Arrowstone Hills, samples were analyzed from every location at this source where materials had previously been collected during other archaeological projects by academics and consultants. In addition, geological samples were collected during my field reconnaissance. In total, 191 samples were obtained from 18 archaeological sites at this source. Figure 13 illustrates the locations of these sites, as well as other locations where materials were gathered during preliminary field reconnaissance. Sampling of the Arrowstone Hills source for this study focused on quarry sites; of the 18 archaeological sites from which materials were sampled, 17 are described as quarrying sites in provincial archaeological reports, with cultural depressions associated with lithic extraction activities. This focus was to capture the range of variability in the materials that were being selected for use by those utilizing the Arrowstone Hills source. A further 68 samples from the general Arrowstone Hills area, without specific provenance to archaeological sites, were also analyzed, to provide further coverage of the source outside of archaeological sites. Added to the extant 55 XRF samples for this source, the total number of samples reached for the Arrowstone Hills source was 314 (Appendix A and B).

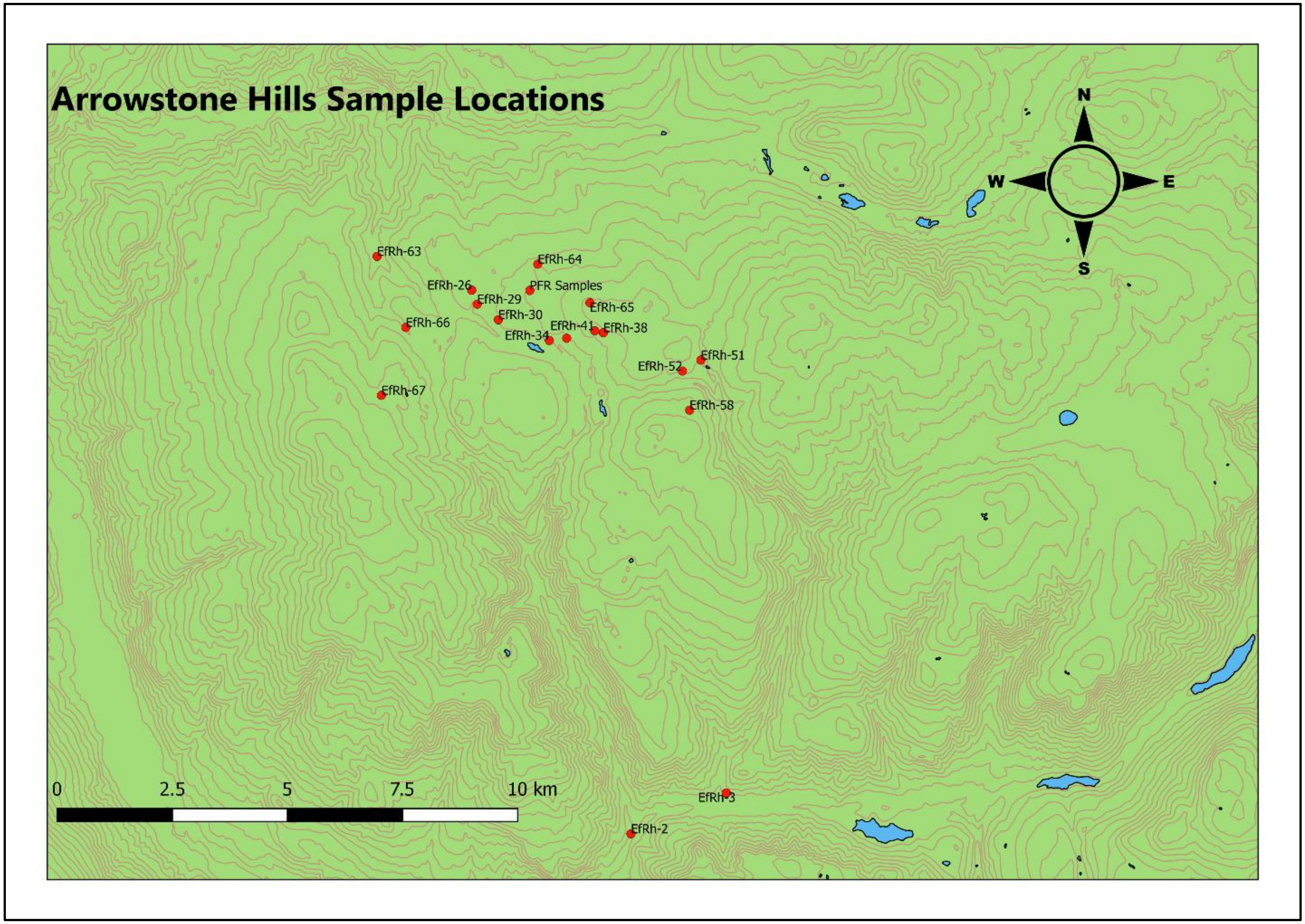

Figure 13: **Arrowstone Hills source sample locations.**

XRF data from five other fine-grained volcanic sources (Cache Creek, Maiden Creek, Hat Creek, Watts Point, and Turbid Creek) were employed as reference points against which to compare the Arrowstone Hills and regional archaeological samples. 25 samples from the Cache Creek lithic source, 28 from the Maiden Creek lithic source, and 10 from the Hat Creek lithic source were included. All three of these sources are located within a 50 km radius of the Arrowstone Hills, and may have a common formational history. This means that differentiating between them based on the comparison XRF data may not be entirely possible. Figure 14 illustrates their locations; the Cache Creek source is not explicitly identified, but is located nearby the town of Cache Creek. Watts Point and Turbid Creek, dacite sources in Squamish Nation territory along the shore of Howe Sound, were included with 25 samples each. The approximate locations of these sources are illustrated in Figure 2; they are geographically separated from the Arrowstone Hills by approximately 175 km, and do not share a common geological history. As such, it is likely that they can be readily distinguished from the Arrowstone Hills based on the comparison of XRF data. In total, 113 samples were included from lithic sources other than the Arrowstone Hills.

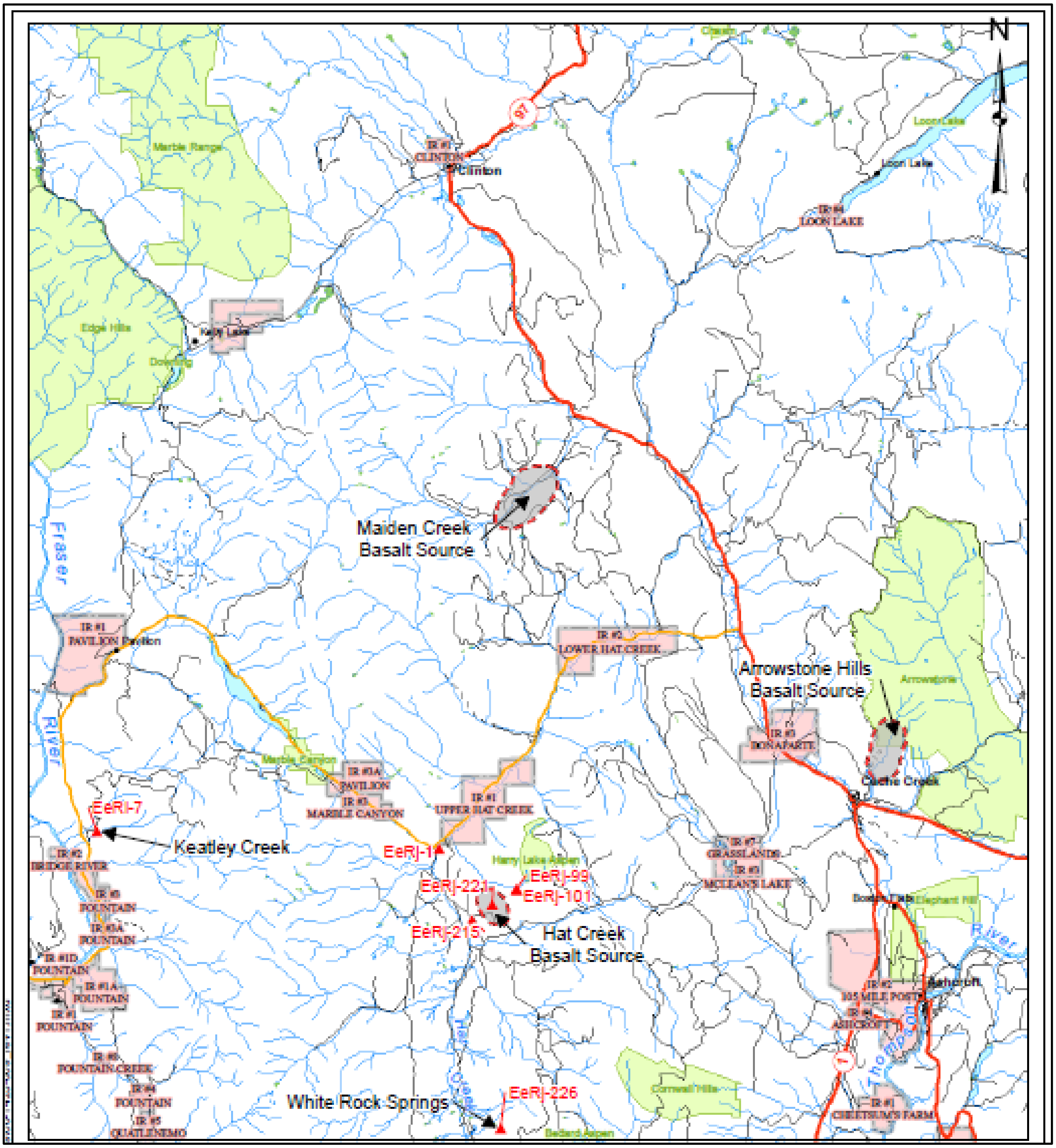

Figure 14: Arrowstone Hills, Maiden Creek, and Hat Creek fine-grained volcanic Sources.

Image: Golder 2008.

Second Objective: Provenance Analysis. The second objective was to explore the distribution of Arrowstone Hills materials across the Plateau. The information required to complete this was geochemical data from lithic artifacts from sites across the Plateau. When selecting samples for the regional survey, I focused on materials that visually resembled Arrowstone Hills lithics, based on colour, crystal structure, luster, and my own familiarity with the material (Table 1). I sought to obtain samples from sites within the traditional territories of major Plateau First Nations groups: the Secwepemc (Shuswap), Nlaka'pamux (Thompson), Lil'wat (Lillooet), Ktunaxa (Kootenay), and Sylix (Okanagan and Nicola) (Figure 2). Selected samples were formed tools or obviously retouched flakes because these are indicative of an active decision to use a material. A total of 876 samples from 113 sites across the Plateau (Figures 15-16) were obtained. This brought the total number of samples in this study to 1,303 specimens (Appendices A-C).

The availability and scope of the collections from which samples were drawn set limits on the location and number of sites that were included in the analysis of a) the Arrowstone Hills source, b) other lithic sources, and c) regional archaeological sites. Samples were obtained from collections housed at the Simon Fraser University Department of Archaeology, The Royal British Columbia Museum (RBCM), the Okanagan Museum of Heritage, the Upper Nicola Band, and Tipi Mountain Eco-Cultural Services Ltd. Samples were selected to meet the requirements for XRF analysis (size, morphology, flat spots, thickness, cleanliness, lack of weathering), as previously discussed. The number of artifacts available to sample for each site varied significantly because of the nature of the assemblage for each site. For assemblages containing less than 20 suitable samples, all suitable samples were analyzed. For assemblages containing more than 20 suitable samples, at least 20 samples were analyzed, with additional data collected as time permitted. Additionally, existing PXRF data from previous research projects and analyses were obtained from Dr. Rudy Reimer's XRF Laboratory at SFU, Golder Associates, and the Northwest Research Obsidian Studies Laboratory in Oregon.

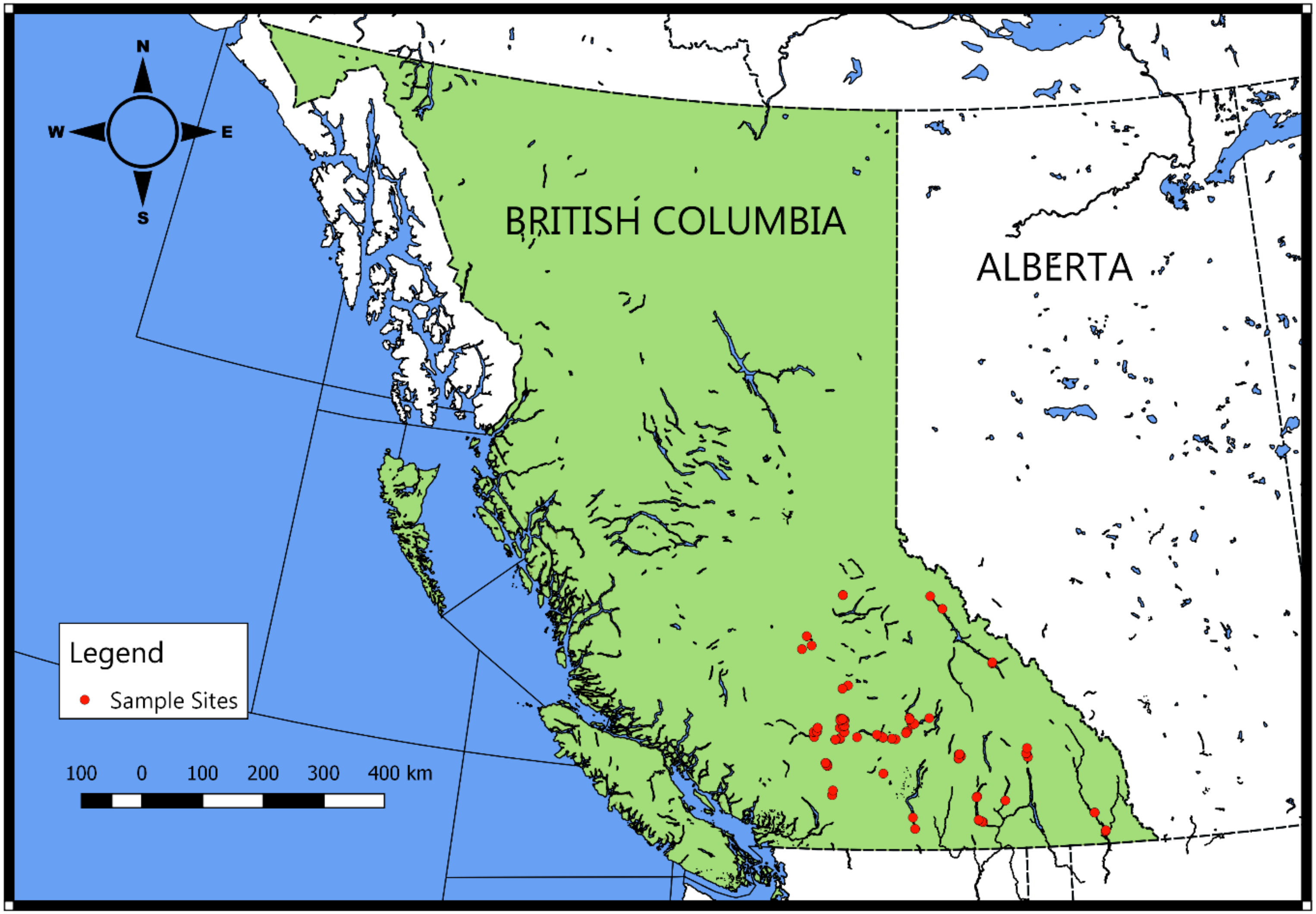

Figure 15: Regional sample sites in larger context.

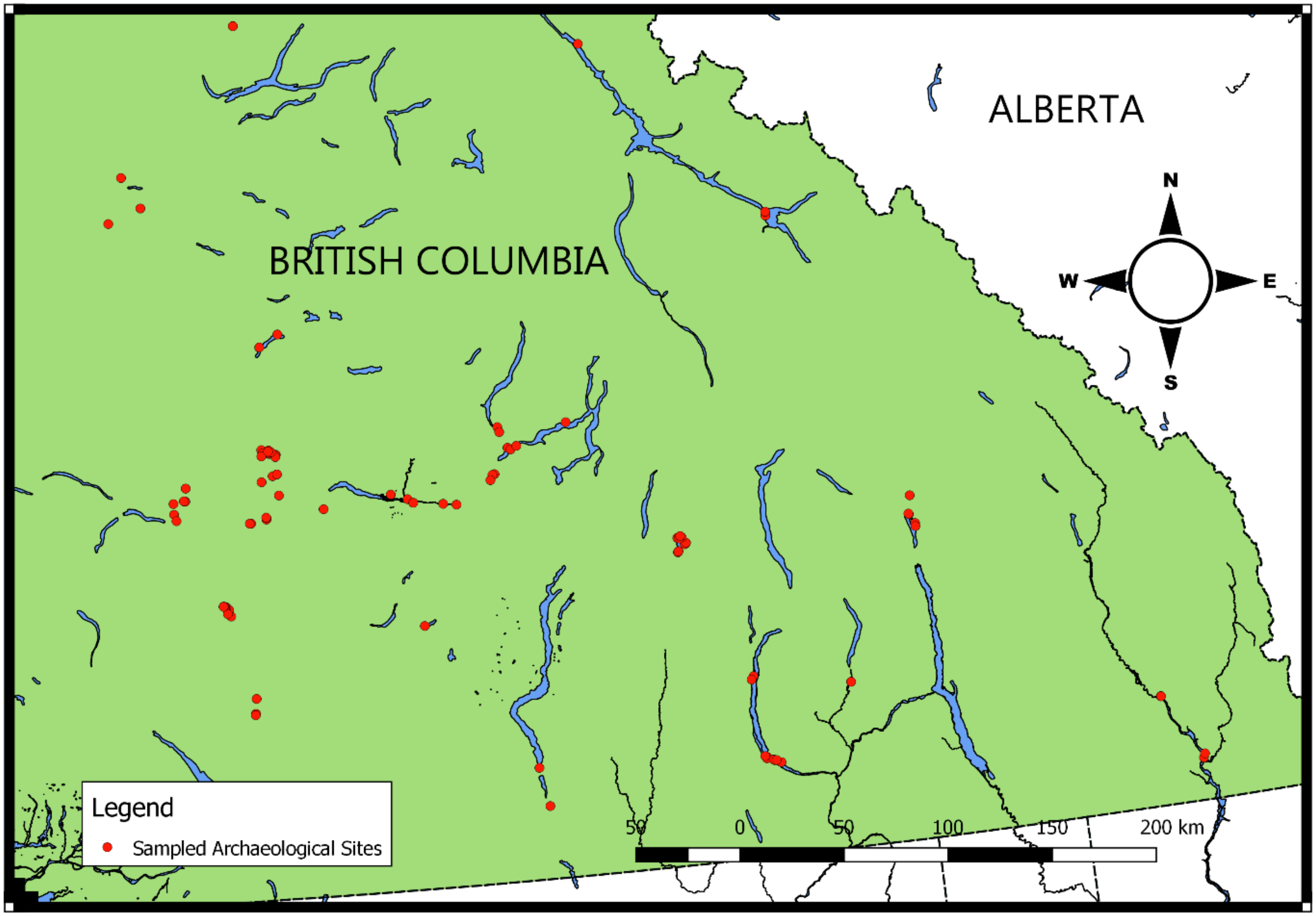

Figure 16: **Detail of regional archaeological sample sites.**

Table 2: Summary of Source and Regional Samples.

Source	Archaeological	Geological	Physical Sample	Extant XRF Data	Total
Arrowstone	120	194	259	55	314
Cache Creek	0	25	25	0	25
Hat Creek	0	10	0	10	10
Maiden Creek	0	38	0	38	38
Turbid Creek	0	25	0	25	25
Watts Point	0	25	0	25	25
Regional Samples	876	0	723	153	876

Table 2 shows the total number of samples included in this research, the number of archaeological and geological specimens, and whether they were physical samples or extant XRF data. It is important to note again that more full characterizations of each lithic source included in this research would have been helpful, but impractical to achieve within the scope of this research. As such, though I place confidence in the results of this study, they should be considered exploratory and preliminary, and subject to future refinement.

Summary

This chapter outlined the methods and planning by which this research was carried out. XRF was chosen as the analytical method as it provided rapid, non-destructive analysis, had the ability to detect a wide range of elements, and had low cost. The weaknesses of this technique can be mitigated against fairly easily. I briefly reviewed the use of XRF analysis in archaeology, focusing on lithic source characterization and provenance studies. Finally, I described the sample selection strategy. Samples for the Arrowstone Hills source were drawn from existing collections, while samples for the Hat Creek, Maiden Creek, Cache Creek, Turbid Creek, and Watts Point sources were drawn largely from extant XRF data, though some physical samples were analyzed. Samples for the provenance aspect of this project were drawn from existing assemblages, with the goal of obtaining materials from as many archaeological sites across the study area as possible.

Chapter 4.

Results

The two primary objectives of this study were to generate an elemental signature for the Arrowstone Hills source, as a way to differentiate it from other lithic sources, and to provide an initial assessment of the distribution of its materials at archaeological sites across the Plateau. An elemental signature was successfully generated for the Arrowstone Hills, but could not be used to fully differentiate the Arrowstone Hills source from other fine-grained volcanic lithic sources on the Plateau. Comparison of elemental signatures for the Arrowstone Hills, Cache Creek, Hat Creek, and Maiden Creek lithic sources indicate that they have similar elemental compositions; given the geological history of the area, they most likely share a formational history, and are potentially different flows from the same or related eruptive events. As such, they are better conceived of not as distinct sources, but as parts of a larger geological complex, termed here the *Kamloops Fine-Grained Volcanic Complex* (KFGVC). Exploring the distribution of KFGVC materials through comparison of XRF data from artifactual assemblages to source materials revealed their ubiquity at archaeological sites across the Plateau. This supports the idea that these lithics, originating from source areas within a constrained geographic area (approximately a 50km radius) were distributed across the region. In addition to these primary results, data were obtained that suggest the existence and utilization of several other lithic sources unknown to this study.

This chapter begins by discussing the source characterization component of this research, reviewing the sampling strategy and analytical procedures. It continues on to describe the elemental signature of the Arrowstone Hills, how it compares to the other lithic sources included in this research, and the implications of these results. I then turn to the exploratory provenance study, and discuss the distribution of lithics from the KFGVC at archaeological sites across the Plateau. Finally, some preliminary information is presented on the identification of several as-yet unidentified lithic sources that are represented in the samples analyzed.

Source Characterization and Differentiation for the Arrowstone Hills

To generate an elemental signature for the Arrowstone Hills source, 314 samples from this source were analyzed using XRF analysis. XRF data for five other fine-grained volcanic sources were included in the study. These included the Cache Creek, Hat Creek, Maiden Creek sources on the Plateau, and the Turbid Creek, and Watts Point sources on the Northwest Coast (Figures 2, 14). The elements measured were Mn, Fe, Zn, Ga, Th, Rb, Sr, Y, Nb, and Zr; Table 3 summarizes the average value for each of these elements for the Arrowstone Hills, converted to parts per million. This represents the elemental signature for this source, as found by this research; future studies my refine it with additional sampling. Average values for the other lithic sources are not presented here because a) the total sample populations for each of them are relatively small compared to the data available for Arrowstone Hills, and b) determining their elemental signatures was not part of this research's objectives.

Table 3: Recorded Average Elemental Values for the Arrowstone Hills Source.

Element	Mn	Fe	Zn	Ga	Th	Rb	Sr	Y	Zr	Nb
Value (PPM)	412.15	17593.32	82.04	16.81	11.13	124.19	537.49	11.37	200.55	7.12

Principal component analysis revealed that the two elements that provide the best discrimination between the sources are strontium (Sr) and rubidium (Rb). Figure 17 illustrates that Sr and Rb values account for most of the variability between samples from all the sources included in this research, over 75%. However, utilizing these elements to differentiate the sources still resulted in a degree of overlap between the Arrowstone Hills, Cache Creek, Hat Creek, and Maiden Creek sources, though the Watts Point and Turbid Creek sources are easily distinguished. This overlap means that complete differentiation between these four interior lithic sources is not possible with the current data. The inability to completely distinguish between lithic sources suggests, as has been discussed previously, that the sample sizes for each lithic source are not adequately representative, or that the sources have a common origin. These possibilities have been suggested by other researchers (Kendall 2014: 102; Kendall and MacDonald 2015) who have undertaken lithic characterization studies using similar methods as potential explanations for the inability to differentiate between certain sources.

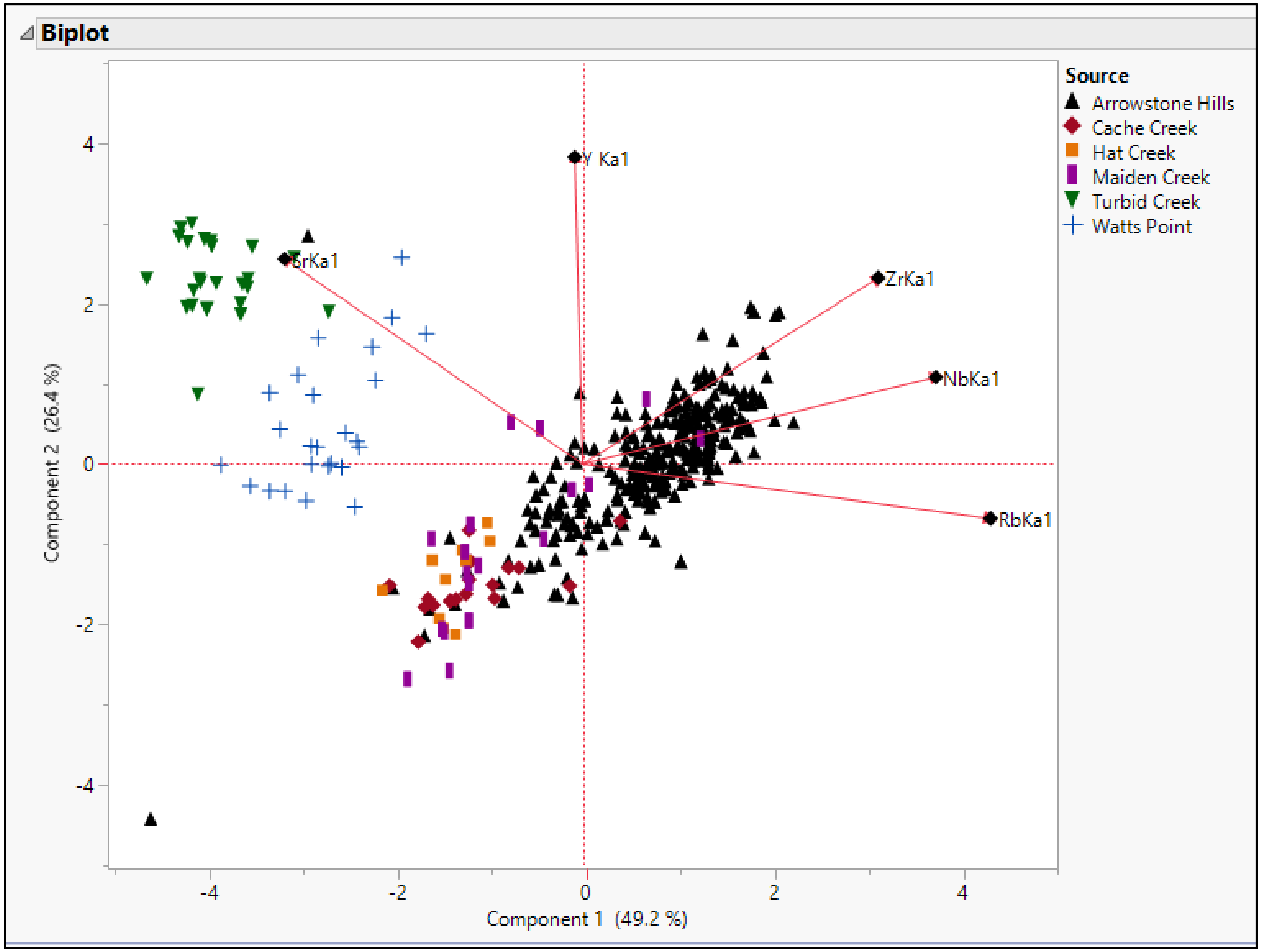

Figure 17: **Principal Component Analysis of all lithic sources included in this research. Strontium and Rubidium provide the greatest separation between the sources.**

Comparison of trace element ratios was also employed to differentiate the Plateau lithic sources. Elemental ratios that were compared include Rb:Zr, Sr:Zr, Y:Zr, Nb:Zr, Fe:Zr, and Sr:Rb. However, this was not as effective as simply comparing trace element concentrations, where the comparison of Rb to Sr values continued to provide the most differentiation between source materials. Returning to Table 1, which compares the visual characteristics of the materials from the sources included in this research, it is evident that discriminating between them using visual analysis alone would be unreliable at best. As visual analysis and the comparison of trace element ratios are not effective to distinguish between the Arrowstone Hills, Cache Creek, Hat Creek, and Maiden Creek source materials, the comparison of absolute trace element values currently provides the highest degree of differentiation between these sources in this research. Studies employing petrographic and mineralogical methods (Bruchert and Greenough 2016; Greenough et al. 2004; Mallory-Greenough et al. 2002) report success in differentiating FGV materials and sources in BC. However, sample sizes in these studies, at least for the petrographic and mineralogical analyses, are comparatively small. Further application of these methods to a larger sample population may result in a similar outcome as in this thesis.

Figure 18 further demonstrates that it is not possible to completely differentiate between the Arrowstone Hills, Cache Creek, Hat Creek, and Maiden Creek sources, based on a biplot of Sr and Rb values. The overlap between the Hat Creek and Maiden Creek sources is almost total, while the Cache Creek and Arrowstone Hills sources are more distinct. As such, the Hat Creek and Maiden Creek sources cannot be distinguished from each other using this method. However, most artifactual and geological samples collected at or originating from the Arrowstone Hills fall outside of the overlap between the elemental signatures of the sources. As such, it is possible to assign some artifacts to the Arrowstone Hills, and to a lesser extent, the Cache Creek, Hat Creek, and Maiden Creek sources. If the elemental signature for an artifact falls within the 95% confidence ellipses of a single source, and not into an overlapping area, then it can be considered likely that that artifact originated from that source. However, if an artifact's elemental signature falls within the overlapping area of two or more sources, it cannot be attributed to any single one, and must be considered equally likely to have originated from any of them.

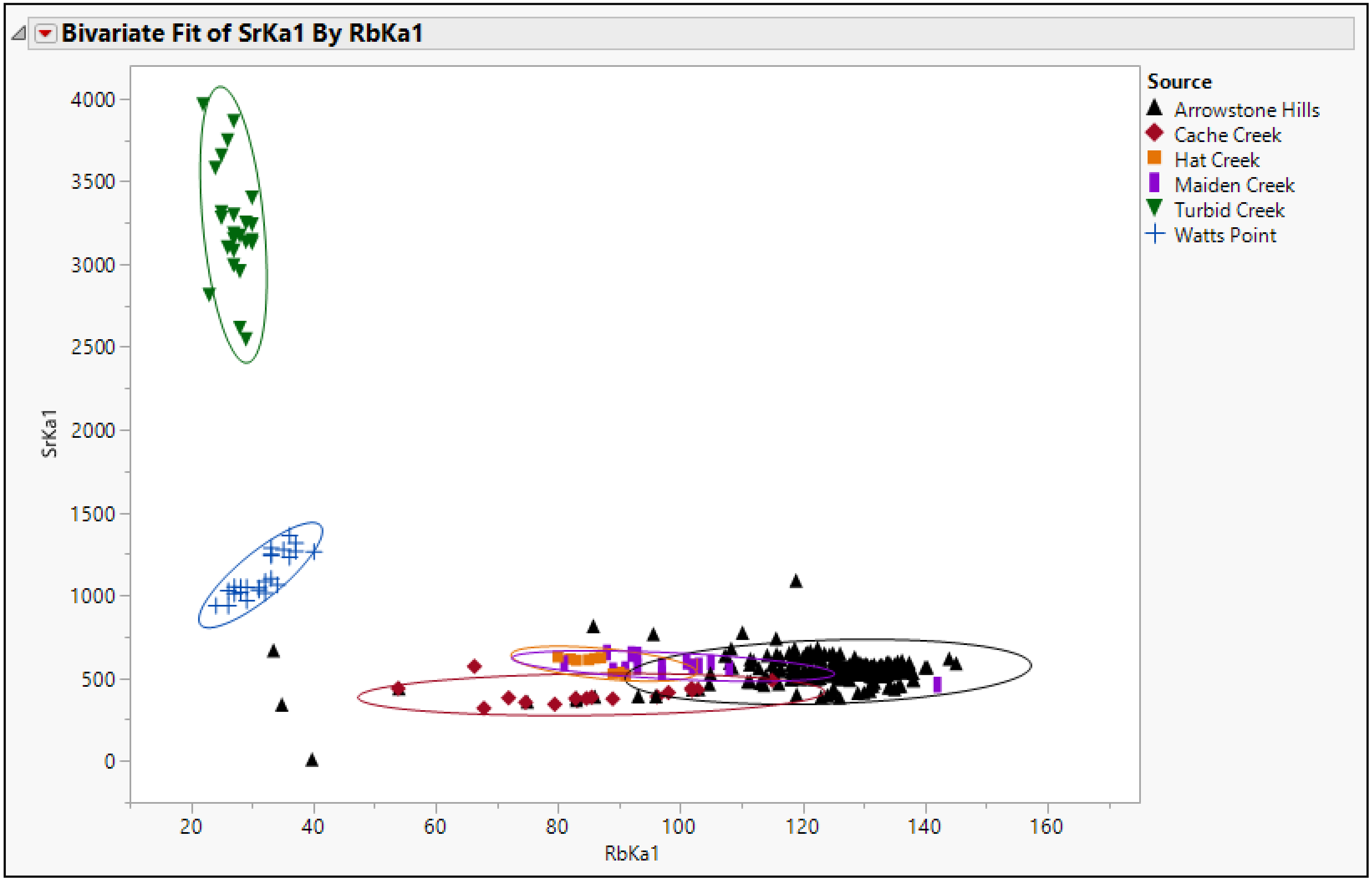

Figure 18: **Biplot of Strontium vs Rubidium (ppm) for all lithic sources included in this study. Confidence ellipses are 95%.**

In addition, some source material samples from the Arrowstone Hills, Cache Creek, and Maiden Creek sources fall well outside their 95% confidence ellipses. Removing these outliers results in much less overlap between the sources, except the Hat Creek and Maiden Creek sources. Figure 19 illustrates the reduction in size of the confidence ellipses when the most obviously outlying samples were removed. It also illustrates the reduction in the overlap between the confidence ellipses. Thirteen outliers were removed from the Arrowstone Hills source material data. Of those, only two had specific provenance to quarry sites at this source; the other eleven were collected by other researchers and have uncertain provenances.

The variation between those samples with uncertain provenances and the remainder of the sample population may be explained by three possibilities. First, they may be materials with a different geological origin deposited at the source by geophysical processes. Second, they may indeed have been formed by the same general process that formed the remainder of the source, but contained abnormal amounts of trace elements as a result of irregularities in the formational process. Volcanic eruptions are dynamic events, and the composition of the lava may alter throughout the event (Bordet et al. 2014:74) Finally, the samples may have experienced weathering that altered their compositions, or influenced the analytical readings (Dillian 2014; Gauthier and Burke 2011).

The difficulty in differentiating the Plateau fine-grained volcanic sources has implications for the overall results of the provenance study. It is not fully possible to distinguish the sources, or to assign an artifact found at any archaeological site to the Arrowstone Hills, Cache Creek, Hat Creek, or Maiden Creek sources with total confidence. However, these results may be mitigated by two factors. First, these sources are in close geographic proximity to each other; all occur within approximately a 50 km radius. Therefore, if lithics found elsewhere can only be attributed to this group of sources and not a specific one, they have still originated from a relatively limited area. Second, given the formational history of this area's geology it is likely that all these distinct sources represent one very large source, with Arrowstone Hills being the primary flow and the other sources being secondary or related flows showing some degree of variation. As such, while this study may not be able to identify the specific source from which a sampled artifact originated, it is likely that that artifact can be assigned to this group of sources.

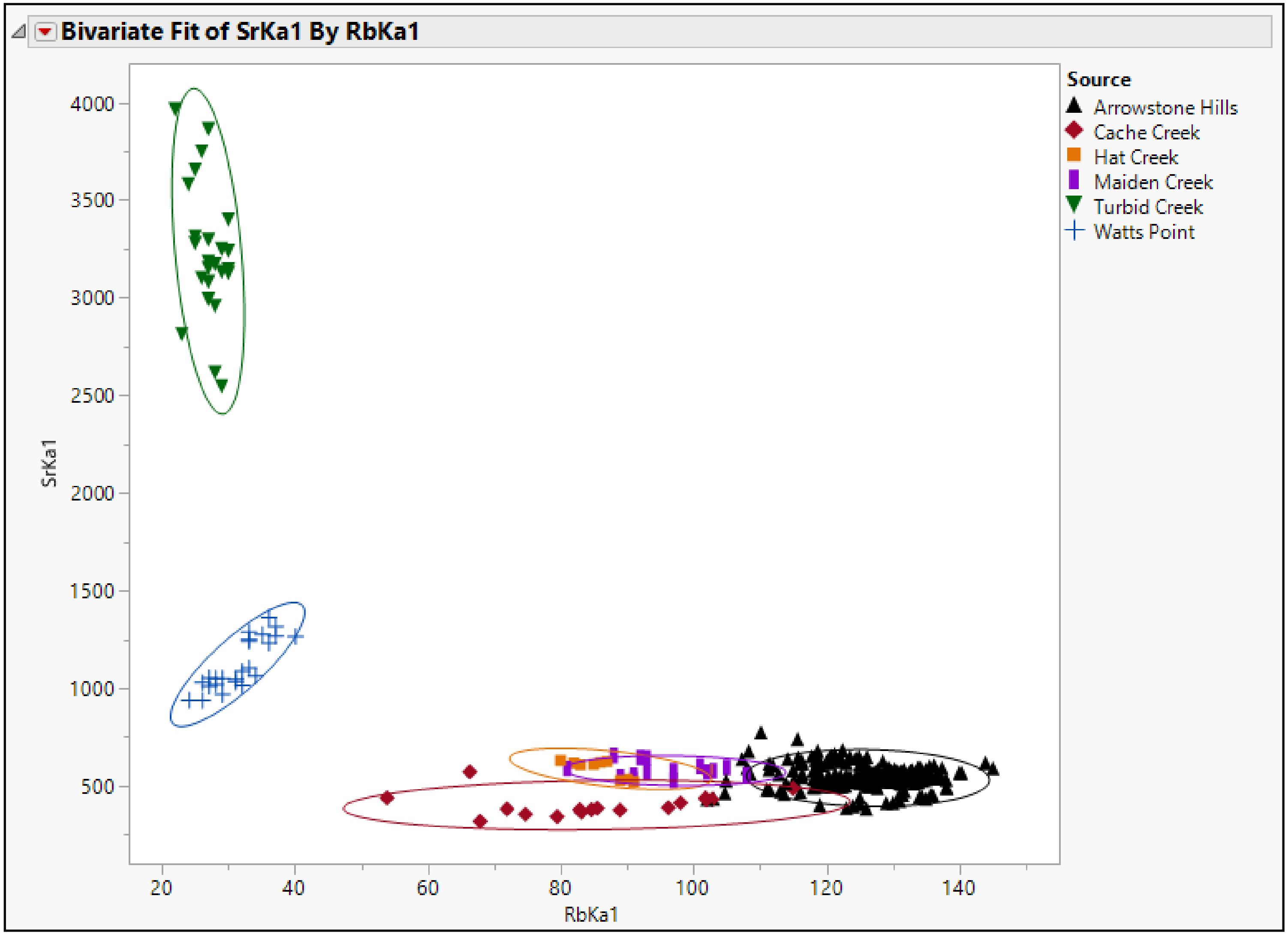

Figure 19: Biplot of Sr and Rb Values for All Sources, with Outliers Removed.

Provenance Study

Once the elemental signature for the Arrowstone Hills was generated and compared with the elemental signatures from other fine-grained volcanic sources, XRF data collected from artifacts found at archaeological sites across the Plateau were then compared to the sources. If an artifactual sample fell within the 95% confidence ellipse of a given source, it was considered statistically likely to have originated from that source. As Figure 20 shows, the clear majority of the samples from archaeological sites across the Plateau originate from the Arrowstone Hills, Cache Creek, Hat Creek, and Maiden Creek sources. However, in many cases it could not be determined from which source an artifact originated, as numerous artifactual samples fell within the overlap between the confidence ellipses for two or more sources. Table 4 details how many artifacts could be assigned to specific sources, as well as how many artifacts were only able to be assigned the KFGVC sources as a group. Additionally, Table 4 details the number of sites at which materials from a source, or in the case of the KFGVC, a group of sources were identified.

Table 4: Attribution of artifacts to sources.

Source	No. of Artifacts	% of Artifact Sample Population	No. of Sites	% of Site Sample Population
Arrowstone Hills	464	52.968	90	79.646
Cache Creek	4	0.456	4	3.539
Hat Creek	0	0	0	0
Maiden Creek	0	0	0	0
Watts Point	2	0.228	2	1.769
Turbid Creek	1	0.114	1	0.884
Unknown	155	17.694	54	47.787
Kamloops FGV Complex	721	82.31	104	92.035
	Total Samples: 876		Total Sites: 113	

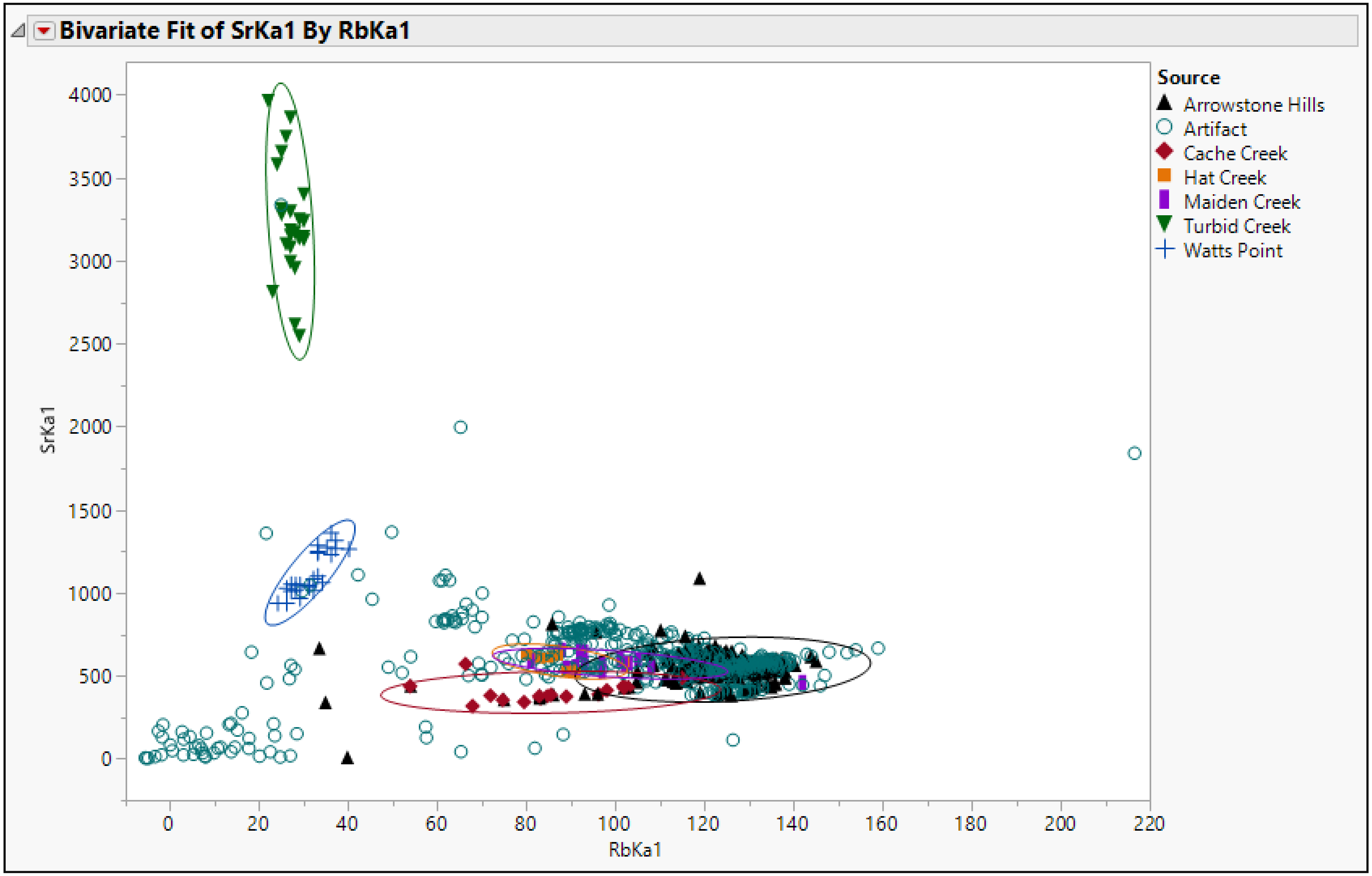

Figure 20: **Artifact samples plotted over source samples, using Sr vs Rb. Confidence ellipses are 95%.**

As previously mentioned, several outliers were observed within source material samples for the Arrowstone Hills and Maiden Creek sources. With these removed the overlap between the confidence ellipses for the Plateau lithic sources was reduced. This allowed more artifactual samples to be assigned to specific sources. Figure 21 illustrates this replotting of the XRF data for the artifactual samples against that from the source materials, with the previously mentioned outliers removed. This made it even more apparent that the majority of artifactual samples from Plateau archaeological sites included in this research are statistically likely to have originated from the KFGVC. The majority of the materials originating from the KFGVC that could be attributed to a specific source from within the complex originate from the Arrowstone Hills.

Table 5 also presents the attribution of artifacts to sources, based on the comparison of XRF data with outliers removed. It illustrates how many artifactual samples were assigned to specific sources or to the KFGVC as a group, as well as artifacts that could not be assigned to a source. Additionally, it shows the number of sites where materials from a source were identified.

Table 5: Attribution of Artifacts to Source with Outliers Removed.

Source	No. of Artifacts	% of Artifact Sample Population	No. of Sites	% of Site Sample Population
Arrowstone Hills	597	68.15	100	88.49
Cache Creek	4	0.51	4	3.53
Hat Creek	5	0.57	4	3.53
Maiden Creek	0	0	0	0
Watts Point	2	0.22	2	1.76
Turbid Creek	1	0.11	1	0.88
Unknown	168	19.17	63	55.75
Kamloops FGV Complex	705	80.47	103	91.15
	Total Samples: 876		Total Sites: 113	

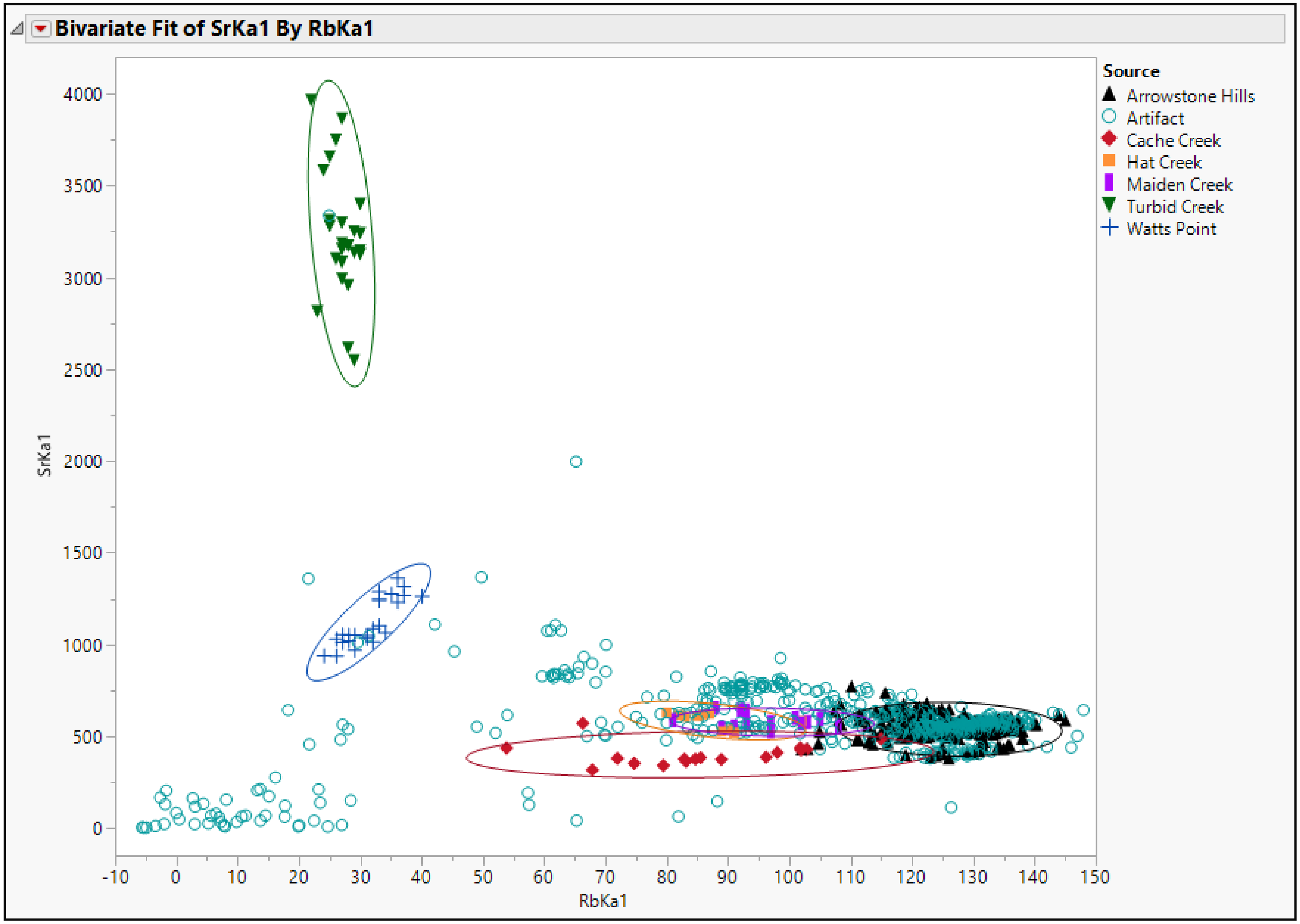

Figure 21**: Artifactual samples plotted against source materials, with outliers removed. Confidence intervals are 95%.**

When outliers were removed from the Arrowstone Hills and Maiden Creek source data, more artifacts were able to be attributed to specific sources. This resulted from the reduction in size of the confidence ellipses by the removal of the outliers. Arrowstone Hills materials were then found to compose almost 70% of the artifactual assemblage, an increase of more than 15%. Conversely, the KFGVC was found to comprise just over 80% of the artifactual assemblage, a decrease of just over 1.5%. While KFGVC materials remain the most abundant material present in the artifactual assemblage, it is apparent that Arrowstone Hills materials compose the majority of that portion, and indeed of the entire sample population. Excluding the Arrowstone Hills, Kamloops fine-grained volcanic materials compose only 11.30% of the entire sample population. Based on this data and on the intense quarrying activities recorded at the Arrowstone Hills, this source was clearly the most heavily utilized out of all the KFGVC sources.

Furthermore, in this reassessment of the data Arrowstone Hills materials were identified at just over 88% of the sites from which artifactual samples were drawn, more than a 10% increase over the initial assessment. While the number of sites at which Kamloops fine-grained volcanic materials decreased by one, these materials were still found to be present at over 90% of the sites sampled. The widespread distribution of these materials strongly suggests that they were frequently exchanged across the Plateau.

Figure 22 details the location of the Arrowstone Hills source, and sites where lithics from that source were and were not identified. This was based on artifacts which were attributed to the Arrowstone Hills alone by comparison of artifactual and lithic source XRF data by this research. Figure 23 details the locations of sites at which materials from the Arrowstone Hills, Cache Creek, Hat Creek, and Maiden Creek sources were identified, using the same method described above. This included samples that could not be attributed to a single source, but originated from the KFGVC.

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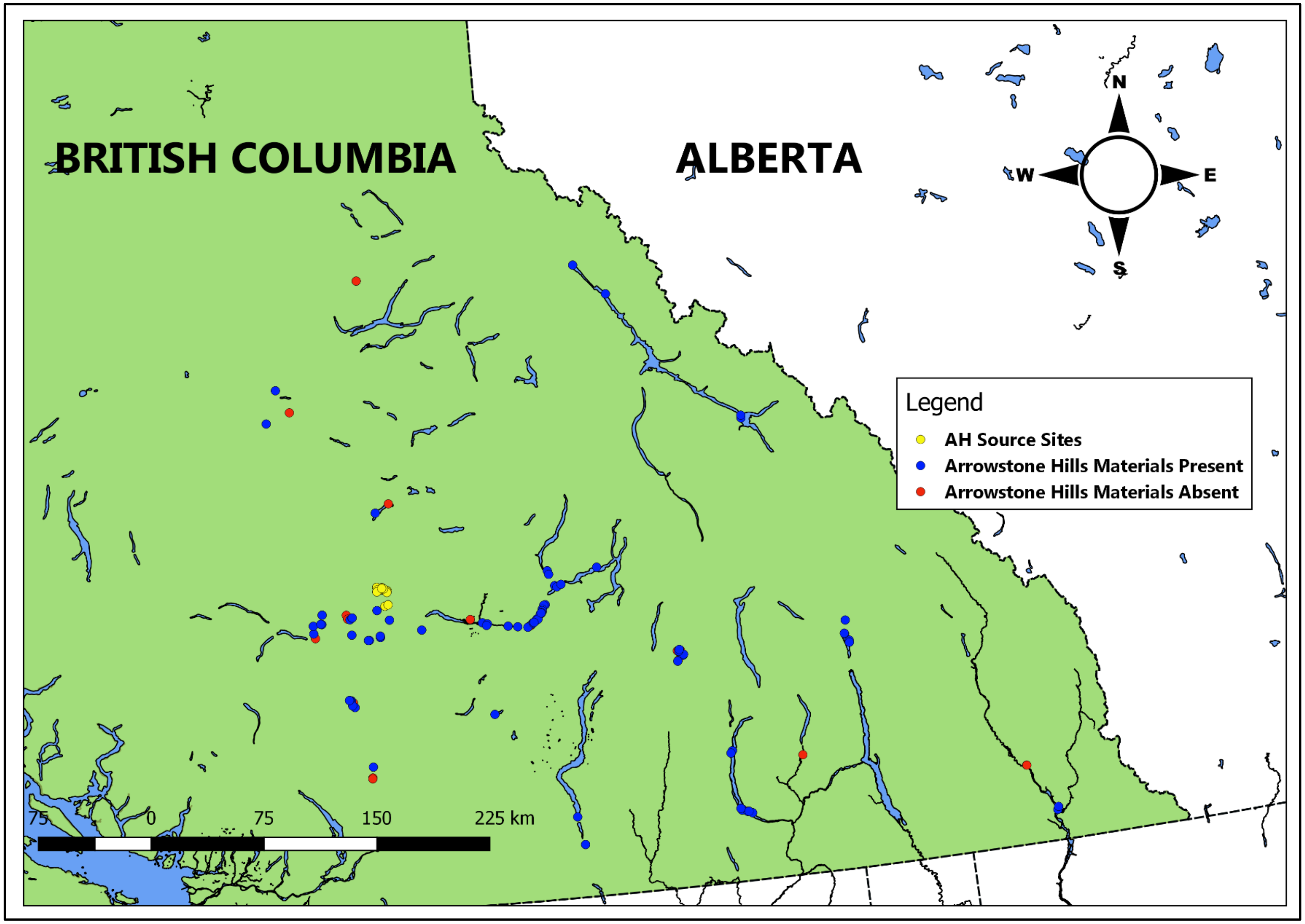

Figure 22: Location of the Arrowstone Hills source and sample sites with and without the presence of Arrowstone Hills lithics.

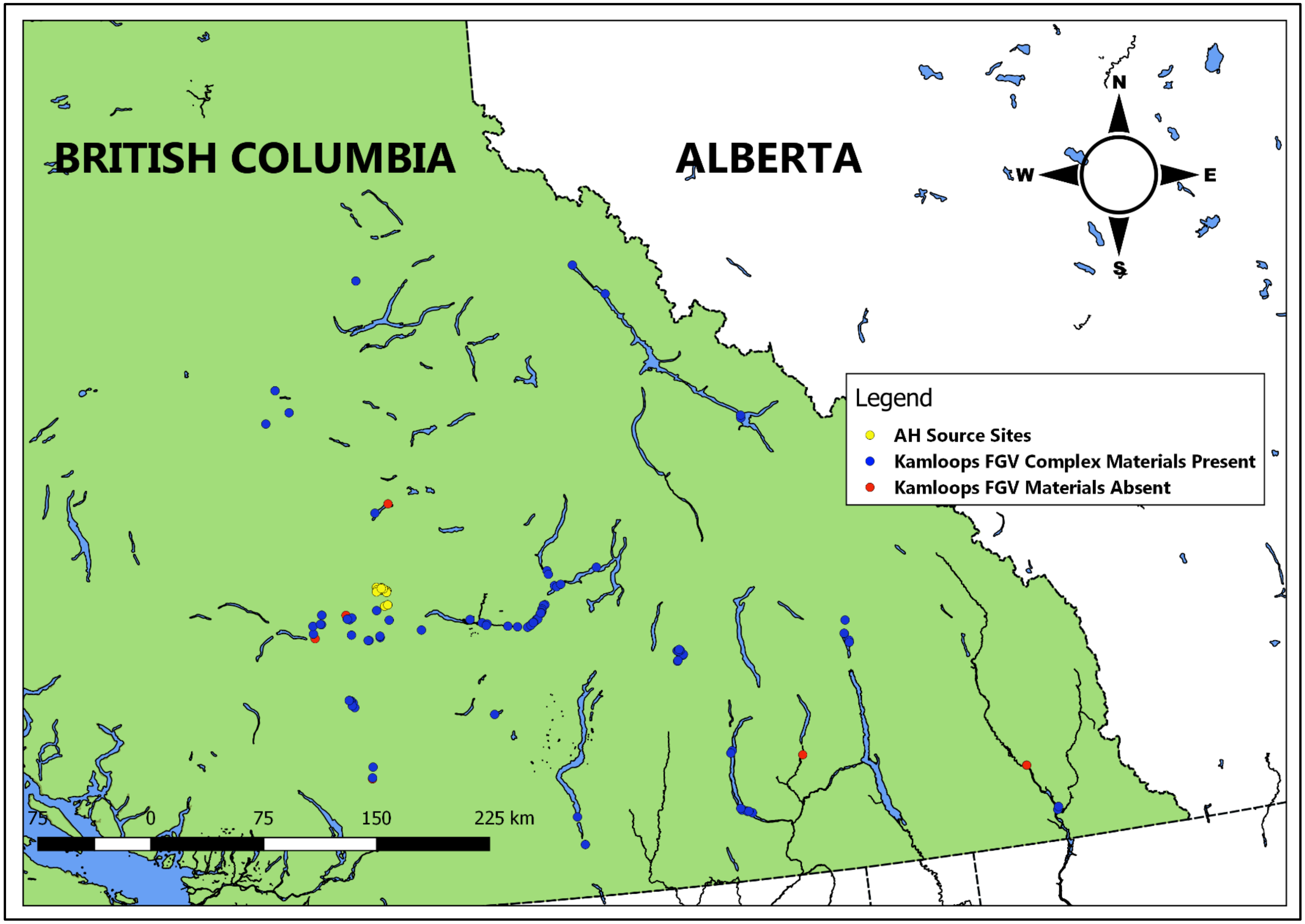

Figure 23: **Location of the Arrowstone Hills source and sample sites with and without the presence of Kamloops FGV complex lithics.**

As can be seen in Figures 22 and 23, some sites were identified as possessing no artifacts having originated from the KFGVC sources. It is important to note that the assemblages from which samples were drawn for those sites may not be representative of the entire site. While this analysis did not identify any KFGVC materials at those sites, it may be the case that materials from these sources were, in fact, present at the sites in question, but were not recovered during archaeological investigations. In each of these cases, those sites that had no materials from the sources in question also had small sample sizes, i.e. <2 artifacts each. This further supports the idea that the assemblages for those sites may not be representative, and explain why lithic materials otherwise ubiquitous on the landscape around them are absent.

From Figures 22 and 23 it is apparent that Arrowstone and KFGVC lithics have a broad geographic distribution, having been transported long distances in numerous cases. Table 6 summarizes the linear distances that lithics have been transported from these sources across the Plateau. Referring to Table 6, most archaeological sites where KFGVC lithics were identified by this research are located between 100 km and 300 km away from the source area. This attests to the existence and operation of long-distance exchange networks on the Plateau (Connolly et al. 2015; Hayden and Schulting 1997:52; Ignace and Ignace 2017:107), and that lithic materials in either raw or refined forms were one of the numerous items that were exchanged between First Nations groups. The relatively high numbers of sites where KFGVC materials were identified at 100-300km away from the sources suggest that a simple distance-decay model does not represent the distribution of these materials. Instead, it is likely that redistribution through one or more forms of exchange likely accounts for the patterns of distribution.

Table 6: Summary of Sample Site Distances from the Arrowstone Hills Source.

Max Distance	473 km
Min Distance	12 km
Mean Distance	145 km
Mode Distance	78 km
No. Sites 0-50 km	19
No. Sites 51-100 km	17
No. Sites 101-200 km	39
No. Sites 201-300 km	28
No. Sites >300 km	10

Interestingly, three lithic artifacts from the South Coast were identified at Plateau sites. Two artifacts from the Watts Point dacite source and one artifact from the Turbid Creek dacite source were identified among the assemblages of three different sites. The artifacts from Watts Point were identified at sites EeRl-7 and EeRb-11, while the lone artifact from Turbid Creek was identified at site EbRj-22. Sit EeRl-7, also known as Keatley Creek, is a regionally significant housepit site in Stl'atl'imx territory, associated with complex lifestyle patterns and seasonal exchange, and occupied between 3500-1100BP (Hayden 1997). Site EeRb-11, also known as the Leonard site, is in Secwepemc territory in Kamloops, a major Secwepemc center of occupation and exchange (Ignace and Ignace 2017:222). Site EbRj-22 is in Nlaka'pamux territory in Lytton, and is identified as a Lehman phase burial mound, potentially dating to between 6000-4500BP (Stryd and Rousseau 1996:189-191). These findings align with evidence for long-term exchange between Coastal and Plateau First Nations, identified archaeologically (Bruchert and Greenough 2016:101; Hayden 1997:256; Rousseau 2004:15), ethnographically (Dawson 1891:11, 17; Teit 1900:260–262; 1906:232–233), and in First Nations Traditional Knowledge and oral histories (Ignace and Ignace 2017)

In addition to those artifacts that likely originated KFGVC sources, there are numerous artifacts that have not been assigned to known sources in this research. Three clusters of artifactual samples were identified that may represent other lithic sources possessing elemental signatures unknown to this study (Figure 24). Figure 24 shows artifactual samples that were not able to be assigned to any source by this research. Three clusters are apparent but whether they represent distinct lithic sources cannot be determined until the sources have been identified, located, and sampled to assess their level of variability and establish an elemental signature. Some samples not attributed to any source fall just outside of the elemental signatures of one or more sources. In the case of the Cache Creek, Hat Creek, and Maiden Creek sources, future sampling may expand these elemental signatures and result in currently unprovenanced samples being assigned to a source.

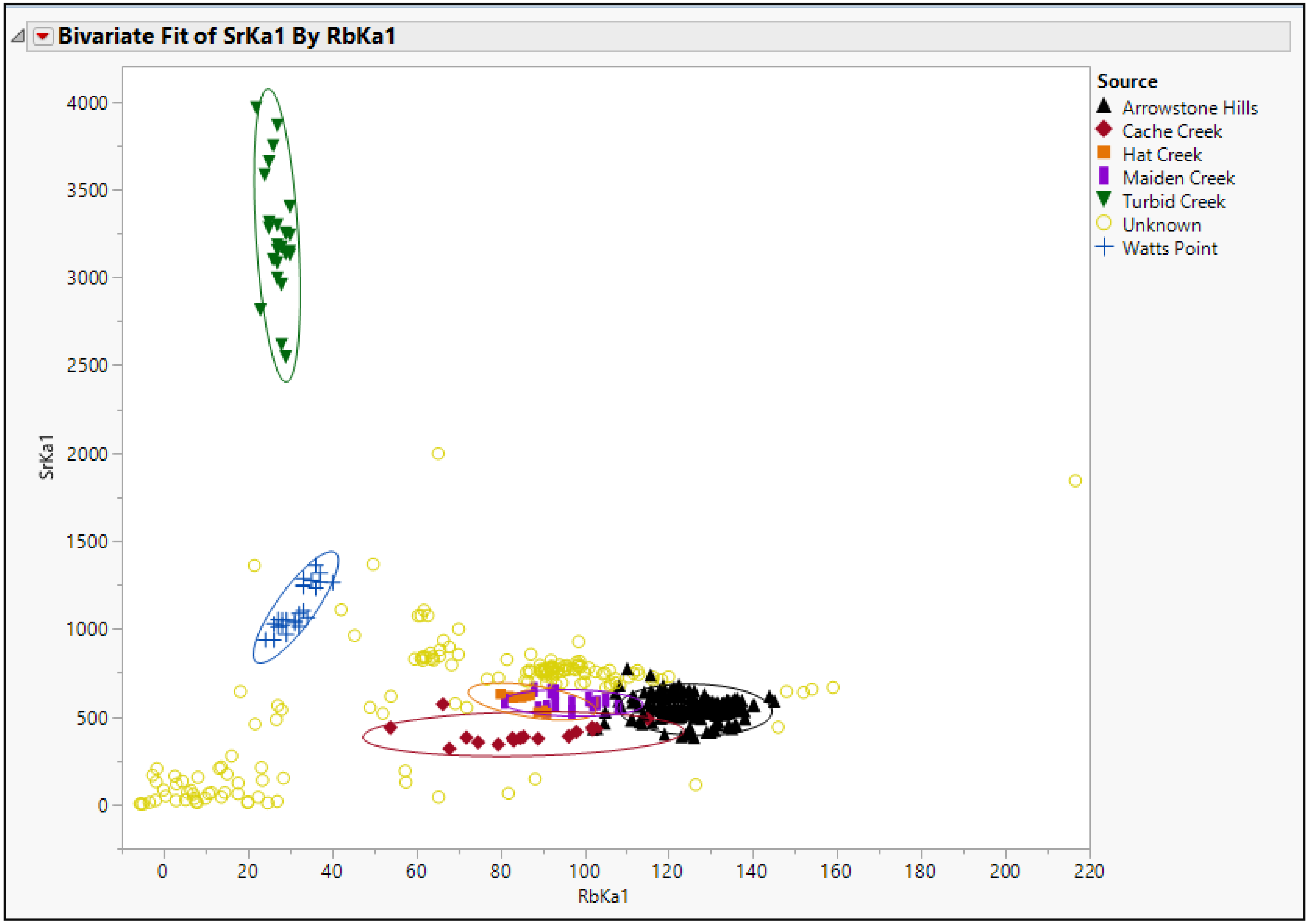

Figure 24: **Biplot of Sr and Rb showing known sources and samples that were unable to be attributed to a source.**

Previous research has identified other fine-grained volcanic lithic sources on the Plateau at East Pennask, and on the Similkameen River (Mallory-Greenough et al. 2002:42; Rousseau 2015:30). Figure 25 shows these sources in relation to the Cache Creek source. Mallory-Greenough et al. (2002) used mineralogical and geochemical techniques to characterize these sources, and found that they were distinguishable from each other. Unfortunately, no compatible data were available from that study to compare to the XRF data gathered during this research. As such, it was not possible to determine if any of the artifactual samples could be assigned to a source in either the East Pennask or Similkameen River identified by Mallory-Greenough et al. (2002). Other potential fine-grained volcanic sources have been tentatively identified on the northern Nechako Plateau, just outside the northern limit of this research's study area. Bruchert and Greenough (2016:98) identify four potential sources: Baezaeko River, Little Mountain, Pantage Lake, and Baker Creek. Figure 26 illustrates their locations; interestingly, these sources are near historic and post-contact trade routes, the Mackenzie and Telegraph trails, and to an archaeological site interpreted to be a trade hub on the Nechako Plateau near Punchaw Lake (Bruchert and Greenough 2016:100). These follow older, well-established Indigenous trail systems. Given that these lithic sources are located so close to exchange routes, and to a potential trade hub site, they may indeed be the source of some of the artifactual samples that were unable to be assigned an origin by this study. However, further research on these sources is necessary to determine their elemental signatures (Bruchert and Greenough 2016:116).

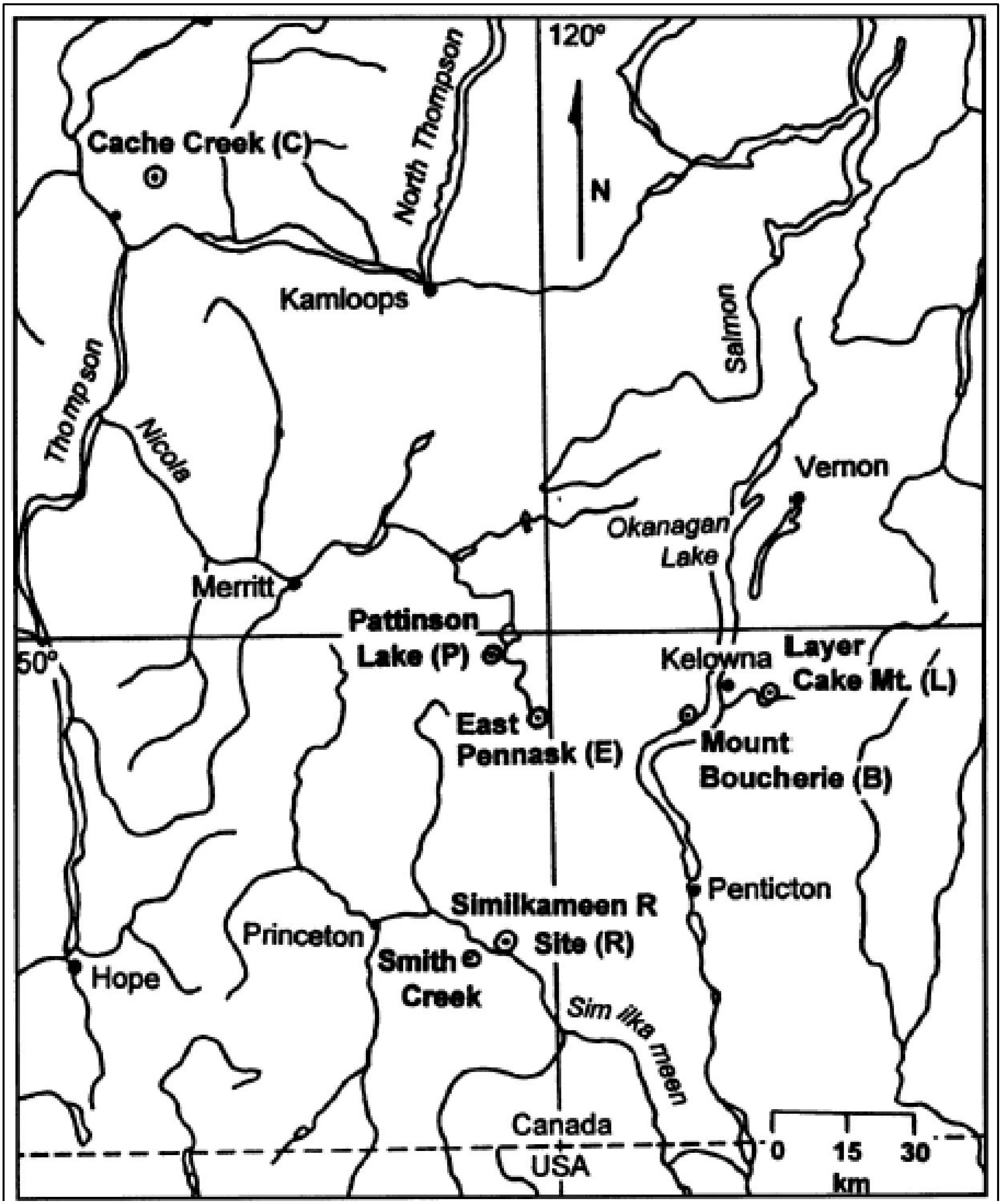

Figure 25: **Map showing the East Pennask and Similkameen River Fine-Grained volcanic lithic sources.**

Image: Mallory-Greenough et al. 2002

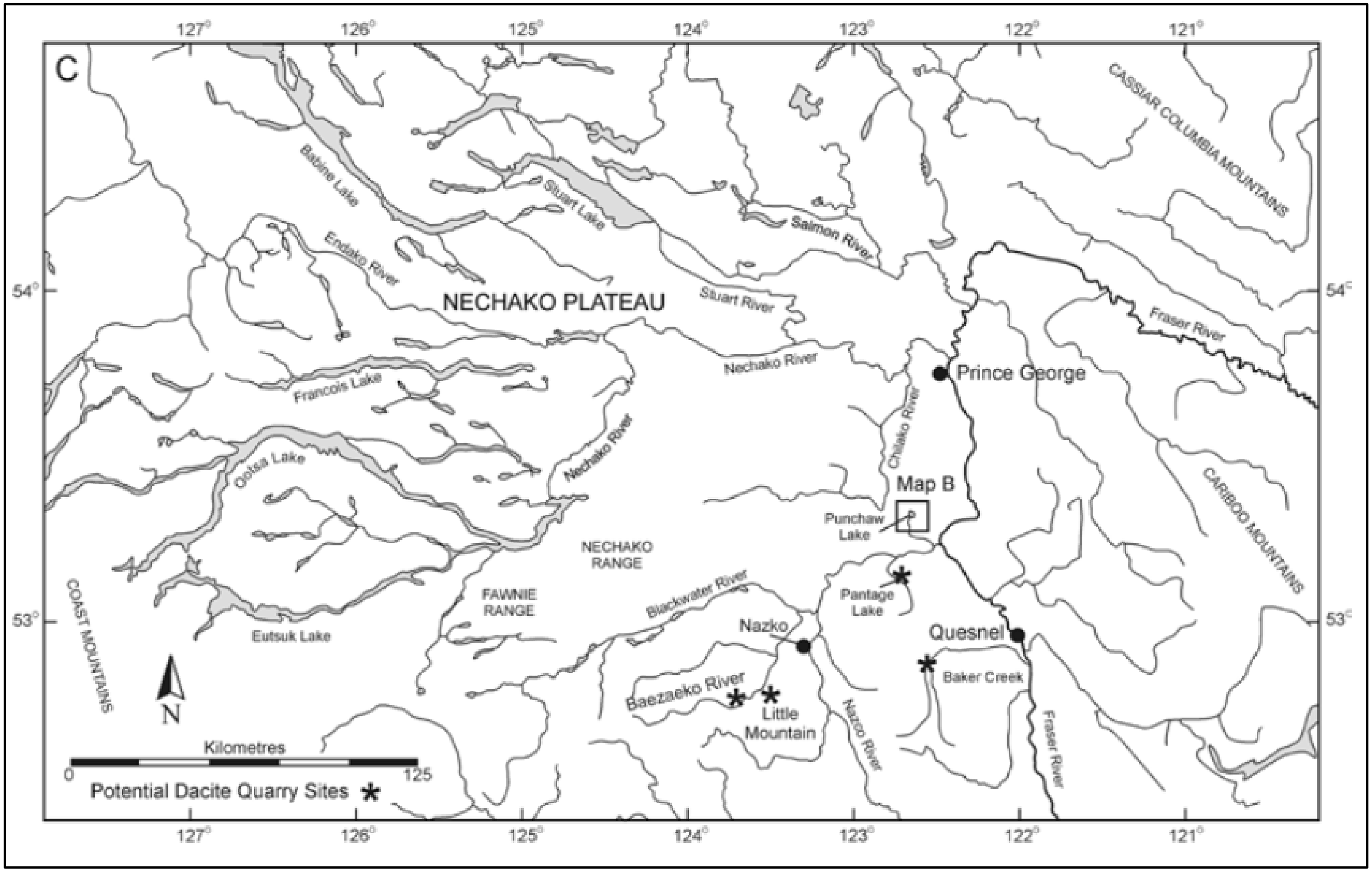

Figure 26: **Locations of potential lithic sources that may be the origin points of artifacts not assigned to a source by this research.**

Image: Bruchert and Greenough 2016

Summary

This chapter has discussed the results of this research, covering the characterization of the Arrowstone Hills source, and its comparison to the other fine-grained volcanic sources included as reference points. It was determined that the Plateau sources can only be partially differentiated using XRF analysis and comparison. This is likely because the Arrowstone Hills, Cache Creek, Hat Creek, and Maiden Creek source share a geological history, and are probably best considered to be a single source with multiple flows. I termed this the KFGVC, a group of related lithic sources that were differentially utilized throughout the past by First Nations peoples. This chapter then described the comparison of XRF data from artifacts located at archaeological sites across the Plateau, with the data from the source materials. This resulted in the identification of Arrowstone Hills, and more generally the KFGVC materials, as comprising most of the artifactual assemblage included in this research. Mapping the locations where these materials were identified indicates that lithics from these sources were widely distributed across the Plateau, supporting the existence of large-scale, long-distance exchange networks. Finally, the existence of lithic sources not identified by this research was discussed, based on data from artifacts that could not be assigned to any of the sources included in this study.

Chapter 5.

Discussion

This chapter examines the spatial patterning of KFGVC lithics at archaeological sites across the Plateau. It discusses the frequencies with which these materials occur at archaeological sites located within the territories of the Secwepemc, Nlaka'pamux, Stl'atl'imx, Nicola, Okanagan, and Kutenai. Based on the ubiquitous use of fine-grained volcanic lithics as toolstone material on the Plateau, the evidence for intense use of KFGVC sources, the widespread distribution of these materials across the study area, and the existence of well-established, long-distance exchange networks across the Plateau, I argue that KFGVC materials were widely exchanged by First Nations groups throughout the past. Four potential means by which those materials arrived at these locations include direct acquisition, direct exchange, redistribution centres, and down-the-line exchange (Dillian and White 2010:3–5; Renfrew 1977:85; Torrence 1986). Indigenous social and cultural systems likely organized these means of exchange, and affected the distribution of KFGVC lithics and other materials across the Plateau. Cultural concepts and protocols from Plateau First Nations, specifically the Secwepemc, but also the Nlaka'pamux and Stl'atl'imx, are employed to inform this discussion. Many of these cultural concepts have been handed down through oral traditions, ethnographies, and Traditional Knowledge. While the time depth to which they may be extended is not clear, they provided an informative framework from which to approach the subject of how cultural beliefs and systems influence economic activities such as resource collection and the exchange of goods.

Spatial Patterning of Kamloops FGV Complex Lithics Across the Plateau

Comparison of XRF-generated geochemical signatures for the Arrowstone Hills source and other local sources made it apparent that these are likely one larger geological source complex. This I have termed the Kamloops Fine-Grained Volcanic Complex (KFGVC). Comparing XRF data from artifacts found at archaeological sites across the

Plateau with the elemental signatures from KFGVC sources permitted an initial mapping of the distribution of these materials across the region. Materials from the KFGVC are ubiquitous across the Plateau (Tables 4, 5, Figure 23); over 80% of the artifacts sampled were identified as such, and these materials appear at more than 90% of the sites sampled. Out of the 113 archaeological sites sampled in this research, only ten appear to lack materials from these sources. This may be because no KFGVC materials were ever deposited at these sites, or potentially because the archaeological assemblages from which samples were drawn were not representative of the full range of lithic materials that were present. In either case, it remains apparent that KFGVC materials have a broad distribution across the Plateau.

Examining the spatial distribution of these materials regarding to major Plateau First Nations territories reveals that KFGVC lithics are present in each of them. Table 7 summarizes the number of sites within a given First Nation territory, and the percentage of those where KFGVC lithics were identified. Sites located within currently shared territories are denoted with hyphenated names (e.g., Secwepemc-Nlaka'pamux). I define shared territories as areas used jointly by two or more First Nations groups, based on current and historic boundaries. It should be noted that though currently the Nicola and Okanagan identify as Sylix peoples, the Nicola were originally an Athapaskan group, and the Okanagan were part of the Interior Salish (Wyatt 1998:220).

Table 7: Presence of KFGVC materials within Historic Plateau First Nation territories.

First Nation Territory	Total Sites Sampled	Sites with KDC Lithics	Relative Proportion (%)
Secwepemc	37	35	94.5
Nlaka'pamux	17	16	94.1
Stl'atl'imx	6	6	100
Ktunaxa	5	2	40
Nicola	13	13	100
Okanagan	11	10	90.9
Secwepemc-Nlaka'pamux	12	12	100
Secwepemc-Ktunaxa	9	9	100

A high percentage of sites where KFGVC materials are present are evident in all territories, except for that of the Ktunaxa. However, this relatively low proportion may be explained by the small number of sites sampled, as well as the small artifact sample size for those sites (*n* = 2). Furthermore, all sampled sites located in territory shared by the Secwepemc and Ktunaxa include materials from these sources. Therefore, while this research cannot demonstrate a wide distribution of KFGVC materials in Ktunaxa lands, it is possible that that these materials are present in other Ktunaxa sites.

These results only indicate that KFGVC materials are present at a given site or within a given territory; they do not indicate the absolute frequencies with which they appear in that site's whole lithic assemblage. However, a strong case for the intensive and extensive exchange of these materials across the region can still be made if the following are considered:

1) That fine-grained volcanic materials were the most widely used lithic resource on the Plateau, at times making up between 70-90% of the lithic assemblage at a given site (Bakewell and Irving 1994; Bruchert and Greenough 2016; Greenough et al. 2004);

2) The evidence for the high intensity of use of KFGVC sources, especially Arrowstone Hills, but also at Cache Creek, Hat Creek, and Maiden Creek (Ball 1997; Rousseau 2015:35, 45) and;

3) Comparison of XRF data between KFGVC materials and artifactual samples from archaeological sites across the Plateau indicates a broad spatial distribution of lithics from those sources across the region.

Describing and Identifying Material Acquisition and Exchange in the Archaeological Record

Within the context of Plateau exchange systems, there are four primary means by which materials from the KFGVC could have been distributed; direct acquisition, direct exchange, redistribution, and down-the-line exchange. The concept of *direct acquisition* is relatively simple; individuals or groups travel to the source of a material, collect it, and remove it (Rousseau 2015:43). *Direct exchange*, sometimes called direct distribution, is where a material or good is exchanged between a producer and a consumer (Alden 1982:85). This takes place through face-to-face contact, distinguishing it from down-the-line exchange (Alden 1982:85). In the context of direct exchange, a producer of KFGVC material would be any group or individual who accessed those sources directly; a consumer would be a group or individual who acquired those materials from the producer. *Down-the-line exchange* refers to a type of exchange where one node in a trade network receives a quantity of a good or material from a neighbour that is either nearer to the source or accesses it directly, then utilizes a portion of that material and passes the remainder on to the next node (Earle 1982; Earle and Ericson 1977; Renfrew 1977:77–78). Finally, *redistribution* occurred on the Plateau, both at strategic locations such as trade fairs, or at other locations. The ethnographically recorded practice of First Nations groups acting as intermediaries in redistributing materials through exchange networks and relationships adds a variation on the down-the-line model. Instead of utilizing a portion of the received material or good, though this may also have occurred, the group acting as an intermediary moved materials directly between producer and consumer groups, introducing an aspect of direct exchange (Ignace and Ignace 2017:220).

Describing and Modelling Distribution

The spatial patterns associated with these types of distribution represent models that seek to describe patterns of human activity. In direct acquisition, the distribution of a material from a source follows what Renfrew (1977:72) refers to as the law of monotonic decrement, or the distance-decay model (Wilson 2007). This is where the frequency of occurrence of a particular material with a localized source area decreases proportionally to the distance traveled away from that source (Earle 1982; Renfrew 1977:72). The key factor is the rate with which the decrease of materials away from the source occurs. This may be related to distance, and the value placed on the material. Some materials will travel farther than others, based on the value placed on them, their transportability, and effective life (Earle and Ericson 1977; Renfrew 1977:76–77). The value placed on a material may be influenced by several factors, including, but not limited to, practical use value, cultural importance, or scarcity. The transportability of a material is largely defined by its physical properties, such as size, weight, or fragility. The effective life of a material is related to its perishability or durability; however, the value placed on a material in terms of these aspects is not dictated by low or high perishability or durability. For example, some perishable goods, such as foodstuffs, may have had a high value and been exchanged over long distances if they had important ceremonial functions, and were locally unavailable.

When referring to distance, it is important to consider the effective distance, which is not necessarily the same as linear distance (Renfrew 1977:72). While the distance from a source to a point may not be physically far, there may be boundaries that prevent direct acquisition from easily occurring. These include both social or ethnic boundaries (Wright 1974:4), and geographic boundaries (Reimer 2018b; Renfrew 1977:72; Wilson 2007). With ethnic or social boundaries, access to a resource may be restricted based on status as a member of a group; this is seen on the Plateau in rights of access to resources being limited to members of a First Nation (Ignace and Ignace 2017:282), or to a family, such as with fishing platforms (Prentiss and Kujit 2012:120–123). Geographic boundaries, terrain features that increase the energy expenditure required to access a resource beyond the value of the return, include, but are not limited to, deserts, mountain ranges, and gorges (Renfrew 1977:72; Wilson 2007).

With direct exchange the spatial patterning of material distribution is like direct acquisition, except the source of the material being accessed is not the physical origin point, but rather a group or individual who redistributes the material in question (Alden 1982:85). If near to the source, then the distribution of materials may resemble Renfrew's (1977) distance-decay model discussed above, as consumers are effectively still accessing the source directly. This would be the case for direct exchange occurring within the KFGVC supply zone; a supply zone is an area where a material is obtained by direct access, and occurs with a high frequency (Bettinger 1982:112).

However, if producers transported a material some distance from the source to a redistribution point, such as a trade hub or seasonal gathering area, then the distribution of that material would become more equal between consumers equidistant to that point, even if some are located farther away from the point of production (Alden 1982:88). Distribution points that lie outside of the supply zone are in the falloff zone; a falloff zone is where materials occur in substantially lower frequencies, and are typically acquired through exchange (Bettinger 1982:112). Such redistribution points have been identified on the Plateau as trade hubs, where First Nations groups would gather to exchange goods and participate in social activities (Bruchert and Greenough 2016:115; Reimer 2018b:8; Springer et al. 2018). For direct exchange the effective distance between a consumer and the redistribution point must still be considered.

Down-the-line exchange is represented by an exponential decrease in the amount of material present at locations farther away from the source (Earle 1982; Earle and Ericson 1977; Renfrew 1977:77–78). The key condition in this model is that the reduction in the amount of material being passed down the line is proportional to the number or quantity of material remaining at a given point (Renfrew 1977:78). The pattern of distribution would therefore see increasingly smaller amounts of material at locations away from the source, as opposed to distance decay where the amount of material is unaffected by distance, only the frequency of its occurrence. Exchange of this kind is typically conceived of in terms of networks or chains of exchange (Renfrew 1977:84). These networks are highly efficient in that the energy expenditure required for a group to access a distantly available material is substantially reduced when the supply chain is composed of multiple, short-range links, as opposed to the group accessing the source directly (Earle and Ericson 1977:120). However, the actual amount of material arriving at distant sites might be relatively minimal.

While down-the-line exchange likely did occur on the Plateau, and between the Plateau and Coast (Carlson 1994:323), there was also a robust network of intermediaries who moved goods between different groups across the Plateau (Dawson 1891; Kennedy and Bouchard 1998:176; Morin 2016; Teit 1900). This can be considered a form of direct exchange; in this case, an area is preferentially supplied compared to its neighbours (Renfrew 1977:85). This type of distribution requires little effort on the part of the intermediaries other than the actual travel between the exchange partners (Earle and Ericson 1977:120). The patterning of distribution is also different from down-the-line exchange, and can be referred to as a concentration effect, where materials occur at a location in greater quantities than they would in instances of down-the-line exchange or direct access (Renfrew 1977:86). Direct exchange results in greater frequency of materials at a given location than would otherwise be the case with direct access/distance-decay, or down-the-line exchange/exponential decrease (Renfrew 1977:86).

Archaeological Indicators of Acquisition and Exchange

Describing potential modes of acquisition and exchange is helpful for hypothesis generation, but it is more important to be able to recognize them in the archaeological record. Otherwise, it is difficult or impossible to determine how a good or material came to be at a site. In conjunction with the models of exchange discussed above, archaeological correlates can help ascertain how materials came to be deposited at a location. These include considerations of technological strategies such as lithic reduction and use, the types and nature of materials and goods at a given site, and the spatial relationship of materials to their sources.

Indicators of Direct Acquisition. Direct acquisition of lithic materials from a source can usually be identified in the archaeological record by numerous, large, primary reduction assemblages identified at sites located near major lithic sources (Rousseau 2015:43–44). Both formal and informal tools are typically produced in areas were high-quality lithic materials are abundant; conversely, at locations where there is little direct availability of high-quality lithic materials, few formal tools are present, as materials often occur in sizes and shapes not suited for the production of formal tools (Andrefsky 1994:29). In addition, there is often little concern for conservation of materials at archaeological sites where high-quality materials are locally and abundantly available; this may manifest in the form of large amounts of waste, or discard of slightly imperfect tools or preforms (Andrefsky 1994:29). However, where access to lithic resources is restricted on a seasonal basis (e.g., due to snowfall closing routes of access), conservation or curation of lithic tools or materials may occur; as noted for some Plateau sites where direct acquisition of local materials is postulated (Hayden 1997:59).

Basic lithic assemblage analysis can help recognize direct acquisition of lithics, and differentiate between conservation of materials because of raw material scarcity and seasonal unavailability. Unworked cobbles or cores may be removed from the source and stored at sites for use during periods of seasonal unavailability (Hayden 1997:59). Heavy cobbles of raw material are unlikely to have been exchanged very far, based on the principles of transportability and value (Renfrew 1977:76–77); the exchange of lithics on the Plateau more likely occurred in the form of preforms or finished tools (Hayden and Schulting 1997; Ignace and Ignace 2017:220; Morin 2015; Teit 1900:260–262). Therefore, at archaeological sites removed from primary and secondary deposits of toolstone where large, unworked cobbles of that toolstone are present, direct access to those lithic sources likely occurred. One exception to this is when finished products are too fragile to transport. Steatite pipes are an example of this; steatite pipe tubes were too fragile to withstand transportation over long distance, and in response steatite was widely distributed as a raw material (Austin 2007:43; Galm 1994:294). However, this likely does not apply to KFGVC materials, as they are quite robust, and goods manufactured from them would not be especially fragile unless manufactured to be so.

Indicators of Exchange. There are two widely used indicators of exchange that can be applied to the archaeological record: 1) the presence at a site of non-local materials and, 2) the presence of goods believed to have been manufactured elsewhere based on stylistic, technological, or other grounds (Wright 1974:3). Determining if a material found in an archaeological site is non-local to an area requires knowledge of the local resources. However, even if a material is found to have non-local origins, it may not necessarily have arrived through exchange; groups may acquire non-local materials through direct acquisition if they have a high level of residential mobility extending over a large territory (Hughes 2011:5). Therefore, while extended distances between the source of a material and its occurrence at an archaeological site may suggest that material arrived by exchange, it is not necessarily the case. Distance must be combined with other indicators for greater certainty. One such indicator is the concept of territoriality, which is highly applicable in the Plateau context.

Territoriality refers to the practices that serve to communicate territorial or tenure interests (Springer et al. 2018:47). It can be identified by the presence of styles of material goods specific to a given area (Bettinger 1982:112), geographic boundary markers (Ignace and Ignace 2017:317), or by the restriction of materials outside of a group (Reimer 2018b:26). In a territorial system, resources are often owned or controlled by specific groups (Bettinger 1982:112). This ownership or control may be maintained by cultural prescriptions or protocols, but is ultimately controlled by force or the threat of force (Torrence 1986:42). Those without rights of access to resources controlled by one group would have occurred through force, subterfuge, or exchange. While exchange for access to materials is a costly process (Bettinger 1982:112), it can be negotiated and decided upon, as opposed to the use of force with the outcomes potentially uncertain and often hazardous. Territoriality has been recognized on the Plateau archaeologically (Cannon 1992), ethnographically (Dawson 1891; Teit 1900, 1906), and in oral histories and Traditional First Nations Knowledge (Ignace and Ignace 2017:317). Therefore, if non-local materials were being moved across territorial boundaries, and especially across great distances, then exchange was likely responsible.

Archaeological differentiation between direct and down-the-line exchange poses an additional challenge; random walk processes could conceivably result in distributional patterns of material that resemble any of these mechanisms of exchange. While it may not be archaeologically possible to differentiate these modes of exchange, the existence of archaeologically identifiable exchange networks suggests that materials were distributed through such means, as opposed to random processes. Identifying the such networks involves asking questions about them, focusing on their content and magnitude, the diversity of materials being exchanged, their size and temporal duration, the directionality and symmetry of the exchange, and the centralization and complexity of the network (Plog 1977:129). Plateau exchange networks meet these criteria, and were likely involved in the distribution of KFGVC materials.

The content of Plateau exchange networks included a wide variety of items. Durable goods such as toolstone, marine shell, and whalebone (Carlson 1994; Galm 1994; Morin 2015) have been archaeologically identified as having been exchanged. Meanwhile, the exchange of perishable goods such as salmon, hides, feathers, berries, wooden materials and goods, and clothing are recorded in ethnographies (Dawson 1891; Teit 1900, 1906, 1909) and Traditional First Nations Knowledge (Ignace and Ignace 2017:220). Extrapolating from the ethnographic record, this wide range of items identifiable as exchange goods also attests to the diversity of materials involved in these networks. The magnitude or quantity of materials that were exchanged is difficult to determine. Obsidian is frequently focused upon as an indicator of exchange, but makes up less than 1% of flaked stone assemblages on the Plateau (Galm 1994:282). Conversely, marine shells such as dentalium appear in large quantities at Plateau sites, often in mortuary contexts (Galm 1994:292). Returning to ethnographic records concerning perishable goods, plant resources provide an example of goods that were exchanged in "considerable" quantities according to Teit (1900: 232). Traditional First Nations Knowledge from the historic period indicate that the Hudson's Bay Company would buy or exchange goods for between 12,000 to 20,000 salmon a year between the 1840s and 1860s (Ignace and Ignace 2017:211). These lines of evidence support the idea that a large volume of different goods and materials were exchanged through these exchange networks. The area covered by these networks, as well as their temporal duration, was substantial; Galm (1995:296–297) and Carlson (1994:348–349) identify exchange networks that extended across the Plateau to the coast and that endured with differing, but generally increasing levels of intensity over the past 10,000 years. Concerning directionality, the exchange of such items as marine shell and whalebone from the coast to the Plateau (Bruchert and Greenough 2016:101; Hayden 1997:256) and the movement of items such as nephrite celts (Morin 2015, 2016) in the opposite direction illustrates that these networks were at minimum bi-directional. The identification of nephrite celts in Alberta, originating in the Fraser Canyon, suggests these networks reached beyond just BC (Kristensen et al. 2016). Finally, centralization appears to be a feature of Plateau exchange networks, as represented by centers of exchange, or trade hubs. Galm (1994:294–297) identified a major center of exchange in the Lytton-Lillooet area of the Plateau; this is based on the complexity, age range, and quantity of sites where archaeologically identifiable evidence of exchange in obsidian and marine shell extends deep into the past, intensifying after 5,000 B.P. Numerous exchange centers were located across the Plateau throughout the past, especially the later periods, often near major waterways, trail networks, and fisheries (Bruchert and Greenough 2016:115; Ignace and Ignace 2017:222; Morin 2015:543). These hubs were probably the location of seasonal trade fairs drawing thousands of visitors who travelled long distances to exchange locally abundant goods and engage in social activities (Fladmark 1982; Galm; 1994; Morin 2015:543).

Networks of exchange are evident in the archaeological record of the Plateau, and their existence is further supported by ethnographic and Traditional First Nations' Knowledge. Such networks often include a system of circular, down-the-line exchange as a mechanism by which materials were distributed (Brose 2011:216). “Logically embedded within that system, but capable of independent existence” is direct or focused exchange, where goods move solely from one individual or group to another (Brose 2011:216). As previously mentioned, the boundaries between these two mechanisms overlap, and recognizing them based only on archaeological data is frequently more "an art than a science" (Brose 2011:216). Employing other lines of evidence, such as ethnographic records, oral histories, and Traditional First Nations' Knowledge is therefore a helpful way to distinguish between them. Table 8 indicates key archaeological indicators of the various modes of exchange that have been discussed above. Again, it must be noted that these indicators should be considered alongside other lines of evidence when attempting to determine if a mode of exchange occurred.

Table 8: Potential archaeological correlates of acquisition and exchange.

Type of Acquisition/Exchange	**Archaeological Correlates**
Direct Acquisition	• Collection of workable materials from primary, secondary, or tertiary source deposits. • Evidence of quarrying at primary localities (e.g. quarry pits or shafts). • Numerous, large, primary reduction assemblages at sites at primary lithic sources. • Production of formal and informal tools. • Little conservation of material, discard of slightly flawed tools at primary source deposits. • Presence of large boulders and cobbles of raw material at primary source deposits and smaller materials (cobbles and pebbles) at secondary and tertiary sources.
Direct Exchange	• Non-local lithic materials found at sites distant from the source, the frequency of which decreases with distance away from source deposits. • Prepared cores and bifaces common in site assemblages.
Down-the-line Exchange	• Non-local lithic materials found at sites distant from the source, the frequency and amount of which decreases with distance away from source deposits. • Finished tools, smaller prepared cores, and large flakes more common in site assemblages.
Exchange through Intermediaries	• Non-local lithic materials found at sites distant from the source in greater frequencies and amount that would be expected in direct or down-the-line exchange. • Large amounts of non-local material found in one context, such as a cache, either in raw material form, or as finished tools that appear to have been produced by one individual or in a standardized style. • Non-local lithic materials found at sites away from the source, across territorial boundaries. Greater curation and resharpening of tools made from non-local materials.

Cultural Influences over the Exchange of Kamloops FGV Complex Materials

Networks and relationships of exchange on the Plateau were part of Indigenous societies and cultural systems. As such, cultural and social protocols would likely have influenced these networks of exchange, and potentially controlled them. How KFGVC materials were dispersed across the Plateau would therefore also have been subject to these factors. These cultural factors are described below, and relied upon to inform interpretations about how networks of exchange that may have functioned in this region in the ancient past.

Major cultural influences over the distribution of KFGVC materials were based in Secwepemc and Nlaka'pamux cultural laws. According to *stsptekwll* (ancient stories) of the Secwepemc, there were three fundamental laws: 1) the law of sovereignty in Secwepemc territory; 2) the law that defines rights of access and rights to resources and; 3) the law that acts as impetus to make treaties among nations (Ignace and Ignace 2017:57–59). These cultural concepts relate to exchange between closely related members of a group, and to exchange between less closely related groups would have influenced the distribution of KFGVC materials. These concepts include *knucwentwécw,* a principle that refers to values of generosity and mutual support between kin, and e*ỷkemînem* and e*yentwécw,* which both relate to exchange of goods between individuals or groups not closely related (Ignace and Ignace 2017:222–223).

Cultural protocols pertaining to territorial sovereignty and rights of access to resources, and to principles governing exchange between groups based on their relationship as kin were the strongest influences on how exchange operated. The laws of territorial sovereignty and rights access to access resources and the principles of *knucwentwécw*, and e*ỷkemînem* and *eyentwécw* would have most directly affected the distribution of these materials. This is because they directly relate to the inclusion of specific resource areas within First Nations' territories, who was permitted to access and utilize them, and how they were shared. As such they are the primary focus of this discussion. The law governing treaties likely functioned in conjunction with that concerning rights of access, in that treaties would have an effect in determining which First Nations' would have relationships of exchange or otherwise with each other. As such, the actual interactions would be subject to the law of rights of access; this third law will therefore be only briefly reviewed. I examine each in turn.

The Law of Territorial Sovereignty. The law of sovereignty in Secwepemc territory reflects broader patterns of territoriality on the Plateau; among the Secwepemc, Nlaka'pamux, and their neighbours there existed a "definite sense of territory and territorial boundaries," maintained by treaties and laws of trespass and access (Ignace and Ignace 2017:317). Transgressions against such laws were serious offenses, and oral histories and ethnographies record instances of violence in reaction to such incidences. The common theme in oral accounts is that warfare revolved around intruders into the territory of other nations, with the goal of invading resources grounds or taking slaves (Ignace and Ignace 2017:309, 317). Secwepemc groups would join to drive out invaders, or to make incursions into neighbouring lands themselves (Ignace and Ignace 2017:317). Ethnographers recorded that a Sekani group "would send active young men far down the river…to gather arrowstone" from Secwepemc lands, but that the intruders were driven off by force (Teit 1909:546). Oral histories from the Dakelh First Nations in the more northern portion of the Plateau describe battles fought over obsidian deposits, providing a specific example of control being sought over valuable lithic resources (Reimer 2018:8). Violation of territorial boundaries and forceful incursions to take resources was frequently met with resistance, suggesting a high level of control by First Nations over their lands and resources, including toolstone sources (Ignace and Ignace 2017:211).

Knowledge of and control over lands and valuable resource areas by Plateau First Nations is further supported by the existence of individuals who acted as resource stewards (Ignace and Ignace 2017:193). In the Secwepemc and other First Nations, such as the Stl'atl'imx (Kennedy and Bouchard 1998b:182), these individuals would monitor and assess the quality and quantity of resources accessed by the community, and would undertake maintenance (Ignace and Ignace 2017:193). Resource steward positions were often hereditary, and required special knowledge (Kennedy and Bouchard 1998b:182). Having an established position within a community where an individual or individuals were responsible for assessing and maintaining resource grounds suggests familiarity with and frequent use of those areas. That resource stewards were hereditary positions, or at least possessed requirements to be held, suggests a level of control within the community over resource areas. While resource steward positions are only recorded in the historic period, and cannot be identified archaeologically, frequent use of and access to resource areas undoubtedly occurred throughout the past. There is little reason to believe that Plateau First Nations did not take regular inventory and practice maintenance of resource areas. Archaeological evidence for planned burning and management of plant and berry patches (Lepofsky and Lertzman 2008; Turner et al. 2011), and construction and maintenance of fishing platforms (Prentiss and Kujit 2012:120–123) and weirs (Prince 2014) attest to this.

Considering the level of knowledge of and control over lands and resources, it is likely that access to lithic resources such as the KFGVC sources was limited to those with the proper authorization. Such materials would presumably have been dispersed according to cultural protocols. As discussed above, laws of territorial sovereignty would have directly affected the distribution of KFGVC materials. As the quarry areas lie within the territories of the Secwepemc and Nlaka'pamux, attempts to access them would have violated these laws, which were a widely-held concept among Plateau First Nations (Ignace and Ignace 2017:317). Incursions into Secwepemc or Nlaka'pamux lands by other First Nations to access KFGVC sources would likely have been met with resistance or physical violence. This ties into the second fundamental law, that concerning rights of access and rights to resources.

The Law of Resource Access and Resource Rights. In recent times, rights of access and rights to resources in Secwepemc and Nlaka'pamux territory were based in collective land tenure at the level of the nation; resource rights were not exclusive to individual communities (Ignace and Ignace 2017:282). All members of the nation, "whether by descent or by blood," had access to resources within a territory (Ignace and Ignace 2017:282). While some Plateau First Nation families had privileged access to desirable resource areas, such as salmon fishing rocks (Hayden 1997:255; Kennedy and Bouchard 1998b:182), most areas were available for the use by the entire group. Direct family relationships, intermarriage between members of different nations, formal treaties, and other means (e.g. the adoption of children or adults) created and sustained the kinship bonds that allowed individuals and groups to access the lands and resources of First Nations' with whom they had ties (Ignace and Ignace 2017:319). Individuals or groups with no close relationships to a First Nation or community lacked the proper authorization to access resources.

Other nations included in this research with kinship ties to the Secwepemc and Nlaka'pamux include the Okanagan (Kennedy and Bouchard 1998b:239) and Stl'atl'imx (Ignace 1998:205). This would support the idea that any Indigenous person or group with ties to the Secwepemc or Nlaka'pamux would be able to access KFGVC sources directly. However, Secwepemc or Nlaka'pamux peoples who lived in locations that made direct access to these sources impractical (e.g., too distant, geographic obstacles) would probably not have done so. More likely, KFGVC materials would have been exchanged within Secwepemc and Nlaka'pamux groups between those who lived near enough to access these sources (e.g. within the supply zone), and those who did not. Those peoples with kinship ties to Secwepemc or Nlaka'pamux nations would have participated in an exchange system based in familial relationships. Less closely-related people could have obtained KFGVC materials through formalized economic-based exchange. Exchange between Secwepemc and Nlaka'pamux kin groups, and outsiders was differentiated by separate underlying principles, known as *knucwentwécw,* and *eỳkemînem* and *eyentwécw*, which are discussed later in this chapter (Ignace and Ignace 2017:222).

In sum, the laws governing rights and access to resources would have affected the distribution of KFGVC materials in the following way: Individuals or groups not related to the Secwepemc or Nlaka'pamux would not have been permitted to access these sources directly. This is because they did not have the requisite kin relationships necessary to be considered members or part members of the Secwepemc or Nlaka'pamux. As mentioned previously, this is closely tied to the law of territorial sovereignty, as access to a territory or a resource was contingent upon status as a member of the nation who owned or controlled that area or resource.

The cultural protocols discussed above suggest that larger First Nations groups, like the Secwepemc or Nlaka’pamux, existed as unified, cohesive units. However, it should be recognized that divisions did exist within these larger groups, and that not all resources were shared openly. For example, Teit (1909:582) identifies major band divisions within the Secwepemc, such as with the Fraser and Canyon Shuswap, and specific resource gathering areas owned by clan crest groups or bands, especially for food resources and food gathering areas. Despite this, divisions or contentious relationships within groups and ownership of specific resource gathering areas were likely still subject to the broader cultural protocols explored previously. Additionally, Teit (1909:583) recorded that more distant resource gathering locales were infrequently claimed by specific bands, but left as common property for the larger group; it is possible that this was applied to KFGVC sources as well. This is further supported by the fact that ownership at the band or clan crest group level seems to be more frequently applied to food resource areas; no mention is made of lithic quarries being owned at the band or clan level.

The Law that Governs Treaty-making with other Nations. Historically, treaty making was a way for Plateau nations to settle disputes and fix territorial boundaries (Ignace and Ignace 2017:289). Dawson (1891:5) recorded one such treaty between the Secwepemc, Stony, and Ktunaxa people, which was negotiated to settle a dispute over access to resource grounds (Ignace and Ignace 2017:291–294). While this law would not likely have directly affected the distribution of KFGVC materials by itself, it may have acted in conjunction with the laws concerning territorial sovereignty and rights and access to resources. Disputes over territorial boundaries or access to resource grounds did occur, and sometimes resulted in conflict; warfare or raiding was often economically motivated, with the goal being the acquisition of resources or slaves (Cannon 1992). If the Secwepemc, or Nlaka'pamux, or divisions within these nations concluded a treaty with another group, it would have been designed to resolve the dispute. This would be beneficial for relationships of exchange; in the past, exchange was potentially hazardous, and best undertaken with established partners (Austin 2007:38; Schulting 1995:33). By creating or maintaining positive relationships through treaties, relationships of exchange would have been facilitated.

The Principle of Knucwentwécw. The principle of *knucwentwécw* refers to values of generosity, reciprocity, and mutual care and support between relatives in Secwepemc culture (Ignace and Ignace 2017:222–223); similar principles applied across the Plateau and the Northwest Coast (Bruchert and Greenough 2016:118; Prentiss and Kujit 2012:71; Reimer 2018b:23–24; Walker 1998:5). Close family groups formed the basic social unit of numerous other Plateau First Nations, including the Stl'atl'imx (Kennedy and Bouchard 1998a:181–182), Nicola (Wyatt 1998:220–221), Ktunaxa (Brunton 1998:226–229), and Okanagan (Kennedy and Bouchard 1998b:247). These family units were important in resource-gathering activities where families and kin groups would share with each other; resources would be collected by a group composed of members from multiple families, and then distributed equally afterwards (Brunton 1998:228; Ignace and Ignace 2017:207, 356). This applied to hunting and food gathering, and probably also to collecting raw materials, such as toolstone (Ignace and Ignace 2017:356). Within Secwepemc and Nlaka'pamux territories, the distribution of KFGVC materials was most likely the result of this form of collection and exchange. The principle of *knucwentwécw* would therefore have affected the distribution of KFGVC materials in that these materials would have been shared freely within Secwepemc and Nlaka'pamux kin groups that accessed the sources directly. They would likely also have been shared freely between those groups that accessed the sources directly, and their extended kin groups with whom they had regular contact. This effectively expanded the supply zone of KFGVC materials, in that those with direct access to the sources acted as sources of material to kinship groups living in areas that would otherwise be considered part of the falloff zone.

The Principles of Eỳkemînem and Eyentwécw. The principles of *eỳkemînem* and *eyentwécw* refer to the ideas of trading something as payment for purchases, and payment as part of barter or profit-seeking (Ignace and Ignace 2017:222–223). These principles applied to individuals not closely related to the trader, as well as to *sexlítemc*, strangers to Secwepemc lands who held no resource rights (Ignace and Ignace 2017:223, 359). Additionally, these concepts tied into existing notions of making profits from surpluses of locally abundant items; journals from Hudson's Bay Company traders in the region "describe and often lament the astute bargaining of the Indigenous people…" (Ignace and Ignace 2017:223). Ethnographic accounts discuss a robust exchange in raw materials across the Plateau and into Coastal areas; dentalium shells, nephrite jade, different types of wood, hides, furs, cedar and hemp bark, and feathers were among the items traded between the Secwepemc, Nlaka'pamux, Stl'atl'imx, and other First Nations (Dawson 1891:11,17; Teit 1900:260-262; 1906:232-233; 1909:531-539). This is affirmed archaeologically based on the presence of non-local materials at Plateau sites, such as obsidian, whale bone, and once more, dentalium shells (Bruchert and Greenough 2016:101; Hayden 1997:256). The principles of *eỳkemînem* and *eyentwécw* would therefore have influenced the distribution of KFGVC materials in the following way: Those who had access to materials from these sources, either as members of the Secwepemc or Nlaka'pamux nations, or as members of other nations holding resource rights (e.g. because of intermarriage), would likely have exchanged KFGVC materials with other, less-closely related groups based on either the desire for profits, or to barter for materials not locally available to them. This could have taken the form of either direct or down-the-line exchange, the latter possibly involving intermediaries.

Acquisition and Exchange of KFGVC Materials on the Plateau

There are four primary means by which materials from the KFGVC were likely distributed; direct acquisition, direct exchange, down-the-line exchange, and exchange through intermediaries. These are discussed below, stated as hypotheses about which means of acquisition or exchange likely resulted in the presence of KFGVC materials at archaeological sites within a given First Nations territory, based on the cultural protocols described above. Additionally, I discuss the physical contexts within which the acts of exchange likely took place.

Direct Acquisition. Direct acquisition of KFGVC material would have involved groups or individuals either making specific visits to the sources, or collecting materials on an encounter basis at primary or secondary deposits. Direct acquisition is the first step in both direct and down-the-line exchange; the materials must obviously first be procured before they can be distributed. Direct acquisition of materials from these sources would have most likely been undertaken primarily by ancestral Secwepemc and Nlaka'pamux peoples. All the KFGVC sources lie in territory currently shared by the two nations, and so both would have enjoyed rights of access (Ignace and Ignace 2017:105–110). However, current territorial boundaries may not be representative of those that existed in the past. It is possible that in earlier periods, when there was greater mobility and lower levels of territoriality, that other groups could have accessed these sources directly. However, this would likely have decreased as residential sedentism increased, territorial boundaries solidified, and cultural protocols became more established. Direct acquisition would explain the presence of KFGVC materials at locations near to these sources.

There is evidence that most primary reduction of lithic materials from KFGVC sources occurred at the sources themselves, or at nearby sites (Rousseau 2015:32–35). This suggests that individuals or groups accessing these sources preferred to undertake the initial stages to tool production at or near quarry areas. This would maximize the amount of tool material they could carry; by producing finished tools or preforms at the source, less waste material would have to be transported than had they simply removed cobbles of raw material from a source. This is supported by the sheer volume of primary reduction debitage, cores, and preforms found at the Arrowstone Hills source, as well as the presence of numerous quarry pits (Ball 1997; Figures 5-10). It is suggested that an individual or pack dog could carry up to 15 kg of raw or refined toolstone, meaning that a great deal of lithic material could have been removed from a source by a small group of individuals in one trip (Bruchert and Greenough 2016:115: Rousseau 2015:45). This strategy enjoyed the added benefit of producing value-added items that could be exchanged for profit later.

The concept of added value for processed or manufactured items existed among the Secwepemc and other nations; for instance, finished stone hand mauls were imported from the Stl'alt'imx by the Nlaka'pamux (Ignace and Ignace 2017:223; Teit 1900:183). This is likely related to the strategy of undertaking primary reduction and manufacturing tool blanks or preforms at lithic extraction sites. Archaeological evidence suggests that industries focusing on manufacturing finished lithic tools for exchange or prestige existed in the region; for example, the production of nephrite adzes along the Lower Fraser Canyon. Based on mineralogical data and spatial distribution, Morin (2016) concluded that nephrite adze production was a highly-specialized activity that occurred in relatively few communities, but that these production centres supplied many hundreds of communities.

Direct Exchange. Direct exchange would likely explain the presence of KFGVC materials at locations within Secwepemc and Nlaka'pamux territories that were near the sources. For the purposes of this research, I consider direct exchange to be between those accessing KFGVC sources directly and exchanging it with other parties. This is opposed to exchange between those who had themselves obtained KFGVC lithics through exchange, and other parties. This mode of exchange would also have likely occurred within Secwepemc and Nlaka'pamux groups, between those who lived in locations that allowed them direct access to these sources, that is, within the supply zone, and those who did not; those living in the falloff zone. In this case, kin relationships between those with access rights to the KFGVC sources may have artificially extended the supply zone to reach groups or individuals who also enjoyed rights of access to these sources, but for whom physical access was impractical. This means of exchange may also have occurred between Secwepemc and Nlaka'pamux peoples and their close neighbours, at least with those with whom they had positive relationships. It may explain the presence of these materials at locations in the Nicola, Okanagan, Stl'atl'imx, and Ktunaxa territories that border one or both of either Secwepemc or Nlaka'pamux lands (Figure 2).

Down-the-Line-Exchange. Down-the-line-exchange would have occurred between Secwepemc and Nlaka'pamux peoples and both nearby and distant groups. This would have either occurred in the traditional down-the-line model, where each participant in a trade network reserves some of the material it receives, and passes on the rest, or with other First Nations acting as intermediaries, something documented in archaeological research (Kennedy and Bouchard 1998:176; Morin 2016), ethnographies (Dawson 1891; Teit 1900, 1906, 1909), and First Nations knowledge (Ignace and Ignace 2017:220). While both means are equally able to result in the patterns of distribution found in this research, the extensive support for existence of intermediaries in ethnographic recordings and Traditional First Nations knowledge suggest it as the main means of long-distance exchange, at least within the context of exchange systems, and especially across territorial boundaries. This means of distribution may account for KFGVC materials found at sites in Nicola, Okanagan, Stl'atl'imx, and Ktunaxa territories. Distribution of these materials to coastal areas would likely have followed this pattern as well.

Physical Contexts for Exchange. The physical acts of both direct and down-the-line-exchange most likely occurred at trade hubs across the Plateau, at which different First Nations would gather seasonally for social and economic purposes (Bruchert and Greenough 2016: 100; Ignace and Ignace 2017:222; Reimer 2018b:8). Direct exchange would likely have occurred at any single given trade hub, as direct exchange is defined by materials changing hands only once, between the producer and consumer (Alden 1982:85). Conversely, down-the-line-exchange might have seen goods change hands at multiple trade hubs, as goods were passed between multiple exchange participants (Renfrew 1977:77–78). Where intermediaries moved materials directly between producers and consumers, there was potentially a combination of both direct and down-the-line exchange. A consumer acting as an exchange intermediary between the Plateau and Coast might have obtained material from a group or individual who acquired KFGVC materials directly, and then transported it to one or more trade hubs for delivery to other consumers. Of course, both direct and down-the-line exchange could have occurred outside of exchange hubs, and likely did, especially in the contexts of local exchange. However, the existence of these hubs suggests that exchange was occurring with enough frequency and volume to necessitate them.

Numerous hubs were located within Secwepemc territory, such as at Green Lake, Fountain, and Kamloops; these hubs were often locate near major waterways such as the Fraser and Thompson rivers, both for ease of access via canoe, and because the productive salmon fisheries brought numerous groups together to fish, and then exchange surpluses (Ignace and Ignace 2017:222). Archaeological sites interpreted as trade hubs have been identified at locations across the Plateau, as well as the Fraser Valley and coastal areas (Bruchert and Greenough 2016:115; Reimer 2018b:8; Springer et al. 2018). These trade hubs have been identified based on the presence of numerous, non-local items including lithics, and their location at the nexus of pre- and post-contact trail networks (Bruchert and Greenough 2016). Movement of goods followed waterways and established trail networks; these trails were numerous, maintained and managed by First Nations long before European contact (Farvholdt 1997:29–30; Ignace and Ignace 2017:222–233; Reimer 2018b:8). They extended across the entire Plateau, connecting to the Subarctic, Coast, Plains, and Columbia Plateau (Bruchert and Greenough 2016:100; Reimer 2018b:8; Walker 1998; 5–6).

The Secwepemc and Nlaka'pamux had access to a surplus of locally available, high-quality lithic materials from the KFGVC. Research focusing on the use of other high-quality lithic materials at Plateau sites such as obsidian (Austin 2007) chert (Kendall and MacDonald 2015), and nephrite (Kristensen et al. 2016; Morin 2015, 2016) has demonstrated that there was demand for such materials, for both technological and prestige purposes. Such research has also demonstrated that these high-quality lithic materials were supplied from both local (Kendall and MacDonald 2015; Morin 2015; Rousseau 2015) and exotic sources (Carlson 1994: 349; Connolly et al. 2015; Kendall and MacDonald 2015). Given the distribution of KFGVC materials over the Plateau as found in this research, it appears that this local supply of high-quality lithic material was being moved across the region through Indigenous exchange networks to meet a regional demand, at least during the period or periods when particular exchange networks were operating. This discussion should be qualified with the statement that determining the mode of acquisition and exchange that resulted in the presence of KFGVC material at a site is beyond the scope of this research. The hypotheses presented above could be affirmed or refuted by future analysis of the lithic assemblages of archaeological sites sampled in this research, with reference to archaeological indicators of modes of exchange like those presented in Table 8.

Chapter Summary

This chapter has described the distribution of KFGVC lithics across the Plateau; it has been demonstrated that the materials are nearly ubiquitous across the region. This is argued to be the result of these materials being widely exchanged between Plateau First Nations. The exchange of these materials would have been influenced by cultural factors such as laws of territorial sovereignty, laws of rights and access to resources, and cultural concepts pertaining to exchange, based in the relationships that existed between First Nations' groups. Exchange of KFGVC lithics would most likely have occurred through kinship networks, and formal exchange networks. Those with rights to access the KFGVC sources directly, primarily the Secwepemc and Nlaka'pamux, would have collected and distributed these lithic materials to their own close kin based on the principle of *knucwentwécw* (mutual care and support for relatives). This would largely account for the distribution of KFGVC materials in Secwepemc and Nlaka'pamux lands. Based on the principles of *eỳkemînem* and *eyentwécw*, exchanging goods for payment or profit, KFGVC materials would have been distributed to groups less closely, or not at all related to those who had rights to access these sources. This would likely account for most of the distribution of these materials across the broader Plateau outside Secwepemc and Nlaka'pamux lands, especially to distant locations. The cultural principles and laws that this research has utilized to inform the discussion of how KFGVC materials were exchanged cannot be accurately projected beyond the historic period into the distant past. However, combining these aspects of Traditional First Nations' Knowledge with ethnographic records and archaeological evidence provides a rich illustration of the potential range of cultural influences on Plateau exchange networks and relationships.

Chapter 6.

Conclusion

This chapter reviews the conclusions drawn by this research. I begin by discussing archaeological interpretations of the distribution of KFGVC materials across the Plateau. I then consider the implications that this research may have for both past and future research involving fine-grained volcanic materials, especially studies focusing on source characterization and provenance analysis. Finally, potential directions for future research are presented.

Archaeological Interpretations and Implications

This research contributes to our understanding of Plateau exchange systems by synthesizing quantitative archaeological data, First Nations knowledge, and ethnographic records. It has explored the distribution of KFGVC lithic materials originating from sources in Secwepemc and Nlaka'pamux territories at archaeological sites across the Plateau, and considered how cultural systems and protocols of access and exchange would have influenced this distribution.

KFGVC lithic sources were heavily exploited by Plateau peoples for millennia and were an important material resource. The majority of sites at which KFGVC materials were identified lie 100-300km away from the source complex. This means that materials are not decreasing in abundance as distance from the sources increases in a linear manner, as in a simple distance-decay model. This supports the idea that these materials were being collected at the source and redistributed through exchange of one form or another, including through formal economic exchange and kinship networks, both across and beyond the Plateau. This is demonstrated by the extensive presence of these materials in the Plateau archaeological record, ethnographic records of use and exchange, and First Nations Knowledge regarding trade and resource rights. Exchange networks and relationships were operated and maintained in an organized manner, with different types of exchange occurring depending on the parties involved (Hayden and Schulting 1997:52–53; Ignace and Ignace 2017:220). Kinship bonds by blood or marriage influenced the type of exchange that might take place between groups or individuals

(Ignace and Ignace 2017:222–223). This included exchange for mutual assistance, or for barter or profit seeking (Ignace and Ignace 2017:222–223). Kinship bonds also dictated the level of access to resources within and across First Nations territorial boundaries, boundaries that were well recognized by Plateau groups (Ignace and Ignace 2017:223, 263). The time depth to which these cultural protocols existed and applied to networks of exchange is not certain, and projecting them back may not necessarily represent what actually occurred. However, they provide useful points from which to begin generating hypotheses.

It is apparent from the results of this research that there were extensive, widespread networks of exchange across the Plateau. The widespread distribution of KFGVC materials, well-established and maintained exchange routes and relationships, and concepts of value-added goods and exchange for profit suggest a complex regional economy. Though lithic materials are the most physically enduring evidence available to explore these networks, they were only one part of it. Ethnographic records and First Nations knowledge suggest that goods such as food, hides, weapons, clothing, feathers, and wooden goods were exchanged, while archaeological research demonstrates that other toolstones such as obsidian, finished goods like nephrite adzes, and raw materials such as whalebone and marine shells were also distributed through these networks. When the amount and variety of materials that were exchanged are considered, the complexity and scale of these regional exchange networks is impressive. Combined with Traditional First Nations Knowledge and archaeological research supporting high levels of resource management and stewardship, well-established and widely-recognized territorial boundaries, and systems of treaty establishment and maintenance, Plateau First Nations are clearly autonomous cultural-political entities, enjoying sovereignty over their lands, and regulating internal and external relations through established cultural protocols. This thesis has linked archaeological research and First Nations knowledge to provide a richer understanding of the past, but also a means to demonstrate Indigenous territorial sovereignty.

Implications for Past and Future Fine-Grained Volcanic Lithic Research.

From what has been demonstrated in this research, it is apparent that the KFGVC sources can only be partially differentiated from each other using XRF analysis. While this research certainly adds to the fine-grained volcanic lithic database for British Columbia, it brings with it a note of caution. Adequate sampling of sources must be undertaken to understand the chemical variability therein, and even once accomplished, it may still be impossible to differentiate certain sources. Fortunately, this is tempered by the geographic proximity of KFGVC sources to one another, but that may not hold true for other research. Previous provenance studies that have assigned any of the KFGVC sources as origins for artifacts found elsewhere may need revisiting to specify that artifacts may not be able to be assigned to a specific source, but rather to a group of sources. In addition, the use of visual analytical techniques alone to characterize source or assign origins to artifacts is inadequate, as this research has demonstrated. While it may be useful for initial analyses in the field, more rigorous, quantitative techniques are necessary for increased confidence in the reality of results.

Future Directions

There are numerous directions that future research in this area could take. Expanded sampling of KFGVC sources, especially Cache Creek, Hat Creek, and Maiden Creek, would be beneficial to more firmly establish their geochemical signatures. This may either allow them to be more readily differentiated, or support the idea that they are likely subflows of a single source. This would be helpful in assigning artifacts to specific sources, or in determining preference for materials from a particular part of the complex. Employing other analytical techniques such as Neutron Activation Analysis (Glascock and Neff 2003), Raman Spectrography (Smith and Clark 2004), or ICP-MS (Orange et al. 2016) to characterize these materials would further contribute to this goal. Locating, identifying, and characterizing unknown lithic sources, materials from which were identified in this study, would add to our understanding of exchange networks on the Plateau and beyond. Doing so would create the data necessary to demonstrate where these materials originated from, and illustrate further pathways and relationships of exchange. Sampling artifacts from archaeological sites outside the scope of this research, on the Northwest Coast, Columbia Plateau, Western Plains, and Sub-Arctic, and comparing it to KFGVC source data has the potential to identify exchange networks and relationships outside the British Columbia Plateau, and further demonstrate the extent and complexity of First Nations exchange systems. Finally, undertaking relative frequency analyses of lithic assemblages at archaeological sites across the Plateau, subjecting those assemblages to XRF analysis, and comparing those data to source signatures for the KFGVC would permit greater understanding of how much these materials were utilized in different regions across the Plateau. This would obviously be a massive undertaking, and would probably be best accomplished through a long-term project, with partnership with First Nations, CRM companies, and multiple research institutes.

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Appendix A – Table of Sample Sites

Key: NWORL – North West Obsidian Research Laboratory

Borden Number	FN Territory	Samples	Date Period	Distance from Arrowstone Hills (Km)
DhPt-10	Kutenai	11		473
DhPt-9	Kutenai	10		473
DhQv-48	Okanagan	21	Late	218
DiPu-16	Kutenai	2		444
DiPu-17	Kutenai	2		445
DiQm-1	Okanagan	10	Late	288
DiQm-13	Okanagan	1		281
DiQm-19	Okanagan	4		281
DiQm-4	Okanagan	8	Late	285
DiQm-5	Okanagan	1		284
DiQm-6	Okanagan	2		286
DiQm-8	Okanagan	2		280
DiQv-5	Okanagan	25		200
DkQi-1	Kutenai	1	Late	301
DkQm-2	Okanagan	3		257
DkQm-5	Okanagan	20	Late	257
DkRi-62	Nlaka'pamux	1		126
DkRi-65	Nlaka'pamux	2		127
DlRi-6	Nlaka'pamux	7	Late	119

EaRb-30	Nicola	5		113
EbQf-19	Kutenai/Secwepemc	1		313
EbRj-1	Nlaka'pamux	6		81
EbRj-10	Nlaka'pamux	1		78
EbRj-173	Nlaka'pamux	2		78
EbRj-174	Nlaka'pamux	7		78
EbRj-22	Nlaka'pamux	10		81
EbRj-3	Nlaka'pamux	15	Middle/Late	78
EbRj-92	Nlaka'pamux	9		78
EcQf-13	Kutenai/Secwepemc	1		313
EcQf-16	Kutenai/Secwepemc	1		309
EcQf-17	Kutenai/Secwepemc	1		309
EcQf-20	Kutenai/Secwepemc	4		309
EcQo-12	Nicola	2		205
EcQo-13	Nicola	1		205
EcQo-2	Nicola	4		205
EcQp-1	Nicola	3	Middle/Late	203
EcQp-18	Nicola	1		203
EcQp-2	Nicola	1		201
EcQp-20	Nicola	1		203
EcQp-3	Nicola	7		202
EcQp-4	Nicola	2		202
EcQp-6	Nicola	8	Late	202
EcQp-8	Nicola	1	Middle/Late	203

EcQp-9	Nicola	6		202
EdQx-28	Secwepemc/Nlaka'pamux	3		103
EdQx-46	Secwepemc/Nlaka'pamux	1		103
EdQx-47	Secwepemc/Nlaka'pamux	1		101
EdQx-48	Secwepemc/Nlaka'pamux	1		101
EdQx-49	Secwepemc/Nlaka'pamux	1		101
EdQx-53	Secwepemc/Nlaka'pamux	7		103
EdQx-54	Secwepemc/Nlaka'pamux	1		102
EdRa-11	Secwepemc	5	Late	94
EdRa-9	Secwepemc	25	Late	88
EdRh-31	Nlaka'pamux	20		33
EdRh-7	Nlaka'pamux	9		32
EdRh-8	Nlaka'pamux	11		32
EdRi-11	Nlaka'pamux	25	Early-Middle	36
EdRi-25	Nlaka'pamux	5	Late	36
EeQw-105	Secwepemc	4		107
EeQw-106	Secwepemc	12		105
EeQw-108	Secwepemc	5		107
EeQw-13	Secwepemc	4		105
EeQw-14	Secwepemc	2		105
EeQw-148	Secwepemc	1		107
EeQw-150	Secwepemc	1		108
EeQw-151	Secwepemc	1		108
EeQw-153	Secwepemc	1		108

EeQw-160	Secwepemc	1		107
EeQw-163	Secwepemc	1		106
EeQw-3	Secwepemc	20		109
EeQw-5	Secwepemc	12	Middle/Late	108
EeQw-55	Secwepemc	1		107
EeQw-6	Secwepemc	20	Late	108
EeQx-23	Secwepemc	1		104
EeQx-25	Secwepemc	13		104
EeQx-30	Secwepemc	1		103
EeRb-10	Secwepemc	11	Middle/Late	71
EeRb-11	Secwepemc	16	Late	38
EeRb-144	Secwepemc	11	Middle/Late	74
EeRb-77	Secwepemc	17	Middle/Late	74
EeRc-8	Secwepemc	1		62
EeRh-3	Nlaka'pamux	25	Middle	15
EeRh-61	Nlaka'pamux	20	Middle	22
EeRj-1	Secwepemc/Nlaka'pamux	21	Late	30
EeRj-101	Secwepemc/Nlaka'pamux	5	Late	28
EeRj-215	Secwepemc/Nlaka'pamux	6		30
EeRj-226	Secwepemc/Nlaka'pamux	14		37
EeRj-99	Secwepemc/Nlaka'pamux	24		31
EeRl-18	Stl'atl'imx	9	Late	54
EeRl-212	Stl'atl'imx	2		55
EeRl-22	Stl'atl'imx	25	Late	52

EeRl-30	Stl'atl'imx	9		46
EeRl-6	Stl'atl'imx	20	Late	47
EeRl-7	Stl'atl'imx	37	Middle/Late	43
EfQt-1	Secwepemc	16	Late	143
EfQv-10	Secwepemc	20		115
EfQv-12	Secwepemc	20	Late	116
EfQv-2	Secwepemc	14		119
EfQw-2	Secwepemc	8	Late	111
EfQw-21	Secwepemc	11	Late	111
EfRh-2	Secwepemc/Nlaka'pamux	5		12
EfRh-26	Secwepemc/Nlaka'pamux	1		1.3
EfRh-29	Secwepemc/Nlaka'pamux	2		1.2
EfRh-3	Secwepemc/Nlaka'pamux	20		11.7
EfRh-30	Secwepemc/Nlaka'pamux	3		11.7
EfRh-34	Secwepemc/Nlaka'pamux	2		0.9
EfRh-35	Secwepemc/Nlaka'pamux	2		1.2
EfRh-38	Secwepemc/Nlaka'pamux	20		1.3
EfRh-41	Secwepemc/Nlaka'pamux	6		1.8
EfRh-51	Secwepemc/Nlaka'pamux	3		1.7
EfRh-52	Secwepemc/Nlaka'pamux	5		4
EfRh-58	Secwepemc/Nlaka'pamux	16		3.7
EfRh-63	Secwepemc/Nlaka'pamux	6		4.3
EfRh-64	Secwepemc/Nlaka'pamux	15		3.4
EfRh-65	Secwepemc/Nlaka'pamux	11		0.6

EfRh-66	Secwepemc/Nlaka'pamux	1		1
EfRh-67	Secwepemc/Nlaka'pamux	2		3
EgQq-1	Secwepemc	7		4
EiRg-3	Secwepemc	1		57
EiRh-4	Secwepemc	15	Late	50
EkQk-14	Kutenai/Secwepemc	1		265
EkQk-4	Kutenai/Secwepemc	2		265
ElRn-14	Secwepemc	3		133
FaRm-16	Secwepemc	5	Late	132
FaRm-23	Secwepemc	4	Late	149
FdQr-1	Kutenai/Secwepemc	1		246
FeQs-16	Kutenai/Secwepemc	9		250
FeRh-4	Secwepemc	1		205
FeRh-5	Secwepemc	1		205
Kamloops General Area	Secwepemc	12		N/A
Hat Creek (EeRj-221) - Golder	Secwepemc/Nlaka'pamux	10		30
Maiden Creek - Golder	Secwepemc/Nlaka'pamux	10		25
Arrowstone Hills PFR Samples	Secwepemc/Nlaka'pamux	7		Datum
SFU Arrowstone Hills Geological Samples	Secwepemc/Nlaka'pamux	68		N/A
SFU Cache Creek Geological Samples	Secwepemc/Nlaka'pamux	25		N/A
Arrowstone Hills Streambed Samples	Secwepemc/Nlaka'pamux	64		N/A
Arrowstone Hills - Golder	Secwepemc/Nlaka'pamux	10		N/A
Maiden Creek - NWORL	Secwepemc/Nlaka'pamux	18		25

Arrowstone Hills - NWORL	Secwepemc/Nlaka'pamux	10		N/A
Watts Point	Squamish	25		N/A
Turbid Creek	Squamish	25		N/A

Appendix B – Calibrated PXRF Data for All Sources

Key:

AHPFR – Arrowstone Hills Preliminary Field Reconnaissance

AHSPFR – Arrowstone Hills Streambed Preliminary Field Reconnaissance

SFUAHGS – Simon Fraser University Arrowstone Hills Geological Samples

SFUAHS – Simon Fraser University Arrowstone Hills Samples

NWORL – North West Obsidian Research Laboratory

S – Sample

Dep – Depression

Sample Site Code	MnKa1	FeKa1	ZnKa1	GaKa1	ThLa1	RbKa1	SrKa1	Y Ka1	ZrKa1	NbKa1
AHPFR Sample Bert 1	295.7241	17424.08	73.32131	15.80648	12.78045	118.252	491.0333	12.58283	191.1428	7.451405
AHPFR Sample Bert 2	243.6418	15616.54	70.56907	16.6447	15.69996	120.1321	512.134	12.24984	204.3012	8.976363
AHPFR Sample Bert 3	407.3204	18115.98	69.35346	14.65302	14.03723	122.426	494.5396	12.61016	206.8466	6.613527
AHPFR Sample Bert 4	439.7161	18590.52	56.44636	14.86635	12.46307	127.4461	560.2731	10.35208	204.4662	5.61002
AHPFR Sample Bert 5	402.0147	19405.47	84.6921	16.55303	14.78303	129.7628	553.3361	10.56065	209.9915	7.83709
AHPFR Sample Bert 6 Bedrock	233.4577	19569.97	66.95729	15.33032	8.850689	113.0262	468.1009	7.071367	181.9505	4.865908
AHPFR Sample Bert 7	483.9882	18990.35	67.82382	15.56941	9.857226	133.9232	543.2258	10.29795	203.8169	5.75124
AHSPFR Spot 1 S1	468.4822	18650.67	106.1849	17.00785	12.23041	130.9411	550.7224	9.886544	204.2093	6.976743
AHSPFR Spot 1 S10	457.4254	19830.36	104.0815	17.51275	10.86455	129.4434	567.2961	11.33988	207.7467	7.601189
AHSPFR Spot 1 S11	575.8445	27562.8	125.1322	16.22877	10.23539	110.141	771.6746	12.60609	205.8548	6.916766
AHSPFR Spot 1 S2	428.2298	20423.33	113.1408	17.7083	12.19221	132.5792	563.2575	11.41135	206.3871	7.90383
AHSPFR Spot 1 S3	412.2056	19072.24	124.7201	18.84604	10.30484	123.3346	537.257	11.61173	197.83	7.217667

AHSPFR Spot 1 S4	444.5607	22571.87	110.4307	17.1493	10.31836	118.5886	630.2032	10.40828	190.4141	4.542684
AHSPFR Spot 1 S5	429.0214	18905.29	118.7298	17.90762	12.28271	120.7488	514.1828	9.568903	188.2206	5.831295
AHSPFR Spot 1 S6	408.0371	20078.12	120.5189	18.4044	8.404252	122.9774	549.4966	12.31201	201.5879	6.172464
AHSPFR Spot 1 S7	501.6294	19799.33	95.62987	16.97301	12.42589	129.6942	576.0984	12.71222	206.6468	7.425838
AHSPFR Spot 1 S8	319.9801	18063.84	110.8483	18.00663	12.43561	132.7168	573.1277	13.9099	204.9597	6.090831
AHSPFR Spot 1 S9	500.0928	19879.05	112.6249	17.99026	12.43039	132.8871	576.7807	14.37064	216.0104	6.655356
AHSPFR Spot 2 S1	416.3848	19595.91	117.1188	18.311	14.33951	132.423	554.1359	11.79492	210.1893	8.496245
AHSPFR Spot 2 S10	532.2974	23480.19	111.88	17.10776	10.73354	122.0324	639.0937	10.25164	190.7699	4.3127
AHSPFR Spot 2 S11	388.7678	19120.27	106.3864	17.66314	13.00073	131.6294	575.7163	12.46118	211.2141	7.263861
AHSPFR Spot 2 S2	188.4987	19755.18	121.1338	18.50788	10.16416	128.482	622.6103	10.63883	196.1568	3.48194
AHSPFR Spot 2 S3	390.0287	19869.05	124.2859	18.3839	13.90164	130.7898	539.6913	9.764298	208.445	7.669542
AHSPFR Spot 2 S4	488.12	24073.48	151.3227	18.76906	13.50169	143.9174	614.3044	12.64913	225.3264	7.859463
AHSPFR Spot 2 S5	356.5089	16815.57	109.1275	18.07111	10.08956	132.6275	567.5926	12.51926	206.3022	7.531998
AHSPFR Spot 2 S6	492.3718	24223.38	123.8535	17.14011	15.49396	126.0385	563.4973	10.65752	207.8903	6.10338
AHSPFR Spot 2 S7	331.0087	19743.37	96.82251	17.1714	12.60879	128.0853	560.2217	11.81019	208.6194	6.822389
AHSPFR Spot 2 S8	454.3261	19584.83	110.1816	17.83947	13.80975	135.5763	550.5338	11.32994	210.4083	9.755108
AHSPFR Spot 2 S9	341.9646	24014.07	150.4611	18.91697	7.849921	108.299	674.7169	11.99034	185.982	6.45186
AHSPFR Spot 3 S1	332.2444	18565.95	102.8397	17.74503	12.54414	126.7664	564.6375	11.38671	196.8047	5.74019
AHSPFR Spot 3 S10	308.4467	19388.53	115.4793	18.28445	14.0431	128.4243	554.8665	13.10236	208.3294	8.168829
AHSPFR Spot 3 S2	370.9483	19746.17	100.227	17.35813	9.932165	122.9057	543.811	10.56511	205.2861	5.629495
AHSPFR Spot 3 S3	440.5121	20976.83	111.0926	17.64858	15.69613	133.8306	590.4527	14.00943	220.7006	7.758259
AHSPFR Spot 3 S4	386.0054	20362.2	107.3708	17.58552	11.82486	137.3901	589.3154	10.97313	209.7542	7.385476
AHSPFR Spot 3 S5	250.6672	15666.61	106.2498	18.59636	13.90457	127.5854	537.9066	12.6732	208.6303	8.412033
AHSPFR Spot 3 S6	355.0606	17103.91	102.3454	17.78152	10.22714	116.2719	541.3582	13.38766	197.2763	4.741035
AHSPFR Spot 3 S7	529.3814	19983.82	108.016	17.54127	9.747985	127.4481	552.2196	10.46737	196.455	7.707468
AHSPFR Spot 3 S8	430.3679	20458.06	87.21151	16.45598	11.48513	136.6373	561.7229	12.64473	211.2946	8.908369
AHSPFR Spot 3 S9	353.3556	19954.98	106.2493	17.62547	11.06318	130.5551	575.8379	10.86954	210.8481	8.365905

AHSPFR Spot 4 S1	327.3078	19971.33	119.0438	18.11976	14.1546	128.8019	569.2854	10.43033	207.9925	6.399401
AHSPFR Spot 4 S10	445.0814	19187.12	99.29463	17.22276	15.31449	135.4966	597.0764	12.29786	215.0425	6.921993
AHSPFR Spot 4 S11	404.0831	19093.04	98.72475	17.41675	13.66467	132.5493	560.3729	10.74714	210.334	8.269556
AHSPFR Spot 4 S12	359.0533	17823.33	110.5676	18.32737	10.71674	122.1489	547.481	11.25016	202.0429	6.395295
AHSPFR Spot 4 S13	418.5393	27826.93	118.7351	16.45866	13.77438	123.5377	645.8845	11.82904	201.3517	3.240841
AHSPFR Spot 4 S14	374.7937	17881.18	89.3102	17.16607	6.914172	113.9006	511.6901	16.01812	191.4825	5.462957
AHSPFR Spot 4 S2	417.4099	21866.86	95.62845	16.13236	17.61419	127.1853	562.6824	14.06257	210.2633	8.30078
AHSPFR Spot 4 S3	426.0066	18507.4	97.36723	16.94693	10.78996	120.2599	499.403	10.91131	191.3658	7.188158
AHSPFR Spot 4 S4	430.3862	25086.72	105.8292	16.35104	14.68044	118.6626	674.9822	11.52742	196.2855	5.945721
AHSPFR Spot 4 S5	415.1341	20911.3	108.8606	16.60617	12.48552	124.9492	605.5215	11.03812	182.7758	4.159261
AHSPFR Spot 4 S6	810.1109	16170.86	103.0111	18.14685	8.996031	124.907	646.8736	11.15771	194.0045	7.314368
AHSPFR Spot 4 S7	411.1921	19482.21	101.1612	17.45116	12.11761	134.1561	587.3146	10.42006	207.6206	7.19099
AHSPFR Spot 4 S8	456.4897	19746.13	101.6225	17.41771	12.95628	131.6426	578.9282	13.23778	214.7224	6.49155
AHSPFR Spot 4 S9	276.9297	19599.52	109.9309	17.92952	11.72884	116.3613	558.4703	12.93776	183.4637	3.988738
AHSPFR Spot 5 S1	398.2663	18260.99	105.0693	17.55273	9.639165	119.6096	494.7839	13.80088	187.6541	6.693501
AHSPFR Spot 5 S10	290.5782	16896.97	92.14914	17.51429	13.52565	130.8353	543.7867	10.16025	206.4368	8.572848
AHSPFR Spot 5 S11	325.0301	19107.25	107.2304	17.90112	14.3442	131.0666	572.6879	11.52996	210.652	6.747039
AHSPFR Spot 5 S12	352.9867	17482.6	108.9832	17.93547	10.5177	129.7948	559.8366	12.74832	207.5107	7.514442
AHSPFR Spot 5 S13	402.289	19900.88	113.2003	17.27186	13.04508	125.739	565.1562	10.81895	208.3868	7.979944
AHSPFR Spot 5 S14	515.1028	19764.45	101.7612	16.89844	13.42484	135.1139	559.9662	9.400457	215.0266	7.747884
AHSPFR Spot 5 S15	357.7012	21297.55	111.0214	17.60755	12.3399	114.9933	576.7067	11.96021	180.3411	4.436882
AHSPFR Spot 5 S16	50.23086	9152.784	48.79085	12.94649	0.356735	39.80029	5.935754	7.421281	38.35508	1.703887
AHSPFR Spot 5 S17	477.4086	18722.57	112.8384	17.805	11.4961	134.2568	555.7876	11.96579	205.9123	6.312418
AHSPFR Spot 5 S18	357.2945	18542.77	101.5512	17.12872	14.59728	123.8165	516.2771	9.53655	207.4224	6.988365
AHSPFR Spot 5 S2	611.3915	28440.37	135.4075	17.19671	14.44038	115.6478	736.4166	11.85929	205.2004	5.128118
AHSPFR Spot 5 S3	523.6588	20049.15	113.3865	17.84454	13.85395	145.0554	586.889	10.5307	227.802	9.788922
AHSPFR Spot 5 S4	298.322	16225.4	118.3869	18.83241	9.605525	120.5116	503.0895	11.62819	189.0048	6.529145

AHSPFR Spot 5 S5	248.2278	18182.72	111.0987	18.04125	13.27201	125.1989	530.0857	13.88727	202.1967	7.798343
AHSPFR Spot 5 S6	390.8919	18853.65	111.5768	18.15277	12.03362	121.3084	560.7699	10.48937	197.2172	6.662994
AHSPFR Spot 5 S7	358.6838	22862.76	110.7675	17.22591	7.919586	125.5031	613.3233	11.02428	189.5472	3.157937
AHSPFR Spot 5 S8	312.6858	18190.32	107.5066	17.02817	14.41923	129.7167	560.2827	11.09982	214.7972	5.764366
AHSPFR Spot 5 S9	212.872	17208.72	103.6647	17.35936	13.75923	130.544	574.3979	13.4171	209.4906	7.118474
EfRh 3 S1 AN0039	485.8684	20515.74	84.08416	15.35072	12.69954	127.6388	567.7096	12.65748	207.4143	7.412625
EfRh 3 S2 AN0034	461.9965	26020.29	85.08527	14.42703	12.66699	127.6619	579.3619	10.02831	184.7859	4.07373
EfRh 3 S3 AN0037	443.888	22899.09	69.74576	14.79324	11.65527	118.6201	611.0367	9.980262	204.1862	4.646272
EfRh 3 S4 AN0035	308.8649	19356.76	96.43311	17.14947	8.534197	128.9461	532.0039	11.51366	203.7548	6.588274
EfRh 3 S5 AN6 69-81 Cobble	305.5432	16460.24	62.45733	15.37239	12.82648	127.3336	560.378	12.07141	217.3255	7.664641
EfRh-2 S1 AN2 69 -104	332.695	19124.53	67.14468	15.62587	10.65789	124.4673	542.2002	11.14143	201.3495	7.331097
EfRh-2 S2 AN3 69-104	374.4796	18649.33	65.99234	15.17528	12.14418	126.1496	528.3545	10.93953	202.8998	6.73411
EfRh-2 S3 AN6 69-104	468.2024	18652.39	58.34779	15.22621	13.29669	128.8627	520.373	7.840804	198.0325	6.986537
EfRh-2 S4 AN4 69-104	420.5	20166.75	76.90622	15.81924	13.76078	132.652	571.5145	10.02904	212.186	6.309835
EfRh-2 S5 AN8 69-104	396.1684	20927.2	75.27789	15.6917	15.14557	129.336	590.3713	10.43053	203.2365	7.938915
EfRh-26 S1 AN0001 Block 554-02 Findspot A	475.256	19015.51	65.43595	15.53505	13.54169	129.8122	549.6981	10.49951	205.8411	8.714401
EfRh-29 S1 AN0001 Block 554-02 Findspot 2	393.4945	18526.83	75.37709	15.78423	10.76869	129.7643	542.1236	11.10312	205.659	7.240215
EfRh-29 S2 AN0002 Block 554-02 Findspot 6	338.3277	18201.76	76.92768	16.16044	13.18945	124.9415	510.7174	10.39018	204.18	6.054651
EfRh-3 S1	340.4794	18596.42	112.0494	18.14215	14.82701	132.6784	567.6473	10.50798	205.6467	7.937792
EfRh-3 S10	415.5479	20475.98	118.5352	18.07152	11.43802	132.6019	568.7488	12.22326	203.3309	7.807099
EfRh-3 S11	393.2586	19260.04	120.168	18.5271	13.52081	131.0401	563.5083	10.10557	207.4215	6.519367
EfRh-3 S12	446.2486	19101.18	115.7293	18.26721	11.41092	128.1188	556.7303	9.851227	194.9069	7.058281
EfRh-3 S13	431.9351	24073.17	121.6396	17.42576	7.625784	115.7165	641.7062	10.68904	191.6551	3.446091
EfRh-3 S14	349.0031	20468.78	117.6936	18.18078	12.04767	130.2284	582.6905	12.83907	205.5382	4.133917
EfRh-3 S15	508.7964	23971.93	128.08	17.43631	12.28323	120.3987	613.5719	8.362225	185.3407	6.503513
EfRh-3 S2	551.5618	18995.7	137.2252	18.67579	9.514597	113.6461	455.4026	9.529691	184.7467	7.366829

EfRh-3 S3	360.1783	19839.08	131.0081	18.49658	9.661713	104.9083	524.7515	7.685143	166.2882	4.526578
EfRh-3 S4	359.809	19854.18	108.115	17.67701	14.86602	130.1586	563.9649	13.57531	208.1406	7.350195
EfRh-3 S5	404.9486	24041.13	120.4878	17.20969	10.57563	118.3152	631.138	9.364728	191.3058	5.023022
EfRh-3 S6	147.2017	18649.67	124.4867	18.85442	12.10746	133.7292	588.2253	8.92789	188.2122	3.404031
EfRh-3 S7	293.3165	18209.98	110.605	18.30401	12.47833	120.1282	523.6663	10.46521	196.8791	8.021367
EfRh-3 S8	484.59	24249.39	132.7794	17.75071	13.22446	107.273	633.5578	12.17534	192.0136	5.187337
EfRh-3 S9	438.9184	24517.85	131.4024	17.78143	12.04888	111.406	611.6432	9.829264	185.2715	5.695941
EfRh-30 S1 Block 554-02 Findspot B	810.0264	54969.93	177.0608	10.28486	5.338435	85.76452	811.8038	8.754684	244.2489	11.29638
EfRh-30 S2 Block 554-02 Findspot B	320.069	19475.49	70.89515	14.94007	14.50193	129.3597	543.7455	10.69542	195.9753	5.644503
EfRh-30 S3 Block 554-02 Findspot B	362.0886	15769.78	49.28526	14.75448	7.607734	104.7208	460.2712	11.74928	185.3296	5.701257
EfRh-34 S1 AN0001 Block 558-01 Findspot 5	424.7531	20162.75	71.06001	15.51002	11.26705	129.4425	543.1941	10.17668	204.4587	6.65547
EfRh-34 S2 AN0002 Block 558-01 Findspot 7	293.5144	16133.89	61.00451	15.38245	7.035125	116.069	464.7409	10.51091	189.5321	5.255998
EfRh-35 S1 Block 558-01 Findspot 4	962.7164	19241.61	65.43066	15.36954	13.79093	130.2057	560.4951	10.96393	210.0798	8.533431
EfRh-35 S2 Block 558-01 Findspot 4	468.5955	23130.34	88.85845	15.93344	9.689705	120.4047	632.7629	8.073321	192.4945	5.216999
EfRh-38 S1 Dep A 10-20cmbs	357.2973	19201.54	69.7454	15.66158	12.46232	125.1736	545.2013	10.87536	206.4936	5.851413
EfRh-38 S1 Dep A Block 558-02	457.2627	17657.62	68.55692	13.98028	11.22518	131.7332	470.2215	11.53164	218.4672	7.778672
EfRh-38 S1 Dep B Test B 200cmbs	431.3884	19403.24	61.16765	15.24823	11.5342	130.178	573.8655	11.41494	207.2919	7.412038
EfRh-38 S1 Depression B Test B 180cmbs	436.738	20377.77	75.90953	15.46719	12.89834	125.5687	543.524	12.94582	207.9251	6.796301
EfRh-38 S2 Dep A	505.9261	19144.54	72.48923	14.91813	13.61764	132.635	553.4412	11.21221	212.9619	9.233012
EfRh-38 S2 Dep A Block 558-02	345.357	18829.67	77.37465	15.70581	9.448165	122.1555	520.3756	13.75861	196.4745	8.935938
EfRh-38 S2 Dep B Test B 180cmbs	441.2195	18797.67	74.91737	16.14287	13.05964	132.6918	564.2253	12.4659	211.3627	8.54925
EfRh-38 S2 Dep B Test B 200cmbs	1378.51	18601.76	78.0757	16.06611	12.25265	133.3811	546.673	10.98011	207.5104	7.494825
EfRh-38 S3 Dep A	427.6843	19438.03	73.78246	15.95134	13.51114	131.1452	569.7303	13.38531	218.9758	6.489538
EfRh-38 S3 Dep A Block 558-02	470.4722	20084.82	73.51979	15.4935	12.01489	134.9421	578.595	10.55887	212.1595	7.963221
EfRh-38 S3 Dep B Test B 180cmbs	419.8169	18738.62	73.14528	16.06865	12.74377	133.1538	559.4467	11.08819	211.1991	7.648724
EfRh-38 S3 Dep B Test B 200cmbs	492.5768	19547.17	71.95242	15.80462	11.25158	130.3303	542.5749	10.67837	213.5013	7.479844

EfRh-38 S4 Dep A	439.56	20572.14	75.96691	15.7003	11.09128	124.5498	549.2064	10.39406	206.4343	6.196668
EfRh-38 S4 Dep A Block 558-02	476.56	20530.71	74.9006	15.75777	11.80655	133.8524	564.8753	10.4295	223.9836	7.310519
EfRh-38 S4 Dep B Test B 180cmbs	306.8083	19878.08	57.42225	14.97533	9.856669	115.1537	505.5417	11.37632	198.3088	7.08772
EfRh-38 S4 Dep B Test B 200cmbs	380.5363	18151.45	63.86409	15.57915	11.93339	122.4185	679.0553	12.69282	198.9219	9.144654
EfRh-38 S5 Dep A	337.6705	19440.13	73.34332	15.85813	14.42379	130.3763	552.3706	11.66051	212.8984	8.401218
EfRh-38 S5 Dep A Block 558-02	373.757	18567.43	72.98953	15.67253	11.12557	123.385	538.427	13.82626	207.1099	5.693514
EfRh-38 S5 Dep B Test B 180cmbs	478.8611	19258.84	63.1783	15.33639	11.78944	131.3979	566.5959	13.00299	220.6524	7.959707
EfRh-38 S5 Dep B Test B 200cmbs	376.7817	19440.85	83.52414	16.43576	16.27784	129.3402	559.4498	11.50376	210.6133	6.858495
EfRh-41 S1 Block 558-02 Findspot 10	514.4167	19067.43	78.94325	15.58112	15.02296	125.2041	556.3749	12.10663	202.6234	6.608386
EfRh-41 S2 Block 558-02 Findspot 10	445.8181	19671.54	73.02167	15.0843	12.12526	126.3946	567.0499	14.00946	204.6493	7.694803
EfRh-41 S3 Block 558-02 Findspot 10	509.6567	18930.56	66.11644	15.62875	8.713717	120.2893	550.0772	11.42117	190.8026	7.508418
EfRh-41 S4 Block 558-02 Findspot 10	389.363	19485.87	74.69248	14.86609	14.16548	133.3139	551.8865	14.76127	209.8489	7.804549
EfRh-41 S5 Block 558-02 Findspot 10	509.1139	19724.07	77.81611	15.75151	12.15887	132.6121	571.7328	13.94529	210.7262	7.321684
EfRh-41 S6 Block 558-02 Findspot 10	495.0825	19842.22	74.43353	15.6279	12.64497	134.2127	588.6176	10.14516	210.8556	6.304605
EfRh-51 S1 AN0002 Block 558-05 Findspot 5	618.9636	22403.89	76.45172	15.02118	8.534827	123.0135	613.3395	9.015108	186.9083	7.098741
EfRh-51 S2 AN0003 Block 558-05 Findspot 6	376.731	22025.74	77.53657	15.31277	11.54359	120.0061	619.9394	10.15886	189.64	3.981645
EfRh-51 S3 AN0001 Block 558-05 Findspot 4	522.953	29787.79	92.50244	14.5286	10.84371	118.896	1086.469	12.97631	235.5212	8.671846
EfRh-52 S1 Block 558-05	386.8656	19477.34	70.62593	14.78767	8.277724	129.5675	557.3563	10.30392	203.318	10.03327
EfRh-52 S2 Block 558-05	332.6097	21473.13	66.65296	15.11502	8.357194	111.3513	580.5276	10.5243	179.0451	4.511521
EfRh-52 S3 Block 558-05	349.8095	22446.5	83.02049	15.62907	10.40012	114.1674	634.8292	10.05931	197.717	4.021712
EfRh-52 S4 Block 558-05	486.7332	22027.55	74.69166	14.90219	10.78338	122.3523	622.9063	9.616979	192.531	2.57631
EfRh-52 S5 Block 558-05	263.0063	20969.4	68.25117	14.64743	8.833715	119.0207	620.6156	7.516726	186.0621	3.075722
EfRh-58 S1 Block 558-07 Cultural Depression 2	423.7191	21418.91	56.62862	14.57402	9.627991	108.0586	589.3044	10.82541	183.1533	1.205311
EfRh-58 S10 Block 558-07 CD 2	1075.982	21771.23	68.89581	15.03894	10.68605	119.2029	602.0531	8.39553	185.2709	3.938167
EfRh-58 S11 Block 558-07 CD 2	1120.479	21262.36	75.89563	15.52316	8.693837	116.3065	610.8012	8.726164	196.5769	5.013079

EfRh-58 S12 Block 558-07 CD 2	531.9299	19990.82	68.44023	13.84916	7.254891	108.5098	561.2712	8.31544	180.3741	4.56111
EfRh-58 S13 Block 558-07 CD 2	352.7409	22108.84	81.90986	15.80836	11.04407	115.9747	609.7707	9.695118	191.6206	3.647157
EfRh-58 S14 Block 558-07 CD 2	378.6498	22943.89	77.71431	15.38115	11.25754	120.6739	650.9504	9.033787	189.1033	5.007448
EfRh-58 S15 Block 558-07 CD 2	487.4306	23587.48	96.03504	15.81979	8.342065	122.1934	624.2921	9.647953	201.2456	5.988282
EfRh-58 S16 Block 558-07 CD 2	918.1981	21747.07	65.80296	14.83601	7.431641	116.2984	624.7399	8.973242	188.9358	4.574292
EfRh-58 S2 Block 558-07 CD 2	1161.245	22419.99	75.88444	15.24843	11.06355	116.2701	615.884	11.37779	196.1882	3.685437
EfRh-58 S3 Block 558-07 CD 2	801.5593	22690.97	67.93644	14.72712	12.43951	120.4898	641.4497	8.552571	195.947	5.259864
EfRh-58 S4 Block 558-07 CD 2	723.8079	21702.62	70.74712	14.40721	11.41195	120.7536	629.7174	9.702306	188.2397	5.108097
EfRh-58 S5 Block 558-07 CD 2	1198.211	22759.2	81.07734	15.14659	9.409744	124.3937	637.5034	8.017652	195.6216	6.194658
EfRh-58 S6 Block 558-07 CD 2 UNUSUAL COLOUR	1110.192	25676.24	93.04017	15.05818	11.19928	137.1331	553.2034	6.819721	193.6132	3.381016
EfRh-58 S7 Block 558-07 CD 2	404.5007	22387.73	77.05232	15.45591	9.676617	126.0934	645.0672	10.33417	194.0684	4.769746
EfRh-58 S8 Block 558-07 CD 2	507.5375	22802.34	80.18461	15.51218	12.56489	121.2316	660.8512	10.10798	200.1573	4.611981
EfRh-58 S9 Block 558-07 CD 2	543.5837	23848.98	85.55321	15.56319	11.21592	117.7886	649.5129	10.51498	193.9116	4.490358
EfRh-63 S1 Block 519-05	353.19	19001.6	76.05883	15.89659	10.41925	125.9177	518.8637	13.10573	209.4222	6.143101
EfRh-63 S2 Block 519-05	331.4128	23335.07	69.98756	14.83455	10.88996	125.6729	535.8402	12.86164	205.4156	8.473692
EfRh-63 S3 Block 519-05	492.6736	19715.82	72.61462	14.77067	13.68109	131.6179	541.5246	10.98292	206.7957	6.278442
EfRh-63 S4 Block 519-05	432.4714	18004.89	71.37791	15.90691	9.160098	121.3104	510.8566	10.3214	200.6836	7.431905
EfRh-63 S5 Block 519-05	416.3903	24724.43	75.4779	14.74866	14.43185	136.2054	601.7425	9.611672	216.3849	8.054906
EfRh-63 S6 Block 519-05	434.8527	23829.48	79.98883	14.46844	12.5159	123.6372	541.732	10.69333	196.615	8.138238
EfRh-64 S1 AN0007 Block 550-08	326.1244	17652.22	60.83884	15.40387	11.19093	125.7502	510.3212	12.67871	198.6941	7.399306
EfRh-64 S10 AN0024 Block 550-08	469.1913	18330.29	83.27431	16.31775	10.04907	122.6317	501.1539	11.68662	205.0594	7.887689
EfRh-64 S11 AN0011 Block 550-08	332.9587	18644.48	81.1797	15.44537	12.78612	132.1631	519.1614	13.68784	218.1707	8.250558
EfRh-64 S12 AN0009 Block 550-08	540.5632	18235.5	67.83743	15.63762	10.43184	132.0317	527.7565	11.21751	214.3697	10.65573
EfRh-64 S13 AN0016 Block 550-08	473.4742	19344.25	73.26642	14.91266	14.41999	130.9033	535.3337	12.16982	208.9292	9.342625
EfRh-64 S14 AN0008 Block 550-08	413.9644	19002.87	78.35645	16.22732	10.58559	128.7712	541.4811	11.51071	218.3401	9.242861
EfRh-64 S15 AN0010 Block 550-08	329.2723	18164.43	65.55648	15.16207	11.2309	134.4641	524.5871	9.664731	215.5214	6.590516
EfRh-64 S2 AN0019 Block 550-08	507.2076	20151.68	68.04999	15.3992	10.81066	135.1152	541.1086	13.30233	209.7212	8.038387

EfRh-64 S3 AN0021 Block 550-08	429.021	18241.13	79.9637	15.66393	12.50839	134.9754	530.0129	11.11893	209.2931	8.088606
EfRh-64 S4 AN0017 Block 550-08	376.4931	18948.29	69.85366	15.74824	12.6135	135.616	553.6744	12.55427	217.8804	6.740706
EfRh-64 S5 AN0025 Block 550-08	391.9204	19351.1	82.97446	16.34329	10.98849	129.5567	561.7266	11.47479	215.8906	8.764406
EfRh-64 S6 AN0018 Block 550-08	416.662	18621.06	68.47163	15.8237	13.73213	135.1867	536.8444	12.41794	219.074	8.876564
EfRh-64 S7 AN0012 Block 550-08	335.5913	17940.6	63.20082	15.6811	13.94096	128.9449	521.4144	14.23369	211.8965	8.242583
EfRh-64 S8 AN0020 Block 550-08	433.3878	19310.33	75.67127	15.58608	13.54942	132.9293	554.9894	12.3053	219.5343	9.119938
EfRh-64 S9 AN0022 Block 550-08	408.8441	18013.17	76.42249	15.98545	12.35228	130.9812	512.1898	11.81968	209.6455	7.735014
EfRh-65 S1 AN0002 Biface SE Corner Block 555-11	458.7993	17747.94	64.78885	15.20342	9.112601	122.6604	502.9613	11.42792	208.6054	7.218741
EfRh-65 S10 AN0012 Block 555-11 PATINATION OVER ANALYSIS AREA	218.6423	13328.13	64.87948	16.77322	9.251276	118.9677	564.915	9.444986	192.716	5.479417
EfRh-65 S11 AN0004 Block 555-11	278.3936	19465.76	68.27594	15.56015	12.35338	132.2433	555.6779	12.27969	210.5297	8.260042
EfRh-65 S2 AN0010 Main Road Centre Block 555-11	441.917	17550.78	63.63198	14.73899	12.49115	131.3233	506.9718	11.96198	211.9909	7.948604
EfRh-65 S3 AN0009 Block 555-11	404.2429	18577.08	73.00485	15.66626	7.318565	132.0788	533.2653	12.84529	206.6569	9.24519
EfRh-65 S4 AN0006 Block 555-11	341.6277	23047.59	74.91441	15.21469	9.032752	111.9302	601.299	10.7967	185.2725	5.453238
EfRh-65 S5 AN0008 Block 555-11	538.2339	19053.17	66.75236	15.51997	9.8525	127.6282	571.3763	13.19739	212.3892	10.91531
EfRh-65 S6 AN0001 Block 555-11	389.3007	18717.96	90.46406	16.2344	13.84581	131.7555	537.5171	12.60307	225.1199	7.373774
EfRh-65 S7 AN0005 Block 555-11	353.9429	16753.88	670.3123	49.83424	13.05043	119.0812	517.8054	13.05219	198.1257	4.239348
EfRh-65 S8 AN0003 Block 555-11	782.3132	19353.14	79.20664	15.14326	11.53679	127.0064	554.3142	13.50108	208.8951	9.486604
EfRh-65 S9 AN0011 Block 555-11	455.0308	18328.65	73.14093	16.05296	10.67352	129.8705	518.7296	13.05739	220.8641	8.696423
EfRh-66 S1 AN0001 Block 526-03	331.717	21033.15	70.70314	15.16238	13.92959	128.3913	550.355	12.04517	199.9364	5.807751
EfRh-67 S1 Block 526-04 SE Corner	412.9349	22409.58	85.90147	15.18438	10.61698	125.3671	528.7812	9.862063	210.883	6.392049
EfRh-67 S2 Block 526-04 SE Corner	369.1087	18180.8	62.78766	15.62358	10.86091	126.8103	502.0572	12.67993	209.0688	6.0983
SFU Cache Creek 1	200.0554	12118.16	54.04955	14.62284	6.063274	85.51674	384.7323	9.20207	144.468	4.799886
SFU Cache Creek 10	178.2593	9510.334	64.91869	15.40126	5.852227	74.69929	353.8721	7.788941	134.8399	4.777318
SFU Cache Creek 11	162.4635	11309.5	53.32111	15.70986	9.559251	96.21557	387.7117	9.036447	160.8583	4.725873
SFU Cache Creek 12	162.4635	11309.5	53.32111	15.70986	9.559251	96.21557	387.7117	9.036447	160.8583	4.725873
SFU Cache Creek 13	374.8198	13606.2	66.62951	16.13963	9.380684	101.9314	427.1435	9.492702	162.0477	5.437684

SFU Cache Creek 14	374.8198	13606.2	66.62951	16.13963	9.380684	101.9314	427.1435	9.492702	162.0477	5.437684
SFU Cache Creek 15	412.3626	18560.75	73.09535	15.85265	4.734726	53.88261	437.317	10.18068	125.9346	5.882053
SFU Cache Creek 16	412.3626	18560.75	73.09535	15.85265	4.734726	53.88261	437.317	10.18068	125.9346	5.882053
SFU Cache Creek 17	255.9845	11684.26	54.39359	16.49145	7.922644	88.94557	374.831	9.272608	146.8604	4.615253
SFU Cache Creek 18	321.3151	11912.79	51.7481	16.25616	7.913952	84.64626	377.11	9.807552	147.246	5.443149
SFU Cache Creek 19	384.4007	16886.17	52.15426	15.3347	11.23905	114.971	486.5245	9.327238	188.7186	7.063739
SFU Cache Creek 2	200.0554	12118.16	54.04955	14.62284	6.063274	85.51674	384.7323	9.20207	144.468	4.799886
SFU Cache Creek 20	241.6994	15332.03	53.80472	15.0313	8.061762	101.8062	437.4051	9.67305	161.1824	5.09372
SFU Cache Creek 21	238.2109	9095.895	43.58595	13.02088	5.455835	79.48263	341.8477	9.4934	137.3021	6.238376
SFU Cache Creek 22	302.245	13607.53	49.03664	14.7562	12.00338	98.04944	412.6452	8.483426	157.2494	4.972251
SFU Cache Creek 23	199.7338	7247.999	51.75911	15.79361	7.758014	67.89285	317.7553	10.07769	123.0974	6.3768
SFU Cache Creek 24	337.8531	8344.086	61.09697	12.8864	9.301738	71.93359	380.7824	9.297804	131.6369	5.541002
SFU Cache Creek 25	590.8564	29604.4	82.59264	13.98623	5.53132	66.33953	571.1044	10.45966	152.9126	6.83367
SFU Cache Creek 3	261.772	11148.91	60.46195	16.16865	3.960226	82.87368	377.0586	9.113989	146.4857	4.12727
SFU Cache Creek 4	261.772	11148.91	60.46195	16.16865	3.960226	82.87368	377.0586	9.113989	146.4857	4.12727
SFU Cache Creek 5	276.1777	14870.42	64.79266	13.31193	6.864381	102.8312	430.3272	7.574137	167.129	7.102313
SFU Cache Creek 6	276.1777	14870.42	64.79266	13.31193	6.864381	102.8312	430.3272	7.574137	167.129	7.102313
SFU Cache Creek 7	230.3916	9804.621	50.76152	15.57838	3.12489	83.15716	364.2034	10.3881	154.1565	5.107782
SFU Cache Creek 8	230.3916	9804.621	50.76152	15.57838	3.12489	83.15716	364.2034	10.3881	154.1565	5.107782
SFU Cache Creek 9	178.2593	9510.334	64.91869	15.40126	5.852227	74.69929	353.8721	7.788941	134.8399	4.777318
SFUAHGS S1	428.4461	36567.08	113.868	13.995	7.98307	95.579	763.214	9.692373	196.3641	8.200916
SFUAHGS S10	179.5676	17544.04	74.94887	16.4665	12.51551	137.1801	535.9053	11.63739	212.9357	8.986638
SFUAHGS S11	539.4074	20384.09	85.19624	16.34137	14.42562	130.5771	529.2451	12.86475	214.0429	6.350162
SFUAHGS S12	495.4786	22380.37	82.41111	15.46768	12.07523	131.7223	559.6397	12.83321	228.1677	6.356302
SFUAHGS S13	258.0137	18384.69	69.60345	15.9851	14.36295	119.3293	511.9597	12.82013	216.1399	7.172457
SFUAHGS S14	376.0943	18242.52	72.81594	15.94053	6.895161	118.6349	522.8904	11.97953	203.7973	7.328103
SFUAHGS S15	185.8748	16511.52	67.37686	15.70838	9.79066	125.807	528.1059	12.2065	209.0723	9.328367

SFUAHGS S16	364.3036	20124.48	73.04321	15.68506	10.81605	131.3678	522.1252	13.86868	233.9637	8.959483
SFUAHGS S17	370.2339	17568.14	67.10124	15.37519	13.37979	131.3556	522.9743	12.80192	217.9073	9.575672
SFUAHGS S18	420.1711	18010.2	79.0048	16.52083	9.159864	133.2294	509.9729	12.31991	208.7008	9.011189
SFUAHGS S19	281.7645	15822.05	77.39434	16.96619	14.4477	133.8162	515.7544	12.32042	217.1387	9.803134
SFUAHGS S2	339.1246	21177.81	62.05444	14.94061	8.225399	123.8486	518.0359	12.66496	206.9024	8.917066
SFUAHGS S20	206.9772	18072.75	78.07309	16.47118	13.51613	130.7077	550.7431	11.61086	205.6984	8.627647
SFUAHGS S21	288.24	12948.08	56.15581	16.38881	11.81036	119.1977	523.2766	12.1846	193.0309	7.434677
SFUAHGS S22	222.2444	15286.21	51.61826	15.64398	11.39101	122.8562	499.0054	10.73048	200.2056	7.925043
SFUAHGS S23	765.5027	39081.89	95.14504	12.16835	8.209579	33.50115	664.2877	7.163201	286.7382	6.447967
SFUAHGS S24	280.0918	17118.43	71.6123	16.17888	11.93994	131.5684	528.7358	14.60294	211.3625	9.018686
SFUAHGS S25	192.9775	14095.51	70.57947	16.94815	11.69844	132.4815	524.0404	10.37034	205.6489	10.34851
SFUAHGS S26	235.2995	13083.37	53.8651	15.94555	10.30657	127.5772	554.6152	12.06907	208.17	7.698164
SFUAHGS S27	221.6624	13994.8	63.20803	16.29335	5.875733	115.1451	529.441	11.50063	191.9931	8.544976
SFUAHGS S28	-2473.08	-115682	93.37897	-38.7303	17.26403	93.10133	388.5504	-23.6791	174.7678	6.275736
SFUAHGS S3	243.1716	13836.52	54.04051	15.74322	10.40747	122.7027	506.8833	10.88875	198.6624	9.129518
SFUAHGS S4	108.7216	2889.118	45.04062	14.75522	-1.20277	34.8663	337.4157	29.04302	107.1376	5.12585
SFUAHGS S5	403.6625	16115.44	65.66268	15.33701	10.11921	127.6875	486.4615	15.93949	211.2898	9.414264
SFUAHGS S6	222.3678	16331.81	75.33796	16.69676	12.62036	125.1584	531.0684	11.73166	226.5286	8.194415
SFUAHGS S7	229.9825	15105.26	71.03557	15.60008	10.36063	112.8106	556.5584	9.996626	195.1705	7.958231
SFUAHGS S8	477.2431	15717.07	75.56255	16.62691	11.41135	126.1917	523.21	12.91009	206.4112	7.766317
SFUAHGS S9	367.5346	22278.17	79.22195	15.54893	14.20118	125.8199	615.3515	9.602439	198.9493	3.682078
SFUAHS Arrowstone 1	534.1247	19907.78	64.88367	15.33586	13.6138	138.1171	486.7973	16.05148	233.4311	9.131037
SFUAHS Arrowstone 10	323.5575	18066.96	62.30592	15.60595	10.42855	120.7412	497.1557	9.626548	194.8009	6.495916
SFUAHS Arrowstone 11	481.3174	17550.13	55.83972	15.36811	10.01928	127.3842	529.8906	14.61872	201.7843	9.232032
SFUAHS Arrowstone 12	483.3193	17480.51	68.05489	16.04449	9.535191	118.4687	533.4482	11.1498	199.1828	7.429498
SFUAHS Arrowstone 13	463.1631	19666.96	59.42778	14.90042	8.679879	128.937	534.9925	10.80355	197.5887	7.404582
SFUAHS Arrowstone 14	412.2744	18747.07	57.58197	14.53215	8.879556	122.1594	515.0865	10.36843	207.989	8.652245

SFUAHS Arrowstone 15	440.8068	14749.49	62.96677	14.47557	6.977944	111.4257	476.9746	9.604797	185.971	6.912992
SFUAHS Arrowstone 16	355.4396	16011.57	67.84408	15.94734	10.94803	120.1285	512.2824	12.67622	204.6039	6.31114
SFUAHS Arrowstone 17	435.6516	17106.25	73.40261	16.44295	11.48518	126.486	493.6635	11.45863	187.9163	8.577344
SFUAHS Arrowstone 18	381.6969	17180.49	47.36564	14.19723	12.04268	118.1962	575.9398	10.87697	198.9787	8.161178
SFUAHS Arrowstone 19	526.3267	18106.53	64.88241	15.47772	10.99529	125.9416	537.5694	11.43711	203.5983	9.20618
SFUAHS Arrowstone 2	431.0906	19599.27	57.19174	14.73347	13.79075	131.4679	450.7498	16.77887	223.7078	9.115162
SFUAHS Arrowstone 20	529.2599	20581.75	93.82657	16.62123	13.23569	133.0451	542.1045	11.44852	213.6502	6.295864
SFUAHS Arrowstone 21	529.2599	20581.75	93.82657	16.62123	13.23569	133.0451	542.1045	11.44852	213.6502	6.295864
SFUAHS Arrowstone 22	526.3267	18106.53	64.88241	15.47772	10.99529	125.9416	537.5694	11.43711	203.5983	9.20618
SFUAHS Arrowstone 23	381.6969	17180.49	47.36564	14.19723	12.04268	118.1962	575.9398	10.87697	198.9787	8.161178
SFUAHS Arrowstone 24	435.6516	17106.25	73.40261	16.44295	11.48518	126.486	493.6635	11.45863	187.9163	8.577344
SFUAHS Arrowstone 25	355.4396	16011.57	67.84408	15.94734	10.94803	120.1285	512.2824	12.67622	204.6039	6.31114
SFUAHS Arrowstone 26	440.8068	14749.49	62.96677	14.47557	6.977944	111.4257	476.9746	9.604797	185.971	6.912992
SFUAHS Arrowstone 27	412.2744	18747.07	57.58197	14.53215	8.879556	122.1594	515.0865	10.36843	207.989	8.652245
SFUAHS Arrowstone 28	463.1631	19666.96	59.42778	14.90042	8.679879	128.937	534.9925	10.80355	197.5887	7.404582
SFUAHS Arrowstone 29	483.3193	17480.51	68.05489	16.04449	9.535191	118.4687	533.4482	11.1498	199.1828	7.429498
SFUAHS Arrowstone 3	354.315	19244.48	62.81358	15.26278	7.085431	135.6484	449.5301	12.73233	219.9982	9.267079
SFUAHS Arrowstone 30	481.3174	17550.13	55.83972	15.36811	10.01928	127.3842	529.8906	14.61872	201.7843	9.232032
SFUAHS Arrowstone 31	323.5575	18066.96	62.30592	15.60595	10.42855	120.7412	497.1557	9.626548	194.8009	6.495916
SFUAHS Arrowstone 32	319.7969	14810.97	69.96084	16.74331	8.947515	123.1722	536.0876	11.32446	198.6988	7.092148
SFUAHS Arrowstone 33	534.1247	19907.78	64.88367	15.33586	13.6138	138.1171	486.7973	16.05148	233.4311	9.131037
SFUAHS Arrowstone 34	431.0906	19599.27	57.19174	14.73347	13.79075	131.4679	450.7498	16.77887	223.7078	9.115162
SFUAHS Arrowstone 35	354.315	19244.48	62.81358	15.26278	7.085431	135.6484	449.5301	12.73233	219.9982	9.267079
SFUAHS Arrowstone 36	327.4285	19620.6	61.48101	15.25504	11.45933	134.3605	442.4866	11.75733	214.9993	9.147401
SFUAHS Arrowstone 37	469.9026	18057.54	63.43581	15.43716	11.11275	140.3271	563.0045	12.65161	212.7241	9.367201
SFUAHS Arrowstone 38	609.2568	16148.26	74.34087	16.4121	10.15408	138.0149	528.284	13.3315	213.4386	7.205037
SFUAHS Arrowstone 39	316.8922	15739.66	80.26798	17.00829	12.94404	136.5721	534.7025	10.90238	217.6227	8.168498

SFUAHS Arrowstone 4	327.4285	19620.6	61.48101	15.25504	11.45933	134.3605	442.4866	11.75733	214.9993	9.147401
SFUAHS Arrowstone 40	536.9681	18073.19	60.28123	15.22726	12.06779	128.7656	524.907	12.20957	213.7628	7.46695
SFUAHS Arrowstone 5	469.9026	18057.54	63.43581	15.43716	11.11275	140.3271	563.0045	12.65161	212.7241	9.367201
SFUAHS Arrowstone 6	609.2568	16148.26	74.34087	16.4121	10.15408	138.0149	528.284	13.3315	213.4386	7.205037
SFUAHS Arrowstone 7	316.8922	15739.66	80.26798	17.00829	12.94404	136.5721	534.7025	10.90238	217.6227	8.168498
SFUAHS Arrowstone 8	536.9681	18073.19	60.28123	15.22726	12.06779	128.7656	524.907	12.20957	213.7628	7.46695
SFUAHS Arrowstone 9	319.7969	14810.97	69.96084	16.74331	8.947515	123.1722	536.0876	11.32446	198.6988	7.092148
Maiden Creek FGV NWORL	387	2.39	74			93	568	9	166	4
Maiden Creek FGV NWORL	323	2.37	64			142	460	13	196	8
Maiden Creek FGV NWORL	313	2.98	73			88	655	9	162	8
Maiden Creek FGV NWORL	274	2.76	91			93	642	8	170	4
Maiden Creek FGV NWORL	258	2.48	77			91	533	5	155	4
Maiden Creek FGV NWORL	350	2.69	72			92	644	9	162	5
Maiden Creek FGV NWORL	259	2.59	92			97	527	7	161	3
Maiden Creek FGV NWORL	355	3.11	65			81	588	11	158	4
Maiden Creek FGV NWORL	414	3.53	86			108	556	15	172	10
Maiden Creek FGV NWORL	630	3.51	75			102	566	15	173	6
Maiden Creek FGV NWORL	296	2.19	81			97	574	7	161	3
Maiden Creek FGV NWORL	297	2.65	77			101	599	10	173	3
Maiden Creek FGV NWORL	285	2.40	69			91	554	5	160	2
Maiden Creek FGV NWORL	337	3.18	81			105	594	12	160	8
Maiden Creek FGV NWORL	366	3.39	61			97	577	16	161	6
Maiden Creek FGV NWORL	217	2.44	55			89	545	7	155	5
Maiden Creek FGV NWORL	443	3.65	79			103	577	12	159	4
Maiden Creek FGV NWORL	435	3.68	60			102	570	12	158	9
Arrowstone FGV NWORL	786	2.14	49			123	384	14	173	8
Arrowstone FGV NWORL	324	2.13	67			126	380	11	178	9

Arrowstone FGV NWORL	303	2.19	37			124	393	12	177	8
Arrowstone FGV NWORL	391	2.59	65			129	409	11	179	8
Arrowstone FGV NWORL	378	2.45	59			130	410	11	175	8
Arrowstone FGV NWORL	439	2.08	64			125	403	14	172	8
Arrowstone FGV NWORL	374	2.66	67			125	437	13	173	10
Arrowstone FGV NWORL	341	2.49	50			131	420	10	171	8
Arrowstone FGV NWORL	258	1.87	45			119	398	12	176	6
Arrowstone FGV NWORL	343	2.55	60			135	431	8	174	9
Maiden Creek (M1)	414	3.53	86	15	14	108	556	15	172	10
Maiden Creek (M1)	630	3.51	75	25		102	566	15	173	6
Maiden Creek (M1)	296	2.19	81	24	4	97	574	7	161	3
Maiden Creek (M1)	297	2.65	77	19		101	599	10	173	3
Maiden Creek (M1)	285	2.4	69	29		91	554	5	160	2
Maiden Creek (M1)	337	3.18	81	13	10	105	594	12	160	8
Maiden Creek (M1)	366	3.39	61	18		97	577	16	161	6
Maiden Creek (M1)	217	2.44	55	19	4	89	545	7	155	5
Maiden Creek (M1)	443	3.65	79	17		103	577	12	159	4
Maiden Creek (M1)	435	3.68	60	29		102	570	12	158	9
Arrowstone Hills (A1)	786	2.14	49	26		123	384	14	173	8
Arrowstone Hills (A1)	324	2.13	67	18	8	126	380	11	178	9
Arrowstone Hills (A1)	303	2.19	37	23	5	124	393	12	177	8
Arrowstone Hills (A1)	391	2.59	65	19	3	129	409	11	179	8
Arrowstone Hills (A1)	378	2.45	59	15		130	410	11	175	8
Arrowstone Hills (A1)	439	2.08	64	26	3	125	403	14	172	8
Arrowstone Hills (A1)	374	2.66	67	26	3	125	437	13	173	10
Arrowstone Hills (A1)	341	2.49	50	31	6	131	420	10	171	8
Arrowstone Hills (A1)	258	1.87	45	16	7	119	398	12	176	6

Arrowstone Hills (A1)	343	2.55	60			135	431	8	174	9
EeRj-221			84	24		89	526	7	146	5
EeRj-221			60	16		90	534	11	147	4
EeRj-221	244	2.31	80	20	7	102	583	8	155	3
EeRj-221	226	2.5	62	35	6	91	520	11	149	5
EeRj-221	240	2.33	72	15		85	610	7	146	5
EeRj-221	334	2.51	84	10	6	83	607	10	141	3
EeRj-221	464	3.24	84	22	8	87	623	10	159	6
EeRj-221	261	2.44	77	19		80	628	11	150	7
EeRj-221	528	3.1	94	29		82	615	9	151	5
EeRj-221	463	2.69	83	21	4	86	619	10	145	6
Arrowstone Hills	296	17424	73	16	13	118	491	13	191	7
Arrowstone Hills	244	15617	71	17	16	120	512	12	204	9
Arrowstone Hills	407	18116	69	15	14	122	495	13	207	7
Arrowstone Hills	440	18591	56	15	12	127	560	10	204	6
Arrowstone Hills	402	19405	85	17	15	130	553	11	210	8
Arrowstone Hills	233	19570	67	15	9	113	468	7	182	5
Arrowstone Hills	484	18990	68	16	10	134	543	10	204	6
Arrowstone Hills	534	19908	65	15	14	138	487	16	233	9
Arrowstone Hills	324	18067	62	16	10	121	497	10	195	7
Arrowstone Hills	481	17550	56	15	10	127	530	15	202	9
Arrowstone Hills	483	17481	68	16	10	118	533	11	199	7
Arrowstone Hills	463	19667	59	15	9	129	535	11	198	7
Arrowstone Hills	412	18747	58	15	9	122	515	10	208	9
Arrowstone Hills	441	14749	63	14	7	111	477	10	186	7
Arrowstone Hills	355	16012	68	16	11	120	512	13	205	6
Arrowstone Hills	436	17106	73	16	11	126	494	11	188	9

Arrowstone Hills	382	17180	47	14	12	118	576	11	199	8
Arrowstone Hills	526	18107	65	15	11	126	538	11	204	9
Arrowstone Hills	431	19599	57	15	14	131	451	17	224	9
Arrowstone Hills	529	20582	94	17	13	133	542	11	214	6
Arrowstone Hills	354	19244	63	15	7	136	450	13	220	9
Arrowstone Hills	327	19621	61	15	11	134	442	12	215	9
Arrowstone Hills	470	18058	63	15	11	140	563	13	213	9
Arrowstone Hills	609	16148	74	16	10	138	528	13	213	7
Arrowstone Hills	317	15740	80	17	13	137	535	11	218	8
Arrowstone Hills	537	18073	60	15	12	129	525	12	214	7
Arrowstone Hills	320	14811	70	17	9	123	536	11	199	7
Arrowstone Hills	200	12118	54	15	6	86	385	9	144	5
Arrowstone Hills	262	11149	60	16	4	83	377	9	146	4
Arrowstone Hills	278	14874	65	13	7	103	431	8	167	7
Arrowstone Hills	230	9805	51	16	3	83	364	10	154	5
Arrowstone Hills	178	9510	65	15	6	75	354	8	135	5
Arrowstone Hills	162	11310	53	16	10	96	388	9	161	5
Arrowstone Hills	372	13622	68	16	9	102	429	10	162	5
Arrowstone Hills	412	18561	73	16	5	54	437	10	126	6
Watts Point	717	26094	70	14	0	26	1032	15	154	3
Watts Point	680	30130	96	14	4	33	1106	12	157	5
Watts Point	709	29693	102	15	0	34	1067	14	151	4
Watts Point	635	32018	88	13	0	31	1036	13	153	4
Watts Point	614	25505	68	14	0	29	972	13	142	3
Watts Point	653	28663	81	14	2	28	1023	12	154	3
Watts Point	502	27239	70	14	2	29	1054	13	148	2
Watts Point	643	27153	74	14	1	28	1054	10	153	6

Watts Point	1036	34233	93	11	2	40	1268	20	180	6
Watts Point	1005	31675	96	10	5	37	1271	16	179	5
Watts Point	906	32145	91	12	6	36	1235	16	178	2
Watts Point	671	27709	77	14	1	27	1014	14	145	5
Watts Point	1018	34939	113	13	7	36	1366	15	187	7
Watts Point	957	32433	112	13	6	35	1279	17	179	6
Watts Point	1048	31093	95	10	5	33	1244	16	164	2
Watts Point	1026	31992	108	13	6	33	1253	14	184	5
Watts Point	1147	33846	99	11	6	37	1320	14	189	2
Watts Point	909	32654	94	8	6	33	1291	17	181	3
Watts Point	595	28496	71	13	1	32	1017	13	147	5
Watts Point	689	26074	63	14	0	28	1052	14	148	6
Watts Point	713	26393	68	13	2	31	1050	13	153	6
Watts Point	548	25721	66	14	2	26	941	15	144	1
Watts Point	696	28447	69	13	3	27	1056	13	156	6
Watts Point	408	23697	61	14	1	24	942	12	138	5
Watts Point	759	27519	81	13	2	32	1089	12	166	4
Turbid Creek	768	34468	97	13	7	30	3241	13	186	5
Turbid Creek	702	35425	91	13	4	25	3281	12	182	4
Turbid Creek	682	33516	90	13	4	27	3084	15	186	5
Turbid Creek	668	32499	96	14	6	29	3136	12	193	4
Turbid Creek	822	32565	104	14	5	27	2994	14	190	3
Turbid Creek	706	31879	93	14	4	26	3102	12	180	5
Turbid Creek	555	31999	109	15	4	30	3128	13	193	4
Turbid Creek	589	33914	83	13	6	27	3866	13	191	4
Turbid Creek	730	34247	103	14	5	26	3750	13	198	4
Turbid Creek	691	31960	96	14	4	24	3583	13	188	2

Turbid Creek	823	35246	112	13	7	30	3402	14	200	3
Turbid Creek	672	34669	111	14	6	22	3966	13	196	4
Turbid Creek	690	32830	82	13	5	25	3658	14	195	3
Turbid Creek	880	37424	115	12	6	29	2548	13	180	7
Turbid Creek	1057	37209	114	13	3	28	2617	16	178	6
Turbid Creek	662	32749	100	13	9	29	3251	15	195	3
Turbid Creek	823	31811	93	13	6	27	3154	14	186	3
Turbid Creek	670	30269	110	15	5	28	2959	14	177	5
Turbid Creek	628	32748	112	14	2	28	3173	13	181	3
Turbid Creek	922	33870	117	14	7	27	3299	13	192	3
Turbid Creek	761	33186	103	14	7	30	3147	14	179	3
Turbid Creek	532	33825	93	12	5	25	3314	16	190	3
Turbid Creek	614	30900	94	13	4	23	2815	10	175	3
Turbid Creek	665	32598	105	14	6	27	3185	13	179	3
Turbid Creek	702	35425	91	13	4	25	3281	12	182	4

Appendix C – Calibrated PXRF Artifactual Data

Key:

AN – Artifact Number

ST – Shovel Test

ET – Excavation Test

S – Sample

CMBS – Centimeters below surface

CMBD – Centimeters below datum

CD – Cultural Depression

U – Unit

LVL – Level

Sample Site Code	MnKa1	FeKa1	ZnKa1	GaKa1	ThLa1	RbKa1	SrKa1	Y Ka1	ZrKa1	NbKa1
DhPt-10 S1	262.2054	37675.03	85.10864	10.47326	-1.76908	3.042594	117.1343	36.12392	47.44111	4.580837
DhPt-10 S10	171.9517	47658.96	93.89865	8.772744	-3.3359	6.455501	80.17731	10.22573	65.31085	3.930138
DhPt-10 S11	217.4053	33102.02	97.22676	14.04766	9.113755	14.53049	68.83116	32.83581	230.6941	15.78903
DhPt-10 S2	443.1398	38101.58	136.1873	14.69125	1.572452	-2.62747	166.1833	22.12803	188.9853	9.229283
DhPt-10 S3	526.8602	19545.43	117.6168	18.34614	14.98694	131.1752	538.5431	12.79417	210.6068	7.084138
DhPt-10 S4	67.32825	18320.99	89.43	12.9596	-0.71329	11.32653	68.72734	19.06347	55.02268	3.058411
DhPt-10 S5	423.0661	44745.84	241.0244	18.26062	4.052991	81.90571	63.65001	10.81011	181.4113	9.908353
DhPt-10 S6	302.6325	30564.04	123.4723	16.06624	-0.0834	-1.7945	129.968	28.00089	231.0923	8.647672
DhPt-10 S7	44.48209	26181.45	74.83245	10.23429	-2.95487	-0.00188	83.13267	16.55663	50.81947	1.742478
DhPt-10 S8	-9.48931	8090.957	107.1909	13.56744	-2.25342	10.68438	63.13684	13.50309	38.94533	-0.20933

DhPt-10 S9	5.257521	6377.925	106.3493	18.60768	5.425598	57.54257	126.5756	16.1468	169.1187	9.640291
DhPt-9 S1	152.0516	29255.77	96.60278	11.29012	-2.29324	13.18651	205.9321	16.29418	56.04419	2.098783
DhPt-9 S10	17.21489	8244.905	75.59805	12.31109	-2.42764	13.66238	212.9235	15.37001	47.29603	1.338726
DhPt-9 S2	34.02666	4027.483	56.62011	17.36386	2.982347	2.668779	162.166	25.22623	164.4429	10.6603
DhPt-9 S3	174.6346	20299.5	85.62526	13.51119	-1.06578	17.7151	122.2738	15.71737	52.69774	1.412968
DhPt-9 S4	-96.0289	1151.255	42.72725	6.810118	-6.28734	-5.59675	4.91393	-0.36206	11.76396	-1.88598
DhPt-9 S5	204.1392	3784.346	67.15869	12.87298	-5.76009	4.398389	133.1309	11.03233	26.56937	0.30856
DhPt-9 S6	79.66417	17163.87	84.39358	11.68965	-0.45437	5.643339	68.05341	17.10241	30.57756	0.489862
DhPt-9 S7	145.8461	12241.94	90.72263	15.78087	-0.43765	23.22274	210.5766	59.02329	51.34088	4.055087
DhPt-9 S8	918.373	30880.48	212.0978	20.81335	29.07315	8.151392	155.0676	26.11605	214.8231	3.167063
DhPt-9 S9	443.3302	18796.46	116.4168	17.87959	15.05999	128.706	521.4283	11.60695	202.4599	8.364566
DhQv-48 S1 AN0219	313.7551	19106.01	85.31748	16.66176	8.927572	115.907	555.094	10.19872	204.7195	7.286465
DhQv-48 S10 AN1092	437.2126	20180.7	84.92223	16.04982	11.13257	132.8171	565.5271	12.52092	214.3545	6.991591
DhQv-48 S11 AN0881	277.3783	17220.78	72.00733	14.61509	5.963199	83.40259	548.3018	9.341992	155.984	3.104363
DhQv-48 S12 AN2081	468.4045	18508.12	97.2213	15.4663	16.80834	122.9367	606.8428	12.76364	212.4454	8.151417
DhQv-48 S13 AN2156	601.8318	26613.76	103.3284	15.88048	8.793701	84.84839	647.6583	11.6816	213.0333	8.673336
DhQv-48 S14 AN2870	356.7447	19485.25	89.6958	16.82418	9.647519	133.8981	551.0407	11.81039	212.7204	7.671282
DhQv-48 S15 AN0127	485.423	28157.3	113.3211	15.14658	6.612375	64.12917	822.0571	9.384683	213.9736	6.438374
DhQv-48 S16 AN0683	354.1721	27374.09	121.013	16.55812	8.62087	63.34042	861.1052	9.965815	215.3224	4.871047
DhQv-48 S17 AN0001	416.7399	18751.48	77.55335	16.21752	10.92898	128.2886	536.6631	10.20903	209.804	10.95117
DhQv-48 S18 AN0421	505.5538	28905.66	91.37599	14.37106	7.206396	63.6041	827.707	9.5288	214.7512	3.504677
DhQv-48 S19 AN0052	489.3028	25868.56	105.8296	16.22163	8.048455	61.18683	831.4406	10.13454	208.2127	3.552067
DhQv-48 S2 AN1840	609.8203	23593.88	97.85441	15.73239	7.080444	79.92711	479.0438	17.46848	203.527	8.121295
DhQv-48 S20 AN0668	552.7758	34796.91	122.2497	14.56087	3.470005	62.33054	838.1689	9.351998	198.8185	4.29902
DhQv-48 S21 AN0172	414.3728	18379.65	73.44266	16.09908	10.74812	125.9648	525.6156	11.31801	203.8569	7.038207
DhQv-48 S3 AN0319	408.4054	28583.66	129.1623	16.73282	8.152004	70.04656	853.0307	9.427669	221.8406	4.058826
DhQv-48 S4 AN0284	601.3055	31745.34	115.2378	13.39424	10.1515	68.42043	794.5467	9.212604	199.8947	3.272444

DhQv-48 S5 AN2883	353.7889	19591.11	88.88478	16.70598	7.374905	96.92678	623.6657	8.841717	177.7869	3.996278
DhQv-48 S6 AN0692	328.4795	18256.1	95.42269	15.86332	6.629725	94.29424	581.3367	8.834267	173.9562	3.21689
DhQv-48 S7 AN2571	664.9742	34229.15	118.4266	14.79499	9.148145	61.83167	1105.671	11.62612	211.1541	3.732169
DhQv-48 S8 AN2653	280.8399	27461.2	119.3611	16.61439	8.212286	63.91821	839.9063	6.28815	216.3941	4.13097
DhQv-48 S9 AN2269	392.8204	25724.74	122.8578	16.26686	7.641642	61.52062	819.82	11.17442	209.8328	2.06158
DiPu-16 S1 AN0071	218.7925	20371.21	59.89668	14.55761	-1.6501	17.66479	61.90677	27.45349	230.9075	8.556635
DiPu-16 S2 AN0053	-47.6491	3151.01	25.17849	5.776367	-3.58718	0.476619	48.45397	5.567132	28.43746	-0.20279
DiPu-17 S1 AN0021	569.8375	28411.68	120.2924	16.36542	10.98424	65.22301	1996.428	13.65444	252.0236	12.51478
DiPu-17 S2 AN0006	68.48658	8396.489	21.65065	12.55672	-3.69123	15.10034	172.8373	15.26384	45.07692	-0.3506
DiQm-1 S1	443.1036	19102.1	113.7997	18.22393	9.82581	126.801	556.2867	12.35128	212.2863	7.076773
DiQm-1 S10	-97.2582	2389.227	44.31518	12.12973	-5.13945	-1.94697	22.93909	5.002591	51.83666	0.259467
DiQm-1 S2	374.2222	19244.44	128.4432	18.69144	11.32824	123.9855	546.2095	13.69097	207.5744	6.553494
DiQm-1 S3	396.0484	19448.44	131.0626	19.16573	14.96614	122.7786	544.3159	12.69604	204.2386	6.08863
DiQm-1 S4	499.0659	19406.37	121.009	18.517	14.83544	129.9446	547.5398	9.620803	208.0256	6.721811
DiQm-1 S5	377.1087	29477.2	169.8866	18.94596	7.824705	65.51479	843.4641	9.415096	209.697	3.828101
DiQm-1 S6	312.3327	20393.27	121.5084	18.2265	12.06441	125.1995	585.9068	11.75052	207.4852	6.989311
DiQm-1 S7	345.8529	23443.7	120.5446	17.09441	10.68488	84.25649	509.1768	15.05072	210.4484	5.387949
DiQm-1 S8	415.6534	28883.55	146.5326	17.73076	8.843171	99.1412	686.2988	23.07357	281.2313	11.1606
DiQm-1 S9	456.9029	24448.19	111.2763	16.85257	10.11734	87.55862	532.3976	15.78109	215.5943	6.704925
DiQm-13 S1	354.803	20039.19	128.6464	18.32869	13.12296	133.151	559.9818	11.31639	204.7578	7.422527
DiQm-19 S1	325.2007	18596.32	128.0264	18.92687	12.03289	127.2822	546.4309	10.10797	209.2219	7.336739
DiQm-19 S2	335.9073	20904.12	120.1476	18.13539	13.47107	131.8859	577.3998	11.97696	204.1465	6.48595
DiQm-19 S3	10.5586	6224.8	45.31069	10.65804	-3.49985	7.721813	15.92542	3.50281	26.23198	-0.82915
DiQm-19 S4	469.9801	19125.15	123.5637	18.80365	12.40316	126.1681	529.0108	13.12853	205.5425	5.801196
DiQm-4 S1	332.589	19091.94	107.0025	17.66536	8.669778	129.5366	538.1983	11.74664	207.6987	6.566794
DiQm-4 S2	393.3025	22663.85	138.2972	18.76207	11.11304	101.7333	515.1973	17.84584	217.3076	6.320591
DiQm-4 S3	-118.432	3354.733	54.9117	13.54367	-2.4681	2.96895	22.61069	4.150937	58.29894	-0.60001

DiQm-4 S4	446.4141	19905.04	126.3363	18.2487	12.11254	129.9235	570.7335	10.77431	204.455	7.486254
DiQm-4 S5	959.5398	32103.99	129.1041	12.71987	26.75317	216.5996	1842.166	20.35453	365.2991	42.23549
DiQm-4 S6	441.7424	19030.6	120.7918	18.00172	11.80446	129.209	547.0608	11.50492	211.2921	7.419185
DiQm-4 S7	1603.599	31122.9	113.7315	14.73235	7.627927	65.31185	42.01457	13.88491	176.8123	5.452391
DiQm-4 S8	446.3229	19847.58	116.4926	18.05802	12.7443	134.2047	555.8092	9.654414	204.3228	8.235597
DiQm-5 S1	-9.84399	6086.863	60.15549	15.56565	-1.32069	26.96925	18.0267	4.257797	49.88685	1.713846
DiQm-6 S1	262.1536	19111.7	116.6938	18.03897	12.93815	121.7839	547.3207	13.09047	207.8449	5.657192
DiQm-6 S2	518.7237	18923.12	123.108	18.70196	10.63034	128.3633	550.2901	8.255942	198.6259	6.734898
DiQm-8 S1	521.6998	18369.96	120.6072	18.75672	13.43972	126.2109	545.3269	14.96863	205.9674	7.746826
DiQm-8 S2	277.3924	16606.96	141.2172	20.43567	11.12446	106.8135	486.4304	11.30861	176.596	3.767701
DiQv-5 S1	314.1095	18849.3	140.0018	19.79232	9.430616	129.8654	538.7213	11.63001	200.2947	5.321336
DiQv-5 S10	405.4553	19213.91	128.7797	18.98287	11.34433	126.7554	554.5391	11.1067	200.9444	6.378151
DiQv-5 S11	502.3027	19491.17	136.2559	18.77021	18.0097	125.7392	561.0396	11.73931	214.9542	6.059083
DiQv-5 S12	445.4068	27099.61	112.7027	15.3826	5.319154	79.55396	720.3522	22.95701	286.1675	12.35707
DiQv-5 S13	-58.6462	9277.141	67.013	15.65147	8.082734	126.4047	112.6867	12.39942	57.02505	5.888923
DiQv-5 S14	-125.718	1294.496	50.40445	10.19862	-4.97851	-4.89518	3.263734	-0.19628	9.271302	-2.43863
DiQv-5 S15	459.5866	23864.47	159.8032	19.60878	12.90479	109.6094	608.9332	10.89416	187.6358	4.809352
DiQv-5 S16	435.2019	22088.41	162.1447	19.86743	9.649805	102.609	755.9589	7.451945	171.7965	5.779932
DiQv-5 S17	630.8712	28444.69	121.2512	16.4224	8.96375	76.82058	713.2534	23.58566	283.8708	12.38731
DiQv-5 S18	468.6155	23752.52	138.1366	18.33617	9.020801	94.5231	543.1275	18.06381	233.244	8.120722
DiQv-5 S19	423.8629	19247	109.1649	17.79758	11.53657	129.567	544.6862	11.28063	205.6722	7.035087
DiQv-5 S2	370.812	19957.79	127.0464	18.40975	16.21464	128.8931	557.5285	11.39341	212.6443	7.517125
DiQv-5 S20	413.4963	18661.93	130.798	19.20916	13.95882	130.5175	526.576	9.512292	210.4448	5.969267
DiQv-5 S21	720.7986	28119.09	137.947	16.96484	7.373381	116.1429	708.8664	22.67874	275.8631	10.04155
DiQv-5 S22	-8.66148	9022.909	48.84193	8.681753	-4.36888	13.69528	41.71065	1.158655	33.71262	0.178543
DiQv-5 S23	403.1316	20045.32	109.3416	17.79612	14.3995	125.7018	566.1789	12.23209	211.174	7.485798
DiQv-5 S24	489.3627	19049.92	110.8312	17.71223	11.71181	130.119	551.3414	12.61376	210.1773	7.8943

DiQv-5 S3	-30.9693	10956.16	78.17044	15.74905	-3.43427	28.43568	150.4411	4.157627	51.55674	2.432704
DiQv-5 S4	401.4697	32585.27	163.4168	17.41632	9.53992	61.1203	1074.806	10.08975	199.3103	5.276688
DiQv-5 S5	306.4199	28935.86	166.5711	18.88528	7.089577	67.8488	897.2045	10.5201	219.7356	4.42121
DiQv-5 S6	327.9213	20622.89	125.6115	18.59828	7.712351	91.87638	761.2573	7.332072	190.0027	0.539437
DiQv-5 S7	440.0508	23274.99	130.2799	17.88834	11.77652	118.3732	611.6486	9.979946	186.8898	3.911425
DiQv-5 S8	386.1004	26849.23	154.6014	18.70411	7.840202	65.66557	880.5504	9.176522	214.5083	5.28925
DiQv-5 S9	509.3016	33771.03	158.8037	16.739	7.049112	60.4788	1073.747	8.479985	199.9582	3.643535
DkQi-1 S1	-85.3692	3012.009	73.38561	11.17737	-6.49137	5.225166	26.40018	4.665826	24.74808	-2.09572
DkQm-2 S1	360.1919	19902.01	125.1266	17.31809	11.89561	128.4526	558.3578	10.21957	206.6156	7.14573
DkQm-2 S2	398.1923	19762.62	104.0073	17.483	13.37049	130.4964	540.9826	12.05119	208.8163	6.380928
DkQm-2 S3	414.2098	23481.07	125.3473	17.49933	8.93604	120.4352	660.8957	8.992161	193.8849	3.434384
DkQm-5 S1	435.2333	18289.17	107.2817	17.95488	11.37312	125.8222	502.1022	8.623881	194.4492	7.169495
DkQm-5 S10	396.8954	19116.08	117.8991	18.39939	9.815941	127.3852	536.3165	13.65638	210.372	6.897811
DkQm-5 S11	392.337	19687.04	126.2832	18.50129	13.33018	133.1618	577.6791	11.97052	212.1424	5.18245
DkQm-5 S12	539.5727	19926.72	128.4481	18.81666	12.75887	124.324	560.5349	10.84074	199.8728	5.043984
DkQm-5 S13	306.6834	19568.79	114.8233	17.70792	14.63955	132.1685	565.76	12.5291	214.0152	5.238816
DkQm-5 S14	514.3549	20333.66	116.0701	17.95319	17.91004	129.7523	542.8892	10.42858	210.4054	8.024883
DkQm-5 S15	258.2422	18285.05	111.2992	17.62776	10.8307	120.5121	512.2571	11.12392	200.8307	7.978303
DkQm-5 S16	384.5939	18530.58	121.1151	18.00057	12.93355	125.2326	536.6902	11.41565	200.6051	7.067501
DkQm-5 S17	466.4765	19342.07	121.9833	18.65822	14.8977	134.7986	556.9373	10.7302	204.2535	9.394488
DkQm-5 S18	273.9999	23047.66	125.7897	17.87045	10.15403	115.8843	631.7259	9.484846	192.6694	4.51632
DkQm-5 S19	386.2098	20369.16	110.9027	17.50328	15.57406	133.9591	572.4381	11.70222	210.4034	7.972256
DkQm-5 S2	276.1976	19711.64	119.6872	16.37448	10.74593	128.2916	574.913	11.91715	214.7362	6.04524
DkQm-5 S20	-194.55	1490.444	39.22457	8.663025	-7.20978	-5.35322	3.637263	-0.83511	10.75432	-1.32178
DkQm-5 S3	344.2347	20123.18	117.8863	17.8376	10.67784	127.0974	567.4484	11.52315	216.602	7.027691
DkQm-5 S4	283.3832	20408.01	127.6928	18.76526	15.6671	138.6737	581.5872	13.00954	214.5716	8.166017
DkQm-5 S5	400.7754	19596.25	109.1286	17.77598	16.0443	129.5368	558.9174	12.26713	205.4713	5.682173

DkQm-5 S6	429.5214	18685.01	129.2439	18.79411	11.04168	127.4394	534.0849	11.24638	205.675	5.554241
DkQm-5 S7	430.9297	21692.44	121.9383	17.64253	13.83979	132.8767	622.3532	12.03955	214.0279	7.335582
DkQm-5 S8	427.8156	20400.01	123.9088	18.52269	23.38676	130.4573	563.6766	14.19947	204.3985	8.198416
DkQm-5 S9	342.4637	20174.68	127.9285	18.54372	13.35661	138.9463	573.0121	9.710785	206.962	6.453799
DkRi-62 S1	379.142	19421.3	107.1411	16.94598	10.12253	121.7584	550.438	11.59882	195.383	8.142292
DkRi-65 S1	199.9067	19607.99	136.405	18.67423	3.699228	89.59185	751.971	7.36549	187.0778	2.452955
DkRi-65 S2	327.1051	20005.11	134.8106	19.25531	4.70345	91.98933	765.0111	8.443351	186.9	3.260038
DlRi-6 S1	426.4775	19519.28	115.863	18.23043	10.36591	134.3296	533.1339	12.35999	211.0889	9.127409
DlRi-6 S2	422.6336	19781.54	130.0535	18.94627	14.42311	132.0926	541.1053	13.74234	206.8221	6.753521
DlRi-6 S3	574.4211	25919.29	106.2937	16.09473	0.413726	57.37662	191.5764	28.05808	152.9729	3.188961
DlRi-6 S4	569.4715	38949.6	128.2455	13.65816	1.424585	52.08083	518.2152	20.1483	216.2749	7.721938
DlRi-6 S5	885.1129	36341.74	118.4625	13.77241	2.645467	26.769	482.3954	15.76628	111.2537	6.944803
DlRi-6 S6	217.5485	21441.49	118.7836	17.98059	10.41605	98.11463	809.7251	6.024702	191.7008	3.357735
DlRi-6 S7	339.2275	20617.79	111.0491	17.63626	12.1764	129.7286	542.8437	12.33776	216.0684	7.231744
EaRb-28 S4 AN0003	391.781	25874.53	66.81557	14.07156	7.48997	86.40384	681.5192	12.00099	222.1764	9.123016
EaRb-28 S5 AN0008	388.95	27378.1	85.6008	14.46797	6.779865	93.17124	685.2145	11.31766	212.5468	7.453012
EaRb-30 S2 AN0028	451.3173	19637.62	82.21373	16.23803	13.63559	122.5124	556.5233	13.7108	212.5925	7.177226
EaRb-30 S3 AN0033	523.6852	25767.96	83.24302	14.29759	9.639674	118.2576	584.2799	10.42196	187.455	5.699003
EaRb-7 S1 AN0012	366.3803	20006.58	70.77072	14.46972	11.3993	129.1149	563.7756	11.48341	194.6411	5.167682
EbRj-1 S1 ST15 0-83CMBS	399.3589	18918.05	125.7601	18.98692	10.78999	123.6845	541.3136	12.37245	201.4589	5.763195
EbRj-1 S2 ST27 120CMBS	246.2173	20830.41	139.7504	19.37331	6.907405	96.18075	767.9779	8.282758	188.7301	1.905144
EbRj-1 S3 ST30 130CMBS	326.9476	20442.79	124.6209	18.56987	10.08527	130.1996	563.4502	13.65036	210.4138	6.942483
EbRj-1 S4 ST 28 0-123CMBS	395.7338	19107.57	112.4292	18.0554	14.55828	128.1028	529.2984	9.670348	200.8003	5.283793
EbRj-1 S5 ST3 0-135CMBS	537.3019	19845.69	161.8666	20.82579	12.75155	131.9849	552.9774	12.63535	213.9068	4.902507
EbRj-1 S6 ST19	1171.473	50304.58	163.6282	12.14101	4.390689	49.74466	1366.65	14.5844	128.4991	1.175808
EbRj-10 S1 ST8 0-75CMBS	536.5018	19823.7	124.0995	18.59171	10.45719	121.7481	551.7941	12.16562	195.5067	5.874341
EbRj-173 S1 ET1 0-10CMBS	295.0838	19662.13	114.6539	17.7055	13.42587	129.6549	556.1152	10.16486	210.06	6.519888

EbRj-173 S2 ET1 0-10CMBS	392.4009	20373.69	135.4348	19.14585	11.27703	137.5286	563.1138	10.15504	210.0158	6.099571
EbRj-174 S1 ST2	212.4302	20523.65	134.3782	19.14273	9.641074	91.84532	773.7095	8.751737	186.6435	1.7448
EbRj-174 S2 ST5	344.2075	20117.42	135.9341	19.30546	7.969987	95.20758	764.9156	10.94442	193.8091	3.175003
EbRj-174 S3 ST7	336.468	20205.82	109.261	17.76374	8.995945	95.5994	775.0422	8.883112	189.1079	2.159247
EbRj-174 S4 ST3	361.5245	19374.45	136.5494	19.23174	12.13817	123.2059	534.5506	11.43125	200.6539	6.623122
EbRj-174 S5 ST3	398.4769	18819.01	105.2239	17.612	12.89635	125.1417	531.3175	12.08154	192.2426	5.38722
EbRj-174 S6 ST2 0-60CMBS	306.2641	19454.44	126.9077	18.7438	11.48119	124.65	570.2297	9.922757	197.2318	5.437847
EbRj-174 S7 ST2 0-60CMBS	394.7684	20403.62	134.609	19.02871	9.962837	127.3045	567.113	11.52975	197.8551	7.832784
EbRj-22 S1	709.5641	35271	164.3321	16.85151	4.862419	24.89352	3336.89	13.61156	202.397	2.890861
EbRj-22 S10	643.0533	40780.53	130.5709	13.68195	6.018306	70.04263	504.3787	17.20678	191.1362	7.911447
EbRj-22 S2	274.4859	21732.28	124.1802	18.06791	8.228266	97.79901	766.5423	9.419741	198.2291	3.03544
EbRj-22 S3	445.8713	20447.9	121.7759	18.2513	13.80622	135.4499	602.369	12.97264	214.8518	7.426956
EbRj-22 S4	213.3433	20717.89	136.6123	19.09397	9.960407	95.80179	789.7192	9.237372	195.927	2.745171
EbRj-22 S5	337.1852	22190.92	131.5228	18.49425	8.105697	98.78258	815.4296	7.829217	192.2094	1.5671
EbRj-22 S6	420.5185	18885.59	105.5387	17.5795	11.83152	120.4923	535.7193	12.12012	193.3905	7.265304
EbRj-22 S7	422.165	18917.5	112.2352	18.20965	12.336	126.6054	524.4271	13.12804	209.9903	9.072947
EbRj-22 S8	293.5011	19590.34	111.9132	18.05899	8.02659	89.66318	766.5837	9.641656	186.3801	1.463584
EbRj-22 S9	459.9915	19850.41	133.7757	18.68808	10.3083	128.7929	550.8214	11.55423	207.9645	6.273916
EbRj-3 S1	212.3426	20504.36	123.3364	18.49405	5.995207	91.3502	750.4326	8.106573	186.654	3.144612
EbRj-3 S1 ST38 0-100CMBS	338.6975	20975.76	134.6183	19.02595	10.12968	95.21932	788.4717	8.94779	189.6917	2.410939
EbRj-3 S10 ST53 0-60CMBS	223.0526	21071.18	115.0347	17.88207	8.501439	90.40828	767.5319	8.691579	187.5656	2.712681
EbRj-3 S2	437.4819	19864.46	140.317	19.44756	11.31675	132.9227	565.4345	11.99946	215.08	6.979835
EbRj-3 S2 ST63 0-80CMBS	430.0654	20237.04	117.9968	18.21722	8.62025	129.0358	533.5072	11.27559	208.9104	9.679934
EbRj-3 S3	517.8078	19490.36	104.8107	17.55634	11.47484	126.5894	556.4622	10.19497	201.4194	6.10316
EbRj-3 S3 ST50 0-50CMBS	441.6197	19008.92	124.952	18.69322	14.164	123.4011	525.0343	11.97848	200.227	5.476158
EbRj-3 S4	366.0613	21168.34	127.6379	18.53059	6.791798	97.25832	772.4918	6.505829	188.2525	2.309985
EbRj-3 S4 ST62 0-80CMBS	372.3146	20022.2	122.1669	18.53033	12.67741	130.7605	586.4828	10.25316	203.1028	5.583163

EbRj-3 S5	317.3694	20637.52	125.1121	18.32533	3.066104	89.76668	756.5321	9.447183	188.362	1.859152
EbRj-3 S5 ST13 0-4CMBS	267.2001	20771.81	138.2112	19.27569	9.65524	98.38473	789.7214	6.061382	187.2046	3.462612
EbRj-3 S6 ST55 0-75CMBS	358.3523	20859.19	128.8587	18.71612	11.54021	123.6722	568.9112	13.74249	209.627	6.302436
EbRj-3 S7 ST55 0-75CMBS	412.5701	20455.49	114.7527	17.32331	12.30079	131.7305	540.0052	10.62807	206.8316	7.414461
EbRj-3 S8 ST17 0-45 CMBS	275.2295	21852.56	141.6247	19.23076	5.949322	90.77519	761.9616	5.814805	184.8591	1.909031
EbRj-3 S9 ST53 0-60CMBS	1091.863	62973.82	213.0238	9.367708	0.871113	-1.62649	204.2766	8.262095	35.58684	0.736951
EbRj-92 S1 ST25 0-40CMBS	862.307	26521.62	137.3921	17.54611	9.93066	107.4267	691.9592	23.70868	268.5242	9.759682
EbRj-92 S2 ET3 30-40CMBS	429.3282	19366.37	144.0605	18.99929	15.34065	131.0783	542.1525	11.9181	210.0171	6.939007
EbRj-92 S3 ET3 20-30CMBS	1047.738	66729.46	209.2777	7.29529	7.468109	21.56317	1358.966	362.197	84.58433	12.81659
EbRj-92 S4 ST3	419.9375	20706.96	126.677	18.62162	14.21501	137.9893	562.6799	12.7783	210.1762	7.629575
EbRj-92 S5 U06	352.1366	19907.66	115.2243	17.67099	11.94676	130.9677	551.4511	13.16554	206.3921	6.672455
EbRj-92 S6 U24 0-40CMBS	419.549	19223.96	119.5898	18.23172	14.10093	130.7943	550.8426	9.456469	206.0955	6.697785
EbRj-92 S7 U46 0-50CMBS	267.0081	22427.76	80.29445	12.81157	-0.93294	22.48741	41.14064	13.78973	80.34339	2.792972
EbRj-92 S8 U46 0-50CMBS	77.00912	69868.67	227.0757	-4.50622	0.73829	16.1419	276.3618	11.76849	102.9469	-0.09632
EbRj-92 S9 ET2 0-10CMBS	424.9284	19654.95	131.4846	19.11888	13.15253	128.7162	551.3984	11.43387	213.968	6.954356
EcQo-12 S1 AN0001	61.14317	2421.642	68.1078	9.374616	0.374139	7.004524	58.64956	13.79825	87.98509	3.440615
EcQo-12 S2 AN0004	307.6604	18491.91	83.02106	16.68178	10.30406	119.9399	606.0421	11.05165	210.3072	7.420103
EcQo-13 S1 AN0001	538.2746	19578.82	95.60787	16.80132	12.48706	130.4732	560.4633	14.20514	214.4398	6.756222
EcQo-2 S1 AN0091	402.4657	20299.65	73.89142	15.53595	9.744057	128.8742	565.6241	11.77346	205.2513	6.34831
EcQo-2 S2 AN0131	434.5566	19257.35	75.33664	16.01149	10.87213	133.9857	576.1713	11.43625	207.0843	6.536711
EcQo-2 S3 AN0001	408.0476	19709.46	90.58623	16.57604	11.76003	133.046	565.4874	11.05967	211.4568	6.85969
EcQo-2 S4 AN0080	445.3642	18741.63	77.7768	15.26537	11.17168	127.1578	544.3123	14.50669	206.3092	6.866765
EcQp-1 S1 AN0321	430.3272	18747.01	76.16555	15.53803	6.544273	126.2983	537.9524	10.27599	203.5341	7.927366
EcQp-1 S2 AN0325	355.0261	21310.51	82.55433	15.9808	7.222369	122.6269	604.9945	6.336979	186.9123	3.97928
EcQp-1 S3 AN0351	268.4216	19819.08	77.71589	15.89935	13.81794	125.8197	533.7495	10.73622	210.6036	9.244845
EcQp-18 S1 AN0004	255.7967	9198.791	41.41934	14.52257	6.573353	42.17435	1108.502	13.29082	109.0565	6.469439
EcQp-2 S1 AN0014	360.5889	18903.41	82.77221	15.78974	11.73411	123.8455	532.5427	11.14248	206.681	6.408895

EcQp-20 S1 AN0001	458.1347	19336.02	72.22389	14.83701	9.910262	119.765	540.2943	14.50919	201.8219	6.542462
EcQp-3 S1 AN0017	815.1657	19694.11	83.68664	16.02363	9.67075	132.8164	539.9491	13.38573	215.4562	8.929711
EcQp-3 S2 AN0070	491.3901	19008.24	60.90735	15.31118	11.63989	132.3146	559.1821	11.51935	205.6015	5.426751
EcQp-3 S3 AN0075	353.3268	19024.16	55.33338	14.8522	10.45261	118.4032	524.2131	11.48187	203.7331	8.518038
EcQp-3 S4 AN0076	381.9226	17725.15	63.85435	15.70984	9.108298	124.6711	530.9864	12.6744	203.1989	7.582641
EcQp-3 S5 AN0055	456.1886	26636.69	75.24202	14.37871	8.587467	112.5622	763.3238	10.90185	204.0448	6.442976
EcQp-3 S6 AN0003	203.4908	15905.58	76.18368	16.73229	12.58551	125.218	500.2931	11.96979	198.4863	5.990628
EcQp-3 S7 AN0004	370.1408	17767.48	72.07246	15.99628	10.32985	128.2476	536.8638	13.22114	205.9867	6.973325
EcQp-4 S1 AN0025	545.3511	22311.6	84.80457	15.82375	11.20028	121.0968	630.8197	11.805	196.5289	3.84424
EcQp-4 S2 AN0009	397.2041	18659.26	72.52702	16.01417	12.20585	126.631	525.9353	10.18576	208.0393	5.952705
EcQp-6 S1 AN0273	370.2095	17495.33	72.89414	15.65698	9.134181	115.1591	501.2789	10.78187	202.1179	4.764653
EcQp-6 S2 AN0240	417.4008	19377.06	101.082	16.53165	11.02356	129.0345	563.5225	10.39252	199.2884	7.955402
EcQp-6 S3 AN0252	473.3006	18605.71	77.72062	16.20875	10.32262	124.7699	537.0209	11.94966	207.2549	6.104234
EcQp-6 S4 AN0315	392.7436	18357.9	77.07917	15.94298	11.04172	120.7619	597.2944	9.96463	201.4523	6.580737
EcQp-6 S5 AN0322	365.3284	18822.37	96.01367	16.13915	10.09765	124.6801	538.408	11.08131	201.3565	6.200879
EcQp-6 S6 AN0388	378.713	18223.53	82.57544	16.40112	11.70087	121.9304	536.2149	11.34723	202.1851	6.227751
EcQp-6 S7 AN0397	430.113	31425.76	125.2932	15.21743	6.431953	62.75243	1075.09	8.835497	206.6561	5.288678
EcQp-6 S8 AN0400	407.8435	19604.4	73.11933	15.75033	9.092405	126.0992	535.7762	12.33887	200.9454	5.833589
EcQp-8 S1 AN0013	367.7377	17078.06	69.883	15.35512	12.30216	119.994	513.0764	10.13056	196.3153	5.874006
EcQp-9 S1 AN0016	373.6896	18429.05	57.70546	15.25275	12.46311	121.3222	515.9522	10.45513	208.4302	8.198236
EcQp-9 S2 AN0009	548.307	20744.58	78.09535	15.82773	10.53073	128.5599	567.8509	12.16342	204.5255	5.061707
EcQp-9 S3 AN0231 Large Core	362.6862	23642.14	75.17176	14.63071	9.41612	121.5115	561.1008	9.527471	190.7294	4.646564
EcQp-9 S4 AN0220	352.2214	19150.03	64.91782	15.54041	11.58488	136.4951	542.5241	10.4728	196.5252	7.453273
EcQp-9 S5 AN0229	329.0022	19157	80.94684	15.603	10.94965	120.41	533.6892	10.37225	197.8009	5.448742
EcQp-9 S6 AN0232	434.0816	17591.53	70.98649	16.06118	9.597311	125.1453	534.341	12.8239	208.7695	6.885138
EdRa-11 S1	216.8465	18259.59	69.73991	13.53237	11.42847	123.9875	521.6765	9.461154	190.816	7.63549
EdRa-11 S2	240.2191	17254.25	71.666	15.91784	9.726582	109.0431	461.2912	9.702407	191.6593	7.859714

EdRa-11 S3	354.5252	18776.75	73.24943	15.65134	11.36937	129.8881	535.841	9.948468	206.5248	6.843214
EdRa-11 S4	354.5167	23606.74	90.04401	15.89373	10.01825	117.6319	596.1714	8.110619	175.3297	6.877825
EdRa-11 S5	438.08	20631.68	66.08846	15.25693	12.31797	126.115	556.0633	12.25612	211.7267	7.052344
EdRa-9 S1 AN0400	333.3032	24394.93	102.2491	16.39928	12.68029	118.6463	562.0466	10.07583	183.8981	3.415639
EdRa-9 S10 AN0452	409.3444	19878.01	107.0216	17.5792	13.3622	130.4615	557.9828	9.179847	206.0109	6.759719
EdRa-9 S11 AN0466	372.1415	18672.35	128.6392	17.59496	12.82757	129.2429	530.8392	10.74851	201.467	6.699859
EdRa-9 S12 AN0467	500.6128	19709.84	97.12955	16.26243	13.41864	127.9736	557.6456	11.34916	211.9718	5.637292
EdRa-9 S13 AN0054	430.2903	19767.05	97.97472	17.21447	12.3198	133.274	544.1491	12.02371	214.9898	6.749006
EdRa-9 S14 AN0063B	335.0716	18862.58	106.6144	16.8455	13.8746	123.5156	547.6236	10.78035	205.5969	6.605813
EdRa-9 S15 AN0071	424.3475	23488.57	107.0547	16.4835	11.00503	119.9924	558.566	10.85249	187.1959	2.52649
EdRa-9 S16 AN0083	344.2009	17717.02	110.9568	18.36115	11.32842	119.3165	514.7196	11.1702	189.988	3.97771
EdRa-9 S17 AN0092	400.7315	23365.64	108.8607	16.97994	10.64492	122.4224	650.575	9.514903	190.8434	4.782447
EdRa-9 S18 AN0094	310.8817	19660.51	100.5922	16.82782	12.97498	127.6505	550.4513	11.52883	200.2608	8.128353
EdRa-9 S19 AN0096	386.3272	19922.53	106.6825	17.49496	11.70113	134.4979	569.7751	11.18447	216.4047	8.250424
EdRa-9 S2 AN0424	417.5939	19410.62	106.1308	17.50722	12.86827	131.8269	560.643	11.62343	214.4072	7.420092
EdRa-9 S20 AN0097	385.7376	20085.4	117.5516	17.55385	8.808353	131.6595	584.1439	10.4833	207.6877	7.186113
EdRa-9 S21 AN0013	359.1071	19479.48	102.7957	16.32123	14.97583	130.692	558.7617	13.80477	200.2849	6.15857
EdRa-9 S22 AN0028	447.1609	19279.82	98.22665	16.98653	11.5426	128.8158	562.3186	10.46518	209.2139	6.813137
EdRa-9 S23 AN0029	403.8064	19500.21	98.09097	17.18076	14.01667	131.824	542.5571	14.35823	215.029	7.199779
EdRa-9 S24 AN0030	351.5794	18439.63	118.9069	18.71717	9.509529	123.198	583.2169	10.22547	201.9366	6.73476
EdRa-9 S25 AN0126	340.3381	19148.36	105.5187	17.60174	11.86205	130.7984	567.0632	11.82675	206.5326	8.598359
EdRa-9 S3 AN0423	415.6217	19848.67	102.7161	16.84134	13.59208	127.5437	566.3638	10.21114	207.6923	9.877587
EdRa-9 S4 AN0446	482.6033	19153.72	108.6652	17.88548	11.21063	126.2994	542.953	13.48498	205.6454	7.068095
EdRa-9 S5 AN0404	401.2015	19038.7	105.192	17.47613	10.80227	123.6349	564.9673	12.67254	202.6303	5.465184
EdRa-9 S6 AN0442	443.8909	19454.59	94.89222	16.97873	13.24162	128.0429	542.5896	10.91029	200.6495	4.849927
EdRa-9 S7 AN0430	334.4723	19279.94	103.1525	16.64215	15.87472	125.1949	535.192	11.49959	206.9851	6.295547
EdRa-9 S8 AN0429	436.0718	19728.57	105.1971	17.34677	16.87029	134.6068	554.4235	11.64133	206.1026	6.830911

EdRa-9 S9 AN0403	253.2913	19089.32	111.6252	17.55303	14.6306	125.971	553.0904	10.95709	211.7697	8.019211
EdRh-31 S1 AN0032 CD4 Unit C Lvl 18	356.8253	19764.49	76.41126	15.9307	13.42155	131.0216	569.6026	13.43716	217.2771	8.224716
EdRh-31 S10 AN0034 CD5 Unit D Lvl 8	439.6134	19169.42	75.52226	15.60231	12.92089	126.8108	521.7024	10.54556	211.9789	8.24938
EdRh-31 S11 AN0034	349.4895	18505.15	95.47616	17.0766	12.39622	117.3986	526.6019	9.181027	195.7016	5.636477
EdRh-31 S12 AN0031 CD1 Unit B Lvl11	475.6632	19354.98	75.96833	15.99383	11.87976	131.0978	538.4458	11.52624	224.107	9.344708
EdRh-31 S13 AN0004 U5 Lvl6	460.2357	19710.96	88.5105	16.40001	11.42435	126.7465	536.4738	12.50681	195.898	7.887225
EdRh-31 S14 AN0017 U19	467.2733	26542.36	105.6854	15.93669	7.381868	108.3861	677.1947	10.52992	192.2637	6.11947
EdRh-31 S15 AN0020 Unit 3 Lvl9	405.1179	19400.66	73.41808	15.7594	14.38206	127.113	542.1174	11.08871	205.2668	7.270507
EdRh-31 S16 AN0005 U9 Lvl5	399.1056	19821.28	86.4845	16.57072	14.55542	125.1875	550.6553	9.130381	208.7228	8.461637
EdRh-31 S17 AN0023	472.7732	19873.02	76.91592	15.428	10.6237	132.9343	550.5018	10.47002	195.7675	8.201124
EdRh-31 S18 AN0013	436.539	20185.62	81.16233	16.15692	11.08471	126.0947	559.4632	12.69864	202.3195	7.660538
EdRh-31 S19 AN0053	468.4365	19249.55	66.18774	15.54449	11.59583	127.0007	536.4971	11.93748	206.4754	8.588076
EdRh-31 S2 AN0060 Unit 9 Lvl6	530.6121	24997.14	95.28379	15.82206	10.28538	117.0567	638.5161	12.15075	190.103	2.941773
EdRh-31 S20 AN0070	485.5237	19386.1	84.2755	15.95376	12.20431	123.3591	514.156	12.63787	205.925	6.399293
EdRh-31 S3 AN0081 CD4 Unit B Lvl 4	304.6774	23978.05	86.96151	15.66614	7.728238	87.21839	854.4986	12.59857	198.9615	4.615744
EdRh-31 S4 AN0009	372.3189	22006.62	84.51573	15.92028	12.36491	117.5299	616.4426	11.71658	190.1862	2.745893
EdRh-31 S5 AN0079	468.2363	28137.33	102.4672	15.33765	6.767354	70.09881	997.9351	10.01923	185.6045	2.155798
EdRh-31 S6 AN00063	411.2048	20045.33	81.80689	16.10799	13.13603	125.7719	580.1374	12.09951	211.4568	7.658039
EdRh-31 S7 AN0021	461.4067	19882.3	84.62103	15.80906	10.15106	122.8893	564.553	12.72686	197.125	5.932026
EdRh-31 S8 AN0001	432.4912	20336.33	83.48343	15.75556	12.03953	128.3044	549.2048	11.01152	209.5004	6.752136
EdRh-31 S9 AN0015	720.1419	28611.18	87.84137	14.35884	8.782164	99.83912	595.416	17.09069	129.0656	5.732962
EdRh-7 S1 AN0006 U4 Lvl6	400.2482	19296.95	71.07784	15.17569	10.53005	130.7956	538.7568	11.58467	203.2404	9.269404
EdRh-7 S2 AN0001 U10 Lvl6	385.9074	20733.11	94.59448	16.58936	10.89816	125.9405	573.4806	11.81787	195.5938	6.848593
EdRh-7 S3 AN0003 U16 Lvl2	370.4503	20341.14	88.37157	16.24279	11.61911	132.4361	557.7625	10.99367	209.0609	6.472878
EdRh-7 S4 AN0004 U11 Lvl4	265.5573	19737.95	86.95287	16.60151	12.72585	127.2798	531.8653	10.85208	200.6978	4.569185
EdRh-7 S5 AN0002 U14 Lvl4	401.5644	23368.06	93.07648	16.07874	10.83132	114.9103	615.9886	9.075786	192.6594	3.369813
EdRh-7 S6 AN0014	432.4475	20299.68	80.6082	15.89853	11.48345	126.7509	475.8284	11.19923	211.8157	8.920184

EdRh-7 S7 AN0013	511.8428	29109.32	116.7693	15.84917	5.2358	66.49319	932.9548	9.130819	176.0975	5.541267
EdRh-7 S8 AN0016	977.5506	36003.7	97.62484	13.06877	1.350501	23.47533	138.3337	29.30266	163.8323	5.339833
EdRh-7 S9 AN0015	444.9462	20853.2	99.96408	16.94725	11.15979	115.5793	478.7212	11.29253	184.434	5.397091
EdRh-8 S1 AN0019 N E Surface	473.1524	20697.62	97.52056	16.31119	14.35711	130.032	532.5696	9.937134	196.2172	8.245141
EdRh-8 S10 AN0007	238.9634	16998.19	74.22943	16.29684	13.35242	126.8551	552.4837	9.781214	207.2807	8.79982
EdRh-8 S11 AN0020	502.8529	20166.03	85.36437	16.16167	13.66816	128.1374	573.0612	14.99842	223.0353	7.728156
EdRh-8 S2 AN0006 Unit 10 Lev 25-30	444.2246	19346.31	83.43672	16.21569	11.315	130.1283	560.6341	11.2283	205.9269	8.963762
EdRh-8 S3 AN0003 U10 L25-30	401.8156	20490.96	79.66773	16.03472	10.23648	124.1602	580.7258	10.99815	199.0199	5.483573
EdRh-8 S4 AN0013 U3 L7	391.1325	19219.59	98.63483	17.35875	11.38572	122.1714	528.9649	11.81409	200.0066	7.869941
EdRh-8 S5 AN0014 U9 L30-35	428.6126	22207.35	106.5331	16.87597	7.420846	81.55286	825.0358	8.921377	162.2905	3.62206
EdRh-8 S6 AN0022	991.8292	37910.41	103.9811	12.93932	1.094139	45.37051	962.0069	15.98205	97.80909	3.021442
EdRh-8 S7 AN0016	125.2261	8569.717	26.21378	8.732131	-1.62189	20.07221	15.35805	4.656948	34.48987	1.882769
EdRh-8 S8 AN0008	428.2782	20188.15	92.25802	16.74865	12.37712	130.7365	562.1989	11.17371	214.6753	8.091148
EdRh-8 S9 AN0023	417.4607	17465.04	70.1742	15.54181	10.38609	122.6185	509.1002	11.8561	191.8356	6.962394
EdRi-11 S1 UNIT 4 211	391.212	19498.9	110.6419	17.82412	14.10264	128.1504	554.8806	6.974113	201.0126	8.66572
EdRi-11 S10 UNIT 16 AN0610	400.0606	18910.31	114.1886	18.32891	8.297582	129.1781	542.4849	11.09915	210.6053	7.313688
EdRi-11 S11 UNIT 16 AN0582	461.7021	20701.34	103.4451	17.2443	12.96833	133.0778	592.8588	9.030579	204.6789	7.742378
EdRi-11 S11B UNIT 16 AN0582	477.6655	19423.98	102.4933	17.50155	10.78434	128.4989	553.6467	11.44109	208.6457	8.451883
EdRi-11 S13 UNIT 16 AN0667	484.8018	19532.75	119.69	16.88874	12.41862	132.6596	566.3898	13.08976	206.573	6.979215
EdRi-11 S14 UNIT 24 AN1452	384.5328	19613.5	99.98176	17.01157	12.37161	124.7348	549.6282	11.58142	205.7202	6.708748
EdRi-11 S15 UNIT 24 AN1438	328.5133	18933.28	110.7325	17.26926	13.13089	117.2156	546.2505	12.79394	199.3483	7.792238
EdRi-11 S16 UNIT 23 AN1352	408.6321	21081.82	106.6635	16.02853	14.66474	135.2721	573.5641	10.94331	210.7324	7.102002
EdRi-11 S17 UNIT 23 AN1351	734.8231	41667.81	122.1014	12.94036	3.641405	69.28506	575.1126	18.70999	208.0226	10.39548
EdRi-11 S18 UNIT 18 AN875	532.2977	31895.07	131.0239	15.90969	10.80891	118.362	709.769	12.08426	191.4575	6.497519
EdRi-11 S19 UNIT 18 AN755	424.0128	20781.94	112.2585	16.43352	8.450002	126.9813	553.8702	10.68229	201.6402	6.740753
EdRi-11 S2 UNIT 4 214	405.5712	19077.98	109.8418	17.77774	12.1572	127.2408	546.2048	11.93619	204.1524	7.1185
EdRi-11 S20 UNIT 22 AN1308	415.6495	23166.31	120.679	17.3802	7.027351	119.0453	569.4476	10.64358	189.6574	4.865916

EdRi-11 S21 UNIT 22 AN1295	143.1802	9221.865	38.90704	10.31502	-3.10337	-3.39643	12.67913	2.987826	31.99162	0.568376
EdRi-11 S22 UNIT 22 AN1283	410.7066	19016.07	118.634	18.18042	8.256504	126.2111	539.075	11.50143	201.1078	7.637708
EdRi-11 S23 UNIT 12 AN0476	428.5577	18078.77	101.1629	17.60964	10.95919	127.0754	524.3967	10.4411	205.6785	7.712975
EdRi-11 S24 UNIT 19 AN0920	410.3064	19453.61	96.52083	17.17176	14.1908	136.4252	522.9014	9.77806	207.994	6.783213
EdRi-11 S25 UNIT 21 AN1104	411.511	20482.47	100.5583	17.15748	10.38698	128.8728	587.6364	12.42552	205.3809	6.074301
EdRi-11 S3 UNIT 4 16	437.4446	20940.05	95.07552	16.78222	10.66186	133.879	600.3968	11.67357	207.4239	6.280878
EdRi-11 S4 SURFACE	385.9298	24436.83	107.5923	16.60023	11.96611	117.3656	651.2073	10.799	194.1575	4.12838
EdRi-11 S5 UNIT 13 481	418.9414	19886.17	119.7924	18.41758	14.55793	132.2397	575.7669	13.50615	217.8704	6.702395
EdRi-11 S6 UNIT 13 483	345.7688	19002.88	115.1955	16.12227	10.9566	125.5322	568.9076	10.04234	206.6946	6.701053
EdRi-11 S7 UNIT 13 482	349.8553	19624.59	121.0268	18.43664	8.245992	94.64632	693.0339	6.549473	188.2168	0.218567
EdRi-11 S8 UNIT 1 AN0001	481.2951	19616.2	108.7686	17.62097	13.46958	131.1038	555.9812	10.75576	212.8917	6.865625
EdRi-11 S9 UNIT 1 AN0037	407.3094	19685.26	98.14387	16.47276	13.17463	127.9567	553.6383	12.67356	208.5036	7.432465
EdRi-25 S1 98cmbd	383.4443	18897.1	140.9637	19.46969	13.26704	119.9511	558.7645	11.98493	197.5297	4.366081
EdRi-25 S2 93cmbd	390.5216	19941.86	120.848	18.4743	12.55021	132.5492	578.0409	11.90462	203.796	6.049474
EdRi-25 S3 85 cmbd	393.7436	19050.95	131.6007	18.89626	13.3399	126.9093	560.9855	11.77075	199.4609	6.787874
EdRi-25 S4	370.3607	19336.18	121.0832	18.1384	14.6042	127.5066	562.1922	13.06174	211.1097	5.633178
EdRi-25 S5 99cmbd	352.0475	19314.99	140.3865	19.69331	12.61258	131.6661	548.174	10.63424	211.5395	6.380808
EeQw-3 S1 AN0001	380.6592	19409.83	114.9919	18.23987	16.02847	124.0636	536.5128	11.49837	214.0071	7.535747
EeQw-3 S10 AN0112	434.811	23653.03	78.97878	15.25307	10.51754	121.4479	584.1065	9.534074	188.8129	4.824317
EeQw-3 S11 AN0113	333.5436	19497.39	86.05389	16.60055	10.41105	124.8567	509.655	11.35147	200.2636	6.324948
EeQw-3 S12 AN0115	471.2758	19979.83	115.4848	17.8725	11.56256	132.3751	575.5361	11.8567	210.1497	6.404757
EeQw-3 S13 AN0116	471.0207	18705.87	90.93022	16.87659	9.502399	128.5325	550.8818	13.11581	215.4007	6.768455
EeQw-3 S14 AN0117	405.1745	18902.5	107.2903	17.87216	14.39636	124.3669	536.5494	10.41177	204.3273	5.921997
EeQw-3 S15 AN0118	439.5007	28214.21	145.0373	17.77318	5.259841	61.54376	839.2989	7.994119	216.959	4.428875
EeQw-3 S16 AN0119	488.7576	24238.59	107.0081	15.97143	9.834179	119.1406	648.2545	7.145968	183.3889	3.605302
EeQw-3 S17 AN0121	552.7686	19410.87	153.487	20.34504	11.54574	132.4771	576.7302	11.35015	213.8526	7.033775
EeQw-3 S18 AN0122	556.2942	20245.16	101.581	17.26718	15.87049	129.5094	583.7518	10.37337	203.5957	8.226048

EeQw-3 S19 AN0124	439.8343	21709.05	84.25192	15.95883	10.1106	115.3399	606.6255	11.61467	189.6445	3.773913
EeQw-3 S2 AN0066	414.9214	18983.18	64.9837	15.5436	12.57288	127.3909	554.8437	13.17701	201.6694	5.752159
EeQw-3 S20 AN0127	439.661	18877.11	90.34084	16.68599	11.88484	126.5375	542.3425	12.38008	205.226	5.821832
EeQw-3 S3 AN0101	381.975	18679.6	76.27111	15.25573	14.77558	123.6397	522.3939	13.70294	200.4876	7.365046
EeQw-3 S4 AN0102	258.3883	19636.27	97.92234	16.90338	12.75274	131.331	565.7243	10.22366	207.5957	6.20937
EeQw-3 S5 AN0104	458.3939	18637.65	83.33162	16.30701	11.97994	127.3458	538.6906	10.85439	206.5181	6.932478
EeQw-3 S6 AN0106	463.0743	19123.91	120.8901	18.36858	10.49536	130.7599	541.4933	11.9905	208.1738	8.869496
EeQw-3 S7 AN0107	373.6678	20486.77	157.5477	19.3592	12.90251	137.2443	578.7651	10.15587	213.194	9.135956
EeQw-3 S8 AN0108	546.1816	19829.03	98.1603	16.74853	12.81337	127.9886	556.9421	12.07439	215.1006	7.453847
EeQw-3 S9 AN0109	506.1547	22274.99	83.56615	15.83185	6.661036	115.9328	619.1299	11.10461	188.6767	2.909911
EeQw-5 S1 AN0105	338.2023	18676.79	96.42274	17.1278	11.29515	124.0226	547.2577	12.35249	202.8674	7.043503
EeQw-5 S10 AN0129	410.4682	17507.61	77.6528	16.37734	10.69557	126.4284	568.1384	9.698099	213.2242	8.301763
EeQw-5 S11 AN0133	322.6948	18722.7	68.90179	15.67352	14.30029	127.8145	547.3965	12.70018	208.2817	6.234114
EeQw-5 S12 AN0138	375.6837	17949.26	205.6954	23.15167	15.02172	118.447	528.977	10.44613	192.6128	7.033145
EeQw-5 S2 AN0105B	348.8835	19799.14	109.3744	17.51088	15.13425	129.8907	550.5382	11.28911	209.083	6.050363
EeQw-5 S3 AN0106	362.326	23341.62	111.9658	17.18095	9.121208	109.606	612.6178	11.39259	186.4881	4.918732
EeQw-5 S4 AN0109	417.0044	22593.92	3041.782	261.1837	9.916593	118.9652	626.2289	11.13018	190.1229	4.743383
EeQw-5 S5 AN0110	357.7147	19710.24	93.44017	16.52315	12.44498	136.4139	556.0225	12.85517	211.0565	6.582504
EeQw-5 S6 AN0112	353.5368	20640.33	118.9503	18.08065	13.02626	129.7666	569.2128	13.02758	207.7201	6.68858
EeQw-5 S7 AN0114	369.1813	23535.5	117.6717	17.45617	13.69908	121.3975	616.4552	9.168461	191.6286	4.097178
EeQw-5 S8 AN0119	359.1205	20109.97	98.47889	16.40187	9.52601	125.5487	544.0514	11.87028	213.1988	5.541764
EeQw-5 S9 AN0126	460.4428	18598.53	101.3705	17.6148	15.10061	126.1249	537.5461	11.27764	201.9307	6.616688
EeQw-6 S1 AN0054	405.6487	20788.79	100.315	16.58803	15.40061	131.8872	563.072	10.50931	207.8871	6.923062
EeQw-6 S10 AN0136	465.1991	18792.66	882.0748	56.67044	12.71851	122.8901	545.173	11.77293	209.7193	6.188772
EeQw-6 S11 AN0138	380.1067	20592.95	2966.458	229.656	13.03434	129.0816	532.8296	10.35046	196.9897	6.555483
EeQw-6 S12 AN0145	274.0213	19551.08	197.4693	22.64539	13.34055	127.9121	555.1071	10.49528	209.4939	7.203942
EeQw-6 S13 AN0147	313.933	20293.79	91.47096	16.38037	11.47944	131.8681	576.5134	12.19635	206.2209	6.694778

EeQw-6 S14 AN0150	390.0174	17660.69	15301.63	3164.901	9.417832	120.3873	506.0759	11.36257	205.1115	6.572042
EeQw-6 S15 AN0151	414.4517	21926.46	81.12487	15.78881	10.21097	116.2452	628.7459	11.81783	189.4082	5.492145
EeQw-6 S16 AN0152	552.2601	22511.88	7989.505	1078.332	11.2555	119.8241	599.6303	7.613617	183.8026	5.032948
EeQw-6 S17 AN0154	382.5763	18906.59	136.1067	18.01512	8.094439	128.4519	541.349	11.86877	200.8604	7.649009
EeQw-6 S18 AN0156	410.4656	23739.45	119.8302	17.44235	9.298085	112.4437	619.3323	8.398795	183.4488	2.882918
EeQw-6 S19 AN0161	352.4675	17501.79	2167.213	154.0532	10.6073	134.5648	548.5066	11.11639	200.9207	6.288758
EeQw-6 S2 AN0055	405.4324	18956.56	85.14669	15.65195	10.23611	121.5558	528.7355	10.46734	200.9218	8.914012
EeQw-6 S20 AN0164	343.1356	19414.91	89.47851	16.17397	11.91763	131.4108	577.4727	10.15819	207.9385	7.172268
EeQw-6 S3 AN0056	347.2979	19352.86	112.6631	18.01564	13.03933	128.1001	553.3744	10.92276	195.1123	7.211484
EeQw-6 S4 AN0061	248.3259	19551.32	86.5236	15.9005	16.49142	123.5712	558.8379	10.04291	208.9119	8.122676
EeQw-6 S5 AN0062	428.0813	18346.06	82.45132	16.6153	10.70446	121.6372	534.2806	14.2629	202.4038	7.178179
EeQw-6 S6 AN0064	522.9157	19781.07	6391.143	720.497	10.24403	126.7785	548.0788	10.4744	211.8366	6.331865
EeQw-6 S7 AN0101	332.4967	21316.09	162.7136	20.54099	7.332057	86.78935	764.6135	8.695733	187.4384	2.452504
EeQw-6 S8 AN0117	466.4946	18914.2	482.6101	36.65002	7.357424	130.3388	543.164	14.40639	203.1307	6.820671
EeQw-6 S9 AN0123	401.4405	18491.52	76.12051	16.24279	8.818865	122.0161	523.2385	11.95842	201.6626	8.742022
EeRb-10 S1	404.9998	17703.61	78.91919	15.61949	8.447856	121.4763	607.5867	13.76222	200.941	5.419192
EeRb-10 S10	439.4043	18062.68	128.6493	19.33937	13.27228	116.109	502.9491	9.949959	192.8538	4.190667
EeRb-10 S11	398.005	18936.47	136.8243	18.61471	14.28018	127.2069	532.7592	9.23704	199.2935	7.900634
EeRb-10 S2	293.675	17716.78	79.17766	15.97169	10.33426	121.2815	561.2628	11.68425	204.9276	7.518944
EeRb-10 S3	468.8369	24850.69	119.0922	17.08812	10.4846	105.9281	764.4399	12.76159	200.2966	7.070334
EeRb-10 S4	397.2128	19079.95	87.55648	16.65456	13.18447	125.5541	557.2468	13.418	215.1356	6.199281
EeRb-10 S5	491.5253	18788.12	82.55661	16.54424	9.907626	124.3596	520.6266	12.02408	203.7705	7.028434
EeRb-10 S6	425.9714	17789.66	70.06257	15.64267	11.27328	132.5689	612.3179	10.05187	208.1308	7.831059
EeRb-10 S7	382.5254	20297.25	72.57676	15.46633	8.461451	131.6872	564.4629	12.71342	208.3309	3.309567
EeRb-10 S8	324.0767	20105.51	66.08361	15.38162	10.669	133.0189	534.4463	9.905678	207.5947	7.508655
EeRb-10 S9	476.2967	19764.98	72.37429	15.71047	8.947932	123.6059	538.2651	10.72131	205.1439	5.385906
EeRb-11 S1	359.1833	24431.81	137.8665	18.31432	11.29438	118.6456	628.798	9.712086	198.3118	4.12682

EeRb-11 S10	352.4754	25085.76	79.63995	14.44716	10.26945	116.1569	641.7579	10.58012	192.8662	6.460495
EeRb-11 S11	518.3603	23926.78	92.15407	15.81426	9.485135	125.3566	570.3037	10.18378	199.8506	6.649772
EeRb-11 S12	430.9141	19902.5	85.7751	16.5002	13.44406	129.1377	569.0751	11.75047	201.7439	6.076225
EeRb-11 S13	301.5268	17398.63	62.51798	15.3611	7.083802	115.8991	491.7909	10.49087	181.815	7.865647
EeRb-11 S14	477.1333	51817.01	166.9156	12.09278	1.981839	88.26377	145.9176	26.47616	138.5467	1.837775
EeRb-11 S15	371.6874	23032.36	122.3455	16.84256	8.433528	100.6322	582.4843	9.921478	177.5157	5.292796
EeRb-11 S16	392.2574	20002.87	81.46807	16.25222	12.33676	125.7048	558.8122	11.91312	192.6032	5.333753
EeRb-11 S2	853.5468	41726.53	121.928	12.84836	2.366083	31.41765	1045.617	16.82134	117.8753	2.845848
EeRb-11 S3	440.1138	25642.42	76.84749	14.48693	8.908015	116.8621	667.4187	11.98592	193.6663	5.529682
EeRb-11 S4	475.7272	19326.36	105.3097	16.99989	10.4435	122.4491	568.1821	10.23279	198.666	5.981273
EeRb-11 S5	324.0242	19142.33	82.29115	16.1887	17.3989	129.1632	530.5666	12.62561	206.3762	9.198662
EeRb-11 S6	322.9659	23303.16	62.75701	12.26848	-3.0822	18.24518	642.7885	24.268	139.3702	2.163901
EeRb-11 S7	260.7127	17324.65	75.42015	16.4978	10.83722	124.0705	554.1155	11.88915	209.114	5.721156
EeRb-11 S8	407.004	19405.58	78.87313	16.14859	8.507802	131.5242	566.5956	12.29399	211.6465	6.701278
EeRb-11 S9	485.894	18959.19	77.83663	15.94324	10.56761	127.0013	533.5438	13.58507	205.8802	6.94306
EeRb-144 Sample 1 Unit N28E27 LVL 3 10-15 cmbd Basalt Stemmed Point	380.1182	20990.14	86.87408	16.26983	12.78308	132.7867	543.5429	11.74624	218.6033	7.45695
EeRb-144 Sample 10 Unit N17E18 20-25 cmbd	398.0826	19881.38	80.4572	16.10881	11.20074	113.9591	592.8174	8.856578	176.3342	5.11747
EeRb-144 Sample 11 Unit N7E9 LVL 4 15-20 cmbd Lochnore Base	304.569	19145.95	83.95442	16.58692	10.64563	131.2398	545.5024	10.80484	213.8894	6.061628
EeRb-144 Sample 2 Unit N29E2 LVL 7 30-35 cmbd Shuswap Point	424.6785	24483.55	81.27551	14.8102	10.9456	110.1371	636.2688	10.80066	195.419	4.097483
EeRb-144 Sample 3 Unit N15E18 LVL 3 10-15 cmbd	447.5183	18506.55	77.24403	14.60052	8.335721	120.5757	545.8335	13.60963	202.4451	6.900846
EeRb-144 Sample 4 Unit 2 18-19 cmbd Thompson Phase Point	446.3341	20166.98	65.01143	15.02705	13.36891	130.9287	574.0401	11.51917	212.4936	9.214263
EeRb-144 Sample 5 Unit N12E11 LVL 3 10-15 cmbd Thompson Point	428.5977	23975.52	92.04397	15.88371	9.009151	114.5831	630.335	11.78933	188.3779	5.015789
EeRb-144 Sample 6 Unit N15E18 LVL 3 10-15 cmbd PP	346.2155	19676.92	64.13234	15.07448	14.46811	130.9596	555.8865	14.14996	198.0656	7.350824

EeRb-144 Sample 7 UnitN9E11 LVL 3 10-15 cmbd Lochnore Point	444.7385	19879.8	72.78517	15.33519	12.66131	125.1513	537.0254	12.72006	207.9246	6.00406
EeRb-144 Sample 8 Unit N11E6 LVL 4 15-20 cmbd Lochnore PP	532.2536	24528.78	91.73937	15.32341	10.22931	109.0176	592.3356	8.761715	186.1733	4.648383
EeRb-144 Sample 9 Unit N7E8 LVL 2 5-10 cmbd Biface	405.4425	23094.98	97.45054	16.42349	12.6313	125.2848	608.2811	9.784103	191.7372	4.853009
EeRb-77 Sample 1 Unit S4W8 Level 20-30cmbd Shuswap Point Base	393.0432	23229.48	70.8834	14.87968	11.43801	125.0612	623.5117	10.3233	188.7779	2.407014
EeRb-77 Sample 10 Surface Collection	382.9864	23441.89	82.59492	15.1867	8.842609	105.6849	598.2619	9.937155	184.4612	6.345057
EeRb-77 Sample 11 Unit N13W5 LVL 20 95-100 cmbd Leaf Shaped PP	366.1	24497.44	83.40341	15.09431	8.610205	106.7428	638.8606	11.46427	190.3605	3.700946
EeRb-77 Sample 12 Transect A Unit 1 LVL 5 41-5D West Side to 53 Leaf Point	443.0982	21502.07	88.26539	16.24439	12.5258	109.2211	654.577	15.01502	229.5658	4.170677
EeRb-77 Sample 13 Unit N11W2 LVL 26 125-130 cmbd Preform PP	451.4151	20147.13	86.72115	16.1209	14.05132	133.6733	565.4054	10.30503	212.7432	7.08291
EeRb-77 Sample 14 Unit N13W4 LVL 22 105-110 cmbd Inc Biface Point	320.557	19440.82	73.37126	15.12765	12.19141	129.4894	537.0223	11.97151	203.9388	7.468968
EeRb-77 Sample 15 Unit N13W4 LVL 24 115-120 cmbd Preform	319.3414	21525.22	68.01904	15.15475	11.73567	116.7524	596.8593	10.66183	181.2994	5.238445
EeRb-77 Sample 16 Unit N13W4 LVL 25 120-125 cmbd Preform	327.1246	18726.46	70.72652	15.85465	11.16182	118.0215	522.2763	11.81887	198.6773	6.871703
EeRb-77 Sample 17 Unit N6W8 LVL 32 90 cmbd Preform	290.6323	17973.75	77.11189	16.45982	11.51666	125.5241	563.0499	9.545404	209.1287	6.713508
EeRb-77 Sample 2 Unit N14W2 Level 17 80-85cmbd Shuswap Point	379.1674	20220.27	77.9666	15.99842	14.64521	131.2203	573.1011	12.21414	209.0258	7.559266
EeRb-77 Sample 3 Unit N6W12 Level 28 135-140cmbd Plateau Point	369.1267	19837.93	89.05607	14.92816	10.35422	132.454	575.7655	11.37869	208.8177	7.957667
EeRb-77 Sample 4 Unit 740-750	365.4127	20271.96	71.87549	15.18764	10.72334	133.1879	556.7151	11.96332	206.3366	5.389924
EeRb-77 Sample 5 Site S3W7 Quad S4W8 Level 17 80-85cmbd Late Period PP	382.6208	25634.77	81.14708	14.93229	8.868444	111.6141	673.1655	9.411598	194.4061	3.581806
EeRb-77 Sample 6 Unit N13W4 Lvl 23 110-115 cmbd Plateau Point	444.1724	19932.31	69.9115	14.8647	11.28374	126.9163	559.246	11.04292	199.8677	8.197646
EeRb-77 Sample 7 Unit N13W4 LVL 21 100-105 cmbd PP	403.6992	18712.78	68.92459	15.70769	8.389467	128.757	543.031	12.45583	205.2938	7.968268
EeRb-77 Sample 8 Unit N14W3 LVL 19 90-95 cmbd Plateau Point	491.4876	24204.53	91.15373	15.22717	11.89098	129.9268	571.8871	11.66448	207.9165	4.688426

EeRb-77 Sample 9 Unit 1 150-160 cmbd	449.5007	19863.17	78.05016	15.25137	9.119096	130.7333	547.6865	10.64075	202.1461	6.375226
EeRc-8 S1 AN0011	240.9938	18506.54	99.9063	17.3562	9.930425	120.1256	510.9077	10.69863	193.9464	6.339418
EeRh-3 S1	335.6599	18626.94	81.38583	13.97478	-1.28047	24.70208	9.605607	4.559282	40.93037	0.949366
EeRh-3 S10	429.529	19876.89	125.4518	18.46576	10.03447	126.2433	554.7787	13.72085	199.1673	6.937345
EeRh-3 S11	353.9698	20242.28	192.5591	22.05552	15.55395	128.5185	561.4739	10.57419	203.4439	6.869546
EeRh-3 S12	382.5951	19922.66	134.0951	19.23779	16.14859	130.337	541.725	11.63414	208.946	5.793502
EeRh-3 S13	466.2084	20318.5	108.8939	17.69088	11.26221	134.3718	550.8122	9.608928	210.415	5.031264
EeRh-3 S14	423.0243	19572.72	118.6635	18.08567	11.96151	130.4386	526.3455	11.66872	207.6454	7.325901
EeRh-3 S15	390.9579	19716.62	187.4624	22.35901	13.68037	125.2922	546.0144	12.34886	209.3279	9.345513
EeRh-3 S16	438.8083	21700.27	230.27	24.21859	13.69397	121.8092	514.2403	11.77797	210.4126	9.487819
EeRh-3 S17	268.8278	19824.53	154.8819	20.4882	8.286794	87.08895	752.8034	7.43169	186.4223	2.339934
EeRh-3 S18	338.7162	19725.38	108.7586	17.34529	10.75332	129.226	537.0897	10.86862	204.3178	7.741839
EeRh-3 S19	346.4586	23857.2	120.2954	17.39165	13.52347	122.5104	644.3896	10.75301	196.6414	4.049321
EeRh-3 S2	393.7533	23111.07	111.8134	17.17095	10.36223	106.9615	605.5034	10.36526	181.7396	2.989109
EeRh-3 S20	402.1929	27412.02	134.2844	17.23392	9.185719	119.9398	727.3478	9.831821	198.4618	4.631484
EeRh-3 S21	338.711	19803.02	125.5764	18.76024	11.60786	130.0811	545.737	11.55149	204.1044	9.16552
EeRh-3 S22	394.254	23974.89	132.8887	17.67105	13.78561	111.8105	606.4132	11.79333	183.7264	1.313666
EeRh-3 S23	330.1257	21416.43	100.5658	16.75287	13.48206	129.1678	559.3527	12.50773	212.7253	6.797984
EeRh-3 S24	369.2771	19666.37	111.5738	17.92012	11.12957	126.466	535.901	12.19045	211.889	8.060558
EeRh-3 S25	381.1277	21125.13	119.771	18.10385	11.34359	133.501	561.7843	13.12851	206.2674	6.904247
EeRh-3 S3	445.6681	20361.06	116.1206	18.09832	13.24627	129.7903	555.3459	11.88703	204.7423	8.062205
EeRh-3 S4	374.4426	20774.93	117.8552	18.00735	14.8042	132.7803	552.226	11.77999	208.7726	6.271044
EeRh-3 S5	497.9249	17161.97	130.6403	18.72838	12.36759	121.3059	491.8758	9.808123	187.4918	7.027106
EeRh-3 S6	327.4768	21222.89	135.0165	18.98487	11.44297	122.8723	511.6616	12.14571	208.2074	6.023326
EeRh-3 S7	260.8884	22062.92	148.7836	19.33288	8.07137	92.30207	776.1922	7.842645	183.4719	3.2055
EeRh-3 S8	451.2477	20650.45	119.6901	18.09803	13.89476	129.2614	552.2232	11.06886	214.8956	6.37131
EeRh-3 S9	304.1459	19875.82	131.0476	19.04055	11.70901	130.4526	573.684	10.68275	203.6486	6.036123

EeRh-61 S1	364.307	18754.6	109.4594	17.86125	11.58549	120.6732	535.4294	11.46492	195.7862	6.374941
EeRh-61 S10	368.7869	18280.73	105.643	17.99606	12.70223	124.5115	544.0793	12.02151	198.7754	6.717442
EeRh-61 S11	411.7642	20142.13	125.3238	17.71755	11.70803	134.4108	562.3993	8.235436	210.8819	7.279853
EeRh-61 S12	488.4004	19221.6	104.3566	17.6232	10.4499	122.8607	548.0471	11.89371	196.5475	8.077656
EeRh-61 S13	299.461	19767.38	106.9038	17.73246	12.21731	128.3385	558.7777	13.60256	213.0213	8.289933
EeRh-61 S14	486.2641	19834.36	131.3711	18.80333	15.73415	131.9226	546.4377	9.779574	210.875	8.717369
EeRh-61 S15	384.7878	19627.36	122.3673	18.5698	13.91204	131.3975	566.5534	11.3778	215.3948	7.523441
EeRh-61 S16	372.6473	20074.68	153.492	20.12981	8.959676	129.5374	562.3082	12.34298	202.8446	4.950717
EeRh-61 S17	455.0491	20569.66	132.4347	18.71841	14.3676	136.0319	581.0563	12.86071	208.3378	8.63483
EeRh-61 S18	367.7953	20960.23	136.6085	18.88713	13.99333	130.6611	575.8347	12.27154	204.6826	6.707157
EeRh-61 S19	389.1969	20007.98	124.5655	18.59547	10.70495	135.86	571.9805	11.64567	209.6798	7.399592
EeRh-61 S2	412.7294	29017.47	153.899	18.14763	11.03832	118.2036	653.1981	8.08988	199.4505	6.383132
EeRh-61 S20	418.4096	19748.99	109.7558	17.88132	11.52815	125.0807	538.874	9.896734	202.4046	6.378773
EeRh-61 S3	314.1015	19860.09	120.877	18.21577	10.76513	119.0164	533.0732	10.44732	198.181	6.623973
EeRh-61 S4	286.0932	19915.65	106.0023	17.19214	8.765043	119.7282	537.7052	11.04029	193.7061	5.779078
EeRh-61 S5	439.3292	20007.62	113.277	17.07445	13.54022	129.5968	565.1428	12.35283	209.4314	7.731409
EeRh-61 S6	459.1553	19057.42	135.9529	19.28022	13.96998	127.5964	544.792	10.58986	204.0094	8.93056
EeRh-61 S7	404.0094	20194.97	133.4383	18.77684	13.07564	132.8445	562.2897	14.66777	204.8041	5.918418
EeRh-61 S8	468.6593	18861.58	119.7256	18.62383	13.80601	121.1971	547.6559	12.0366	202.7712	7.733267
EeRh-61 S9	470.7347	26072.47	134.6184	17.52089	9.524656	105.0502	664.606	10.66228	182.4422	5.537965
EeRl-18 S1	431.3715	21027.16	86.80535	16.29545	15.03476	133.2279	563.4987	10.38707	213.2358	7.851073
EeRl-18 S2	394.4176	20252.23	80.42442	16.1328	12.70282	131.3714	567.8349	10.73811	213.6415	8.046944
EeRl-18 S3	424.0425	18506.09	72.82401	15.8399	8.885108	127.2132	518.2021	13.15406	206.8146	7.622237
EeRl-18 S4	380.7211	20302.98	91.31393	16.73238	12.79137	127.9545	579.174	10.52523	206.51	7.156421
EeRl-18 S5	367.675	18741.21	80.36499	16.3323	9.360081	123.6088	533.9382	11.66483	203.0696	6.867003
EeRl-18 S6	395.5819	20464.77	87.01591	15.95255	6.810956	90.60244	733.3222	6.365897	187.5937	2.482545
EeRl-18 S7	312.1599	21862.09	79.44566	15.70547	12.30192	129.9362	567.1877	9.670728	211.3167	7.769593

EeRI-18 S8	419.3566	18911.21	79.42585	16.31889	14.96356	130.6957	552.1555	10.03471	212.6038	6.320538
EeRI-18 S9	-19.2839	1500.763	4.077396	3.082318	-7.56951	-5.42696	2.95157	-1.01309	13.41542	-1.65345
EeRI-212 S1 ET 1-5 AN0001	256.6767	18626.21	120.1863	17.90471	6.039282	86.52024	699.8822	7.315112	170.781	2.248913
EeRI-212 S2 ET 1-5 AN0007	332.2375	21606.28	127.483	18.46724	9.12541	94.03327	795.5361	7.722267	193.4976	3.146576
EeRI-22 S1	335.0917	18789.76	118.5333	18.56026	11.92169	124.6504	528.2933	11.29267	206.4885	6.233907
EeRI-22 S10	478.4388	20704.23	125.5923	18.52312	10.80746	128.6696	574.0051	14.08824	216.6572	7.793527
EeRI-22 S11	336.6483	19520.52	149.2715	20.1286	6.26331	85.87834	705.2598	8.253957	181.7773	2.798626
EeRI-22 S12	579.2334	20667.28	127.813	18.43657	5.419535	92.09221	785.9667	8.257514	188.2926	1.748982
EeRI-22 S13	445.613	20643.28	122.9008	18.14496	11.60507	133.8619	566.5155	12.04956	218.0347	6.331876
EeRI-22 S14	387.2491	17680.39	126.4267	19.21879	13.45766	119.385	487.472	10.51101	187.3325	5.254703
EeRI-22 S15	493.677	22384.79	131.9144	18.47919	10.21353	116.0701	614.8174	11.48794	185.3876	4.272088
EeRI-22 S16	332.7792	19976.46	119.797	18.01889	15.80503	128.19	555.5584	13.67468	210.73	8.353514
EeRI-22 S17	424.1915	19787.2	131.6931	18.32543	12.62746	125.9245	555.3238	9.245387	197.3862	9.920546
EeRI-22 S18	458.9503	19347.71	125.7323	18.75971	14.53421	130.4042	570.5234	11.7467	203.2646	7.743428
EeRI-22 S19	298.8533	20314.7	123.9019	18.5643	10.89615	93.83995	770.6724	8.107411	190.4603	3.302856
EeRI-22 S2	855.6137	20446.8	166.0472	20.57607	8.053367	95.74995	776.1384	7.518933	188.4292	2.107296
EeRI-22 S20	470.2261	20448.02	123.7123	18.50456	14.72005	135.575	552.2448	11.2879	212.37	10.71316
EeRI-22 S21	450.4071	19459.51	176.8924	20.98766	12.8733	126.4261	556.7636	12.2228	206.1502	6.303635
EeRI-22 S22	405.0099	20143	142.7105	19.43707	11.05702	127.9224	562.6354	11.50375	201.7525	8.693756
EeRI-22 S23	561.0617	19266.77	105.5232	17.68132	13.8019	124.6069	544.5534	14.09206	216.6735	8.75699
EeRI-22 S24	284.6387	20577.94	133.1281	18.63102	9.137321	90.65289	771.5099	7.914295	185.7588	2.420957
EeRI-22 S25	360.9883	20012.83	121.4052	18.14226	12.24431	126.6341	534.3349	12.02577	205.16	6.306866
EeRI-22 S3	388.1415	20297.03	122.2797	18.36264	14.0164	134.0014	580.2211	11.1399	210.1506	6.320404
EeRI-22 S4	339.5958	19856.38	124.0063	18.56928	7.670638	92.15372	733.5765	7.423983	181.5831	2.254119
EeRI-22 S5	443.943	20530.41	132.6004	18.92591	11.23625	135.3028	588.4342	11.32455	217.2468	7.259998
EeRI-22 S6	319.4281	19315	121.3914	17.88718	11.60892	123.1087	551.288	11.18498	201.7182	7.45936
EeRI-22 S7	612.0879	19659.7	120.8849	17.61864	15.17054	131.4686	554.2498	10.64172	205.8313	7.659821

EeRI-22 S8	478.6909	20010.92	213.6243	23.33977	13.72554	121.7858	571.4847	12.60686	214.5266	8.221032
EeRI-22 S9	363.92	20493.41	116.7506	17.93829	6.699869	98.80207	780.3296	6.148817	194.5335	3.358314
EeRI-30 S1	360.0228	19782.95	78.51803	15.21454	14.96315	129.6371	558.9641	11.78839	215.5053	5.216448
EeRI-30 S2	356.7087	19110.6	80.08436	15.95067	8.993104	125.0361	556.1168	8.822391	209.6848	8.092175
EeRI-30 S3	431.5509	19972.93	82.77825	15.86998	11.00385	131.4391	557.1088	11.19481	213.4781	7.932989
EeRI-30 S4	754.3572	21754.79	93.25315	16.35855	11.30396	134.715	589.2251	14.05736	214.256	7.861782
EeRI-30 S5	397.3398	20251.09	74.70474	15.52434	11.02687	127.555	560.6475	13.9409	201.4335	6.238403
EeRI-30 S6	452.0324	28083.97	98.68759	15.28265	9.603603	111.5973	748.6952	12.0232	211.382	7.967805
EeRI-30 S7	391.6655	20197.59	81.93035	15.45114	9.128111	132.2688	561.1672	10.49447	210.8005	7.02165
EeRI-30 S8	404.169	19873.37	74.42397	15.46757	10.89299	129.2448	549.9827	12.05561	212.1609	6.213814
EeRI-30 S9	377.7522	20053.64	67.99259	15.48415	13.17389	130.803	574.1827	11.52918	207.6673	8.243196
EeRI-6 S1	420.597	20653.93	121.2911	17.98994	13.48831	133.6231	572.489	10.32655	211.2739	5.849011
EeRI-6 S10	400.2937	18497.5	112.1263	18.03414	8.235041	121.5384	489.7258	11.12372	185.4045	5.383392
EeRI-6 S11	430.4673	19520.72	123.9888	18.26442	11.94444	127.2012	537.8294	12.07734	207.1394	9.382286
EeRI-6 S12	467.7629	25375.09	142.9117	18.25021	12.18344	123.2289	632.5651	9.417167	193.5777	3.688005
EeRI-6 S13	460.2429	18804.1	114.6041	18.31661	10.56906	126.1662	530.8571	11.53559	203.3926	7.304254
EeRI-6 S14	281.1986	20744.34	128.5604	18.42269	6.343358	89.38536	793.1019	10.03249	188.8171	4.255698
EeRI-6 S15	425.0742	19386.45	113.7026	18.06322	12.1812	133.2417	544.3333	10.00068	211.9678	8.370811
EeRI-6 S16	464.3662	21365.16	117.0968	17.90754	13.6925	140.1518	587.5196	10.20426	216.6512	8.045528
EeRI-6 S17	386.6283	20852.98	137.2957	19.16307	7.717577	92.45795	755.1544	9.951228	199.1053	3.818315
EeRI-6 S18	339.2884	20450.29	114.6447	17.66658	7.642816	92.0592	774.6569	9.911923	191.4948	0.504059
EeRI-6 S19	413.1706	20047.36	114.7649	17.46183	10.33878	86.16253	752.7508	8.14173	193.0908	1.69998
EeRI-6 S2	376.7324	19729.18	111.0354	17.96976	11.1685	130.1247	554.2887	12.6287	215.5826	7.553895
EeRI-6 S20	377.8509	19826.79	123.1432	18.4725	13.39078	127.5738	545.1211	12.71438	202.1865	6.377983
EeRI-6 S3	367.4085	19617.6	113.5933	18.11587	10.25074	128.5927	554.7172	10.921	206.4998	7.114247
EeRI-6 S4	418.2179	20686.93	118.1131	17.92115	11.14413	133.1897	575.1911	9.284422	208.4817	6.323763
EeRI-6 S5	417.2483	21343.74	118.0442	17.98272	9.764713	104.7932	619.1191	11.63803	185.0637	4.980939

EeRI-6 S6	404.2135	19032.62	114.5458	18.26866	12.38825	123.7679	539.0583	10.20727	198.7217	7.553257
EeRI-6 S7	370.8759	20260.81	122.8499	18.5061	10.13677	93.60545	757.4832	7.956761	183.8517	1.896654
EeRI-6 S8	298.3987	20488.91	132.2548	18.78584	12.3567	127.8143	559.5007	11.30616	202.2597	7.706982
EeRI-6 S9	527.3572	30215.66	135.0566	16.49442	10.77885	104.7292	749.5485	10.24551	190.5493	3.95021
EeRI-7 S1	363.2863	24641.26	156.0517	19.34565	11.89037	107.8773	631.7029	9.706631	190.5264	6.129231
EeRI-7 S10	461.8049	28602.49	132.3835	16.44865	9.26024	99.84799	752.925	10.00101	194.1619	6.852423
EeRI-7 S11	353.5242	20085.9	124.2442	17.48093	11.48173	127.9978	566.5226	12.14885	205.2107	5.83479
EeRI-7 S12	414.7259	20115.69	116.6602	18.18879	11.87027	133.2934	565.2705	11.62273	209.5003	7.575479
EeRI-7 S13	319.5555	18993.28	115.2093	18.37772	13.70855	129.6503	550.9294	12.09928	209.0041	6.415518
EeRI-7 S14	711.5946	56024.55	158.3045	9.423069	0.185402	29.59577	1010.489	16.78622	192.8694	6.560394
EeRI-7 S15	265.8386	19801	122.2643	18.54714	16.05014	129.4411	555.3858	12.03795	207.6603	6.423632
EeRI-7 S16	63.47371	6558.605	69.69605	13.24865	-2.29817	19.92293	10.60597	3.603166	30.52676	1.756852
EeRI-7 S17	481.0778	20115.38	118.2626	18.23837	10.68271	129.4277	564.3542	12.85023	203.789	4.330319
EeRI-7 S18	446.5001	20104.09	119.3819	18.26187	12.36136	123.0077	557.7625	13.60419	203.6384	5.843812
EeRI-7 S19	556.134	27923.3	137.0761	16.29827	10.16888	110.549	725.3182	10.0737	206.1228	7.038269
EeRI-7 S2	499.1006	19370.89	120.6707	18.41688	10.26786	122.3961	508.945	11.54864	203.014	8.563262
EeRI-7 S20	481.3597	19859.09	114.6689	18.0431	11.14237	129.2344	577.9984	12.12371	201.9757	4.466421
EeRI-7 S21	359.3818	18636.71	117.247	18.00811	10.47222	120.3775	514.447	10.24394	190.1931	6.296101
EeRI-7 S22	298.6163	20369.7	135.3939	19.22111	6.169161	89.35	765.1112	7.431614	194.3998	2.112331
EeRI-7 S23	274.4129	18827.87	111.3527	18.1152	12.84671	123.807	518.8886	13.57323	204.8508	9.333199
EeRI-7 S24	363.8208	19547.04	120.4212	18.20919	11.03778	128.4964	552.1856	10.89234	206.7746	7.86884
EeRI-7 S25	252.3712	20221.58	129.6701	18.92654	9.49693	92.22397	749.1416	6.971868	187.5756	3.049811
EeRI-7 S3	290.2355	18718.5	119.6311	17.70538	11.95998	114.6515	522.2575	10.48573	192.9898	7.491506
EeRI-7 S4	410.7923	21333.86	153.2842	19.94192	9.675011	99.21747	786.778	7.824157	194.2866	2.251954
EeRI-7 S5	333.2309	19629.02	132.8487	19.23817	15.28199	131.6212	558.5741	12.49091	211.3649	8.295108
EeRI-7 S6	221.8123	19732.39	122.6486	18.56639	7.391496	90.32988	751.5711	9.229411	189.4081	2.900571
EeRI-7 S7	327.1826	19216.44	121.0227	18.62792	14.66929	129.1662	533.4811	10.94517	206.6619	8.139361

EeRl-7 S8	360.8875	19863.23	136.9629	18.6352	11.30447	131.6759	574.7127	13.63222	218.9246	9.318539
EeRl-7 S9	278.2615	21135.47	129.652	18.63979	9.781031	98.57493	795.464	8.979854	196.8524	2.119171
EfQt-1 S1	405.54	19177.48	134.8543	19.37353	11.57297	127.0665	533.2121	11.15902	206.7329	7.657095
EfQt-1 S10 U34 Lvl4	365.8705	18066.14	133.6112	19.51766	16.67608	127.364	516.1077	11.57288	208.3936	7.099338
EfQt-1 S11 Area B Surface	420.6769	19757.14	136.3084	19.39526	14.50629	134.9159	576.2284	13.69458	212.9034	8.318033
EfQt-1 S12 U38 Lvl2	418.173	18782.31	134.5005	18.97035	11.05859	126.2933	550.8557	13.56434	206.648	7.305484
EfQt-1 S13 U6 Lvl2	476.8537	20105.19	144.7689	19.6989	12.66455	129.5595	560.1517	11.12082	205.4116	8.280818
EfQt-1 S14 U39 Lvl2	336.9005	18436.58	133.6512	19.25523	9.791627	128.2061	541.7413	13.54093	209.7286	6.285286
EfQt-1 S15 Surface	344.1276	19027.38	151.256	20.452	13.16289	131.6866	555.692	10.70422	206.6607	7.318577
EfQt-1 S16 U34 Lvl1	339.4027	19369.2	137.8351	19.02829	12.85377	123.0082	548.6939	12.83438	202.7111	6.560397
EfQt-1 S2 Unit 49 Lvl4	409.3191	19523.6	115.4622	17.9857	12.38579	125.8832	545.1777	12.23394	209.0152	7.957153
EfQt-1 S3 Unit 49 Lvl2	574.8996	19533.9	123.6882	18.0042	16.03133	123.356	523.3885	10.85255	211.7468	9.172783
EfQt-1 S4 U49 Lvl3	909.7746	30522.21	130.2777	15.84227	0.949184	27.10991	563.403	14.09302	126.5895	6.888167
EfQt-1 S5 U28 Lvl1	479.1305	18716.62	128.1644	19.10407	15.28646	130.0586	547.0274	11.17713	212.794	8.473783
EfQt-1 S6 U44 Lvl2	475.2419	18322.43	155.3371	20.74472	13.1695	124.0123	515.186	10.72814	203.8949	6.170816
EfQt-1 S7 U49 Lvl3	236.6643	18042.9	153.855	20.83593	13.90759	119.5212	488.6609	12.03981	196.6238	6.999464
EfQt-1 S8 U49 Lvl3	341.5718	19622.89	136.8854	19.3401	13.26133	130.9363	536.5552	11.80247	200.5729	7.170659
EfQt-1 S9 U49 Lvl1	464.8012	19693.89	138.1864	19.45148	12.32045	129.4623	541.2309	10.90768	204.5794	6.722735
EfQv-10 S1 AN0002	513.0708	19501.55	97.16415	17.08401	13.2527	127.659	559.6256	10.71262	208.3751	7.163621
EfQv-10 S10 AN0023	263.7009	19790.2	73.71524	14.62165	14.58523	128.4944	531.5594	11.96044	203.7643	5.54502
EfQv-10 S11 AN0028	535.8358	24702.75	96.63394	15.63091	11.07836	111.3153	623.9909	13.06026	187.8929	2.918759
EfQv-10 S12 AN0041	394.8231	19750.29	86.7775	16.57146	14.24729	131.638	552.4331	12.25137	210.8919	7.240101
EfQv-10 S13 AN0054	418.1671	19464.28	1097.33	82.91412	13.39292	128.9203	550.5376	10.63421	199.4303	8.743547
EfQv-10 S14 AN0055	480.3134	19453.56	76.12639	15.68685	12.49017	127.1975	556.9977	12.85724	205.7581	6.331774
EfQv-10 S15 AN0102	420.536	18769.74	95.33719	17.28402	9.209241	123.9282	540.3319	12.94351	202.3115	4.855446
EfQv-10 S15 AN0103	432.5245	19097.48	283.225	27.67527	10.0519	121.9123	524.0459	12.36488	201.3454	5.219492
EfQv-10 S16 AN0109	407.5599	18749.36	54.22857	13.49167	11.65836	122.0268	509.3518	14.1016	203.9292	7.169153

EfQv-10 S17 AN0120	429.2701	23336.94	7280.022	918.4002	10.13183	121.8815	604.7634	8.206496	186.7371	4.037102
EfQv-10 S18 AN0131	447.9418	19024.01	78.7694	16.29703	12.0435	129.7195	538.2232	10.68942	197.2082	5.49476
EfQv-10 S19 AN0132	450.098	18580.14	84.01369	16.15793	12.5413	122.2428	515.1618	11.73748	199.0639	5.506371
EfQv-10 S2 AN0004	365.5313	19028.19	73.09639	15.28393	13.03742	127.2176	529.9796	9.406413	207.2761	7.997216
EfQv-10 S20 AN0133	503.4661	21562.57	100.4892	16.40297	11.32249	117.4192	586.8379	11.80929	186.6581	5.201016
EfQv-10 S3 AN0007	444.1442	19915.43	94.22741	16.53683	10.68585	125.2306	545.5716	10.43487	204.6276	7.140289
EfQv-10 S4 AN0012	356.1415	19320.61	98.08908	15.73843	14.43578	128.7478	563.7636	11.0212	204.0734	7.710507
EfQv-10 S5 AN0015	421.4412	20149.22	141.4437	18.96676	12.86833	130.7856	573.9969	10.68195	209.3191	6.262111
EfQv-10 S6 AN0019	596.9994	30918.62	191.2903	19.43703	7.830539	100.1533	746.8039	10.68559	208.8271	4.674694
EfQv-10 S7 AN0020	500.231	27755.87	174.5553	19.51807	7.827705	104.3505	743.9782	14.16548	217.4136	7.679207
EfQv-10 S8 AN0021	428.7273	20078.97	82.49953	15.58604	11.31778	120.0831	538.3193	13.33009	203.5728	6.769898
EfQv-10 S9 AN0022	366.9021	18949.28	6629.529	752.7579	14.49885	118.2176	530.6686	11.61145	204.6568	6.621257
EfQv-12 S1 AN03-0957A CD2 Unit M Lvl9	345.5293	18771.14	75.23594	15.68787	12.40136	121.455	526.2714	10.73935	196.6393	5.771018
EfQv-12 S10 AN03-1222a CD2 Unit F Lvl6	407.3436	17915.16	132.3303	19.36387	13.34499	128.6499	555.912	11.69532	212.3947	7.034785
EfQv-12 S11 AN03-1220A CD2 Unit G Lvl5	344.1526	20947.07	83.59632	16.16712	11.21515	132.7104	570.3626	13.61811	209.2826	7.695474
EfQv-12 S12 AN03-1208A CD2 Unit K Lvl5	478.1087	19181.5	80.20917	16.2321	10.22341	130.7145	535.0425	12.65768	206.8276	7.253919
EfQv-12 S13 AN03-0697a CD2 Unit J Lvl3	427.3716	23251.56	87.77109	15.82275	11.89967	124.7638	608.724	11.26305	190.1771	3.714623
EfQv-12 S14 AN03-1195a CD2 Unit K Lvl8	71.25291	10835.32	18.89933	7.42381	-6.31253	9.844758	34.6546	3.844452	26.19712	1.040031
EfQv-12 S15 AN03-1138A CD2 Unit E Lvl7	399.443	19666.29	101.435	17.34318	12.43291	133.823	541.7679	11.11065	211.9202	8.684209
EfQv-12 S16 AN03-1133A CD2 Unit G Lvl6	291.3099	20434.93	85.67838	16.21288	8.898941	129.8827	572.0366	10.53933	208.098	6.902177
EfQv-12 S17 AN03-1037B CD2 Unit D Lvl5	322.4937	18104.92	74.69626	15.09143	10.96776	120.0661	494.294	11.03751	193.3136	7.221612
EfQv-12 S18 AN03-1267A CD2 Unit D Lvl7	412.0126	19143.9	70.0196	15.36153	10.83834	134.2063	531.5482	12.18669	203.7728	7.286159
EfQv-12 S19 AN03-1123A CD2 Unit J Lvl7	381.8662	19872.86	75.83765	15.53543	9.953213	128.8671	547.0554	8.724532	198.2589	7.898371
EfQv-12 S2 AN03-1031A CD1 Unit U Lvl6	382.2272	19372.4	69.2702	14.55452	10.36914	127.2892	538.883	10.23903	197.1054	8.129021
EfQv-12 S20 AN03-1082A CD2 Unit G Lvl8	548.0363	28075.88	92.37573	14.90289	11.36401	107.2312	716.1279	13.38663	213.0794	6.254493
EfQv-12 S3 AN03-1032A CD1 Unit U	379.1795	19941.21	69.25858	15.51125	11.29922	133.2832	550.7954	12.05466	204.7851	5.696819
EfQv-12 S4 AN03-0952 CD 2 Unit D Lvl 0-30cm	329.2375	18499.84	87.65504	16.94477	8.685289	116.248	725.9001	11.30626	197.0931	8.118447

EfQv-12 S5 AN03-0901A	359.6376	19394.11	86.71846	16.59421	10.55326	124.9107	534.5312	13.23166	196.4275	6.243796
EfQv-12 S6 AN03-0896A CD1	429.208	23821.1	81.16702	15.31253	8.611144	121.566	586.2994	11.53555	191.6952	5.806359
EfQv-12 S7 AN03-0887A CD2 Unit M Lvl7	444.0053	19009.72	84.24827	15.38376	11.61121	123.3141	525.1421	9.784382	202.0921	7.034607
EfQv-12 S8 AN03-0847A CD2 Unit K Lvl9	456.3267	23400.55	76.91659	15.07562	10.57728	114.8256	604.9171	9.389119	178.891	4.393701
EfQv-12 S9 AN03-0714a CD2 Unit J Lvl9	368.6744	18615.63	92.04216	16.81717	12.54919	127.9961	530.8932	9.392089	201.4972	8.062306
EfQv-2 S1	478.1413	19882.36	161.751	20.75669	14.80802	131.399	553.9424	12.90355	214.6136	7.003396
EfQv-2 S10	445.9109	22120.89	147.9069	19.49765	8.998922	112.3083	606.8637	8.985735	174.7928	5.856638
EfQv-2 S11	354.8585	24436.34	197.3166	19.93941	11.85888	111.1225	581.6883	7.478025	178.3209	5.059778
EfQv-2 S12	481.671	25705.93	162.1918	19.23997	10.76964	61.81396	838.6944	14.22946	206.7015	3.803488
EfQv-2 S13	472.4834	18543.18	142.9957	19.36683	11.70352	120.9654	523.9214	11.44672	200.5368	6.003648
EfQv-2 S14	406.7427	19925.52	137.7497	19.25741	8.615894	126.0106	568.8441	11.30492	200.8319	6.022774
EfQv-2 S2	466.758	19534.92	153.829	19.81272	11.26802	125.4971	541.6985	9.701331	204.7036	5.950882
EfQv-2 S3	420.8394	18115.79	155.242	20.07493	15.50206	121.207	508.7852	11.09768	197.8291	5.851392
EfQv-2 S4	507.2999	19013.22	169.0106	21.38109	11.71324	131.5239	522.1207	11.3058	214.6501	7.642629
EfQv-2 S5	428.2067	19390.64	150.7401	20.31693	14.75719	125.8528	543.4111	12.19203	242.2682	6.973331
EfQv-2 S6	525.532	24934.66	153.0479	18.98471	13.33201	106.0687	673.764	11.26586	190.7068	4.678702
EfQv-2 S7	420.1349	21213.58	137.8956	18.96841	12.59961	136.0083	582.2658	12.42793	222.0083	5.688765
EfQv-2 S8	375.8335	19220.74	121.4405	18.66556	11.41274	127.8055	530.98	12.11635	198.5049	9.021746
EfQv-2 S9	408.6942	22924.21	158.2128	19.90187	10.29783	110.3582	575.0411	8.834926	178.1123	4.984771
EfQw-2 S1 AN0178	381.2596	19569.2	86.85271	16.1469	11.094	134.99	562.9041	11.59449	203.589	7.082358
EfQw-2 S2 AN0162	493.7444	26243.42	86.04679	14.9153	12.3971	106.3064	685.3151	11.95544	198.1065	5.806868
EfQw-2 S3 AN0144	361.6839	19262.57	71.85817	14.91917	8.489296	129.2424	548.314	9.877079	206.4971	6.823666
EfQw-2 S4 AN0034	296.5563	19642.07	74.18073	15.2844	12.1696	130.8704	555.5866	10.52407	210.3858	4.50424
EfQw-2 S5 AN0072	494.9139	19566.19	76.54107	15.07248	10.36858	132.6653	557.2453	11.5256	210.2971	10.33551
EfQw-2 S6 AN0208	453.7219	19022.31	66.64225	15.49156	10.2843	128.9845	513.8023	11.31122	199.9174	7.687103
EfQw-2 S7 AN0182	506.3153	19558.56	85.92984	14.90513	11.12344	127.9456	528.7412	11.99572	212.7068	8.055956
EfQw-2 S8 AN0187	329.9651	17913.2	73.28076	13.86344	9.240704	119.8337	501.3055	12.87303	196.1747	5.11811

EfQw-21 S1 AN0101	466.592	19803.5	60.28109	14.83057	10.78808	126.938	552.6171	10.81799	210.1299	5.634571
EfQw-21 S10 AN0068	-14.1317	5115.78	11.26717	7.122713	-5.15453	7.963612	10.98997	3.967575	27.33186	-1.14955
EfQw-21 S11 AN0195	330.3207	20068.29	70.44521	14.1037	10.20835	122.6123	539.0064	11.38515	214.651	7.39551
EfQw-21 S2 AN0126	358.3502	20832.2	73.6235	14.61479	11.61825	132.3343	576.3136	12.20961	206.5709	4.89212
EfQw-21 S3 AN0185	440.8296	19233.35	77.945	16.20317	12.64319	128.042	560.8843	14.85824	211.5308	9.114394
EfQw-21 S4 AN0007	480.2708	18701.79	71.93445	15.93272	11.23784	134.7424	549.9388	14.31788	209.6313	7.508275
EfQw-21 S5 AN0184	527.636	19227	69.23585	15.61495	9.746169	130.0373	534.9263	10.24605	210.6472	8.649467
EfQw-21 S6 AN0081	-86.1144	5700.095	15.43612	5.480054	-4.01459	7.222476	33.44647	2.228012	26.85483	0.283323
EfQw-21 S7 AN0031	367.789	20159.8	79.26365	16.10087	11.35993	129.7038	557.9401	11.52838	206.8943	6.872302
EfQw-21 S8 AN0175	637.0478	25386.84	91.02387	15.39716	10.52913	116.3115	649.5621	9.08289	191.4857	5.659715
EfQw-21 S9 AN0149	398.4364	19628.99	74.08867	15.81412	14.06973	134.0351	567.8945	8.985883	205.2968	6.822694
EiRg-3 S1 AN0001	387.9055	20507.62	94.99896	16.77469	8.72924	95.22096	762.4664	8.789847	190.2972	0.538901
EiRh-4 S1	353.1653	18617.45	122.6547	18.56357	10.578	123.1533	512.2273	10.97553	194.3999	6.144918
EiRh-4 S10	383.3749	18768.64	125.23	18.57931	10.75485	126.9894	515.8371	11.46336	205.9498	7.243467
EiRh-4 S11	229.0283	19557.53	116.6932	17.74527	11.88554	136.3692	558.6837	10.41311	209.7458	7.367963
EiRh-4 S12	394.7081	20713.98	114.3608	17.01037	12.13966	136.0996	574.0097	10.27023	205.2326	6.64085
EiRh-4 S13	354.0392	19221.05	110.7471	17.94278	11.80282	128.2652	565.0351	10.04231	204.0013	5.997381
EiRh-4 S14	447.4205	20028.65	139.7937	19.37052	11.67247	126.9203	562.659	12.37162	210.556	5.790745
EiRh-4 S15	407.8745	19653.45	136.2133	19.02465	15.01071	134.3085	577.0224	12.6812	221.1844	7.374788
EiRh-4 S2	431.1393	18566.8	111.3268	18.07886	9.047758	122.0062	545.5033	9.939403	225.9347	8.638074
EiRh-4 S3	499.0955	28854.02	119.4926	15.87363	11.40625	112.8145	740.6955	11.41456	200.4216	6.132457
EiRh-4 S4	843.0422	23967.65	141.0594	18.58771	6.254106	102.6099	655.8781	21.07122	269.8612	10.13912
EiRh-4 S5	695.8459	40178.47	153.8126	14.94159	4.881261	69.81388	508.2547	18.05053	189.7281	7.90504
EiRh-4 S6	472.3459	18815.51	161.8332	20.63493	10.58446	122.6773	613.1395	10.71665	202.5375	6.216497
EiRh-4 S7	817.657	25082.68	141.4777	18.32134	6.518831	87.32409	632.747	20.17506	244.9815	9.350279
EiRh-4 S8	294.1744	21275.31	122.1912	18.20669	12.8347	128.3585	549.7831	14.83659	210.1457	6.465804
EiRh-4 S9	399.341	19260.9	117.9785	18.31639	12.4352	124.3459	530.7172	11.99468	205.6941	6.030717

ElRn-14 S1	389.4173	19445.87	118.8372	18.39029	12.52337	128.0254	565.6951	11.96442	210.1345	9.202815
ElRn-14 S2	681.2967	31683.74	162.4355	17.83557	11.15738	98.56815	926.4001	15.15058	185.3817	11.86363
ElRn-14 S3	963.975	28506.47	203.1554	21.01132	9.348113	92.24251	717.8259	20.14403	261.9365	10.72826
FaRm-16 S1	724.8373	33938.12	107.9681	13.40347	0.408646	21.71095	457.0017	15.3376	99.02607	6.129085
FaRm-16 S2	480.4568	29600.41	140.3818	16.98914	4.079613	59.6434	827.6975	8.229131	179.6003	5.093092
FaRm-16 S3	323.9824	20592.82	130.115	18.85967	5.326022	92.15877	783.9112	6.849055	190.2249	2.534873
FaRm-16 S4	357.1431	21406.17	134.8956	18.62686	8.781526	113.1678	609.4091	10.73653	177.8457	3.389815
FaRm-16 S5	569.5444	31145.91	123.4213	15.42697	9.787707	110.0214	586.5528	11.78854	229.3158	6.869151
FaRm-23 S1 AN0004 U6L1	462.0249	18691.3	80.59115	15.13965	11.18578	127.4759	545.6371	10.87043	209.9001	6.483625
FaRm-23 S2 AN0028 U19L2	484.2035	18651.87	68.97498	14.86674	12.21769	125.0536	545.6458	13.45174	200.5406	7.262606
FaRm-23 S3 AN0026 U19L2	372.591	19067.15	70.73766	15.63658	12.74667	129.674	552.1677	13.82108	207.0853	6.509056
FaRm-23 S4 AN0019 U18L2	502.5107	17182.36	85.1452	16.89277	12.48668	120.2728	519.4954	10.80412	198.391	7.201234
FeRh-4 S1 AN0010 Large (7in Biface)	489.7229	19501.43	93.478	16.97211	10.90831	125.2955	539.1983	9.424412	202.9185	6.527987
FeRh-5 S1 AN0008	305.0619	20453.56	86.64788	16.31917	8.216959	92.23918	774.4622	7.844497	190.9471	1.643899
KSG S1	452.2651	18563.14	84.57219	16.08908	10.81088	122.0303	505.5489	11.48548	208.4637	7.300932
KSG S10	301.8506	17478.73	73.95363	16.41037	11.34771	125.4977	465.8476	12.06099	205.7065	9.77657
KSG S11	255.4302	16501.1	74.82785	15.10966	8.1765	123.4899	528.6219	12.27796	206.1294	9.575665
KSG S12	394.9449	18739.56	73.24877	16.03631	9.85107	125.8543	578.3412	15.04327	207.1661	7.515501
KSG S2	374.3974	18357.88	78.65674	16.10674	11.66207	125.7846	480.1888	11.25093	208.5488	9.225799
KSG S3	254.164	15958.22	94.51551	17.64383	13.49664	125.4112	504.3437	13.63269	212.1692	8.446938
KSG S4	266.0818	17064.93	67.90753	15.8855	12.87346	115.1782	488.9113	12.47246	200.302	8.316142
KSG S5	395.3123	19369.69	67.21704	15.19185	8.489585	127.3763	528.924	10.92734	207.486	7.481527
KSG S6	302.3866	17501.86	68.85084	16.12087	10.38152	117.7627	498.5035	9.626926	191.39	6.102592
KSG S7	232.2685	15507.14	54.22954	15.60729	11.47171	129.3621	511.9393	10.78731	208.5479	8.869954
KSG S8	269.1318	16681.67	66.85474	16.06679	13.43062	131.8263	516.9976	12.23226	220.8226	7.452069
KSG S9	240.4996	16068.63	73.31019	16.67454	8.954031	113.1642	478.4574	10.21754	189.548	7.128143
SDiQv-5 25	349.4326	26331.17	135.9767	17.80043	5.896824	89.40205	648.1665	10.13051	215.9806	10.56499

EbQf-19 S1 AN0003	504	20318	95	17	15	131	582	10	206	9
EcQf-13 S1 AN0005	448	19415	72	16	10	128	562	12	195	7
EcQf-16 S1 AN0335	334	20699	78	15	14	138	607	10	223	8
EcQf-17 S1 AN0022	350	18929	82	16	15	131	533	12	208	8
EcQf-20 S1 AN0065	389	19317	92	17	16	129	562	14	214	8
EcQf-20 S2 AN0006	374	19651	73	16	12	131	570	13	210	6
EcQf-20 S3 AN0862	430	19813	73	16	16	132	536	13	206	8
EcQf-20 S4 AN0490	374	19700	77	16	10	135	539	11	210	7
EkQk-14 S1 AN0006	373	18341	64	16	13	130	552	13	204	8
EkQk-4 S1 AN0002	512	20123	81	15	14	132	560	14	218	6
EkQk-4 S2 AN0251	362	20111	89	16	8	101	778	8	190	4
FdQr-1 S1 AN0041	405	19594	70	15	12	129	553	11	205	4
FeQs-16 S1 AN0042	500	21982	94	16	12	128	585	10	202	8
FeQs-16 S2 AN0047	706	24754	99	16	10	92	660	22	267	10
FeQs-16 S3 Site 7 AN0001	448	18979	85	16	11	123	548	10	198	8
FeQs-16 S4 AN0037	377	22632	101	16	6	92	821	10	192	2
FeQs-16 S5 AN0003	386	19215	82	16	12	123	554	11	194	6
FeQs-16 S6 AN0059	809	38306	84	12	4	28	539	14	114	9
FeQs-16 S7 AN0007	351	18744	76	15	15	125	534	10	198	6
FeQs-16 S8 AN0051	519	22638	79	15	12	147	502	15	242	7
FeQs-16 S9 AN0012	632	38137	71	11	3	67	501	17	190	7
EeRl-7	357	2.42	47	22		92	575	10	157	4
EeRl-7			80	24	11	130	420	13	181	9
EeRl-7	269	2.54	68	14		90	547	8	151	7
EeRl-7			54	25	3	127	433	11	180	11
EeRl-7			71	13	9	129	402	9	169	7
EeRl-7	227	1.98	62	26	4	90	542	5	149	6

EeRl-7			73	18		91	542	6	153	5
EeRl-7			41	23	7	142	444	13	175	9
EeRl-7			69	20		96	549	7	154	
EeRl-7	499	2.4	52	17	7	123	409	12	170	9
EeRl-7			87	25		93	567	10	164	5
EeRl-7			82	20	8	133	435	12	194	6
EeRj-1	405	2.27	70	24	7	127	405	12	178	7
EeRj-1	407	2.7	73	21		89	553	7	162	5
EeRj-1	354	2.4	70	25	13	122	407	12	167	6
EeRj-1	403	2.54	61	19	6	124	410	10	180	9
EeRj-1	315	2.13	46	18	12	126	396	11	182	8
EeRj-1			86	19		94	551	9	161	3
EeRj-1	345	2.06	73	12	5	86	532	8	154	3
EeRj-1	309	2.35	55	24	6	133	417	13	181	9
EeRj-1			67	26	7	116	463	11	163	3
EeRj-1			50	12	11	131	445	12	182	10
EeRj-1	358	2.27	70	14	7	131	404	14	184	7
EeRj-1	315	2	62	33	6	126	400	14	182	10
EeRj-1			60	27	3	129	408	12	179	11
EeRj-1	325	2.24	99	22	11	123	380	12	167	8
EeRj-1	320	2.1	58	15	9	92	520	7	149	6
EeRj-1	321	2.29	68	19	3	124	408	8	175	8
EeRj-1	391	2.73	74	21		80	573	11	152	2
EeRj-1	365	3.28	70	14		93	523	13	155	4
EeRj-1	458	3.39	85	26	3	112	546	13	178	7
EeRj-1	227	2.13	66	21	12	113	551	16	189	8
EeRj-99	437	3.26	93	11	3	105	523	13	175	8

EeRj-99	605	3	71	20	3	125	407	13	179	8
EeRj-99	305	2.29	74	15		127	408	11	175	5
EeRj-99	333	2.42	63	21	6	132	435	13	180	11
EeRj-99	500	2.77	90	12	7	121	398	13	176	8
EeRj-99	370	2.4	55	28	6	130	404	9	174	7
EeRj-99	291	2.66	68	19		84	629	7	156	5
EeRj-99	272	2.78	62	29		85	590	7	164	4
EeRj-99	328	2.19	61	19	5	123	395	10	174	6
EeRj-99	1095	2.1	56	17		103	635	8	172	7
EeRj-99	321	2.99	99	20		76	574	10	160	6
EeRj-99	365	2.07	81	27	5	146	440	14	195	8
EeRj-99	261	2.04	50	19	9	126	393	13	174	9
EeRj-99	309	2.42	73	9		79	621	10	150	4
EeRj-99	292	1.96	51	14	5	122	386	10	169	10
EeRj-99	318	3.07	68	31		82	628	6	151	3
EeRj-99	402	1.98	80	11	5	118	388	11	168	9
EeRj-99			71	22		83	622	8	145	4
EeRj-99	276	1.92	65	18	3	129	431	12	185	9
EeRj-99	247	2.47	79	17	6	81	621	7	161	4
EeRj-101			75	28		86	610	10	158	5
EeRj-101			93	19		124	402	12	173	7
EeRj-101			64	19	4	85	492	12	152	7
EeRj-101			76	19		75	605	10	163	5
EeRj-101			97	21		100	696	13	176	6
EeRj-215	361	2.63	83	19	4	124	473	10	165	7
EeRj-215	487	5.59	130	21		49	552	24	120	5
EeRj-215	350	2.41	52	26	7	131	424	13	178	9

EeRj-215			63	12	7	124	415	11	177	6
EeRj-215	475	4.09	72	23		54	615	12	113	4
EeRj-215	245	2.16	73	24	7	95	556	7	158	4
EeRj-226			53	28	10	129	418	13	183	7
EeRj-226			67	23		97	543	5	156	2
EeRj-226			70	25	7	92	549	7	154	3
EeRj-226	378	2.24	57	24	8	139	448	10	178	8
EeRj-226	415	2.39	48	22		127	411	12	170	5
EeRj-226	435	2.43	66	24	4	133	439	13	174	4
EeRj-226	331	2.4	73	27	6	139	449	12	182	6
EeRj-226	359	2.32	64	29	9	119	412	13	173	8
EeRj-226			89	16	4	132	442	13	178	8
EeRj-226			74	22		89	555	9	161	3
EeRj-226			40	13	3	129	393	13	175	7
EeRj-226	273	2.66	65	22	3	96	537	6	155	3
EeRj-226			91	32	13	106	596	7	168	6
EeRj-226			45	25	4	99	576	8	170	5
EeRj-99	276	1.98	67	18		117	384	15	171	8
EeRj-99	425	3.57	82	26		82	606	8	174	6
EeRj-99			73	24	3	107	470	13	170	5
EeRj-99	347	2.24	37	20	6	127	394	13	179	8
EeRj-1	248	2.68	79	20		72	551	9	146	5
EdQx 28 212	399	19918	71	16	10	121	571	13	204	6
EdQx 28 293	415	16133	71	16	9	105	432	8	166	8
EdQx 28 816	365	19222	71	16	11	134	564	12	222	9
EdQx 46 59	409	19232	65	15	13	133	546	11	215	9
EdQx 47 222	397	29487	93	14	8	88	688	13	210	8

EdQx 48 6704	333	19139	84	16	11	124	534	13	208	6
EdQx 49 16	406	25084	90	16	13	154	656	13	220	8
EdQx 53 275	450	20764	74	15	14	125	551	12	198	7
EdQx 53 324	353	26521	77	14	12	128	661	10	191	5
EdQx 53 467	406	19144	64	15	12	127	544	13	204	6
EdQx 53 499	299	19539	67	15	12	128	551	12	207	4
EdQx 53 605	454	19947	77	15	6	120	558	11	202	7
EdQx 53 916	534	25377	96	15	12	148	643	10	217	5
EdQx 53 955	339	21353	66	15	10	135	600	10	208	7
EdQx 54 150	297	19520	73	14	10	118	519	11	190	8
EeQw 105 50	459	21062	89	15	11	143	630	10	220	6
EeQw 105 55	497	19210	70	15	11	128	555	9	207	7
EeQw 105 56	352	18369	59	15	10	125	558	15	201	6
EeQw 105 75	400	18868	72	15	11	138	551	10	209	6
Eeqw 106 1100	390	20386	77	15	14	137	577	12	217	9
EeQw 106 1254	310	21751	75	15	13	139	602	8	216	5
EeQw 106 1284	430	23998	97	16	12	138	600	11	210	8
EeQw 106 1348	335	19870	68	15	9	136	539	12	223	7
EeQw 106 1409	440	20755	67	15	10	139	566	12	220	9
EeQw 106 1538	463	23570	74	15	13	152	638	10	214	7
EeQw 106 1590	514	21276	82	16	13	131	574	11	207	4
EeQw 106 1762	354	18386	64	16	10	117	527	8	204	8
EeQw 106 1839	460	20036	80	15	13	135	553	14	215	8
EeQw 106 2036	316	20020	94	17	12	132	568	12	213	7
EeQw 106 889	273	18883	66	15	13	124	500	11	203	6
EeQw 106 945	296	19990	83	16	10	123	540	12	201	7
EeQw 108 311	355	20120	85	16	9	134	564	12	215	7

EeQw 108 451	285	20658	90	15	10	126	543	9	195	5
EeQw 108 567	307	21783	81	14	12	137	576	11	220	7
EeQw 108 740	357	24910	89	15	11	144	618	11	221	7
EeQw 108581	505	28660	128	17	13	159	666	10	215	8
Eeqw 13 431	232	18796	65	15	8	124	518	9	193	6
EeQw 13 445	357	17441	65	15	7	113	503	13	196	7
EeQw 13 514	274	24597	74	15	9	107	527	8	172	4
EeQw 13 540	349	19787	79	16	8	124	561	12	199	7
EeQw 132 21	284	16353	79	17	13	124	549	10	196	8
EeQw 14226a	355	19730	63	15	8	130	561	9	212	7
EeQw 14226b	435	19230	59	15	10	116	520	9	186	4
EeQw 148 3	362	18984	73	16	11	129	596	12	207	7
EeQw 150 004	256	19631	74	16	9	127	570	11	206	7
EeQw 151 13	420	24204	77	15	10	122	639	10	195	5
EeQw 153 02	365	19591	67	15	12	131	556	11	202	5
EeQw 160 71	377	18726	73	16	13	134	562	13	218	7
EeQw 163 2	441	21337	72	15	9	139	596	9	209	5
Eeqw 55 18	455	24357	75	15	10	121	628	10	188	4
EeQw 55 21	279	18955	73	16	12	127	539	12	201	7
EeQx 23 684	357	19080	75	15	11	128	535	11	198	6
EeQx 25 1494	297	19406	74	16	10	130	535	12	214	5
EeQx 25 2470	371	24565	81	15	10	86	650	11	203	10
EeQx 25 3018	402	22177	109	17	13	127	548	11	183	8
EeQx 25 3977	415	19204	70	16	9	125	542	11	209	7
EeQx 25 4031	298	19068	74	15	11	128	536	12	212	5
EeQx 25 4829	403	23927	84	15	9	114	637	10	171	4
EeQx 25 506	472	19692	72	16	11	125	574	12	201	9

EeQx 25 5519	358	22801	87	16	10	104	580	10	175	6
EeQx 25 5637	316	18278	78	16	7	126	544	10	195	6
EeQx 25 576	515	23259	100	16	13	132	601	11	207	7
EeQx 25 5819	346	19254	72	16	11	127	536	12	202	5
EeQx 25 5873	493	20104	87	16	9	134	581	9	207	7
EeQx 25 859	438	20442	92	16	13	127	565	10	219	9
EeQx 30 143	347	22167	71	15	13	125	540	12	206	7
EgQq 001 015	348	17372	75	16	11	131	563	13	216	7
EgQq 001 039	436	21046	82	16	10	128	581	11	211	6
EgQq 001 050	489	20114	80	16	13	132	585	13	212	6
EgQq 001 225	427	20159	86	16	12	124	552	12	211	8
EgQq 001 291	519	27858	91	15	4	91	693	11	218	11
EgQq 001 296	535	19405	79	16	13	130	564	7	206	7
EgQq 001 297	755	27114	98	15	9	120	620	12	200	5