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OBSIDIAN OF THE ROCK CREEK SITE (10CA33):

UNDERSTANDING OBSIDIAN SOURCE CHOICE THROUGH SOURCE

LOCATIONS AND PERFORMANCE CHARACTERISTICS

by

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To the Graduate Faculty:

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ABSTRACT

OBSIDIAN OF THE ROCK CREEK SITE (10CA33):

UNDERSTANDING OBSIDIAN SOURCE CHOICE THROUGH SOURCE LOCATIONS AND PERFORMANCE CHARACTERISTICS

Thesis Abstract-Idaho State University (2017)

Obsidian is an important material source for prehistoric tools. Limited in the landscape, this material has glassy attributes and homogeneous characteristics which create superior tools. Obsidian sources differ in elemental make-up and performance characteristics, or fracture predictability. These differences allow obsidian artifacts to be sourced within the landscape and may affect the choice of obsidian sources for creating obsidian tools. To understand these differences, 876 obsidian tools from the Rock Creek site (10CA33) of southern Idaho were sourced using X-ray fluorescence (XRF) and Stepwise Discriminant Analysis. My hypothesis was that obsidian choice at the Rock Creek Site would show balance between distance and fracture mechanics. Instead, the results indicate majority use of local sources, though with additional sources used between 2,000 and 7,000 years ago, especially in projectile points. The results indicate that fracture mechanics may be too narrow a focus to understand obsidian choice.

I INTRODUCTION

The indigenous people of the Snake River Plain and surrounding areas lived in a varied and dynamic environment of desert, river valleys, and mountain areas that included a variety of resources scattered throughout the landscape. These geological and environmental differences affected the subsistence systems of the local inhabitants. Archaeological evidence found throughout the Snake River Plain demonstrates a subsistence system of seasonal movement based on location of both plant and animal resources. This system is seen throughout the Holocene and into the historical period, and lasted in some places through the introduction of the horse and the movement of European fur trappers into the area in the nineteenth century (Henrikson 2004).

Subsistence and resource procurement played important roles in these prehistoric people's lives and choices. Lithic material choice was important in the efficient creation and function of tools, especially of projectile points. The availability of quartz, chert/flint, obsidian, and other lithic sources varied throughout the landscape. They also varied in how well they functioned when creating and using tools. Obsidian was an important source of material for projectile points and other prehistoric artifacts. Found in limited locations throughout the wider landscape, this material was sought after for tool making. Its glassy attributes and conchoidal fractures create very fine and sharp edges and its homogeneous structure has good flaking characteristics, enabling the creation of superior stone tools (Domanski and Webb 1992; Shackley 2005).

Source availability and accessibility varies for obsidian. Obsidian ($SiO2$) is a rhyolitic volcanic rock with high silica content. It forms from either rapidly cooled magma or from magma so thick that crystals cannot form (Black 2014; Bowers and Savage 1962; Shackley 2005). Accessibility is also not equal for different sources. Some sources erode from or near the surface and can be picked up off the ground. Other sources are more difficult to find and access or may be located far from the habitation site. These factors influenced obsidian choice for prehistoric people (Black 2014; Shackley 1998; Shackley 2005).

Obsidian performance can be evaluated via assessments of fracture predictability. When creating stone tools, a nodule is reduced by pressure or percussion flaking until the desired form is reached. The more homogenous the material, the more predictable the flaking pattern, thus making it easier to reach the final product. Not all obsidian deposits are equal. Differences in original magma compositions and cooling rates create some sources with a grainier or less homogenous structure than others, creating irregularities and stress points in the material. When fracturing the obsidian for a tool, the energy transfers though the stone on impact. These differences can affect the behavior of these fractures, leading to less fracture predictability and more time needed to create a useful, refined tool. Therefore, a "high quality" source would be obsidian with the most homogenous structure and few stress points in the material, which would be indicated by predictable fracturing, making it easier to create a tool. One of the best situations would be to have the highest quality source of obsidian to create better quality tools in the quickest amount of time. This is not always possible. While this characteristic is important, it may be outweighed by distance to the actual source (Marler 2009; Nelson, Bastakoti, and Dudgeon 2012).

Because tools were vital in obtaining and processing food, it was important that they be created efficiently in order to increase survival and facilitate resource procurement. Two factors likely influence the efficiency of tool making and the choice of obsidian source material: 1) the distance to the source and 2) performance characteristics of a source, as seen through fracture predictability.

This study looks at the obsidian diagnostic tools of the Rock Creek Site. The Rock Creek Site (10CA33) is located in southern Idaho on a stream terrace near multiple vegetation zones and was utilized over 8,000 years. My hypothesis is that prehistoric people understood these influences and choose to balance these two factors of source distance and performance characteristics by choosing medium distance and higher quality obsidians over closer but low quality obsidian sources. I also predict that prehistoric people would utilize less obsidian sources through time, as the people's shared environmental knowledge of obsidian source locations and differing qualities expanded through time, and some obsidian sources dropped out of use.

2 BACKGROUND

To better understand the processes behind the analysis of prehistoric people's resource use and procurement, this section is sub-divided into five parts. The first part discusses the geographical and physical environment of the Snake River Plain, including the climatic environment during the prehistoric periods. Second, the cultural environment and prehistoric traditions for the region are discussed. The next section includes some of the history of social theories behind human interactions with the environment, as well as an overview of the theories and studies behind resource transportation costs and exchange networks. The last two sections deal with X-ray Fluorescence (XRF) analysis and fracture mechanics, two methods behind studying resource use, particularly obsidian use.

2.1 The Physio-geographic Environment

The Snake River Plain is a geological depression that stretches for 400 miles across Southern and Northeastern Idaho (see Figure 1). This depression follows the movement of the North American plate over a hotspot, starting about 15-16.5 million years ago and now residing in Yellowstone National Park. This created a trail of basaltic volcanic deposits and rhyolitic lava flows with major differences between the structural and geophysical elements between the East and West portions of the Plain (Black 2014; Link 2012; Plew 2000). Ranging from elevations from 4,500 to 6,000 feet, the area currently receives little precipitation, less than 10 inches a year, mostly as rain and snow in the winter and early spring. The vegetation is primarily desert-type, including sagebrush, bitterbrush, and different types of grasses (Henrikson 2005:334). In the surrounding mountain foothills, such as the Camas Creek area and the location of the Rock Creek Site, more precipitation falls, allowing water sources to have higher levels than the plain throughout much of the year (Plew 1976:14). Many more wild edible plants are also available in these areas, such as the camas root (Plew 1976:57).

The original climate reconstruction for the American West was first introduced by Ernst Antevs in the early 1940s and 1950s. Antevs based this chronology on studies from Europe and eastern North America with the assumption that climate transitions would be similar worldwide (Minckley, Bartlein, and Shinker 2004:27). Because of this, Antevs used data from “lake sediments, stream terraces, pollen assemblages, and archaeological studies" to designate the period from 11,000 years ago to about 500 years ago (though a definite shift is evident around 6500 BP to around 600 BP) as the Holocene and to divide it into a "three-part environmental sequence"—the Anathermal, Altithermal, and Medithermal (Minckley, Bartlein, and Shinker 2004:24; Dort and Miller 1977; Butler 1978:42). Antevs' model has continued to provide the basis for the understanding of the environmental periods in the Snake River Plain, with the sequence corresponding to the Late Pleistocene/Early Holocene, the Middle Holocene, and the Late Holocene. However, more current studies reveal many climatic variations within this sequence and also regionally (Minckley, Bartlein, and Shinker 2004). This is illustrated within the geological area known as the Snake River Plain.

The Altithermal climatic phase and Middle Holocene period began around 7500 BP and lasted until around 4000 BP in the Snake River Plain area. There is much environmental evidence that it was hotter and drier than previous periods. For instance, pollen analysis from Swan Lake's Zone S3 in Southeastern Idaho coincides with the Altithermal and shows a warmer, drier trend between 8400 and 3100 BP though it does not show quite the variation in temperature and moisture suggested by Antevs (Henrikson 1991:9–10). Other pollen samples also demonstrate higher temperatures and a changing landscape. Pollen samples from around 7000 BP show larger percentages of "Cheno-ams (plants of the amaranth and pigweed families, including shadscale)" than exists today, suggesting a drier climate (Henrikson 2002:102). Around Middle Butte Cave, the area was "dominated by a more arid sagebrush community" around 7,000 years ago (Henrikson 2002:102). Small animal remains from Middle Butte Cave and other caves also show shifts in local animal diversity (Henrikson 1991:10).

Wider evidence of climate change during this period is also available. Lower elevations in the Great Basin area which were originally dominated by juniper, pinyon, and Joshua tree changed to desert-like conditions with sagebrush, cactus, and joint fir dominating the landscape (Minckley, Bartlein, and Shinker 2004:27). Pleistocene pluvial lakes also showed low levels, with the lowest levels of moisture since the late-glacial period (Minckley, Bartlein, and Shinker 2004:27). In the Sierra Nevada Mountains, pollen found in glacial deposits shows a warming climate between 5000 and 2900 years BP as well as a possible drop in the level of populations in Surprise Valley, Oregon in 5000 BP with a shift in housing structures (Henrikson 1991:17). In Fork Rock, in eastern Oregon, occupied sites shift from lower elevations to higher altitudes between 8000 and 5000 BP, following available food and water sources (18). Even in the Snake River Plain area, the Bison and Veratic Rockshelters in the foothills of the Plain show increased population between 4500 and 4200 BP, possibly as a result of depleted food resources in the Snake River Plain (Henrikson 1991:4).

Figure 1: Relief Map of the Snake River Plain

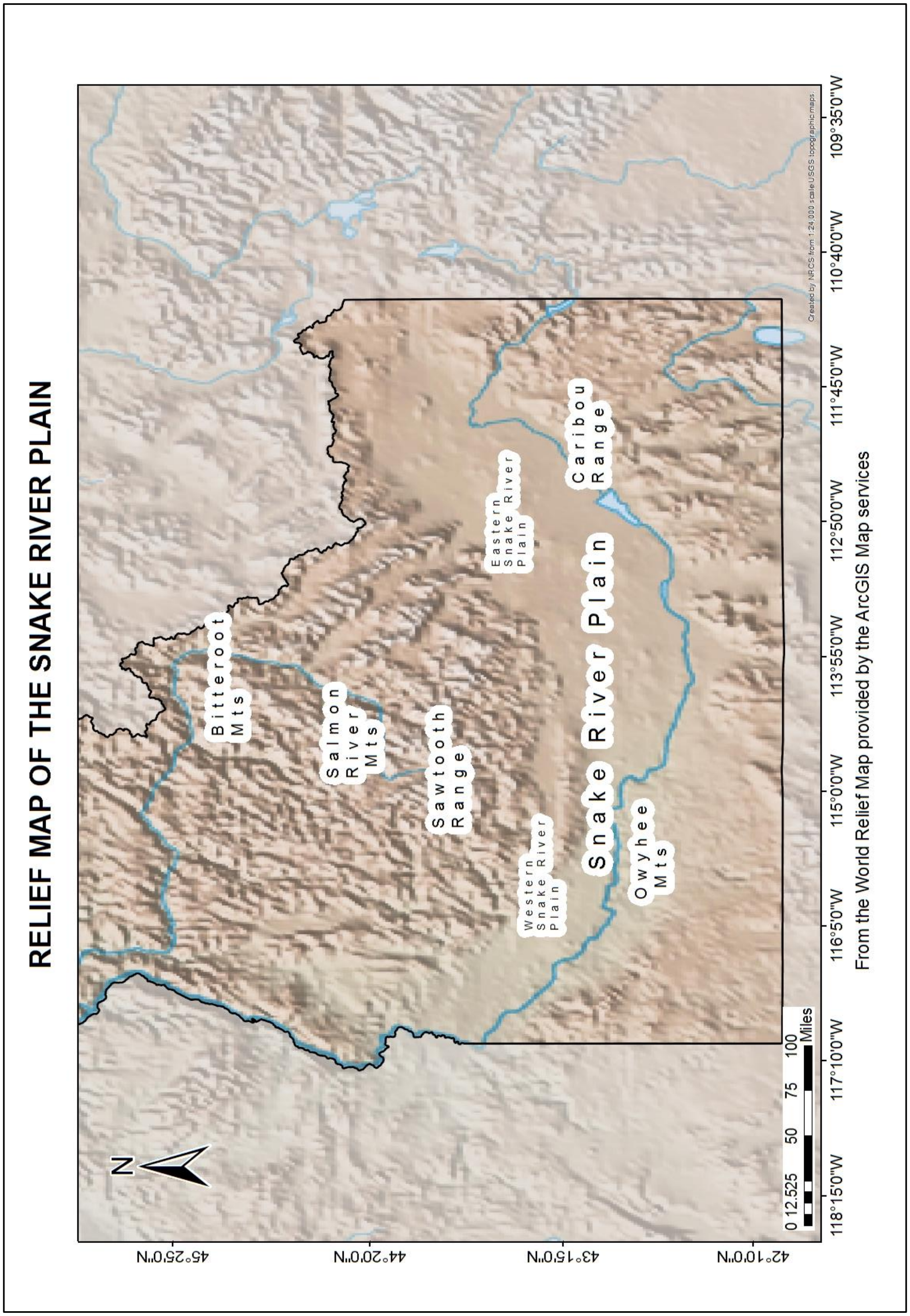


Figure 2: Ecological and Cultural Succession of the Snake River Plain, as found in Butler 1978, Figure 37.

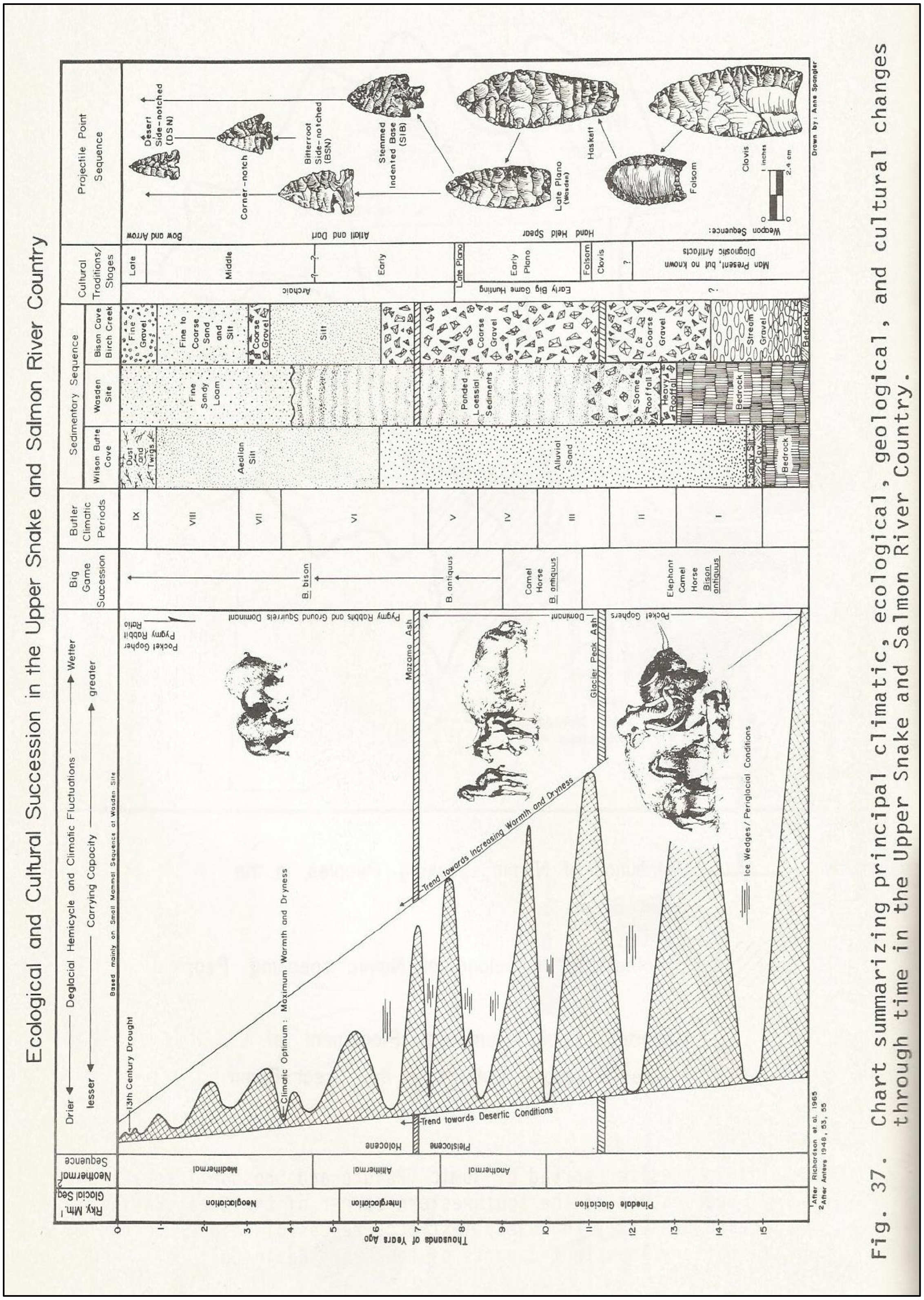
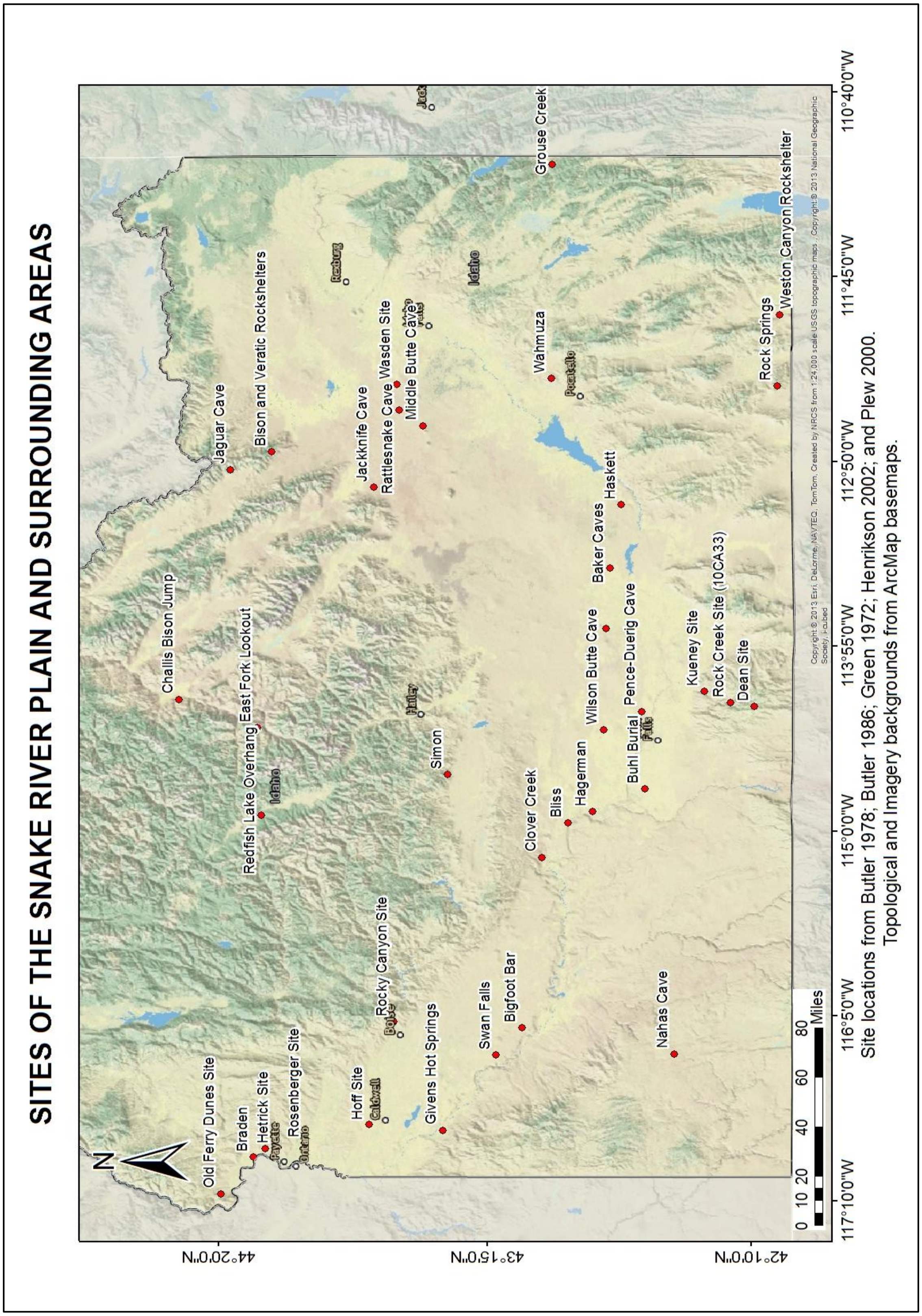


Figure 3: Featured Archaeological Sites of the Snake River Plain and Surrounding Areas



2.2 The Cultural Environment

Ethnographic contexts of the Snake River Plain suggest two types of seasonal mobility as a lifestyle for the people of the Snake River Plain (Holmer and Holmer 2014). These types of seasonal mobility were: collector mobility strategy for the Snake River Shoshone people, where resources were moved to the users and three site types were common: field camps, harvesting locations, processing locations; and forager patterns, where users moved to the resources, identified for Grouse Creek and White Knife Shoshone (Plew 2000). Archaeological evidence suggests these patterns also existed for prehistoric people. Archaeological cultural traditions for the Snake River Plain are often divided into two main stages prior to the historic period and the introduction of the horse: the Paleoindian and Archaic periods. These intervals are subdivided into smaller periods which are commonly characterized by changes in technology (see Table 1).

Table 1: Cultural Periods of the Snake River Plain. Data from (Plew 2000).

Period	Sub-period	Approx. Dates	Technology/Other
Paleoindian	Pre-Clovis	15,000-12,000 BP	No projectile points found
Paleoindian	Clovis	12,000-11,000 BP	Fluted points; Use of Spears; Utilize mammoth and bison (extinct)
Paleoindian	Folsom	10,000-9,600 BP	Smaller fluted points; Use of Spears; Utilize mammoth and bison (extinct)
Paleoindian	Plano	9,600-7,800 BP	Unfluted projectile points; Use of Spears; Bison and big game hunting
Archaic	Early Archaic	7,800-5,000 BP	Atlatl
Archaic	Middle Archaic	5,000-2,000 BP	Extensive use of groundstone
Archaic	Late Archaic	2,000-300 BP	Bow and Arrow; Smaller projectile points; Small mammal hunting; Increased Fishing; Introduction of

			Pottery
ProtoHistoric/ Historic		300 BP (18th century)	Introduction of the horse; EuroAmerican materials

The Paleoindian period is sub-divided into four sub-periods or cultural traditions: Pre-Clovis, Clovis, Folsom, and Plano. Wilson Butte Cave provides evidence of some of the earliest human occupation of the Snake River Plain with cut-marked bone fragments from the Pre-Clovis period (Plew 2000:29). The Clovis and Folsom periods are characterized by large fluted points and big game hunting of the now extinct megafauna: mammoth (*Mammuthus sp.*), camel (*Camelops sp.*), horse (*Equs sp.*), and bison (*Bison antiquus*) (Plew 2000:36). Folsom points are associated with utilized mammoth, camel, and bison bones, as well as smaller mammals at Wasden Cave. In addition, analysis of the skeleton from the Buhl Burial, dating to 10,675 BP, suggests a diet of meat and marine food (Plew 2000:30–35). In the Plano period, the hunting of bison and sheep is associated with unfluted lanceolate points and wider selection of tools, including some use of groundstone at the Wilson Butte Cave (Plew 2000:37).

The Archaic period is characterized by changes to the environment of the Snake River Plain including: the shift to a warmer drier environment, the extinction of megafauna, and the spread of smaller mammal species. These changes correlate to changes in inhabitants' tool and resource use. This period is divided into three sub-periods: Early, Middle, and Late Archaic. A shift from spear use to atlatl use during the Early Archaic is seen with the presence of lanceolate and large notched projectile points. Scrapers, re-sharpened knives, and other tools of both stone and bone have been found in archaeological levels dating to the Early Archaic and associated with bison, sheep, and avian and fish species. Evidence of game traps and corrals at Owl Cave (Wasden Site) and shellfish use at Hetrick site show increased variety in procurement (Plew 2000:39–52).

The Middle Archaic (5000-2000 BP) is characterized by specialized sites and site diversity, as well as an increase in cultural complexity. For instance, the Kueney Site contains ochre-stained manos, and absence of mammal faunal remains, and thousands of mussels, while the Dean Site stone artifacts showed early stages of object manufacturing and simple tools, with the toolstone quarried near the site (Plew 2000:53–55). Jackknife Cave contained multiple earth ovens and fire hearths, as well as a large amount of material culture including stone and bone tools, milling stones, and basketry (Plew 2000:56). Evidence of cold storage use in Bobcat Cave and storage pits and decorative items at Nahas Cave suggest increased complexity in resource use (Henrikson 1991; Henrikson 2002; Plew 2000:57, 61–62). Other sites show increased social complexity with social differentiation in burial goods (Plew 2000:73–76).

With the Late Archaic period, another change occurs with the shift from atlatl to bow and arrow, seen with the presence of small side- and corner-notched projectile points throughout the Snake River. Ceramics also appeared during the period, possibly from migrating Shoshoni people coming from the southwestern Great Basin or from Fremont people of northern Utah. Populations expanded and economic/procurement strategies diversified. Fishing became a greater focus for groups along the Middle Snake River, with fishhooks, nets, and other fishing gear found near salmon runs. And hunting blinds, walls, and enclosures are common around the Upper Snake River. Petroglyph rock art also start to appear in this period (Plew 2000:79–81).

The Rock Creek Site (10CA33) spans the period from the Paleoindian Plano period through the Late Archaic period, with some historic deposits of metal and glass. Lithic artifacts dominated the collection from the site, including some groundstone, quartz, chert, and a large quantity of volcanic glass. No structures, burials, basketry, or pottery was at the site and food waste, with the exception of some animal bone, was also lacking (Green 1972).

2.3 Social Theory

2.3.1 Environment and Culture

Environment influences how people spend their energy and, thus, how their culture develops. Julian Steward focused on the environment's influence on culture, specifically on the idea of universal cultural cores. This "cultural core" idea concentrated on the similar features "most closely related to subsistence activities and economic arrangements" (Steward 2006:5). Steward's ecological approach included fundamental procedures that include studying the technology of a culture and how it relates to the environment, interpreting how the technology affects behavior patterns, and how the behavior affects the society as a whole (Henrikson 1991:83–84). Steward's intent was to understand cultural change in regards to the environment, such as settlement patterns and looking at settlements in an environment as a whole network, rather than just different sites (Henrikson 1991:83–84; Trigger 2006:376).

Lewis Binford also took an interactive and environmental approach to culture. Binford argued that culture was more than just a category of objects found. Instead, culture included "man's extrasomatic means of adaptation" (Yesner 2008:41). Material culture represented the “structure of a total cultural system” that included both adaptive social and environmental contexts and dealt with the social, physical, biological, and environmental variables that impacted culture (Binford 1962:217). Binford believed, like Steward, that the environment played a part in the potential and processes of culture by setting limitations on the variants of culture that were viable in an area. These limitations lead to similarities between groups of similar social complexities and environmental zones, especially in the technology found. Binford argued that “cultural ecology” was a way to better understand cultural processes, as well as understand the “structural relationships” between social and ideological systems and evolutionary change in the social systems (Binford 1962:218–219). In other words, he believed that a functional model was important to develop because it examined all parts of a system as a whole, looking at many variables and adaptations that created stability (Plew 1976:8).

More recently, Steward’s and Binford’s ideas have been expanded with concepts borrowed from the biological and physical sciences to help look at “human populations as a single element within a larger ecological setting” (Haenn and Wilk 2006). Conrad P. Kottak discussed “ethnoecology” as a native group’s “traditional set of environmental perceptions” or their ways of “categorizing resources, regulating their use, and preserving the environment” in regards to change through time (Kottak 2006:42). Virginia D. Nazarea focused on understanding the native point of view, their “intimate” knowledge of local resources, and their expertise when “juggling their options for meeting day-to-day requirements” (Nazarea 2006:35). The knowledge of the environment of the Snake River Plain, Rock Creek Site (10CA33), and environs, as well as the various resources and the “quality” of those resources (such as obsidian) may have played a role in prehistoric peoples’ resource choice and procurement.

2.3.2 Transportation Costs and Exchange Networks

People’s knowledge and categorizing of their local resources may also influence choices in transporting and trading goods. The Law of Least Effort states that people will choose the “least energy-expending course of action to achieve their aims” (Dark 1995:122), as quoted in Plager 2001). This may influence subsistence methods and resource procurement and use. The least energy spent on an activity means the more energy left for other things important to survival and life. Prehistoric peoples’ selection of obsidian for creating tools is likely influenced by this Law of Least Effort. The environment and transportation costs involved in selecting and using obsidian play significant roles in people’s choices of how to spend their energy.

Transportation costs and the resulting exchange networks also affect how people will spend their energy, particularly when transporting materials. Many studies have utilized obsidian sourcing as a means to explain cultural processes and find sites. Aubry et al. (2012) used lithic material sourcing to infer social behaviors and rock art distribution in the Iberian Peninsula during the Upper Paleolithic period. Combining material analyses and spatial analyses, they use Geographic Information Systems (GIS) to identify patterns in range mobility and transport systems, as well as to inform on questions about human behavior, social networks, and environmental interaction in the past (Aubry et al. 2012). By sourcing obsidian debitage through neutron activation and finding some from the highland zones in the coastal areas in the same period, Rademaker et al. (2013) were able to use GIS to predict a least cost analysis to plot likely routes between known locations and to find locations for other sites in the areas along these routes (Rademaker, Reid, and Bromley 2013:34). Beck et al (2002) discuss costs of transporting heavier materials over long distances and how this may have affected lithic usage and exchange networks. They analyzed two lithic assemblages from the dacite quarry sites of Cowboy Rest Creek Quarry in central Nevada and Little Smoky Quarry in eastern Nevada. They found more biface reduction at quarries far away from residential sites than at quarries near residential sites. Applying central foraging computer models, they concluded that transportation costs were a likely variable in biface reduction locations (Beck et al. 2002). Models have also been used to predict patterns for source diversity at archaeological sites based on distance from source and lithic flake size and usage at the sites (Eerkens et al. 2007).

Eerkens, Spurling, and Gras (2008) apply the patterns for source diversity to a village site in the Owens Valley, eastern California, during two different time periods in order to examine the difference between more mobile societies and more sedentary societies. They found that obsidian was obtained from more desirable sources with earlier, more mobile societies. In general, the debitage flakes were also larger without respect to distance from the site, perhaps due to the larger size of earlier projectile points (Eerkens, Spurling, and Gras 2008:674). With more sedentary societies, local sources of obsidian were utilized, which resulted in larger and more variable-sized debitage. Obsidian from farther away would be "moved as finished tools" and thus the debitage found would be much smaller-showing reworking and microflaking processes (Eerkens, Spurling, and Gras 2008:667).

Taliaferro et al. (2010) also discuss several reasons obsidian can be used to understand exchange networks at a large scale for the Mimbres cultural region in the southwest of New Mexico. These include the ability to differentiate sources, the amount of obsidian artifacts found in Mimbres assemblages, and the strong source database of obsidian studies from the area (Taliaferro, Schriever, and Shackley 2010). In their article, the authors wanted to create a model of technological investments through the costs of obtaining source material. To do this they conducted anisotropic (where directionality is important) least cost path analyses using a 90m Digital Elevation Model (DEM), SRTM data (data collected from the Shuttle Radar Topography Mission to create DEMs), and obsidian source data. They assessed the slope, travel time, and distance to and from obsidian sources and then used these to create a least cost path from obsidian sources to archaeological sites, using this data to run models of potential exchange routes (Taliaferro, Schriever, and Shackley 2010:538–539). They found differences in patterns between geographical areas and suggestions of overlapping exchange networks in the region. According to their models, travel time did not seem to be an important factor for choosing obsidian in some of the communities, possibly because of existing exchange networks (Taliaferro, Schriever, and Shackley 2010:545).

Plager (2001) compiled data for over 2,000 obsidian artifacts from 279 sites in southern Idaho to study the distribution and use of obsidian sources and created isoline density distribution maps (showing the spread and density) of some of the sources in the Snake River Plain. She found that some obsidian was transported far from its parent source, such as Obsidian Cliff, Wyoming, which was found 614 km away from its source (Plager 2001a:54). Other obsidian was not transported nearly as far. The data supported existing theories of mobile procurement strategies for the area. However, distant obsidian sources, such as Double H Mountain, Nevada obsidian, were also found in several sites situated near local obsidian sources (Plager 2001a).

2.4 XRF Analysis--Chemical Sourcing of Artifacts

The Provenance Postulate states " that there exists some qualitative or quantitative chemical or mineralogical difference between natural sources that exceeds the qualitative or quantitative variation within each source" (Weigand, Harbottle, and Sayre 1977; Glascock and Neff 2003). In other words, obsidian (amorphous SiO_2) is considered chemically homogenous at the source but chemically different between different sources (Shackley 1998; Shackley 2005). This attribute allows artifacts to be sourced back to their volcanic sources. One way of performing this sourcing is through using X-Ray Fluorescence.

X-Ray Fluorescence (or XRF) is a process where X-rays are used to ionize the atoms within the obsidian. The radiation dislodges an inner shell (K or L) electron, which destabilizes the atom. In order to reach stability, an outer electron moves to the inner shell, releasing energy proportional to the difference between the two stable energy states. This change causes a lower energy radiation, or fluorescent radiation, to be emitted. The difference between the emitted energy and the usual energy is then compared and the differences are recorded (Shackley 2011:16). Based on the amount of fluorescent x-rays released and measured at specific energies along a continuous spectrum, an XRF calibration can be used to estimate the concentration in the sample for several minor and trace elements. The differences in these minor and trace elements are then used to source the obsidian, as the amount of the trace elements of rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), zinc (Zn), iron (Fe), magnesium (Mn), thorium (Th), and gallium (Ga) have empirically been shown to vary for many different obsidian sources, including the sources found within and along the Snake River Plain (Notice the peaks or higher counts on these trace elements, as seen in Figure 4). Depending on the disparity between sources, the amounts of these elements can be used to differentiate the various sources. Then a sample from an unknown source (an artifact) can be compared to known source data to understand where it fits (Shackley 2011).

A primary limitation of large-scale XRF analysis of obsidian in the past was the time needed for each analysis. Previously, archaeologists have measured obsidian for 2.5 to 5 minutes per artifact in order to get a large count for the trace elements and a high confidence interval of 98% for multiple elements. This amount of time per artifact made sourcing artifacts a long process, especially for sites with many obsidian artifacts, such as the Rock Creek Site. Advances in technology have resulted in more sensitive XRF machines with a higher per second x-ray count rate, which allows more rapid and sensitive element concentration estimates for separating sources (Shackley 2011; Frahm et al. 2014). In a recent article, Frahm (2014) proposed that, especially with distinct obsidian sources, a confidence interval of 90% and shorter measurement times, even as short as ten seconds, can provide accurate obsidian sourcing (Frahm et al. 2014).

Figure 4: Image of the Spectra graph of pXRF obsidian sample data

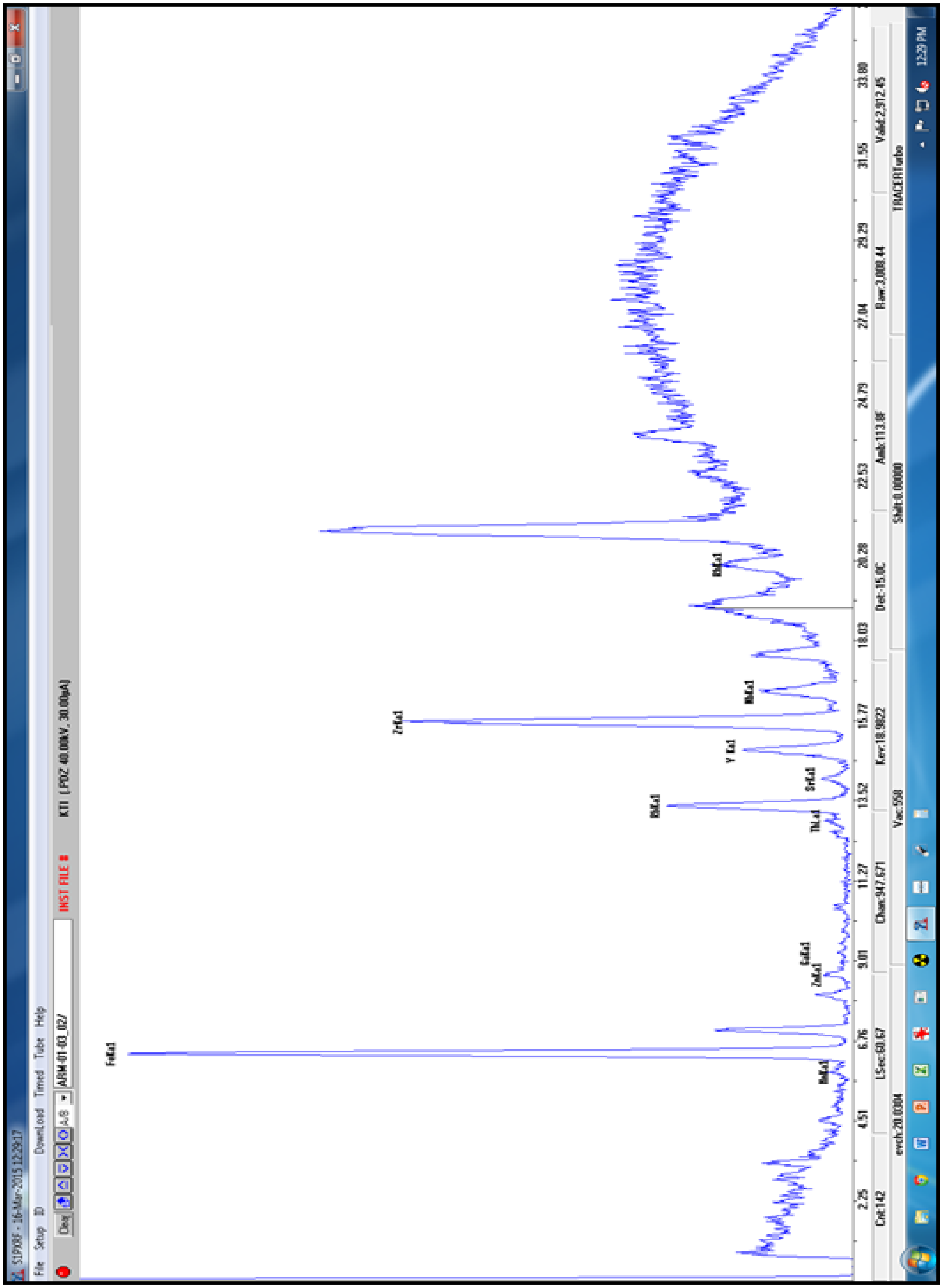
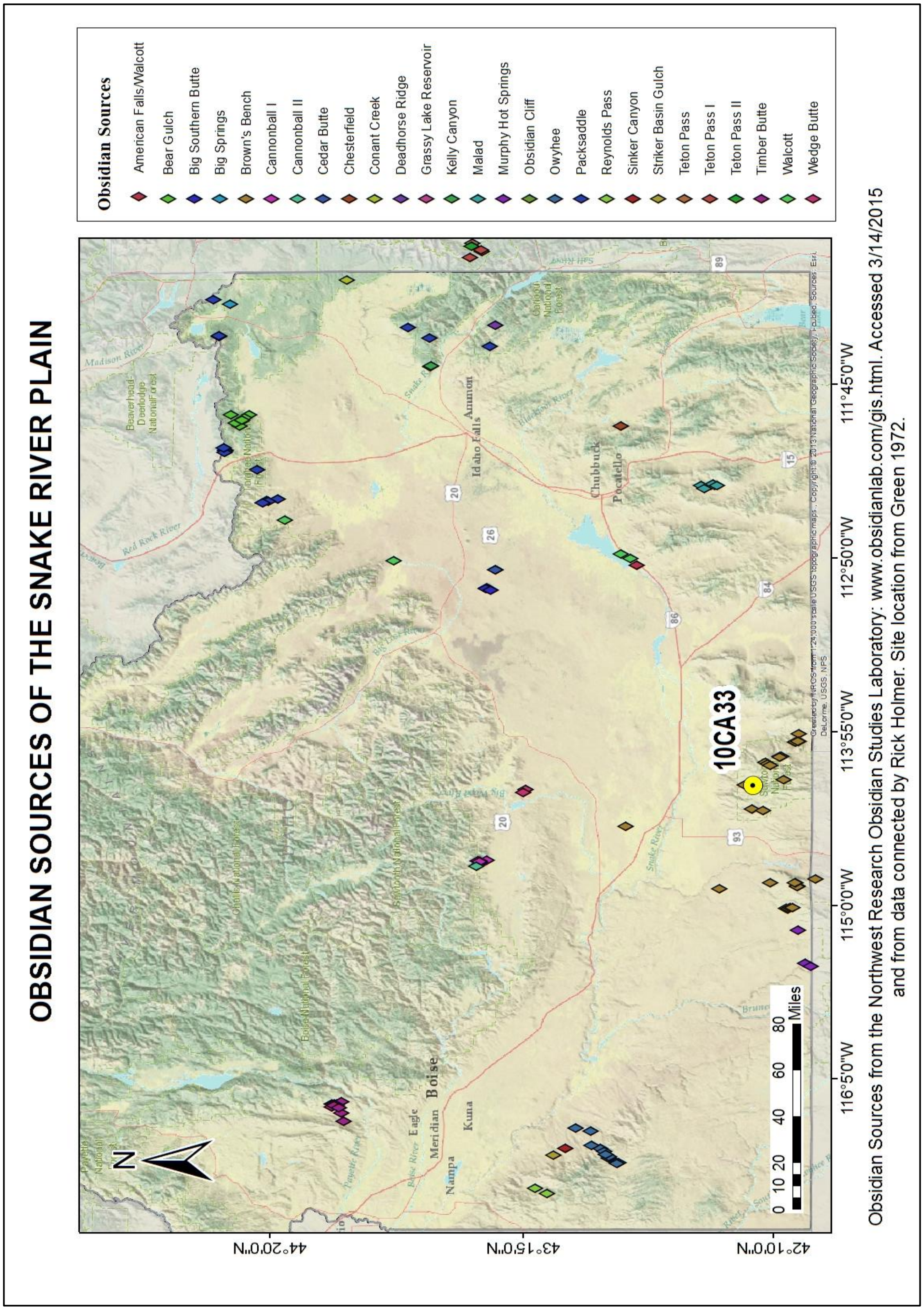


Figure 5: Map of Obsidian Source Locations, from Rick Holmer and the Northwest Research Obsidian Studies Laboratory



2.5 Fracture Mechanics

The Law of Least Effort states that people will choose the "least energy-expending course of action to achieve their aims" (Dark 1995, 122, as quoted in Plager 2001), which may also apply to tool manufacturing. Fracture mechanics is one theory to describe tool stone choice. When creating stone tools, a nodule is reduced by pressure or percussion flaking, or fracturing, until the desired form is reached. The study of this fracturing process is called fracture mechanics. Several factors influence this fracturing and the effort involved in creating the tool, including grain size and cooling and annealing rates.

Eberhardt et al (1999) studied the effect of grain size on stress fractures in the Lac du Bonnet batholith in Manitoba, Canada. They looked at three different rock types with varying grain sizes found in the batholith: granite, granodiorite, and pegmatite (Eberhardt, Stimpson, and Stead 1999:82). They found that, though grain size does not significantly affect the "initial stages of cracking", it does affect the "behavior" of these fractures and increases secondary fracturing (91-94). In fact, "rock strength was found to decrease with increasing grain size" due to the size of grain boundaries (Eberhardt, Stimpson, and Stead 1999:97).

Cooling and annealing rates also affect the microstructure of stone. Domanski and Webb (1992) discuss some of the changes and improvements from heat treatment of stone quartz tools, stating that the heating of these stones create a "more equigranular and better crystallized" structure of the stone, which are more typical of obsidian (Domanski and Webb 1992:601–602). In particular, the elasticity, or "stiffness of a material," and the fracture toughness, or how resistant a material is to fractures, became much more consistent between the various types of quartz studied (603). Fracture toughness also decreased with increased temperatures, creating differences in the flaking performance of various materials, perhaps even obsidian glasses (605). Differences in initial cooling and annealing rates may also affect the microstructure of obsidian sources, creating variations in fracture toughness between sources (Domanski and Webb 1992).

As Domanski and Webb's study states, obsidian was a sought after source for toolmaking by prehistoric peoples because of its fracture toughness and consistency. But there are many different volcanic sources of obsidian throughout the Snake River Plain and surrounding areas. Considering these factors and the effect of grain size on fracture propagation, Nelson, Bastakoti, and Dudgeon (2012) studied fracture patterns in obsidian in order to understand the differences between sources regarding the predictability of fracturing. They believed that the more predictable the flaking pattern, the easier it would be to reach the final product and the more likely people were to choose that obsidian source. Working from data on widespread obsidian use collected by Plager (2001), they chose a sample of eight Snake River Plain obsidian sources, including four high use volcanic sources (Bear Gulch, Big Southern Butte, Brown's Bench, Malad) and four low use sources (Kelly Canyon, Packsaddle, Cedar Butte, Cannonball) (see Figure 5 for map of obsidian sources).

Prepared samples were impacted four to seven times with a Shore Scleroscope to simulate percussion fractures created when making a tool (see Figure 6). The resulting impact fractures were imaged using an FEI Quanta 200 FEG Scanning Electron Microscope (SEM). The initial impact diameter and the conchoidal fracture diameter were measured and compared for each impact to analyze the variation of fracture patterns between different sources. Figure 6 also shows the measurements of one of these fractures. The left image is the inner fracture; the right shows the outer fracture. Measurements of the fracture extents can be seen in green. Figure 7 shows fractures from the high and low-use obsidians: High-use obsidian: A) Brown's Bench; B) Bear Gulch; C) Big Southern Butte; D) Malad; Low-use obsidian: E) Cedar Butte; F) Walcott; G) Cannonball; H) Packsaddle. Results indicated that Bear Gulch obsidian had the least amount of variance (CV_{INV}), while sources such as Brown's Bench, Big Southern Butte, and Malad had a higher variance. Figure 8 show these results, with Bear Gulch as the most predictable source and Packsaddle and Cedar Butte sources the next most predictable. Brown's Bench and Malad were high use obsidians but were not as predictable (Nelson, Bastakoti, and Dudgeon 2012).

Figure 6: Images of a Scleroscope and the impact scars on obsidian surfaces. Picture and Photographs from (Nelson, Bastakoti, and Dudgeon 2012)

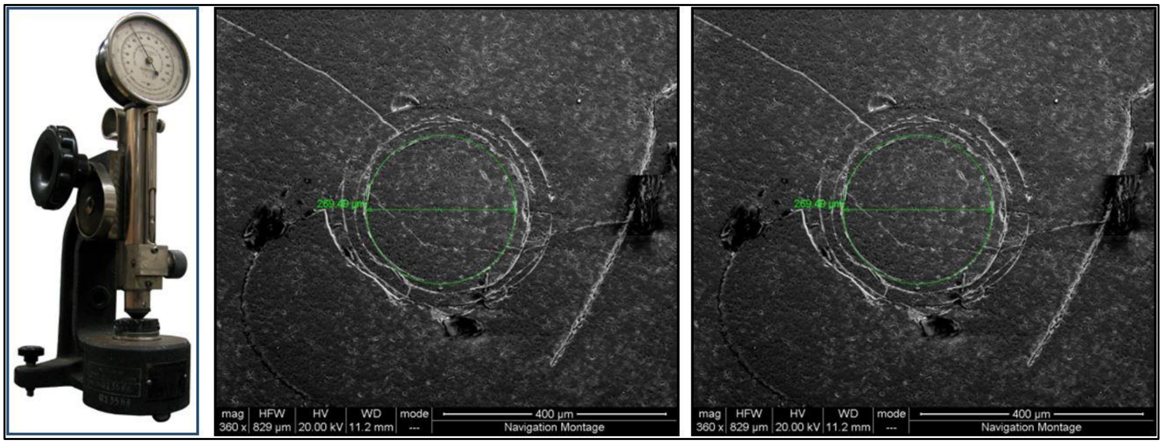


Figure 7: Images of High-use and Low-use fracture pattern variations from (Nelson, Bastakoti, and Dudgeon 2012).

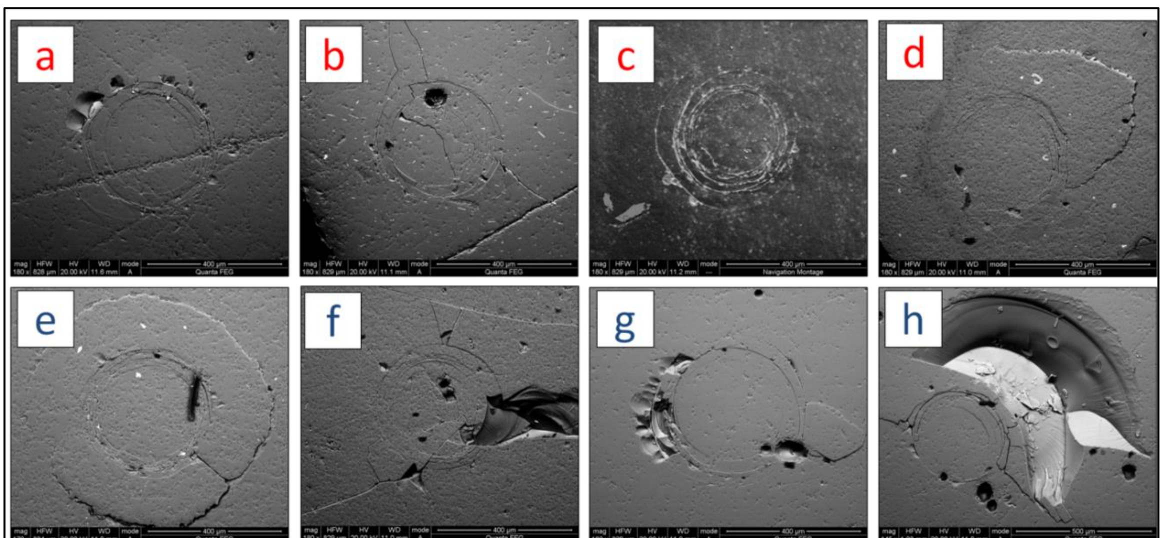
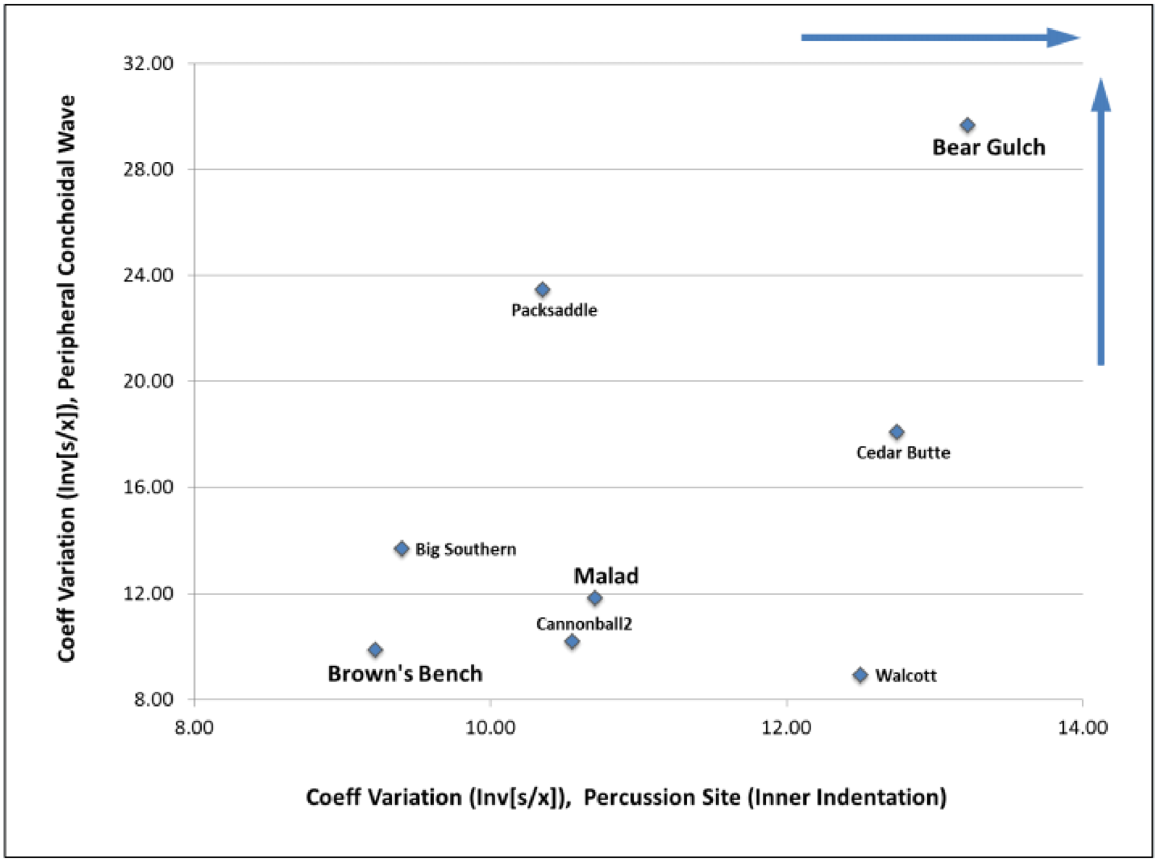


Figure7. Variation in fracture pattern for **high** and **low**-use obsidians. In this figure, a) Brown's Bench; b) Bear Gulch; c) Big Southern Butte; d) Malad; e) Cedar Butte; f) Walcott; g) Cannonball II; h) Packsaddle.

Figure 8: "Inverse coefficient of variation (CV_{Inv}) for obsidians analyzed in this study. Samples in bold indicate high-use obsidian." Graph from (Nelson, Bastakoti, and Dudgeon 2012)



3 ROCK CREEK SITE (10CA33)

3.1 The Site

Located in the Sawtooth National Forest in the Cassia Mountains, south of Twin Falls, Idaho, the Rock Creek Site (10CA33) contains one of the largest collections of lithic cultural items from the area. The site is an open site on a stream terrace. It is part of a regional environmental system bordering the Northern Great Basin, Upland, and Snake River Plain areas (Green 1972). Near both Sagebrush and Juniper vegetation zones, the site has access to fish-filled streams, a variety of mammal species, and the local Brown's Bench obsidian (Green 1972:3–5) (see Figure 9 for map) .

The Rock Creek Site was also used over a period of 8,000 years, possibly as a seasonal camp and workshop (Green 1972:92). Stone (or lithics) was the main material found at the site, but animal remains, 1 shell, and 1 wood fragment were also found in the prehistoric levels. Volcanic glass, or obsidian, makes up a large portion of the lithic artifacts and lithic debitage found at the site. Approximately 84.5% of the diagnostic artifacts and lithic debitage at this site is made of volcanic glass (or ignimbrite[1] and obsidian, used interchangeably throughout), providing a very large sample size from which to work(Green 1972; Plager 2001b). Table 2, Table 3, and Table 4 show some of the artifact counts from the 10CA33 artifact catalog received from the Earl H. Swanson Archaeological Repository (ESAR) and Amy Commendador.

[1] In archaeology, ignimbrite and obsidian both refer to the rhyolitic volcanic glass that is abundant on the Snake River Plain. For this paper, the term "obsidian" was chosen.

Figure 9: Map of the Rock Creek Site (10CA33) location

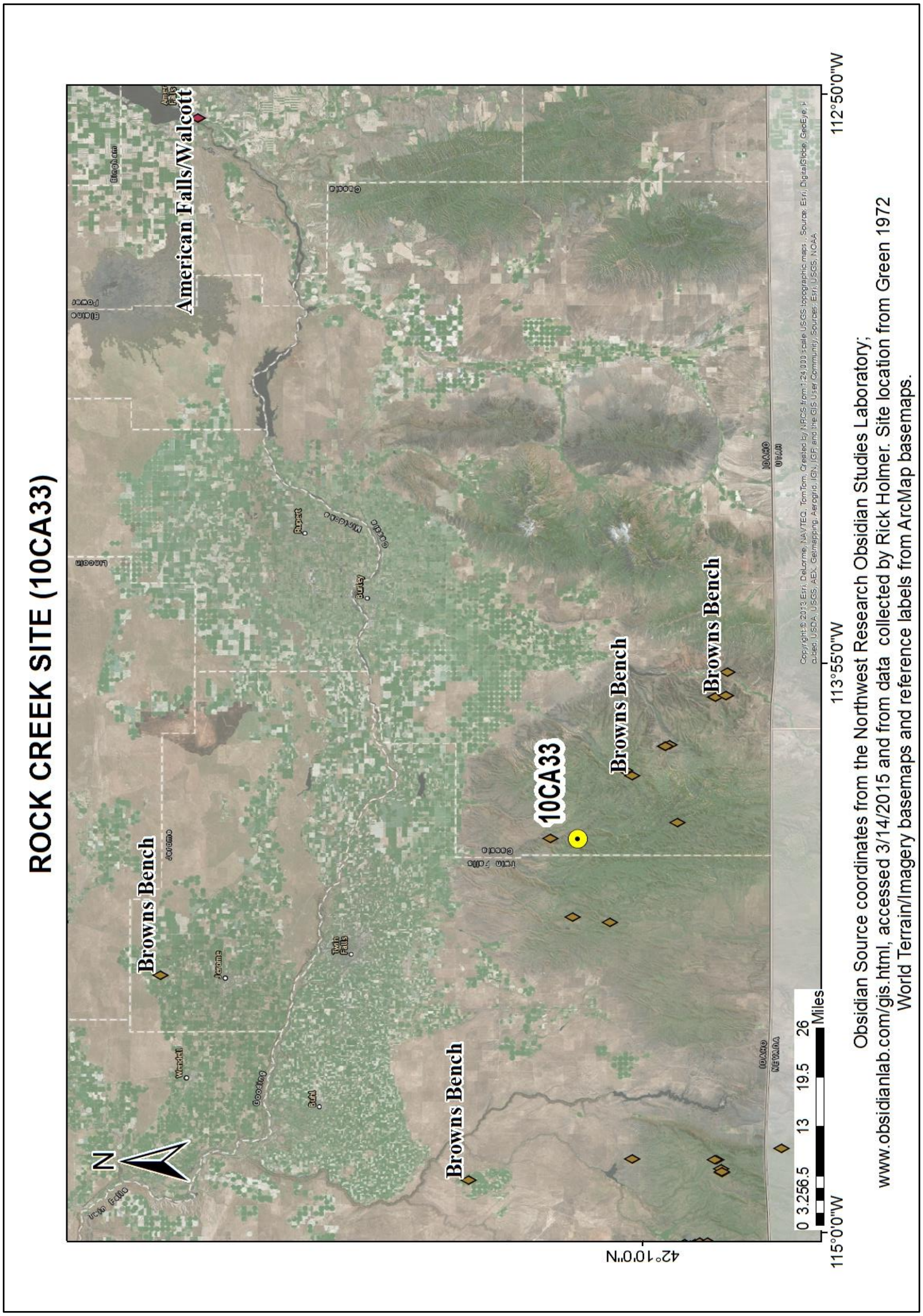


Table 2: Number of artifacts found in each cultural period/levels at the Rock Creek Site (10CA33); (Aboriginal=Prehistoric; European/American=Historic)

Culture	N
Aboriginal	4382
European/American	43
Unknown	29

Table 3: Material classes found in the Prehistoric levels at the Rock Creek Site (10CA33)

Material Class	N
Animal	155
Other	1
Plant	1
Stone	4225

Table 4: Prehistoric level material and artifact types at the Rock Creek Site (10CA33)

Material Type	N
Basalt	15
Bone	143
Carbon	1
CCS	160
Chalcedony	9
Chert	458
Ignimbrite	2498
Mixed	185
Not Given	39
Obsidian	736
Other	1
Pumice	2
Quartz	1
Quartzite	91
Sandstone	2
Schist	1
Shell	1
Siltstone	3
Teeth	11
Unknown	24
Wood	1

Artifact Type1	N
Abrader	1
Biface	296
C-14: Charcoal/Carbon	1
Chunk	15
Cobble	3
Core	37
Debitage: Flake	2983
Debitage: Shatter	1
Faunal Remains	155
Fire Cracked/Affected Rock	1
Flake: Utilized/Retouched	187
Grooved Stone/Shaft Straightener-Abrader	1
Groundstone-Grinding Slab	2
Groundstone-Mano	4
Groundstone-Other	2
Hammerstone	2
Knife	4
Modified/Utilized	3
Perforator/Graver/Drill/Burin	19
Plant Remains	1
Preform	5
Projectile Point	489
Scraper/Planer	125
Spokeshave	8
Unmodified Stone	37

3.2 The 1970 Excavation

Investigations at the site were conducted in July 1970 by Dr. Max Pavesic as part of the Highway Salvage program through Idaho State University Museum (now the Idaho Museum of Natural History), as the half the site was in the path of approaching road construction (Green 1972:1). Excavations reached a depth of 130 cm and recovered a number of lanceolate and other projectile point types that helped indicate the age of the site. The site excavation and preliminary analysis was documented by James Patten Green in 1972 as part of his Master's Thesis. The collection is now housed in the Earl H. Swanson Archaeological Repository (ESAR) in the Idaho Museum of Natural History on the Idaho State University campus. Several characteristics of the Rock Creek Site make this site important for this study: the accessibility of the collection, the large amount of volcanic glass artifacts found (over 800 artifacts), the initial excavation's focus on site chronology, and the long occupational time span of the site.

The 1970 Rock Creek site excavation recovered 1,202 artifacts which were divided into different classes, including projectile points, blanks, utilized flakes, and ground stone, as well as 54,016 more debitage flakes. Green reported 338 diagnostic point types distributed through the different excavation levels and commonly used as "time markers" for a relative chronology for site use, as well as 183 unidentifiable projectile point fragments (Green 1972:32–33). Only 16 of these were complete ignimbrite/obsidian projectile points as listed in the 10CA33 artifact catalog[2]. The rest of the identified projectile points were fragments, though diagnostic features were recognizable (Green 1972).

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[2] The artifact catalog was obtained from the ESAR.

3.3 Stratigraphy and Green's Thesis

Good stratigraphy is important to understand the site chronology and deposition of artifacts through time. The 1970 excavation focused on developing a site chronology from the start. Because the test excavation the previous year did not show clear stratification in the cultural deposit, arbitrary levels of 15 cm were excavated and the locations of cultural arrangements and artifact recovery *in situ* were stressed (Green 1972:11). Because of difficulty with radio-carbon dating and cross-dating material from the site[3], a relative site chronology was determined through the sediment sequence and other sites from the region.

To develop this relative chronology, a soil monolith was taken and compared to the Wasden Site sediment sequence and a Rocky Mountain alluvial chronology (Green 1972:14). The Wasden Site's depositional facies (or geologic accumulation formations) correlated with those of Rock Creek, determining a relative chronology for Rock Creek stretching from about 10,500 years ago with an increased intensity in material culture between 4,850 and 2,000 years ago, during the Holocene period (Green 1972:92). The presence of the Mazama ash layer as an aggregate attached to artifacts and flakes in the 70-90 cm level also matches regional distribution of the ash at other archaeological sites throughout the northern Great Basin and Snake River Plain. This ash deposit is considered a time stratigraphic marker for the northern Great Basin and Northwest and supports the chronological correlation of the Rock Creek Site with the Wasden Site (Green 1972:15–17).

[3] Green states that spring water at the Rock Creek Site was associated with radioactive potassium; Green also states that time boundaries for the point types were not well known for the region (Green 1972: 13).

In his evaluation of the site data, Green used diagnostic artifacts to define five cultural units, or Occupations,[4] representing 8,500 years of use of the Rock Creek Site (Green 1972:26– 29) (see Table 5). Artifact and waste flake distribution throughout these "Occupations" show increased use through time. Only two activity loci were found in the earliest excavation levels. Later levels show more frequent use and an increase of activity with more, larger, and denser activity areas. Green suggested that the site may have functioned first as a lithic reduction/chipping station and small camp and later as a larger workshop and camp on the prehistoric people's annual round (Green 1972:95–109). The cultural unit division and the obsidian artifacts allow us to better understand obsidian source use through time. This can give us a unique understanding of obsidian use and can help correlate different obsidian source qualities, as demonstrated by fracture pattern studies on the obsidian sources.

Table 5: Table of Occupation periods with their corresponding levels and dates and Cultural Periods, as outlined in (Green 1972:29; Plew 2000).

Occupation	Levels	Date	Cultural Period
Occupation I	90-120 cm	7,900-10,500 years ago	Plano (Paleoindian)
Occupation II	75-90 cm	7,000-7,900 years ago	Early Archaic
Occupation III	45-75 cm	4850-7,000 years ago	Early Archaic
Occupation IV	15-45 cm	2000-4850 years ago	Middle Archaic
Occupation V	0-15 cm	Present-2000 years ago	Late Archaic to Historic

[4] "Occupation" is the term used by Green in 1972 to denote the cultural units or periods of use he described in his thesis.

4 METHODOLOGY

4.1 Preliminary Studies

According to Frahm (2014), larger confidence intervals and shorter measurement times are sufficient to measure obsidian artifacts if the sources are chemically distinct (Frahm et al. 2014). Previous studies have found the obsidian of the Snake River Plain to have very distinct chemical signatures in the trace elements (Nelson, Bastakoti, and Dudgeon 2012; Commendador 2008). Two preliminary studies were performed to better understand the parameters needed for optimal results when sourcing the Snake River Plain obsidian.

The Idaho State University Archaeometry class of Spring 2014[5] examined the validity of Frahm et al.'s statement on short XRF run-times, as it regards Idaho obsidian. The students analyzed samples of different obsidian source tiles for 180 seconds, 120 seconds, 60 seconds, 30 seconds, and 15 seconds. From previous data, Idaho obsidian source element data are very disparate. We found that a reduction of time did result in some differences in individual element data, especially at the 30 and 15 second timings, but that the source data still grouped together. 60 second data was closer to 180 and 120 second timings.

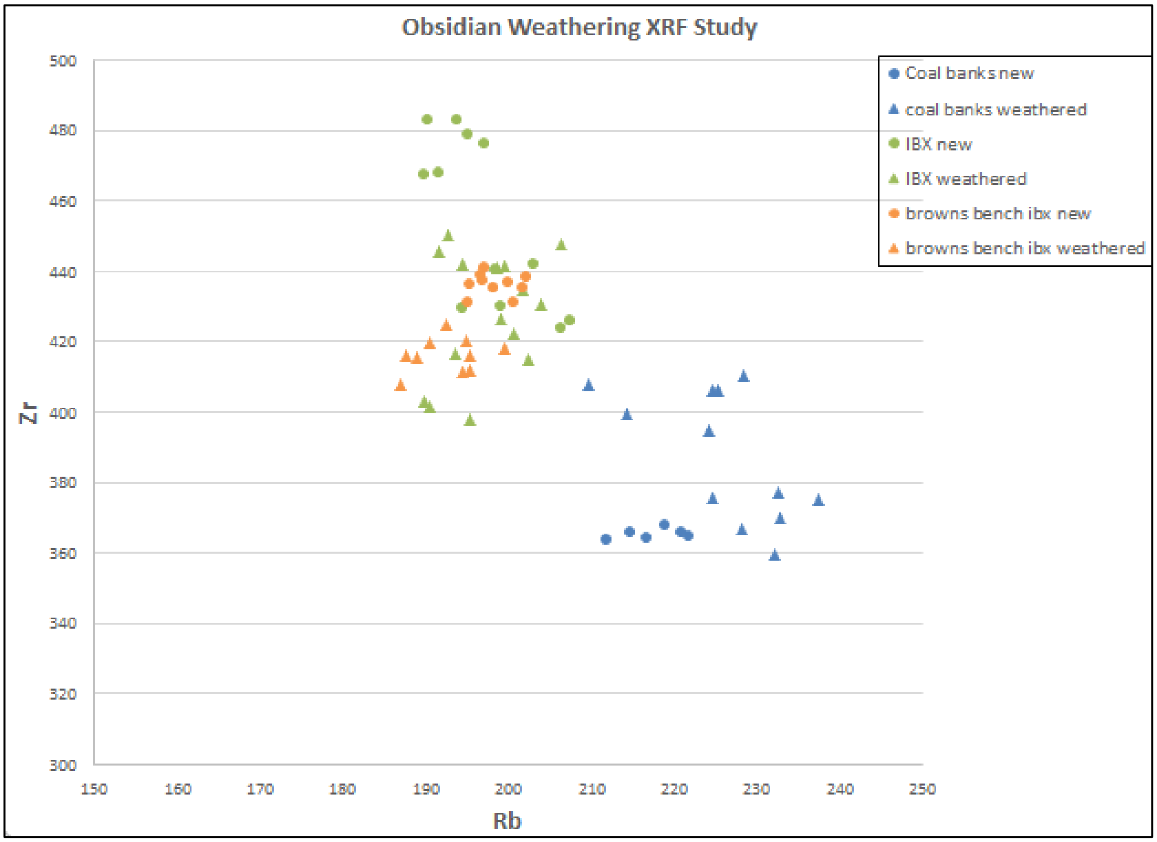
The Spring 2015 Archaeometry class[6] examined the difference between XRF data for weathered surfaces and new surfaces of obsidian. A shift does occur between heavily weathered and new surfaces, though the different values do group together by obsidian

[5] This class included: John Dudgeon (Professor), Elise C. Krauel (M.S. Candidate) and other graduate and undergraduate students in the Anthropology Department at Idaho State University.

[6] This class included: John Dudgeon (Professor), Elise C. Krauel (M.S. Candidate), and the students Dimitra Skoulikari, Daniel Parker, Ethan Kumm, Kendall Rahill and Jeff Beck.

source (see Figure 10). Because of this, heavily weathered surfaces were avoided in collecting data on the 10CA33 artifacts.

Figure 10: Graph showing the differences between weathered and non-weathered surfaces of three sources/subsources of obsidian: Coal Banks subsource, Ibex subsource, and Browns Bench source.



4.2 Geographical Information Systems (GIS)

A map of source locations relative to Rock Creek Site (10CA33) was created using ArcGIS software (see Figure 11). Source locations were used from two sources:

1) Coordinates of the sources collected by Rick Holmer at Idaho State University

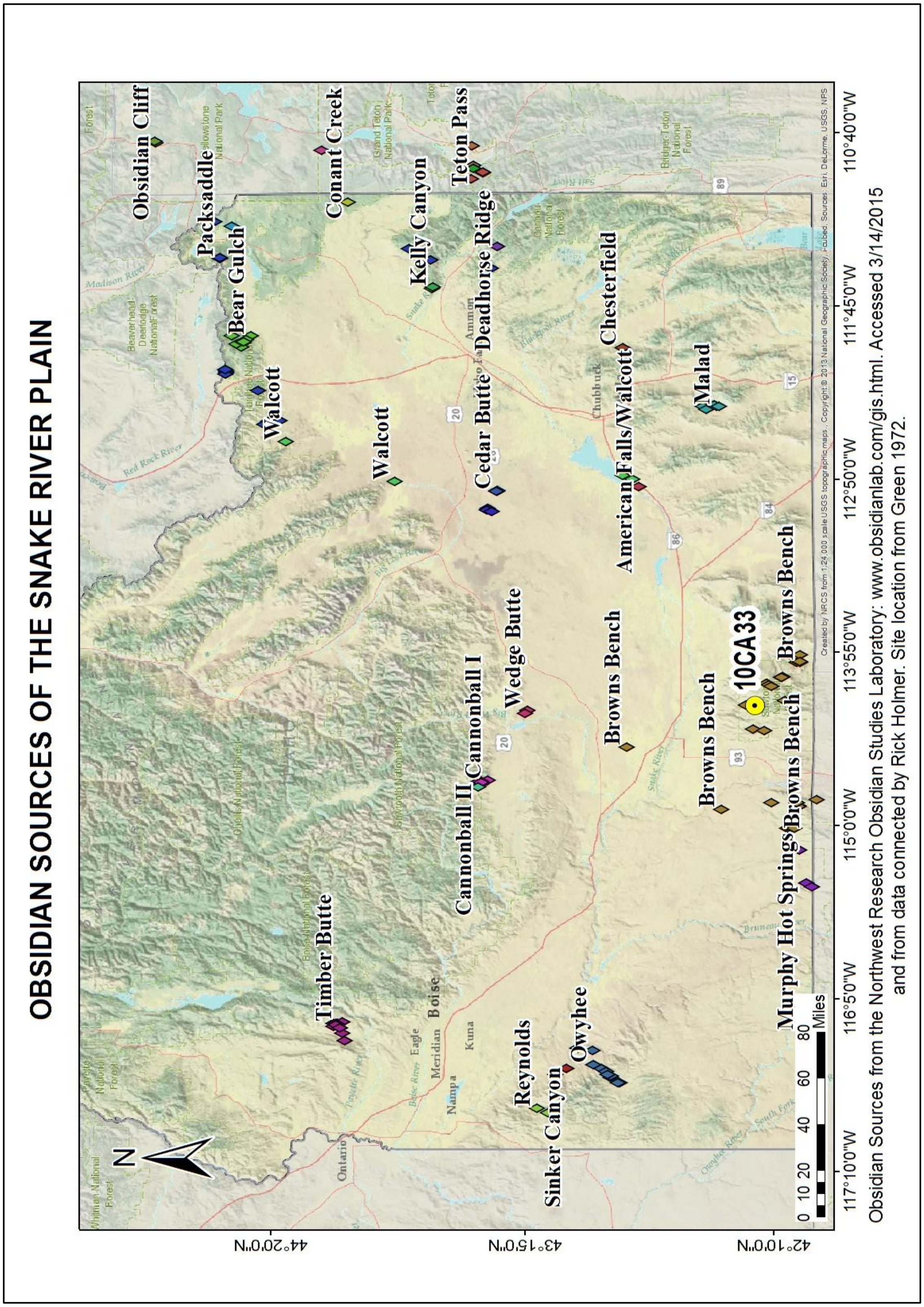
2) Source locations georeferenced from maps from the Northwest Research Obsidian Laboratory online database.

Source locations were combined into a geodatabase in ArcMap. The site location and extent was found from images of the site from Green (1974) and a high resolution base layer map.

Images and diagrams of the 1970 excavation were also georeferenced into the geodatabase from Green (1972). In addition, site locations discussed in this thesis were georeferenced from images and the points digitized into the site locations (see Figure 3). Map images for this were collected from Butler (1978); Butler (1986), Henrikson (2002), and Plew (2000)[7]. Multiple base maps were used from the "Add Basemap" tool in ArcMap, including the World Imagery Basemap, World Terrain Basemap, and World Relief Map. The Idaho State Boundary layer was created by NRCS from 1:24,000 scale USGS topographic maps. The USA Topographic Basemap is from the 2013 National Geographic Society USA, downloaded from ESRI.com. All maps in this thesis were created with ArcMap from this geodatabase.

[7] Plew (2000) maps did not include points, only site names in general locations.

Figure 11: Map of major obsidian sources in the Snake River Plain and surrounding areas

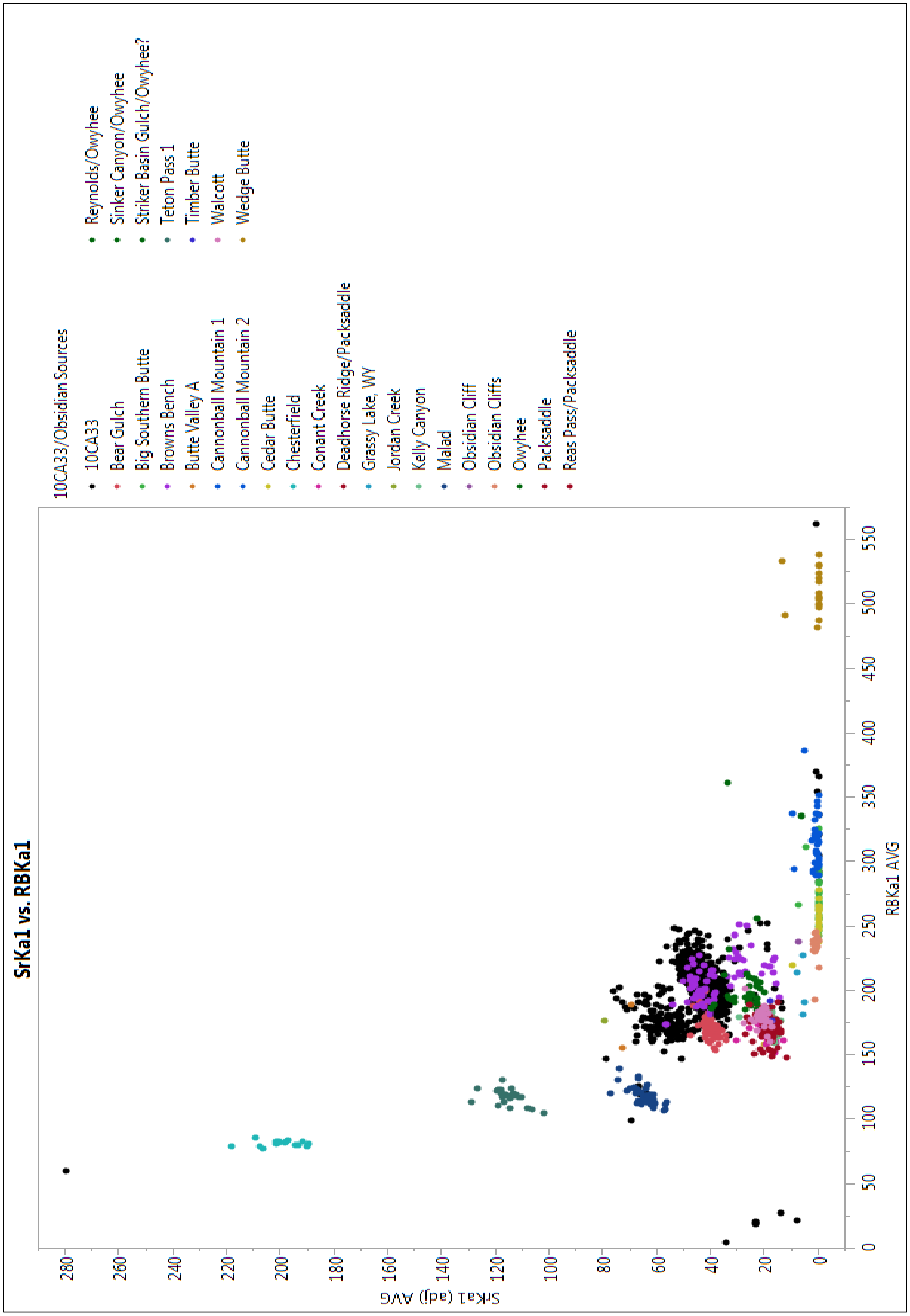


4.3 XRF Methods

For this study, 892 obsidian tools were chosen from the Rock Creek Site to undergo XRF using a Bruker portable X-Ray Fluorescence (pXRF) unit. In addition, XRF data on obsidian sources were also collected from the obsidian source collection in the Idaho State University Anthropology Department. Each sample was run twice for sixty seconds, avoiding any existing labels and obsidian cortex as these could introduce a shift in data with larger iron counts and additional elements (see Appendix A). These two counts were averaged for each trace element and the final number was used. Using combinations of the different trace elements, artifact pXRF data was compared to data collected from known sources in bivariate plots to visually assign sources to the different artifacts (see Figure 12).

The bivariate plot of SrKa1 and RbKa1 data averages (Figure 12) the known source data in different colors, which form distinctive groupings by color or source. This result for the sources supports Frahm et al. (2014) conclusion of shorter times being enough to differentiate obsidian sources (Frahm et al. 2014). In the case of Idaho obsidian, sixty seconds is enough to differentiate obsidian sources in the Snake River Plain and surrounding areas. The artifact data, represented by black dots, are also shown on Figure 12. While many of these data points fit within the colored source groupings, some of the artifact data does not fit in neatly within the source data that this study collected. Because of this, a statistical package was chosen to help source the artifact data.

Figure 12: Bivariate plot of Strontium (Sr) and Rubidium (Rb) showing obsidian source data in different colors according to source, with the artifact data in black.



4.4 Multivariate Statistics in JMP

Though many of the sources are distinctly grouped depending on the element bivariate plot, there are areas on the bivariate plots were the distinctions are less clear. In Figure 12, one area occurs between RbKa1 values of 150 and 250ppm. The elemental bivariate plots also showed several data points outside of the source groupings. The addition of averaged data from previous studies from the Idaho Museum of Natural History and the Northwest Research Obsidian Studies Laboratory were obtained from Marielle L. P. Black's 2014 thesis. This additional data helped expand the base sample for the obsidian source in an effort to place these potential outliers. Weathering of artifact surfaces may also have attributed to these outliers, though effort was made in the initial data collection to avoid areas with heavy weathering and cortex.

To obtain statistically robust source assignment, the Stepwise Discriminant Analysis in the JMP statistical package was used to identify source locations of the Rock Creek Site artifacts. The setup for this analysis is shown in Figure 13 and Figure 14. Unlike with bivariate plots, this analysis uses all ten trace elements collected by the XRF to group the different sources (see Figure 15).

A discriminant analysis is used to "predict membership in a group or category based on observed values of several continuous variables" (SAS n.d.). In order to perform this analysis, data "with known group membership" is needed to help predict or place the unknown items into the groups (SAS n.d.). With the data collected from the Anthropology Department's obsidian source collection to act as these "observed values," this method would allow placement of the unknown values into the known groups. There are several fitting methods available for discriminant analyses. The linear fitting method was chosen for this analysis. This fitting method “assumes that the with-in group covariance matrices are equal” and that the “covariate means for the groups defined by X are assumed to differ” (SAS n.d.). In other words, that each element is assumed to have an impact on the sorting and that there is more than one group in the data. A stepwise discriminant analysis “chooses variables that discriminate well,” assessing the variables one by one, with the most correlated variables used first and shows the order of influence of the different elements in separating the sources (see Figure 14) (SAS n.d.). In this case, Rb, Sr, Nb, and Zr had the greatest influence on sourcing the obsidian.

Figure 16, Figure 17, and Figure 18 show the results of the Stepwise Discriminant Analysis in canonical graphs with the source extents as colored circles around the black data points. Like with the bi-variate plot, the sources do separate into groups. Some of the sources are clearly isolated, while others (such as Cannonball Mountain I and II) are harder to distinguish (see Figure 16). Figure 17 shows a zoomed in look at the center of the canonical graph showing one of these apparently overlapping source extents. However, a look at this graph in 3D generated by JMP shows that there is separation between the groupings (see Figure 18).

One difficulty with discriminant analysis is that it does not include tolerances but classifies all the data into known groups, even if there are outliers. To counter this, only predictions of 90% or higher were considered when looking at the obsidian sources used at the 10CA33 site, resulting in ten artifacts not included in the study (see Table 6). All artifacts not included in the 10CA33 obsidian study were deleted from the final table. Several artifacts had multiple data entries due to initial problems with collecting XRF data (for instance, 10CA33.391 had data with and without the third XRF data values from the obsidian cortex, and 10CA33.425 was run on the XRF for 5 minutes once due to its size). However, there was no difference in the final source predictions between the different entries. These extra entries (included 10CA33.378, 10CA33.391, 10CA33.425, and 10CA33.517) were excluded from the analysis but were not deleted from the table. The full Stepwise Discriminant Analysis JMP software results are found in Appendix B. Following analysis and results were made using the first prediction results, as repeated Stepwise Discriminant Analysis results remained the same.

Figure 13: Dialog box for the Discriminant Analysis, showing the selection of all ten trace elements as the Y1 Covariates for the source data

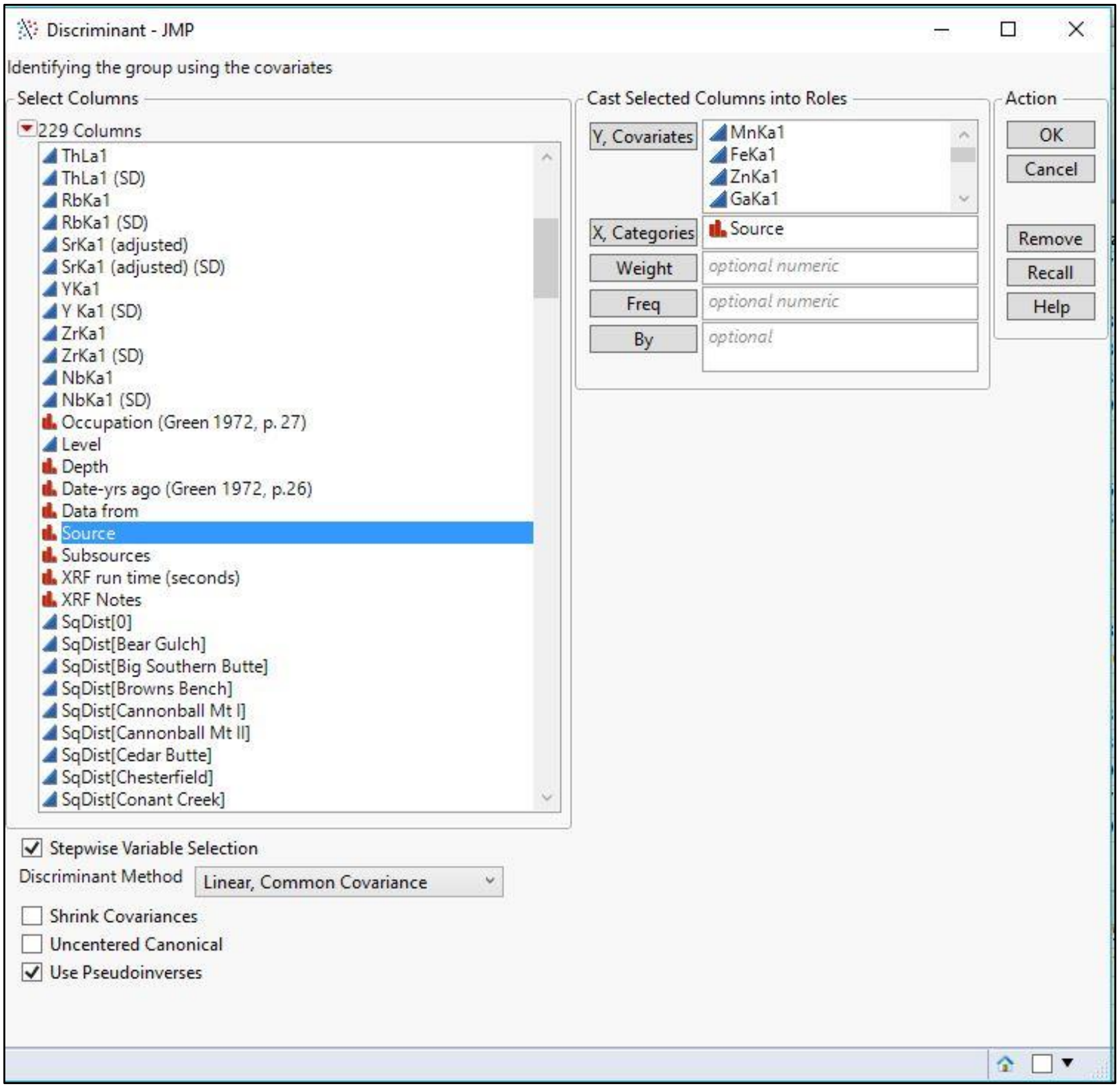
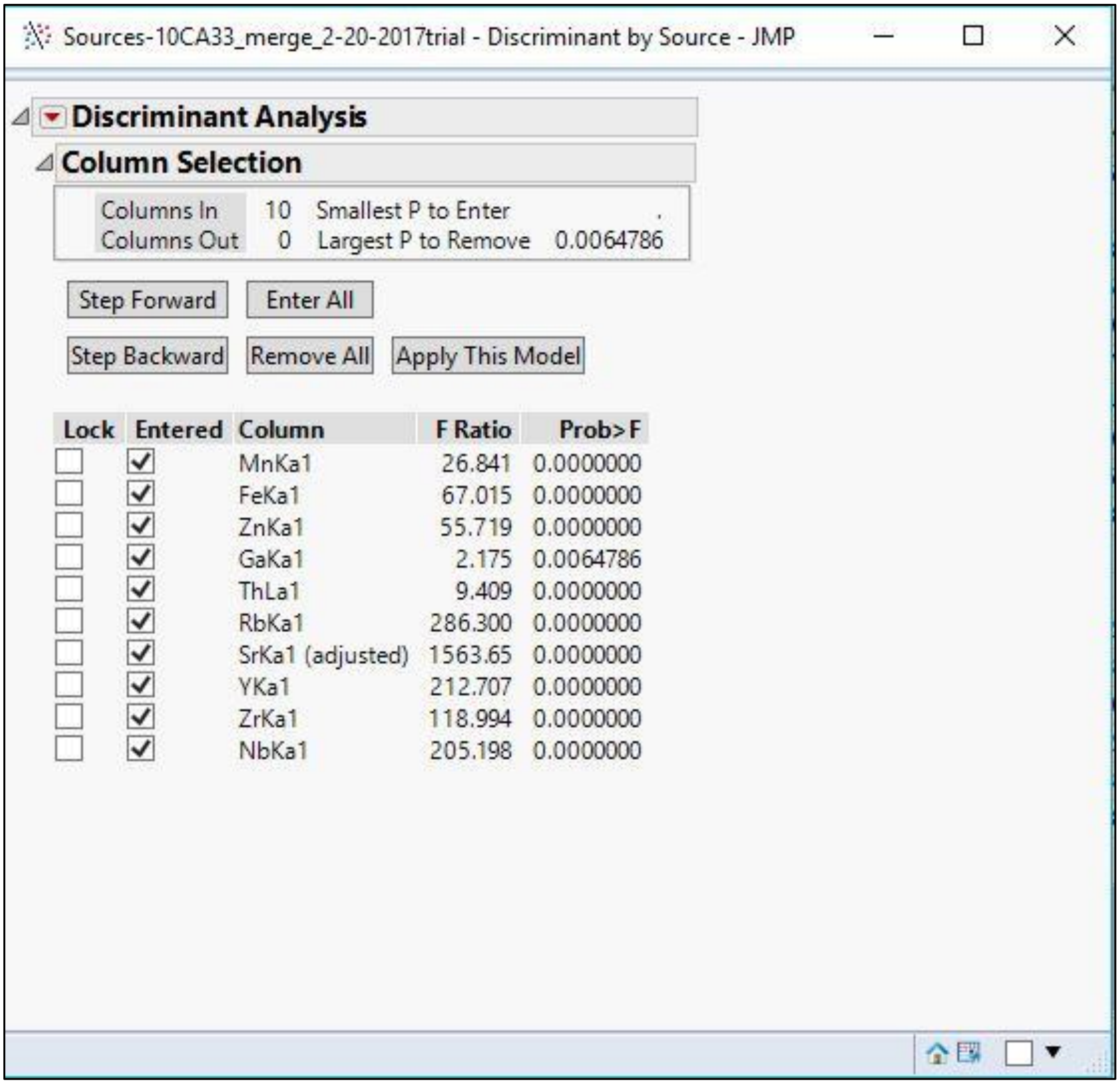


Figure 14: Order of elements selected for the Stepwise Discriminant Analysis. The order was RbKa1, SrKa1 (adjusted), NbKa1, ZrKa1, YKa1, ZnKa1, FeKa1, MnKa1, ThLa1, and GaKa1.



Lock	Entered	Column	F Ratio	Prob>F
☐	☑	MnKa1	26.841	0.0000000
☐	☑	FeKa1	67.015	0.0000000
☐	☑	ZnKa1	55.719	0.0000000
☐	☑	GaKa1	2.175	0.0064786
☐	☑	ThLa1	9.409	0.0000000
☐	☑	RbKa1	286.300	0.0000000
☐	☑	SrKa1 (adjusted)	1563.65	0.0000000
☐	☑	YKa1	212.707	0.0000000
☐	☑	ZrKa1	118.994	0.0000000
☐	☑	NbKa1	205.198	0.0000000

Figure 15: Discriminant Analysis uses more than two variables to assign groupings. This Scatterplot Matrix shows the bivariate plots of the various elements collected by the XRF and used by JMP to generate the final Stepwise Discriminant Analysis.

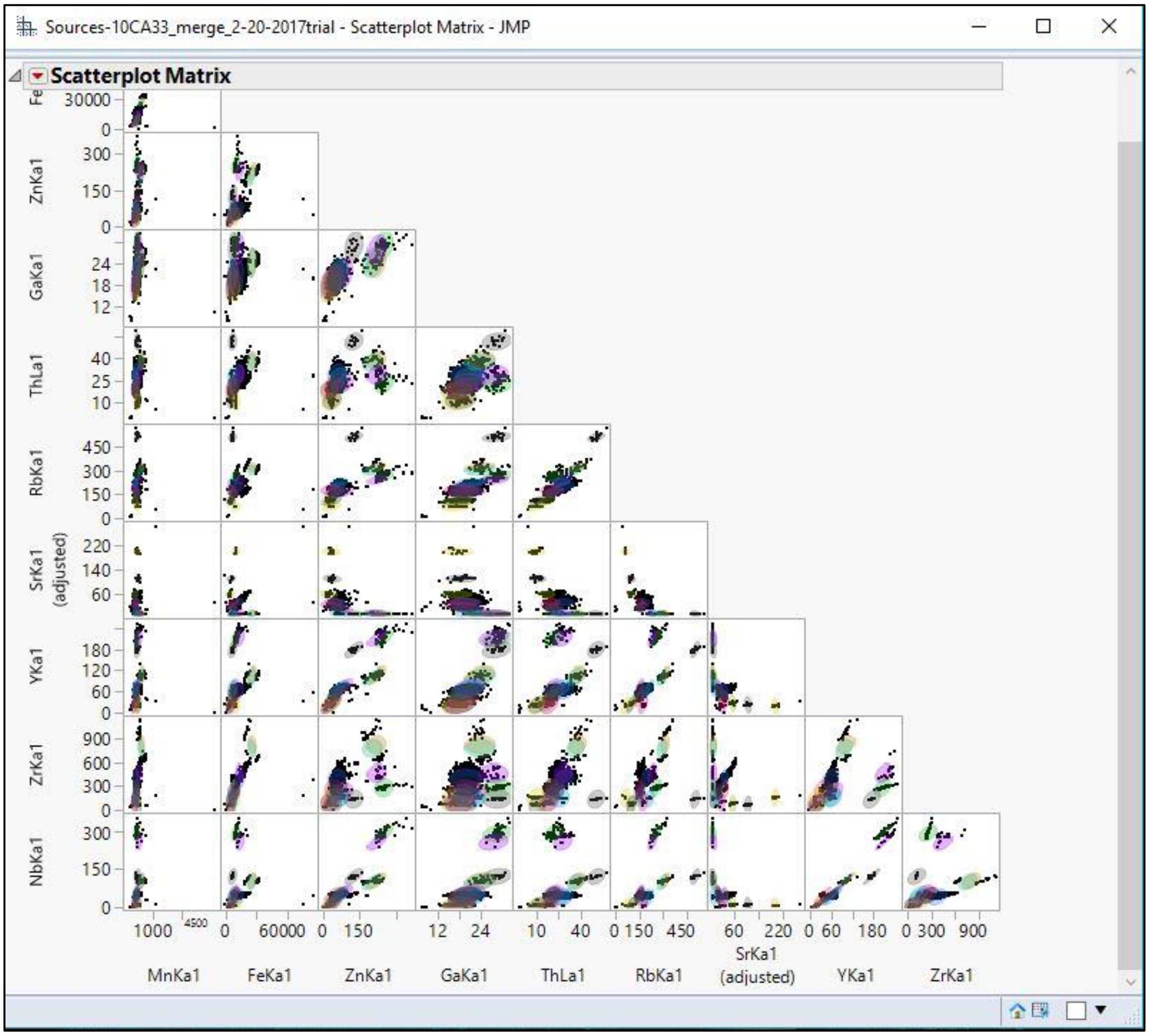


Figure 16: Image of the Canonical Graph generated by the Stepwise Discriminant Analysis. It shows the data points and the extents of the projected source intervals.

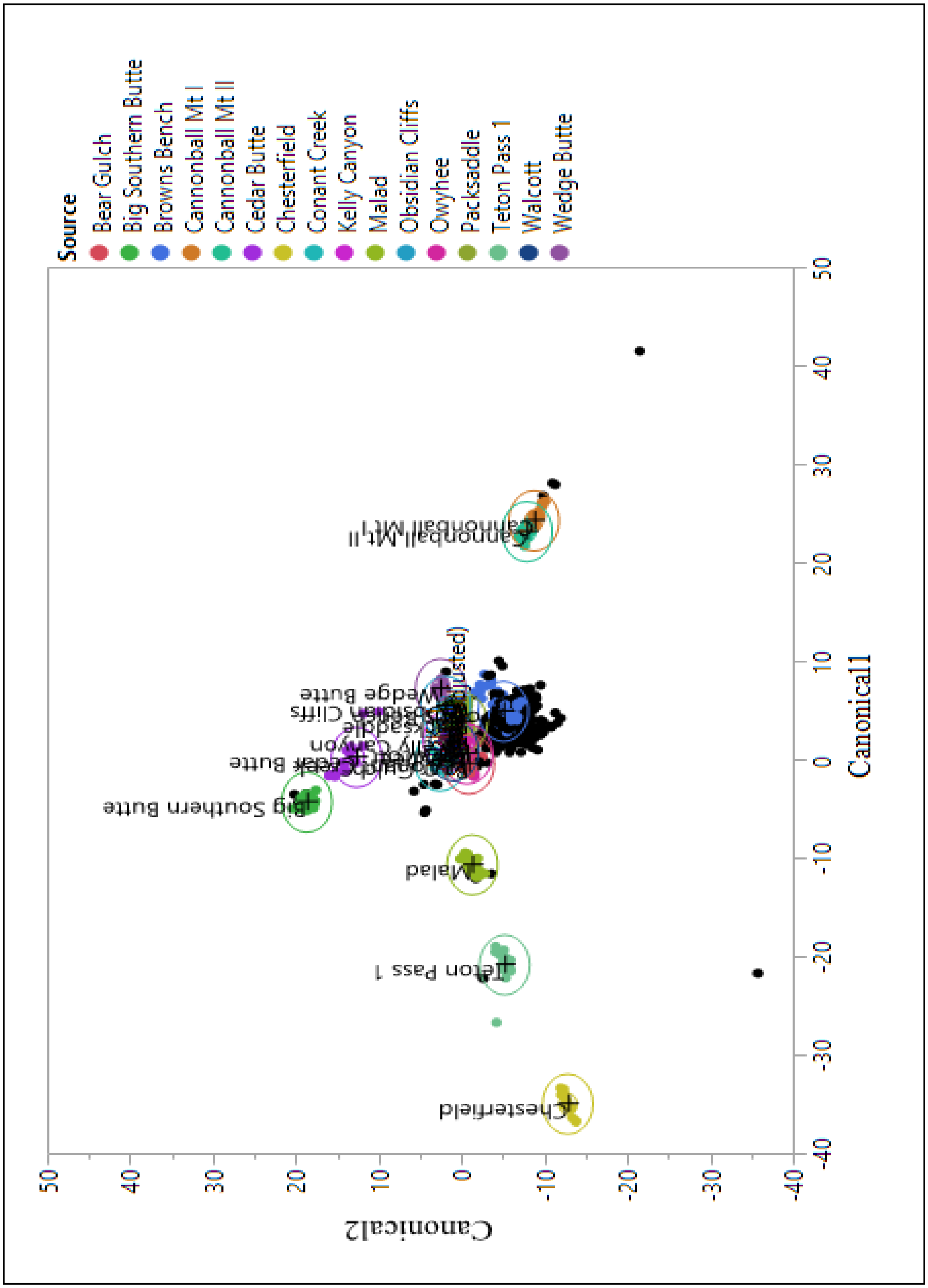


Figure 17: Zoomed in image of the Canonical Graph generated by the Stepwise Discriminant Analysis, showing only the center of the graph with the overlapping source extents. Though this section seems to show the overlapping extents for sources, a look at a 3D graph generated by JMP shows that this is not the case

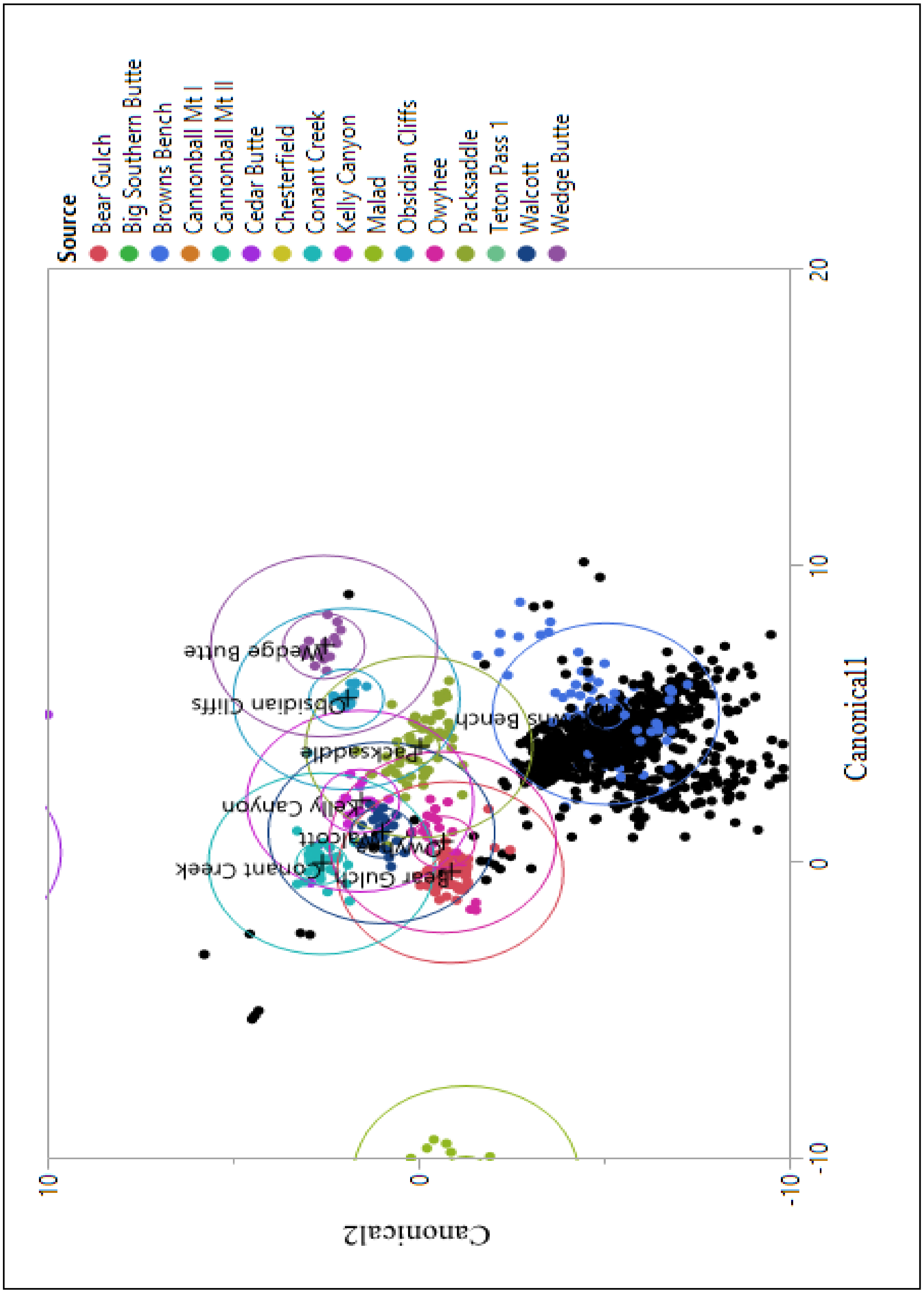


Figure 18: Zoomed in image of a section of the Canonical 3D graph showing the grouping of elemental data into distinct sources. Though not as discrete as the others, several distinct groupings can be seen in the center section of this image.

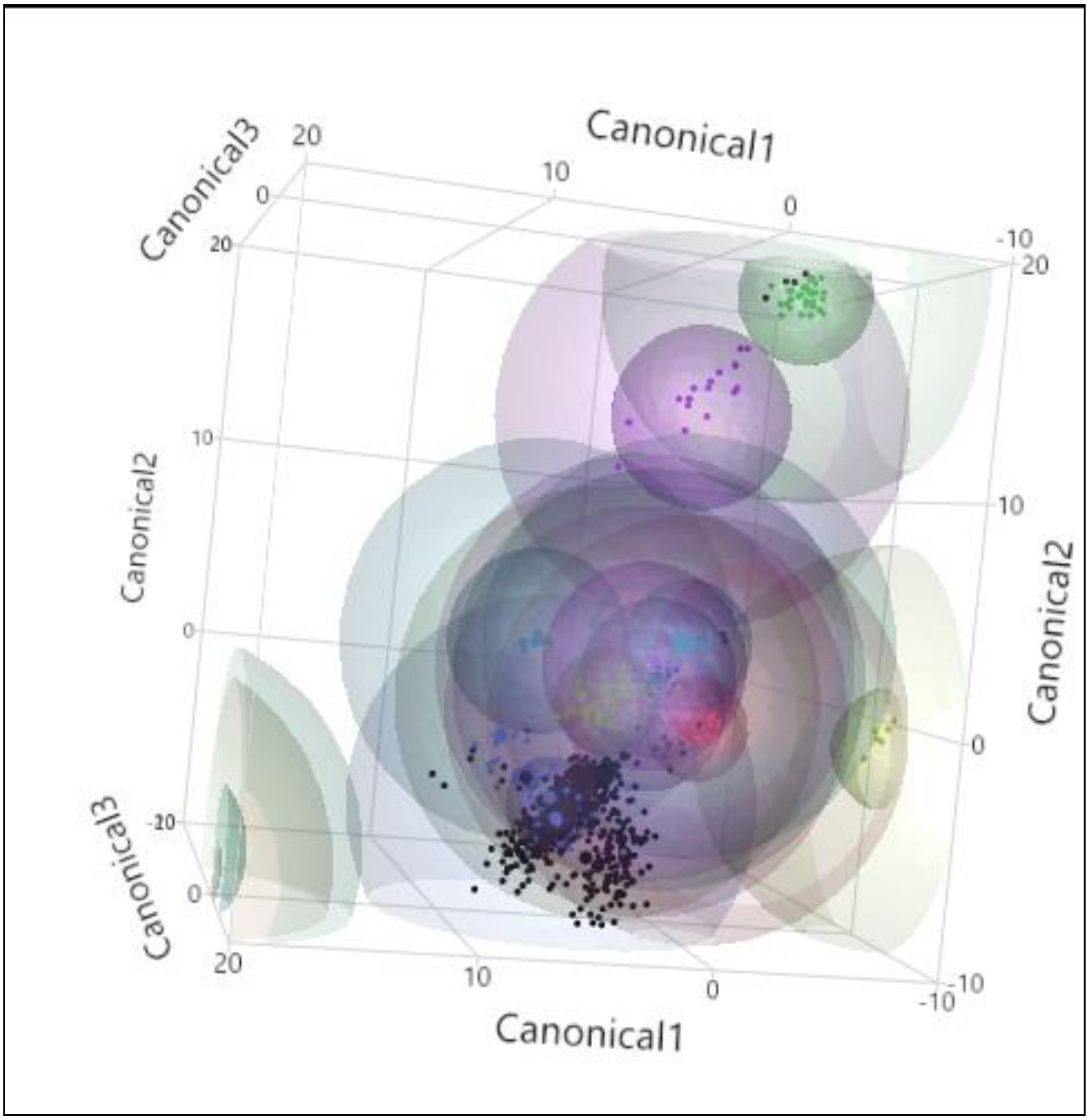


Table 6: Table showing the artifacts 90% probability and not included in this 10CA33 Obsidian study

Sample Name/Artifact #	Stepwise Discrimination Prediction	Probability	Other Prediction & Probability	Artifact Age	Artifact Type
10CA33.136	Brown's Bench	0.8957	Packsaddle 0.10	Occupation IV	Biface
10CA33.159	Brown's Bench	0.5551	Packsaddle 0.44	Unknown	Biface
10CA33.670	Walcott	0.8200	Owyhee 0.18	Occupation IV	Projectile Point
10CA33.717	Walcott	0.8389	Conant Creek 0.16	Occupation III	Biface
10CA33.833	Brown's Bench	0.8430	Packsaddle 0.16	Occupation III	Biface
10CA33.950	Brown's Bench	0.6915	Packsaddle 0.38	Occupation IV	Core
10CA33.1043	Bear Gulch	0.5455	Brown's Bench 0.45	Occupation IV	Projectile Point
10CA33.1163	Packsaddle	0.8191	Brown's Bench 0.18	Occupation IV	Biface
10CA33.1284	Brown's Bench	0.8005	Packsaddle 0.20	Occupation III	Biface
10CA33.1319	Owyhee	0.7876	Walcott 0.21	Occupation IV	Projectile Point

5 RESULTS

5.1 Sources of Obsidian

The first part of this study was to source the obsidian artifacts from the 10CA33 Rock Creek Site. As discussed in the Methodology section, XRF data was collected from 886 obsidian artifacts from the site (see Appendix B for complete results). Ten additional artifacts were excluded due to prediction results below 90%, leaving 876 obsidian artifacts. As seen in Table 7 and Figure 19, the majority of obsidian used for these artifacts was from Brown's Bench. As the site is situated within the large deposit area of Brown's Bench, this would have been a local and easily obtained resource (see Figure 20). There is also minor contribution from a large variety of other sources, including sources such as Bear Gulch, Conant Creek, and Packsaddle, which are over 200 miles away from the site. Figure 20 shows the obsidian sources found at Rock Creek Site in relation to the site location. These source locations follow a north-east arc around the Snake River Plain.

Table 7: Tabulated results from JMP software of 10CA33 artifacts by source prediction

StepDisc1_Predicted	N
Bear Gulch	2
Big Southern Butte	4
Browns Bench	839
Cannonball Mt I	3
Cannonball Mt II	1
Chesterfield	1
Conant Creek	3
Malad	6
Packsaddle	2
Teton Pass 1	1
Walcott	13
Wedge Butte	1

15 rows have been excluded.

Figure 19: Graph of artifact type by obsidian source. Brown's Bench (a local source) was used for all artifact types. The majority of other obsidian sources found at the site were used for projectile points or bifaces.

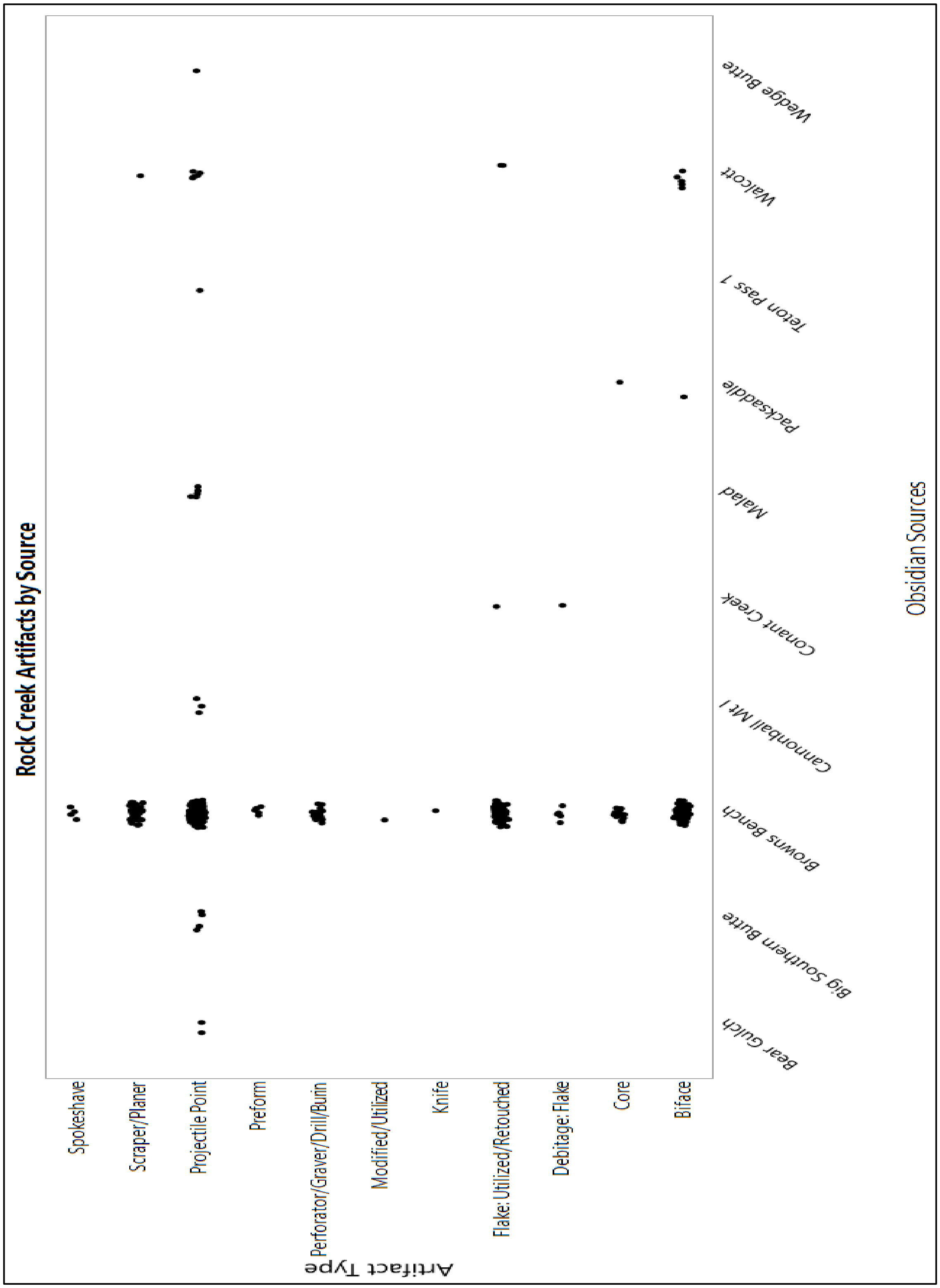
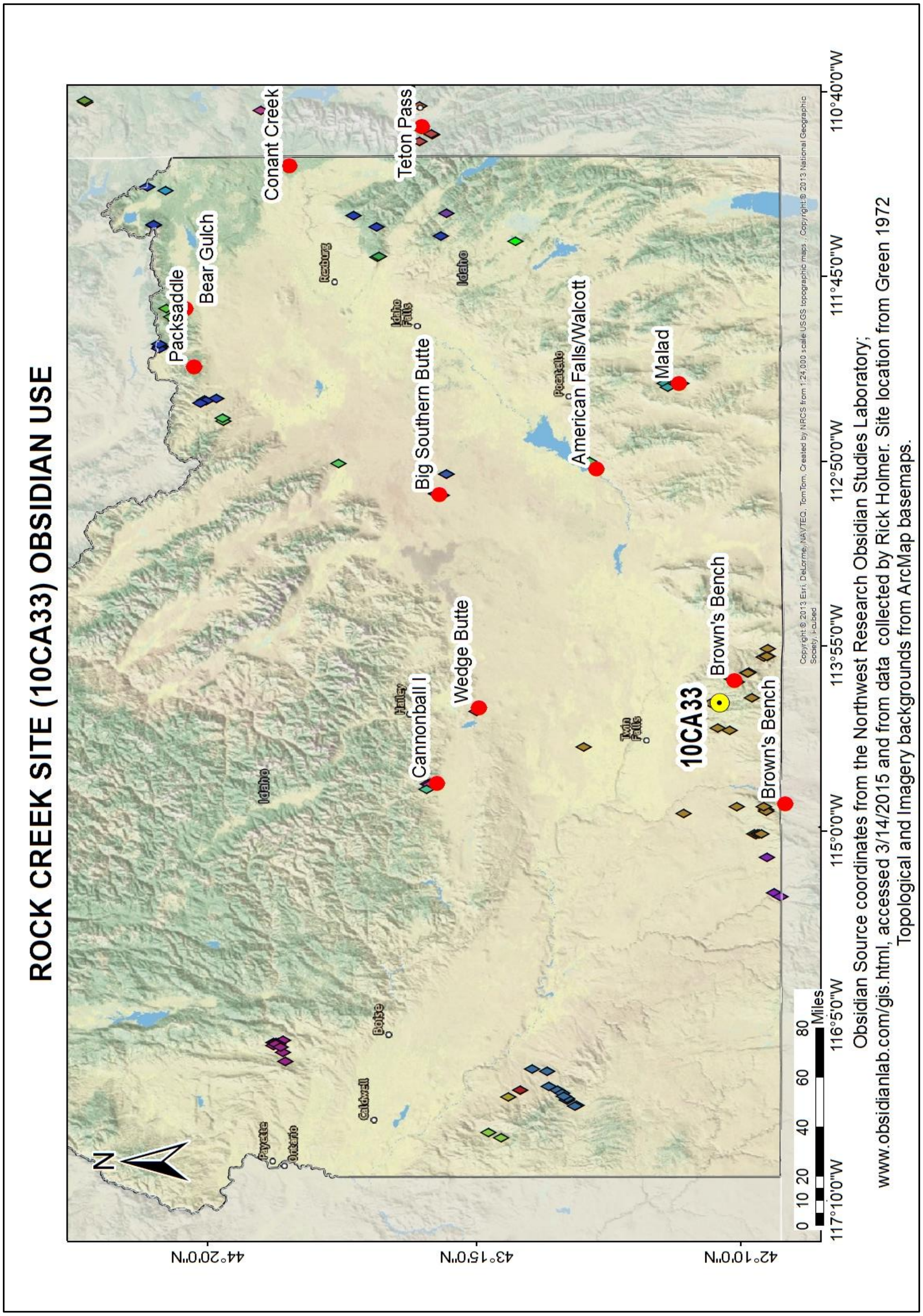


Figure 20: Map showing the obsidian sources used at the Rock Creek site (10CA33)



5.2 Obsidian through Time

As discussed in the Background section, Green used temporally-diagnostic artifacts to define five cultural units, or “Occupations,” of the Rock Creek Site, within the period of 8,500 years of occupation of the area: Occupation I (7,900 to 10,500 years ago), Occupation II (7,000 to 7,900 years ago), Occupation III (4850 to 7,000 years ago), Occupation IV (2000 to 4850 years ago), and Occupation V (present to 2000 years ago) (Green 1972:26– 29) (see Table 5 for more details). Using this division and the level and excavation data from the artifact catalog provided by Amy Commendador from the Idaho Museum of Natural History, the obsidian artifacts were placed within these five Occupations, first by depth, then by corresponding level[8]. Ten additional artifacts were excluded in this section. One artifact, 10CA33.720, had very different level and depth information which would have corresponded to Occupation III and Occupation V, respectively. Nine other artifacts (10CA33.154, 10CA33.155, 10CA33.156, 10CA33.157, 10CA33.159, 10CA33.160, 10CA33.162, 10CA33.1287, 10C33.1372) were also excluded. These artifacts were found on the surface, in the excavation back-dirt, or had no location data given in the catalog, and had no provenance.

Brown’s Bench was used for all artifact types. The majority of other obsidian sources found at the site were used for projectile points or bifaces. As can be seen in Figure 22and Figure 23, the majority of 10CA33 artifacts come from Occupation III and Occupation IV, or between 2000 to 7000 years ago. Only five artifacts, including projectile points, a biface, and a utilized flake, were found in Occupation I. All artifacts

[8] When there were differences, the depth, rather than the level was used to assign occupation periods. If a depth was not given but a level was, the depth was assumed to be the same as the depth were the level and depth was present.

were from the nearby Brown’s Bench source (see Figure 22). Thirty-five artifacts (with a possible four others) were found in Occupation II, with similar types of artifacts as found in Occupation I, with the addition of a core. All but one artifact from Occupation II was also from Brown’s Bench, with the exception of one biface from Walcott (see Figure 23).

Occupation III and Occupation IV had 243 and 467 artifacts, respectively, with a wide range of artifact types. In addition, they also had the most variety of obsidian sources and the widest variety of artifacts from the non-local sources. Occupation III had artifacts made from seven different obsidian sources: Big Southern Butte, Brown’s Bench, Cannonball Mountain I, Conant Creek, Malad, Packsaddle, and Walcott (see Figure 24). Occupation IV utilized even more sources, including Bear Gulch, Big Southern Butte, Brown’s Bench, Cannonball Mountain I and II, Conant Creek, Malad, Teton Pass, and Walcott (see Figure 25). These two Occupations also included obsidian that had traveled the farthest, including Bear Gulch, Packsaddle, Teton Pass, and Conant Creek—all of which are far to the North-East of the site, across the length of the Snake River Plain.

Occupation V had only 92 artifacts but continued the variety of source use. It included artifacts made from 6 different sources, including Big Southern Butte, Brown’s Bench, Chesterfield, Conant Creek, Walcott, and Wedge Butte. Two of these sources, though closer in location to the site than Bear Gulch or Conant Creek, were not included in the artifact assemblage in previous Occupations (see Figure 26).

Table 8: Tabulated results of Rock Creek Site (10CA33) artifacts by Occupation

10CA33 XRF Data_Occupation (Green 1972, p 27)	N
Occupation I	5
Occupation II	35
Occupation III	243
Occupation III/Occupation II	4
Occupation III/Occupation IV	6
Occupation IV	467
Occupation V	92
Occupation V/Occupation IV	9

Figure 21: Graph showing an overview of the Rock Creek Site (10CA33) artifacts and their obsidian sources divided by site Occupation periods. Occupations I and II had almost exclusive use of Brown's Bench obsidian at the site. Occupation III, IV, and V had a wider range of obsidian source use. All the artifacts where the occupation period was unclear were from Brown's Bench.

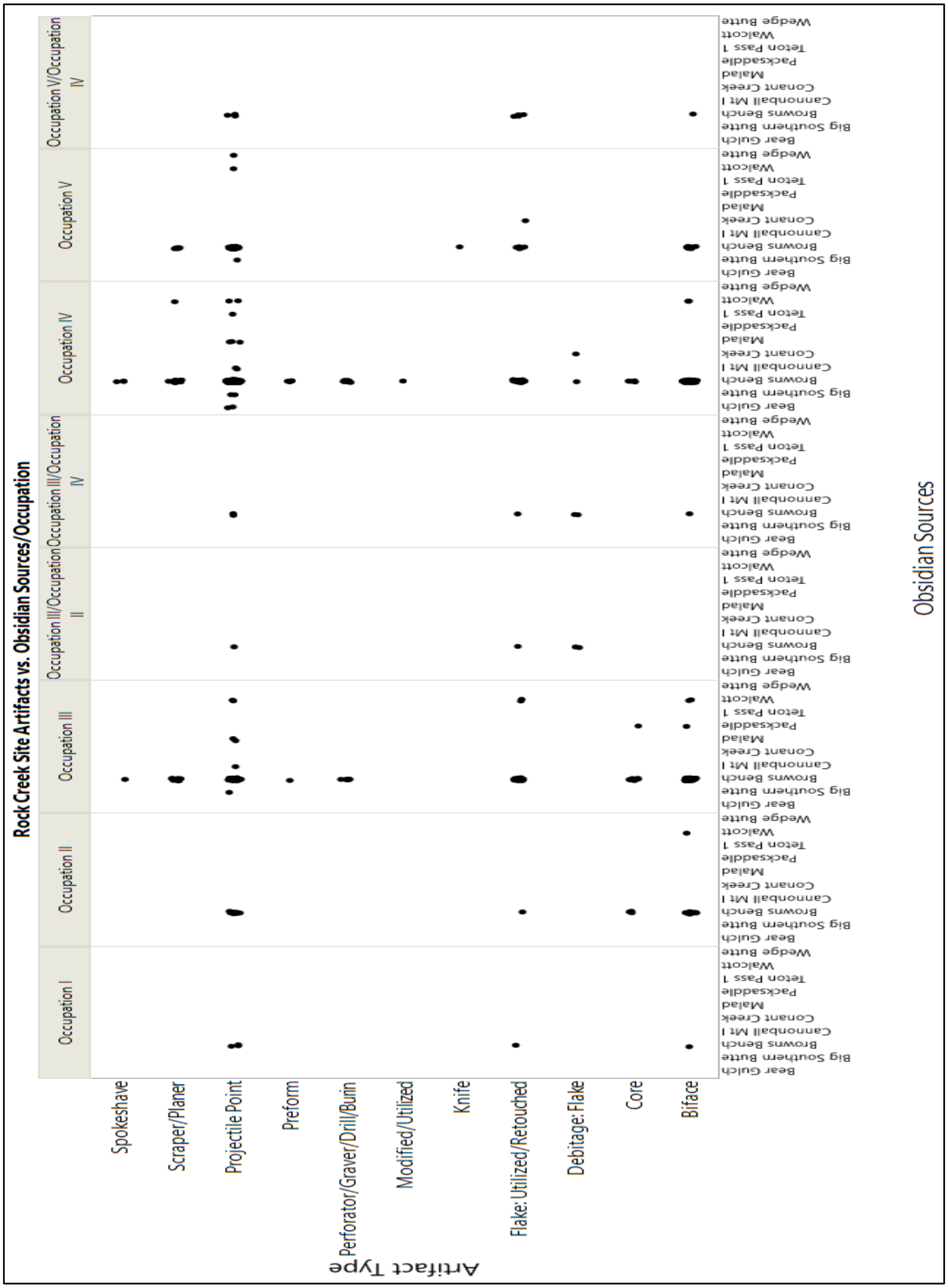


Figure 22: Graph of Rock Creek Site (10CA33) artifacts and obsidian sources from Occupation I period (7,900 to 10,500 years ago).

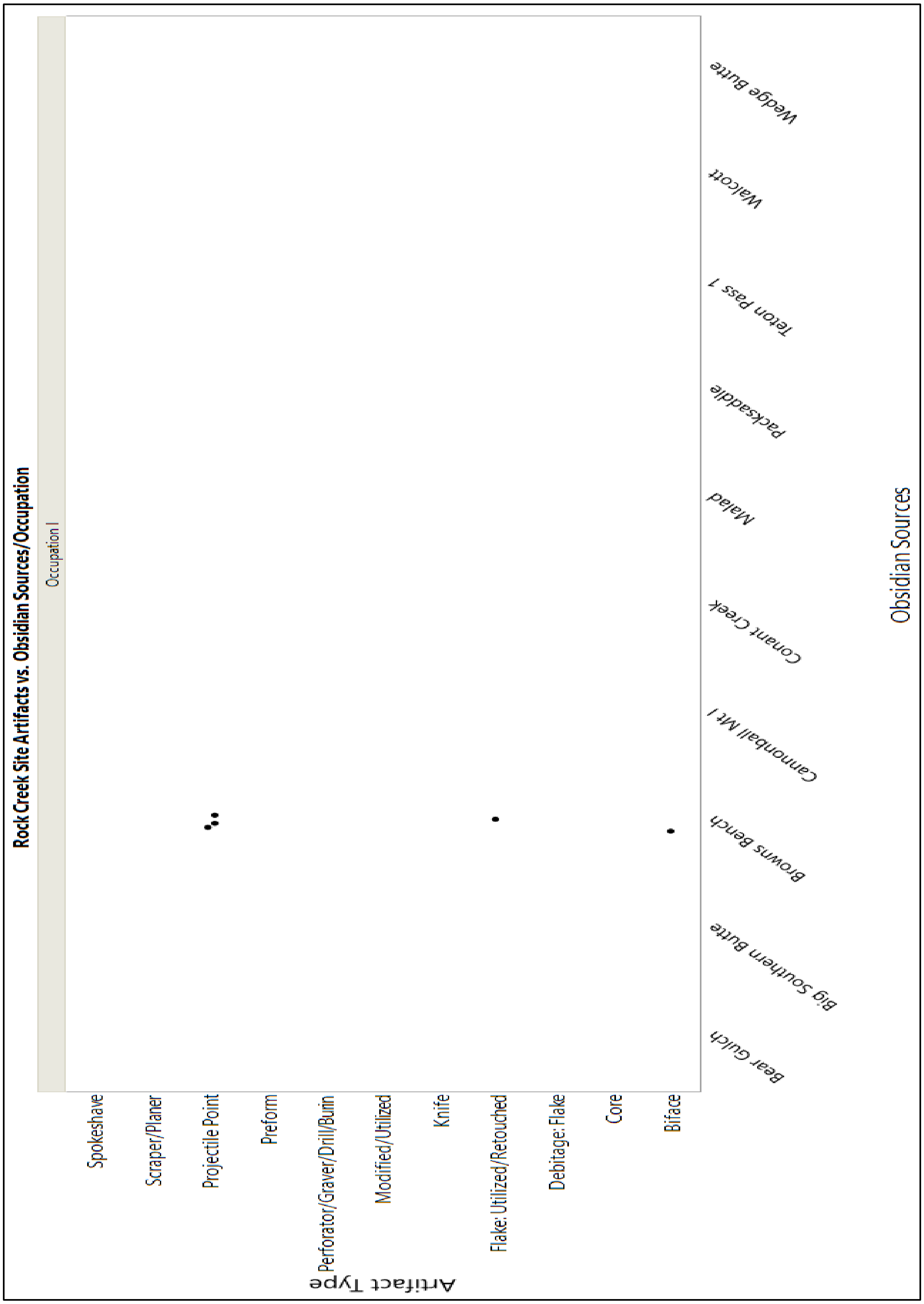


Figure 23: Graph of Rock Creek Site (10CA33) artifacts and obsidian sources from Occupation II period (7,000 to 7,900 years ago).

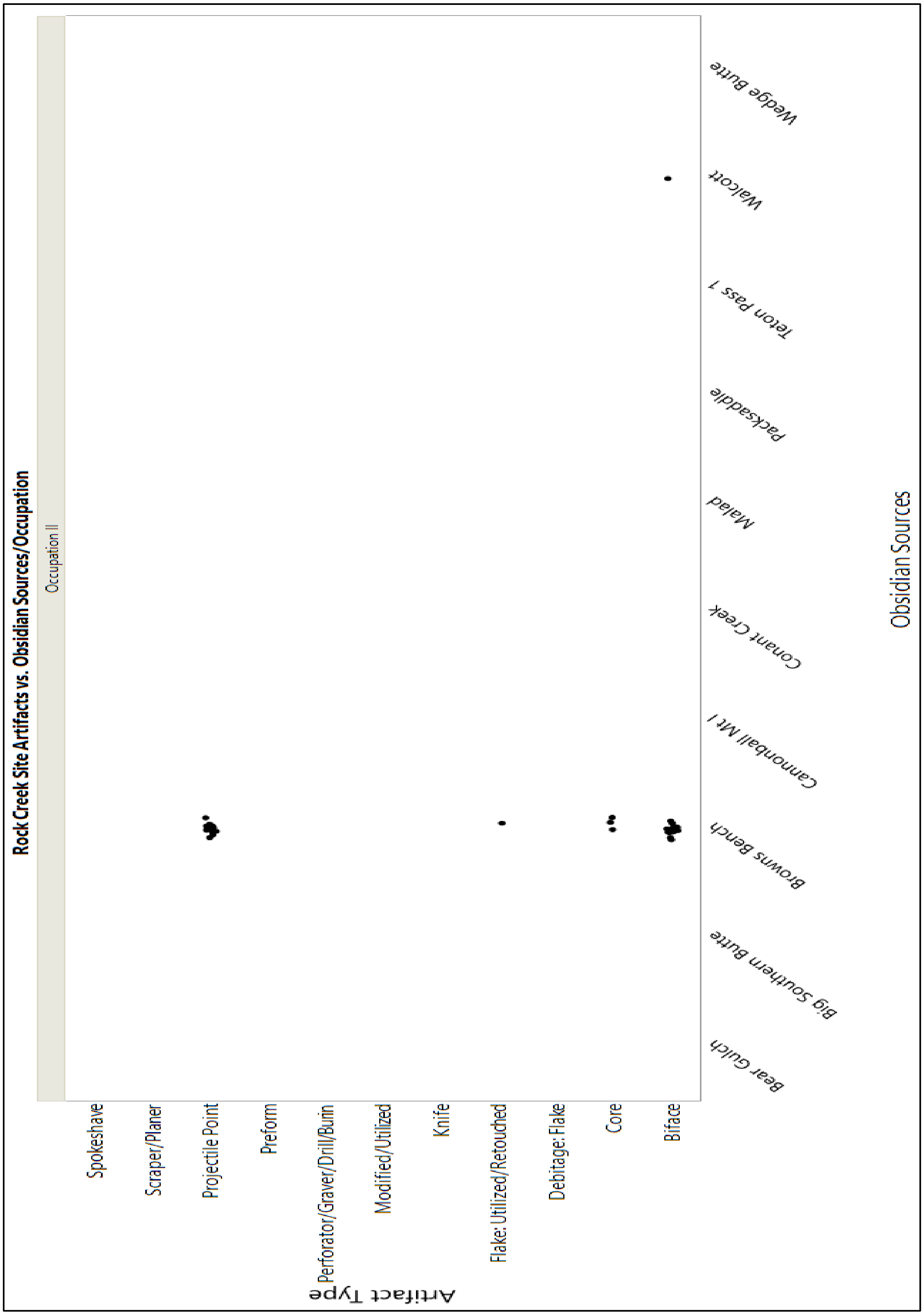


Figure 24: Graph of Rock Creek Site (10CA33) artifacts and obsidian sources from Occupation III period (4,850 to 7,000 years ago).

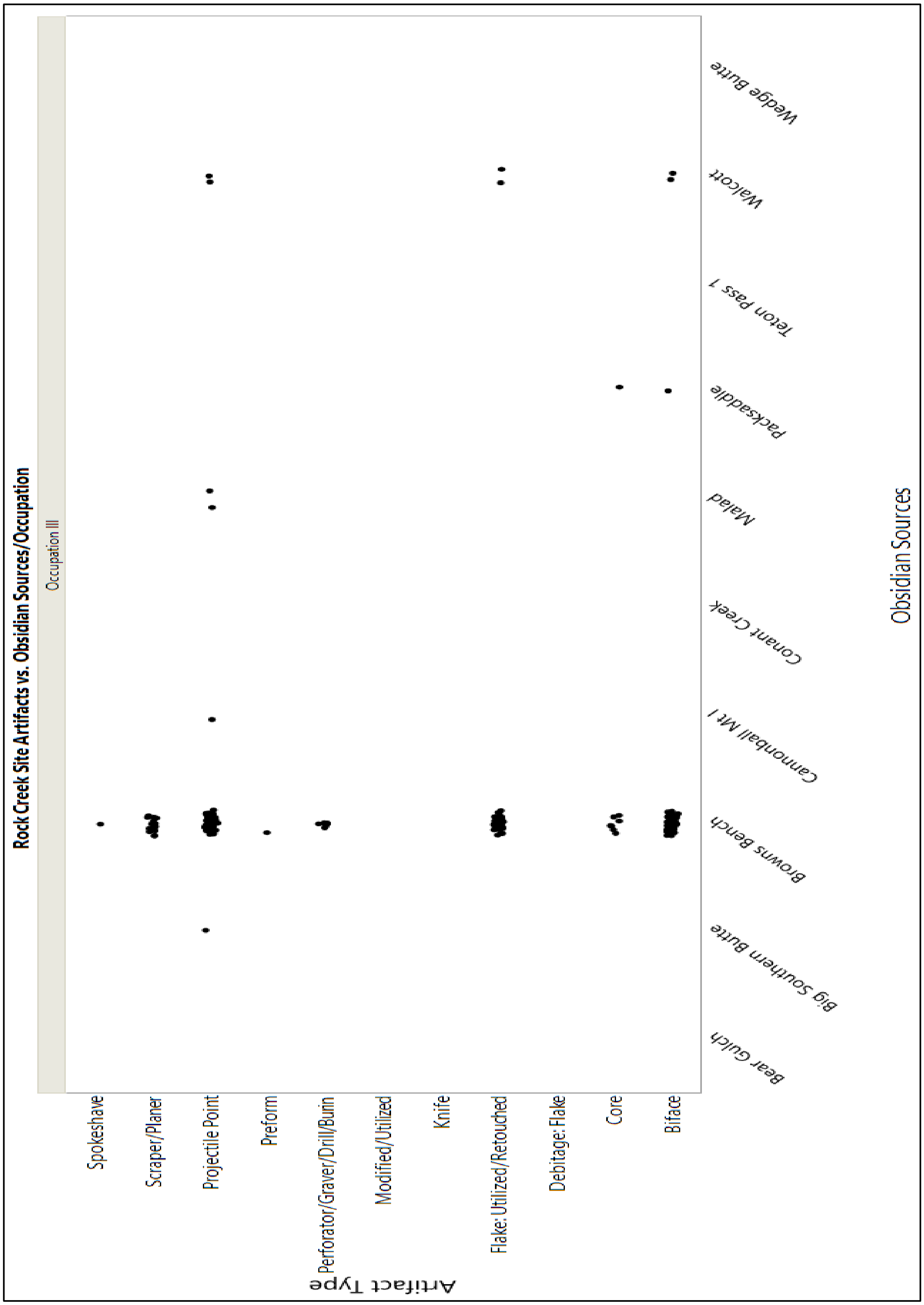


Figure 25: Graph of Rock Creek Site (10CA33) artifacts and obsidian sources from the Occupation IV period (2,000 to 4,850 years ago)

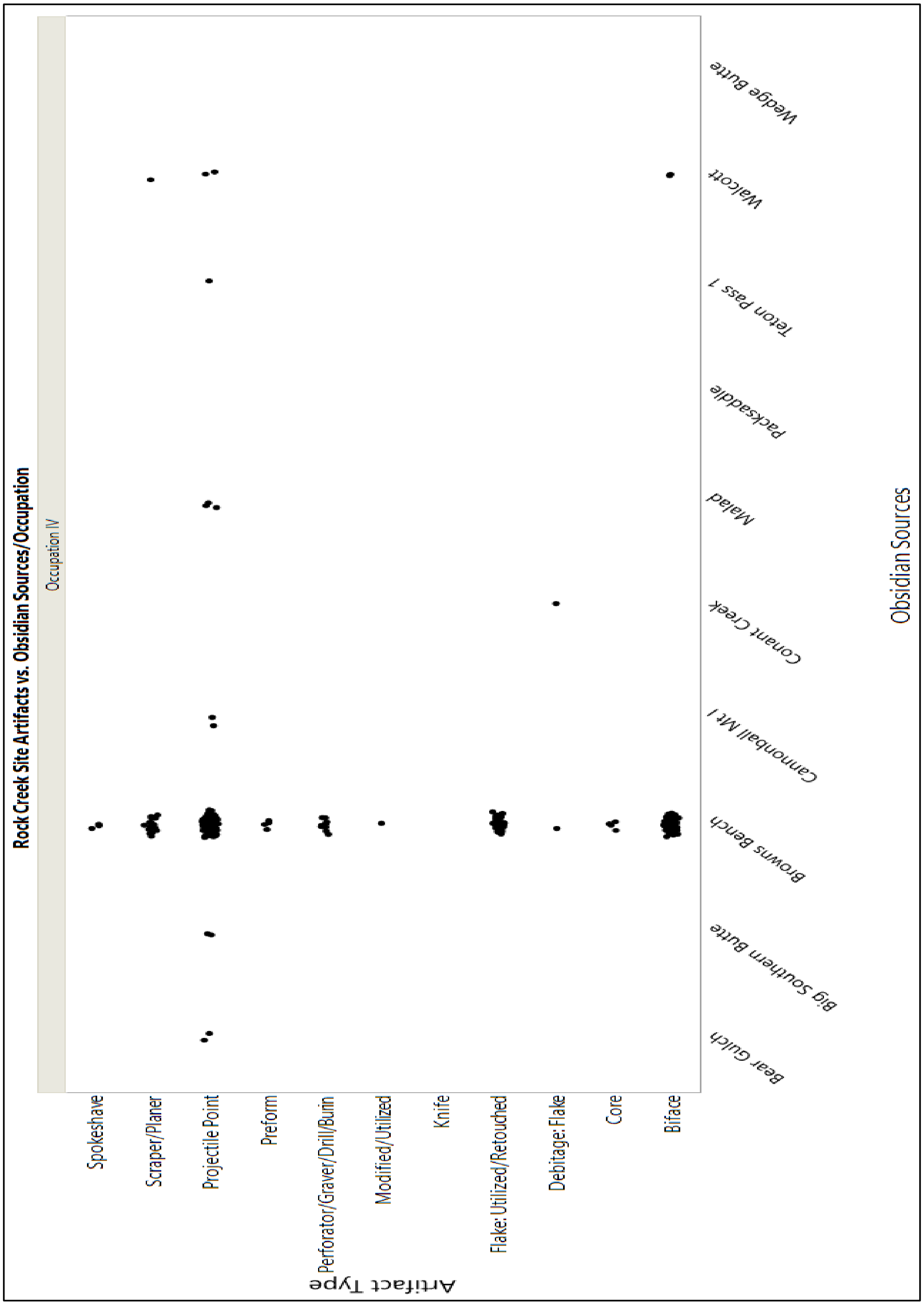
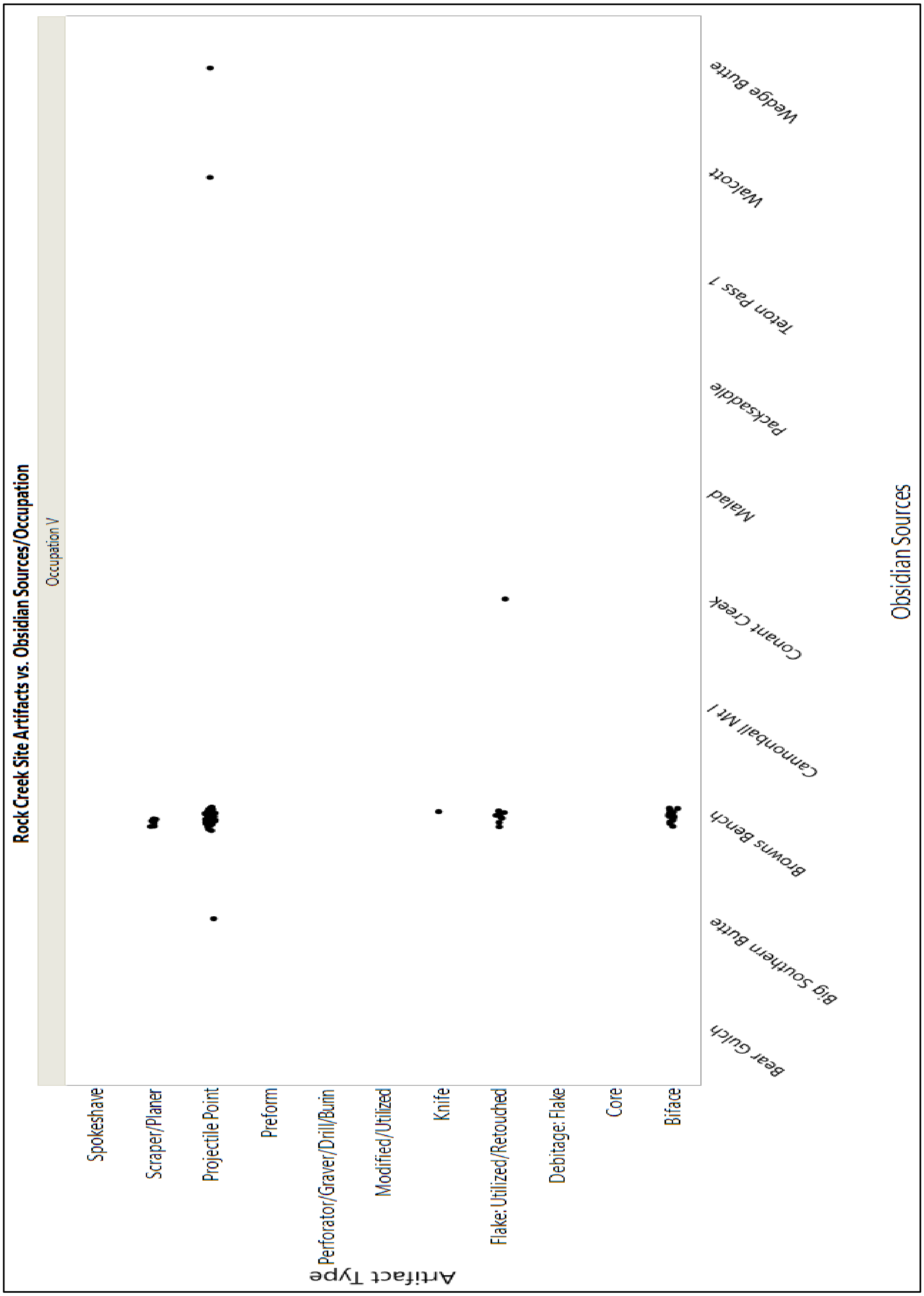


Figure 26: Graph of Rock Creek Site (10CA33) artifacts and obsidian sources from the Occupation V period (present (1972) to 2,000 years ago, minus surface finds)



5.3 Fracture Predictability and the Rock Creek Site

Obsidian performance can be evaluated via assessments of fracture predictability. When creating stone tools, a nodule is reduced by pressure or percussion flaking until the desired form is reached. The more homogenous the material, the more predictable the flaking pattern, thus making it easier to reach the final product. The study by Nelson, Bastakoti, and Dudgeon (2012) found that, of a sample of 8 obsidian sources, including Bear Gulch was the most predictable source, with Packsaddle and Cedar Butte sources next. Brown’s Bench and Malad were not as predictable (see Figure 8). Of the obsidian sources tested by this study, the Rock Creek Site included seven of the eight sources. No Cedar Butte obsidian was found at the site. Four additional sources were found at the site but were not part of their study: Conant Creek, Teton Pass, Chesterfield, and Wedge Butte (Nelson, Bastakoti, and Dudgeon 2012).

With the exception of Packsaddle found in Occupation III and Bear Gulch in Occupation IV, the Rock Creek Site shows the most use of Brown’s Bench obsidian, considered to be poorer quality obsidian, in terms of fracture predictability. Walcott obsidian is the second most common and is better quality obsidian, but is still not as high quality, or as predictable, as many other obsidian sources available.

6 CONCLUSION

Overall, the data do not conclusively support my hypotheses. High quality obsidian (Packsaddle and Bear Gulch) and mid-quality obsidian (Big Southern Butte, Cannonball I and II, Walcott, and Malad) were used during Occupations III and IV but the majority of obsidian used was the local Brown’s Bench source. High and mid-quality sources seemed to be utilized mostly for time-intensive tools such as projectile points and bifaces, though local sources were also used for these tools.

This site does not support the hypothesis that prehistoric people preferentially utilized high or mid-quality obsidian sources over local, poorer quality obsidian. In addition, the hypothesis that prehistoric peoples' would use less obsidian sources through time due to the development of a "ethnoecology" as stated by Kottak (2006) and Nazarea (2006), also was unsupported. Few obsidian artifacts were found in the earliest Occupation levels, those from the Paleoindian Plano period and the Early Archaic, and all these artifacts were from the local Brown's Bench obsidian source. It is not until later Occupation levels (last part of the Early Archaic period and into the Late Archaic period) that more obsidian sources were used in the Rock Creek Site (10CA33) artifacts. Some of these sources are high or mid-quality sources, but the local Brown's Bench obsidian still dominates the source use at Rock Creek Site (10CA33).

This prevalence of local obsidian could be due to the type of site. The Rock Creek Site (10CA33) is located very near the Brown's Bench obsidian source. Green's (1972) delineation of "Occupation" infers use of the area and not long-term permanent occupation of the site. The vast majorities of the artifacts recovered were lithic and did not include other items commonly found at habitation sites, such as large amounts of food waste (Green 1972:113). The location and lithic artifact assemblages may indicate a site specifically used to process Brown's Bench obsidian, which would account for the amount of Brown's Bench obsidian artifacts at the site, though perhaps not for the more distant obsidian sources found.

Eerkens et al. (2008) found that obsidian was obtained from more desirable sources with earlier, more mobile societies in their study of their eastern California site. Unlike the Eerkens study site, the Rock Creek Site earlier levels had less variety than later levels and used local sources. This seems to indicate more variety in obsidian use in later occupation levels, rather than less obsidian source variety through time. An explanation for this result could be an increase in mobility due to expanded seasonal rounds or extended exchange routes between 2,000 to 7,000 years ago. During this time, the climate had become hotter and drier on the Snake River Plain, with lower water levels in the Great Basin area (Henrikson 1991; Minckley, Bartlein, and Shinker 2004). This may have resulted in an increased use or changed use of the site. The area is located at a higher elevation and may have continued to have higher water levels than on the Plain itself. Green (1972) also notes that between 30-75 centimeters (or Occupations III and IV) material culture increases and even includes some groundstone in the 45-75cm levels (Green 1972:96–107). These changes may support Green's analysis of site use from a small lithic reduction area to a larger workshop or temporary camp (Green 1972:92–114).

There are other possible reasons for this result. This could be correlated with the minimum amount of obsidian artifacts from the earlier occupation. It could also be a situation unique to the Rock Creek Site. In his conclusion, Green does point out that, unlike projectile point collections such as the Hogup and Danger Cave collections, "the trend at Rock Creek is toward increasing diversity of point types through time" (Green 1972:121). This seems to be paralleled by a diverse use of obsidian sources as well.

It is difficult to understand the complexities of obsidian use with such wide time spans. Much could change in the environment and with site use within 900 years and especially within 2,000 years. Over a site use of 8,000 years, 876 artifacts, and even the thousands of debitage flakes found at the site, may not be sufficient to say much about obsidian use for the entire area. The lack of distinct stratigraphy in the initial excavation and the reliance on a relative chronology for the Rock Creek Site (10CA33) interpretation increases the difficulty for a more focused understanding of site and resource use through time.

Obsidian fracture predictability may also have been too narrow a focus to understand obsidian choice and preferential use. The percentage of increased fracture predictability discovered by Nelson, Bastakoti, and Dudgeon (2012) between Brown's Bench and other obsidians may not impact obsidian tool making in a significant enough way influence obsidian choice for prehistoric people. Instead, with a ready source of obsidian nearby, distance to the source may have been a bigger factor, which mitigated the overall lower performance parameter measured through predictability.

7 FUTURE QUESTIONS

Even though my study did not find the expected correlation between obsidian performance as measured through fracture predictability and the increasing use through time of more predictable sources, there are many ways to increase the specificity of the analyses done here for future research questions. For instance, a typological assessment of projectile points and other diagnostic tools by obsidian sources would help corroborate the relative chronology constructed for the Rock Creek Site. Projectile points had the most variety of obsidian source use at the Rock Creek Site. A better knowledge of projectile point chronology is available today then in 1972. This closer look may give additional insight on obsidian source use.

Additional research and differentiating the Walcott and Brown's Bench source areas and sub-sources both chemically and in fracture predictability may help inform on additional differences in obsidian source use at the Rock Creek Site. The Walcott source locations are located in a widespread area, such as the American Falls sub-source and other locations nearer to the Packsaddle source. The Brown's Bench source area covers a large area with lots of sub-sources. It may be possible to identify sub-sources with the XRF for both these sources, which could help identify more specific use of obsidian, particularly the local Brown's Bench source.

A closer look at tools, tool use and evidence for seasonality at the Rock Creek Site would help inform on site use. Obsidian source use at the site show use of obsidian sources around the edges of the North and Eastern portions of the Snake River Plain, instead of the sources to the West of the Rock Creek Site (see Figure 20). It would be interesting to see if there is a connection between the type of obsidian used for a tool or type of projectile point and the resources utilized during the seasonal round.

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APPENDIX A: XRF Methods

Process for collecting XRF data: The green filter was used on the PXRF and instructions written by R. Holmer for Bruker XRF Quick Start were followed for this project, with the exception of a Test Time of 60 seconds rather than 180 seconds. In addition, the KTI tube active setting of 40-30-200-1 was chosen and the backscatter was unchecked (problems with timing and saving data collection occurred when the backscatter was turned on). The shield was not used. Data was saved in three file types (txt, csv, pdz). The Coefficient file used was GL1.cfz. A piece of Bear Gulch obsidian was run first each day, in order to track any significant machine aberrations. No significant aberrations were noticed. The following includes the in written procedures for this project.

Rock Creek (10CA33) Volcanic Glass XRF analysis

For the purpose of this study, this includes artifacts classed "ignimbrite" and "obsidian".

1) Photograph back and front of each artifact

2) Perform XRF on each volcanic glass artifact for 60 seconds. Do this twice.

3) Label files:

SiteName.Artifact#_00XRF#

For example: 10CA33.00002_001

10CA33.00002_002

*Follow the **Bruker XRF "Quick Start"** instructions. Written by R. Holmer, Revised 03/06/08*

Bruxer XRF "Quick Start"

<u>To run samples:</u>

1) Connect USB cable from Bruker to computer (left port on Bruker IBM laptop).
2) Turn on Bruker by inserting small key and turning a quarter turn (large key is for securing the PDA). Yellow light on top of Bruker will turn on. Check your watch to be sure that five minutes elapses before step 8 is initiated.
3) Open program S1PXRF on the computer.

4) **Calibrate:** click on Setup> Select Coef (SRZ or CRZ file)> locate file: (for ANTH 3399 use **OBS-CAL 2-1-11.CFZ** located on the desktop) and open it.
5) Click on red dot in upper left of S1PXRF program (the dot will turn green).
6) Click on Download > Port = connection port (=Comm 6 on Bruker laptop) and Baud Rate = 57,6000.
7) **CAUTION!** Make sure the Bruker warms up for a minimum of five minutes after step 1 before continuing!
8) Click on Tube > KTI Tube> Read> and click button for 40 kV and 12 µA (leave window open for next step).
9) Push the trigger on the Bruker and the panel red light turns on, then on the KTI Tube click the Read screen. Wait for kV to reach ~12, then click OK.
10) Push the trigger on the Bruker to the off position (the red panel light will turn off).
11) Click on Timed >Timed Assay>Test Time= 180 sec, and make sure that CSV, PDZ and Autosave are checked, then click OK.
12) Enter the file name (i.e., sample number) and click on Save or push the Return key.
13) Place the sample as flat as possible on the Bruker's sensor (select a flat surface on the sample for the reading).
14) Push the trigger to the on position and assay will start after a few seconds. The time remaining shows in red at the bottom left of the screen.
15) **Optional:** Click on Conc to see the ppm data accumulating.
16) When the reading is complete, push trigger to off position and remove sample.
17) To run another sample, click on the Download>Timed>Timed Assay>OK; then enter the file name and click OK. Put the sample in place and push the trigger to the on position. The timed assay will begin in a second or two.
18) To run more samples repeat step 17.
19) To overlay the current plot with a previous plot, open the desired plot, click on Setup>Spectrum Overlay>Move A>>B, then run the new sample.
20) To shut down the Bruker, click the green circle in the upper left corner of S1PXRF (it will turn red), and turn off the key on the Bruker.

<u>To read and/or analyze previously collected data from samples:</u>

1) Open program S1PXRF.
2) Calibrate: click on Setup> Select Coef (SRZ or CRZ file)> locate file (for ANTH 3399 use **OBS-Cal 2-1-11.CFZ** located on the desktop) and open it.
3) To open a data/plot file: click on the File>Open>locate the *.pdz file of interest and open it.
4) To copy ppm data to Excel: click on Conc and the Result Table opens. Highlight ppm values under the column label Concentration (GLI). Click Copy then open Excel. In the first row enter the sample number; then click on the cell below and click on Paste (ctrl V).
5) Back in S1PXRF, close the Result Table, then open the next data/plot file following steps 3 & 4.

APPENDIX B: JMP Stepwise Discriminant Analysis Full Results

This table shows the JMP row with the predicted source and the probability of that prediction. The first section includes the obsidian artifacts, while the second half of the table shows the source material with the known source and the JMP predicted source. The source data acts as a trainer for the statistical program to predict the unknown sources.

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1		.	.	.		-	Browns Bench	0.9999	
2		.	.	.		-	Browns Bench	1.0000	
3		.	.	.		-	Browns Bench	1.0000	
4		.	.	.		-	Browns Bench	1.0000	
5		.	.	.		-	Browns Bench	1.0000	
6		.	.	.		-	Browns Bench	1.0000	
7		.	.	.		-	Browns Bench	1.0000	
8		.	.	.		-	Browns Bench	0.9999	
9		.	.	.		-	Browns Bench	1.0000	
10		.	.	.		-	Browns Bench	1.0000	
11		.	.	.		-	Browns Bench	1.0000	
12		.	.	.		-	Browns Bench	1.0000	
13		.	.	.		-	Browns Bench	1.0000	
14		.	.	.		-	Browns Bench	1.0000	
15		.	.	.		-	Browns Bench	1.0000	
16		.	.	.		-	Browns Bench	1.0000	
17		.	.	.		-	Browns Bench	1.0000	
18		.	.	.		-	Browns Bench	1.0000	
19		.	.	.		-	Browns Bench	1.0000	
20		.	.	.		-	Browns Bench	1.0000	
21		.	.	.		-	Browns Bench	1.0000	
22		.	.	.		-	Browns Bench	1.0000	
23		.	.	.		-	Browns Bench	1.0000	
24		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
25		.	.	.		-	Browns Bench	1.0000	
26		.	.	.		-	Browns Bench	1.0000	
27		.	.	.		-	Bear Gulch	0.5455	Browns Bench 0.45
28		.	.	.		-	Browns Bench	1.0000	
29		.	.	.		-	Browns Bench	1.0000	
30		.	.	.		-	Browns Bench	1.0000	
31		.	.	.		-	Browns Bench	1.0000	
32		.	.	.		-	Browns Bench	1.0000	
33		.	.	.		-	Browns Bench	1.0000	
34		.	.	.		-	Browns Bench	1.0000	
35		.	.	.		-	Browns Bench	1.0000	
36		.	.	.		-	Browns Bench	1.0000	
37		.	.	.		-	Browns Bench	0.9999	
38		.	.	.		-	Browns Bench	1.0000	
39		.	.	.		-	Browns Bench	0.9997	
40		.	.	.		-	Browns Bench	1.0000	
41		.	.	.		-	Browns Bench	1.0000	
42		.	.	.		-	Browns Bench	1.0000	
43		.	.	.		-	Browns Bench	1.0000	
44		.	.	.		-	Browns Bench	1.0000	
45		.	.	.		-	Browns Bench	1.0000	
46		.	.	.		-	Browns Bench	1.0000	
47		.	.	.		-	Browns Bench	1.0000	
48		.	.	.		-	Browns Bench	1.0000	
49		.	.	.		-	Browns Bench	0.9642	
50		.	.	.		-	Browns Bench	0.9999	
51		.	.	.		-	Browns Bench	1.0000	
52		.	.	.		-	Browns Bench	1.0000	
53		.	.	.		-	Browns Bench	1.0000	
54		.	.	.		-	Browns Bench	1.0000	
55		.	.	.		-	Browns Bench	1.0000	
56		.	.	.		-	Browns Bench	1.0000	
57		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
58		.	.	.		-	Browns Bench	0.9999	
59		.	.	.		-	Browns Bench	1.0000	
60		.	.	.		-	Browns Bench	1.0000	
61		.	.	.		-	Browns Bench	1.0000	
62		.	.	.		-	Browns Bench	0.9996	
63		.	.	.		-	Browns Bench	1.0000	
64		.	.	.		-	Walcott	0.9998	
65		.	.	.		-	Browns Bench	0.9998	
66		.	.	.		-	Browns Bench	1.0000	
67		.	.	.		-	Browns Bench	1.0000	
68		.	.	.		-	Browns Bench	1.0000	
69		.	.	.		-	Browns Bench	0.9995	
70		.	.	.		-	Browns Bench	1.0000	
71		.	.	.		-	Browns Bench	1.0000	
72		.	.	.		-	Browns Bench	1.0000	
73		.	.	.		-	Browns Bench	0.9993	
74		.	.	.		-	Browns Bench	1.0000	
75		.	.	.		-	Browns Bench	1.0000	
76		.	.	.		-	Browns Bench	1.0000	
77		.	.	.		-	Browns Bench	1.0000	
78		.	.	.		-	Browns Bench	1.0000	
79		.	.	.		-	Browns Bench	1.0000	
80		.	.	.		-	Browns Bench	1.0000	
81		.	.	.		-	Browns Bench	0.9999	
82		.	.	.		-	Browns Bench	1.0000	
83		.	.	.		-	Browns Bench	1.0000	
84		.	.	.		-	Browns Bench	1.0000	
85		.	.	.		-	Browns Bench	0.9979	
86		.	.	.		-	Browns Bench	1.0000	
87		.	.	.		-	Browns Bench	1.0000	
88		.	.	.		-	Browns Bench	1.0000	
89		.	.	.		-	Browns Bench	1.0000	
90		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
91		.	.	.		-	Browns Bench	1.0000	
92		.	.	.		-	Big Southern Butte	1.0000	
93		.	.	.		-	Browns Bench	1.0000	
94		.	.	.		-	Browns Bench	1.0000	
95		.	.	.		-	Browns Bench	1.0000	
96		.	.	.		-	Browns Bench	0.9999	
97		.	.	.		-	Browns Bench	1.0000	
98		.	.	.		-	Browns Bench	1.0000	
99		.	.	.		-	Browns Bench	1.0000	
100		.	.	.		-	Browns Bench	1.0000	
101		.	.	.		-	Browns Bench	1.0000	
102		.	.	.		-	Browns Bench	1.0000	
103		.	.	.		-	Browns Bench	1.0000	
104		.	.	.		-	Browns Bench	1.0000	
105		.	.	.		-	Browns Bench	1.0000	
106		.	.	.		-	Browns Bench	1.0000	
107		.	.	.		-	Browns Bench	1.0000	
108		.	.	.		-	Browns Bench	1.0000	
109		.	.	.		-	Browns Bench	1.0000	
110		.	.	.		-	Browns Bench	0.9973	
111		.	.	.		-	Browns Bench	1.0000	
112		.	.	.		-	Packsaddle	0.8191	Browns Bench 0.18
113		.	.	.		-	Browns Bench	0.9999	
114		.	.	.		-	Browns Bench	0.9886	
115		.	.	.		-	Browns Bench	0.9993	
116		.	.	.		-	Browns Bench	1.0000	
117		.	.	.		-	Browns Bench	1.0000	
118		.	.	.		-	Browns Bench	1.0000	
119		.	.	.		-	Browns Bench	1.0000	
120		.	.	.		-	Browns Bench	1.0000	
121		.	.	.		-	Browns Bench	1.0000	
122		.	.	.		-	Browns Bench	1.0000	
123		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
124		.	.	.		-	Browns Bench	1.0000	
125		.	.	.		-	Browns Bench	1.0000	
126		.	.	.		-	Browns Bench	1.0000	
127		.	.	.		-	Browns Bench	1.0000	
128		.	.	.		-	Browns Bench	1.0000	
129		.	.	.		-	Browns Bench	1.0000	
130		.	.	.		-	Browns Bench	1.0000	
131		.	.	.		-	Browns Bench	1.0000	
132		.	.	.		-	Browns Bench	1.0000	
133		.	.	.		-	Browns Bench	1.0000	
134		.	.	.		-	Browns Bench	1.0000	
135		.	.	.		-	Browns Bench	1.0000	
136		.	.	.		-	Browns Bench	1.0000	
137		.	.	.		-	Browns Bench	1.0000	
138		.	.	.		-	Browns Bench	1.0000	
139		.	.	.		-	Browns Bench	1.0000	
140		.	.	.		-	Browns Bench	1.0000	
141		.	.	.		-	Browns Bench	1.0000	
142		.	.	.		-	Browns Bench	1.0000	
143		.	.	.		-	Browns Bench	1.0000	
144		.	.	.		-	Browns Bench	1.0000	
145		.	.	.		-	Browns Bench	1.0000	
146		.	.	.		-	Browns Bench	1.0000	
147		.	.	.		-	Browns Bench	1.0000	
148		.	.	.		-	Browns Bench	1.0000	
149		.	.	.		-	Browns Bench	1.0000	
150		.	.	.		-	Browns Bench	1.0000	
151		.	.	.		-	Browns Bench	1.0000	
152		.	.	.		-	Browns Bench	1.0000	
153		.	.	.		-	Browns Bench	1.0000	
154		.	.	.		-	Browns Bench	1.0000	
155		.	.	.		-	Browns Bench	0.9999	
156		.	.	.		-	Browns Bench	0.9999	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
157		.	.	.		-	Browns Bench	1.0000	
158		.	.	.		-	Browns Bench	1.0000	
159		.	.	.		-	Browns Bench	1.0000	
160		.	.	.		-	Browns Bench	1.0000	
161		.	.	.		-	Browns Bench	1.0000	
162		.	.	.		-	Browns Bench	1.0000	
163		.	.	.		-	Browns Bench	1.0000	
164		.	.	.		-	Browns Bench	1.0000	
165		.	.	.		-	Browns Bench	1.0000	
166		.	.	.		-	Browns Bench	1.0000	
167		.	.	.		-	Browns Bench	1.0000	
168		.	.	.		-	Browns Bench	1.0000	
169		.	.	.		-	Browns Bench	1.0000	
170		.	.	.		-	Browns Bench	1.0000	
171		.	.	.		-	Browns Bench	1.0000	
172		.	.	.		-	Browns Bench	1.0000	
173		.	.	.		-	Browns Bench	1.0000	
174		.	.	.		-	Browns Bench	1.0000	
175		.	.	.		-	Browns Bench	1.0000	
176		.	.	.		-	Browns Bench	1.0000	
177		.	.	.		-	Browns Bench	1.0000	
178		.	.	.		-	Browns Bench	0.9994	
179		.	.	.		-	Browns Bench	1.0000	
180		.	.	.		-	Browns Bench	1.0000	
181		.	.	.		-	Browns Bench	1.0000	
182		.	.	.		-	Browns Bench	0.9965	
183		.	.	.		-	Conant Creek	0.9999	
184		.	.	.		-	Browns Bench	1.0000	
185		.	.	.		-	Browns Bench	1.0000	
186		.	.	.		-	Browns Bench	1.0000	
187		.	.	.		-	Browns Bench	1.0000	
188		.	.	.		-	Browns Bench	1.0000	
189		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
190		.	.	.		-	Browns Bench	1.0000	
191		.	.	.		-	Browns Bench	1.0000	
192		.	.	.		-	Browns Bench	1.0000	
193		.	.	.		-	Browns Bench	1.0000	
194		.	.	.		-	Browns Bench	0.9998	
195		.	.	.		-	Browns Bench	1.0000	
196		.	.	.		-	Browns Bench	1.0000	
197		.	.	.		-	Malad	1.0000	
198		.	.	.		-	Browns Bench	1.0000	
199		.	.	.		-	Browns Bench	1.0000	
200		.	.	.		-	Browns Bench	1.0000	
201		.	.	.		-	Browns Bench	1.0000	
202		.	.	.		-	Browns Bench	1.0000	
203		.	.	.		-	Browns Bench	1.0000	
204		.	.	.		-	Browns Bench	1.0000	
205		.	.	.		-	Browns Bench	1.0000	
206		.	.	.		-	Browns Bench	0.8005	Packsaddle 0.20
207		.	.	.		-	Packsaddle	0.9998	
208		.	.	.		-	Malad	1.0000	
209		.	.	.		-	Browns Bench	1.0000	
210		.	.	.		-	Browns Bench	1.0000	
211		.	.	.		-	Browns Bench	0.9997	
212		.	.	.		-	Browns Bench	0.9992	
213		.	.	.		-	Browns Bench	1.0000	
214		.	.	.		-	Walcott	0.9937	
215		.	.	.		-	Browns Bench	1.0000	
216		.	.	.		-	Browns Bench	1.0000	
217		.	.	.		-	Browns Bench	1.0000	
218		.	.	.		-	Browns Bench	0.9994	
219		.	.	.		-	Browns Bench	1.0000	
220		.	.	.		-	Browns Bench	1.0000	
221		.	.	.		-	Browns Bench	1.0000	
222		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
223		.	.	.		-	Browns Bench	1.0000	
224		.	.	.		-	Browns Bench	1.0000	
225		.	.	.		-	Browns Bench	1.0000	
226		.	.	.		-	Owyhee	0.7876	Walcott 0.21
227		.	.	.		-	Browns Bench	1.0000	
228		.	.	.		-	Browns Bench	0.9989	
229		.	.	.		-	Browns Bench	1.0000	
230		.	.	.		-	Browns Bench	1.0000	
231		.	.	.		-	Browns Bench	1.0000	
232		.	.	.		-	Browns Bench	0.9996	
233		.	.	.		-	Browns Bench	1.0000	
234		.	.	.		-	Browns Bench	1.0000	
235		.	.	.		-	Browns Bench	1.0000	
236		.	.	.		-	Browns Bench	1.0000	
237		.	.	.		-	Browns Bench	1.0000	
238		.	.	.		-	Browns Bench	1.0000	
239		.	.	.		-	Browns Bench	1.0000	
240		.	.	.		-	Browns Bench	1.0000	
241		.	.	.		-	Browns Bench	1.0000	
242		.	.	.		-	Browns Bench	1.0000	
243		.	.	.		-	Browns Bench	1.0000	
244		.	.	.		-	Browns Bench	1.0000	
245		.	.	.		-	Browns Bench	1.0000	
246		.	.	.		-	Browns Bench	1.0000	
247		.	.	.		-	Browns Bench	1.0000	
248		.	.	.		-	Browns Bench	1.0000	
249		.	.	.		-	Browns Bench	1.0000	
250		.	.	.		-	Browns Bench	1.0000	
251		.	.	.		-	Browns Bench	0.9925	
252		.	.	.		-	Browns Bench	1.0000	
253		.	.	.		-	Browns Bench	1.0000	
254		.	.	.		-	Browns Bench	1.0000	
255		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
256		.	.	.		-	Browns Bench	1.0000	
257		.	.	.		-	Browns Bench	1.0000	
258		.	.	.		-	Browns Bench	1.0000	
259		.	.	.		-	Browns Bench	0.8957	Packsaddle 0.10
260		.	.	.		-	Browns Bench	1.0000	
261		.	.	.		-	Browns Bench	1.0000	
262		.	.	.		-	Browns Bench	1.0000	
263		.	.	.		-	Browns Bench	1.0000	
264		.	.	.		-	Browns Bench	1.0000	
265		.	.	.		-	Browns Bench	1.0000	
266		.	.	.		-	Browns Bench	1.0000	
267		.	.	.		-	Browns Bench	1.0000	
268		.	.	.		-	Browns Bench	1.0000	
269		.	.	.		-	Browns Bench	0.9639	
270		.	.	.		-	Browns Bench	1.0000	
271		.	.	.		-	Browns Bench	1.0000	
272		.	.	.		-	Browns Bench	1.0000	
273		.	.	.		-	Browns Bench	1.0000	
274		.	.	.		-	Browns Bench	1.0000	
275		.	.	.		-	Browns Bench	1.0000	
276		.	.	.		-	Browns Bench	1.0000	
277		.	.	.		-	Browns Bench	1.0000	
278		.	.	.		-	Browns Bench	1.0000	
279		.	.	.		-	Browns Bench	1.0000	
280		.	.	.		-	Browns Bench	1.0000	
281		.	.	.		-	Browns Bench	1.0000	
282		.	.	.		-	Browns Bench	1.0000	
283		.	.	.		-	Browns Bench	1.0000	
284		.	.	.		-	Browns Bench	1.0000	
285		.	.	.		-	Browns Bench	1.0000	
286		.	.	.		-	Big Southern Butte	1.0000	
287		.	.	.		-	Browns Bench	1.0000	
288		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
289		.	.	.		-	Browns Bench	1.0000	
290		.	.	.		-	Browns Bench	1.0000	
291		.	.	.		-	Conant Creek	1.0000	
292		.	.	.		-	Browns Bench	1.0000	
293		.	.	.		-	Browns Bench	1.0000	
294		.	.	.		-	Browns Bench	1.0000	
295		.	.	.		-	Browns Bench	0.9997	
296		.	.	.		-	Browns Bench	1.0000	
297		.	.	.		-	Browns Bench	1.0000	
298		.	.	.		-	Browns Bench	1.0000	
299		.	.	.		-	Browns Bench	1.0000	
300		.	.	.		-	Browns Bench	1.0000	
301		.	.	.		-	Browns Bench	1.0000	
302		.	.	.		-	Browns Bench	1.0000	
303		.	.	.		-	Walcott	0.9989	
304		.	.	.		-	Browns Bench	1.0000	
305		.	.	.		-	Browns Bench	1.0000	
306		.	.	.		-	Browns Bench	1.0000	
307		.	.	.		-	Browns Bench	1.0000	
308		.	.	.		-	Walcott	0.9999	
309		.	.	.		-	Browns Bench	1.0000	
310		.	.	.		-	Browns Bench	1.0000	
311		.	.	.		-	Browns Bench	1.0000	
312		.	.	.		-	Browns Bench	1.0000	
313		.	.	.		-	Browns Bench	1.0000	
314		.	.	.		-	Browns Bench	0.5551	Packsaddle 0.44
315		.	.	.		-	Browns Bench	1.0000	
316		.	.	.		-	Browns Bench	1.0000	
317		.	.	.		-	Browns Bench	1.0000	
318		.	.	.		-	Browns Bench	1.0000	
319		.	.	.		-	Browns Bench	1.0000	
320		.	.	.		-	Browns Bench	1.0000	
321		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
322		.	.	.		-	Browns Bench	1.0000	
323		.	.	.		-	Browns Bench	1.0000	
324		.	.	.		-	Browns Bench	1.0000	
325		.	.	.		-	Cannonball Mt II	1.0000	
326		.	.	.		-	Browns Bench	0.9999	
327		.	.	.		-	Browns Bench	1.0000	
328		.	.	.		-	Browns Bench	1.0000	
329		.	.	.		-	Browns Bench	1.0000	
330		.	.	.		-	Browns Bench	1.0000	
331		.	.	.		-	Browns Bench	1.0000	
332		.	.	.		-	Browns Bench	1.0000	
333		.	.	.		-	Browns Bench	1.0000	
334		.	.	.		-	Browns Bench	1.0000	
335		.	.	.		-	Browns Bench	1.0000	
336		.	.	.		-	Browns Bench	1.0000	
337		.	.	.		-	Browns Bench	1.0000	
338		.	.	.		-	Browns Bench	1.0000	
339		.	.	.		-	Browns Bench	1.0000	
340		.	.	.		-	Browns Bench	1.0000	
341		.	.	.		-	Walcott	0.9915	
342		.	.	.		-	Browns Bench	1.0000	
343		.	.	.		-	Browns Bench	1.0000	
344		.	.	.		-	Browns Bench	1.0000	
345		.	.	.		-	Browns Bench	1.0000	
346		.	.	.		-	Browns Bench	1.0000	
347		.	.	.		-	Browns Bench	1.0000	
348		.	.	.		-	Browns Bench	1.0000	
349		.	.	.		-	Browns Bench	1.0000	
350		.	.	.		-	Browns Bench	1.0000	
351		.	.	.		-	Browns Bench	0.9999	
352		.	.	.		-	Browns Bench	1.0000	
353		.	.	.		-	Browns Bench	1.0000	
354		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
355		.	.	.		-	Browns Bench	1.0000	
356		.	.	.		-	Browns Bench	1.0000	
357		.	.	.		-	Cannonball Mt I	0.9997	
358		.	.	.		-	Browns Bench	1.0000	
359		.	.	.		-	Browns Bench	0.9894	
360		.	.	.		-	Browns Bench	1.0000	
361		.	.	.		-	Browns Bench	1.0000	
362		.	.	.		-	Walcott	0.9957	
363		.	.	.		-	Browns Bench	1.0000	
364		.	.	.		-	Browns Bench	1.0000	
365		.	.	.		-	Browns Bench	1.0000	
366		.	.	.		-	Browns Bench	1.0000	
367		.	.	.		-	Browns Bench	1.0000	
368		.	.	.		-	Browns Bench	1.0000	
369		.	.	.		-	Browns Bench	1.0000	
370		.	.	.		-	Cannonball Mt I	1.0000	
371		.	.	.		-	Browns Bench	1.0000	
372		.	.	.		-	Browns Bench	1.0000	
373		.	.	.		-	Browns Bench	1.0000	
374		.	.	.		-	Browns Bench	1.0000	
375		.	.	.		-	Browns Bench	1.0000	
376		.	.	.		-	Browns Bench	1.0000	
377		.	.	.		-	Browns Bench	1.0000	
378		.	.	.		-	Browns Bench	1.0000	
379		.	.	.		-	Browns Bench	1.0000	
380		.	.	.		-	Browns Bench	1.0000	
381		.	.	.		-	Browns Bench	1.0000	
382		.	.	.		-	Browns Bench	1.0000	
383		.	.	.		-	Browns Bench	1.0000	
384		.	.	.		-	Browns Bench	1.0000	
385		.	.	.		-	Browns Bench	1.0000	
386		.	.	.		-	Browns Bench	1.0000	
387		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
388		.	.	.		-	Browns Bench	1.0000	
389		.	.	.				.	
390		.	.	.		-	Browns Bench	1.0000	
391		.	.	.		-	Browns Bench	1.0000	
392		.	.	.		-	Browns Bench	1.0000	
393		.	.	.		-	Browns Bench	1.0000	
394		.	.	.		-	Browns Bench	1.0000	
395		.	.	.		-	Browns Bench	1.0000	
396		.	.	.		-	Browns Bench	1.0000	
397		.	.	.		-	Browns Bench	1.0000	
398		.	.	.		-	Browns Bench	1.0000	
399		.	.	.		-	Malad	1.0000	
400		.	.	.		-	Browns Bench	1.0000	
401		.	.	.		-	Browns Bench	1.0000	
402		.	.	.		-	Browns Bench	1.0000	
403		.	.	.		-	Browns Bench	1.0000	
404		.	.	.		-	Malad	1.0000	
405		.	.	.		-	Browns Bench	1.0000	
406		.	.	.		-	Browns Bench	1.0000	
407		.	.	.		-	Browns Bench	1.0000	
408		.	.	.		-	Browns Bench	1.0000	
409		.	.	.		-	Browns Bench	1.0000	
410		.	.	.		-	Browns Bench	1.0000	
411		.	.	.		-	Browns Bench	1.0000	
412		.	.	.		-	Browns Bench	1.0000	
413		.	.	.		-	Browns Bench	1.0000	
414		.	.	.		-	Browns Bench	1.0000	
415		.	.	.		-	Browns Bench	1.0000	
416		.	.	.		-	Walcott	0.9998	
417		.	.	.		-	Browns Bench	1.0000	
418		.	.	.		-	Browns Bench	1.0000	
419		.	.	.		-	Browns Bench	1.0000	
420		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
421		.	.	.		-	Browns Bench	1.0000	
422		.	.	.		-	Browns Bench	1.0000	
423		.	.	.		-	Browns Bench	0.9995	
424		.	.	.		-	Browns Bench	1.0000	
425		.	.	.		-	Browns Bench	1.0000	
426		.	.	.		-	Browns Bench	0.9960	
427		.	.	.		-	Browns Bench	1.0000	
428		.	.	.		-	Browns Bench	1.0000	
429		.	.	.		-	Browns Bench	1.0000	
430		.	.	.		-	Browns Bench	1.0000	
431		.	.	.		-	Browns Bench	1.0000	
432		.	.	.		-	Browns Bench	1.0000	
433		.	.	.		-	Browns Bench	0.9991	
434		.	.	.		-	Walcott	0.9998	
435		.	.	.		-	Browns Bench	1.0000	
436		.	.	.		-	Browns Bench	1.0000	
437		.	.	.		-	Browns Bench	1.0000	
438		.	.	.		-	Browns Bench	1.0000	
439		.	.	.		-	Browns Bench	1.0000	
440		.	.	.		-	Browns Bench	1.0000	
441		.	.	.		-	Browns Bench	1.0000	
442		.	.	.		-	Browns Bench	1.0000	
443		.	.	.		-	Browns Bench	1.0000	
444		.	.	.		-	Browns Bench	1.0000	
445		.	.	.		-	Browns Bench	1.0000	
446		.	.	.		-	Browns Bench	0.9999	
447		.	.	.		-	Browns Bench	1.0000	
448		.	.	.		-	Browns Bench	1.0000	
449		.	.	.		-	Browns Bench	1.0000	
450		.	.	.		-	Browns Bench	1.0000	
451		.	.	.		-	Browns Bench	1.0000	
452		.	.	.		-	Browns Bench	1.0000	
453		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
454		.	.	.		-	Browns Bench	1.0000	
455		.	.	.		-	Browns Bench	0.9970	
456		.	.	.		-	Browns Bench	1.0000	
457		.	.	.		-	Browns Bench	1.0000	
458		.	.	.		-	Browns Bench	1.0000	
459		.	.	.		-	Browns Bench	1.0000	
460		.	.	.		-	Browns Bench	1.0000	
461		.	.	.		-	Browns Bench	1.0000	
462		.	.	.		-	Browns Bench	1.0000	
463		.	.	.		-	Browns Bench	1.0000	
464		.	.	.		-	Browns Bench	1.0000	
465		.	.	.		-	Browns Bench	1.0000	
466		.	.	.		-	Cannonball Mt I	1.0000	
467		.	.	.		-	Browns Bench	1.0000	
468		.	.	.		-	Browns Bench	0.9727	
469		.	.	.		-	Browns Bench	1.0000	
470		.	.	.		-	Browns Bench	1.0000	
471		.	.	.		-	Browns Bench	1.0000	
472		.	.	.		-	Browns Bench	1.0000	
473		.	.	.		-	Browns Bench	1.0000	
474		.	.	.		-	Browns Bench	1.0000	
475		.	.	.		-	Browns Bench	1.0000	
476		.	.	.		-	Browns Bench	0.9995	
477		.	.	.		-	Browns Bench	1.0000	
478		.	.	.		-	Browns Bench	1.0000	
479		.	.	.		-	Browns Bench	1.0000	
480		.	.	.		-	Browns Bench	1.0000	
481		.	.	.		-	Browns Bench	1.0000	
482		.	.	.		-	Browns Bench	1.0000	
483		.	.	.		-	Browns Bench	1.0000	
484		.	.	.		-	Browns Bench	0.9999	
485		.	.	.		-	Browns Bench	0.9874	
486		.	.	.		-	Walcott	0.9967	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
487		.	.	.		-	Browns Bench	1.0000	
488		.	.	.		-	Browns Bench	1.0000	
489		.	.	.		-	Browns Bench	1.0000	
490		.	.	.		-	Browns Bench	1.0000	
491		.	.	.		-	Browns Bench	1.0000	
492		.	.	.		-	Browns Bench	0.9992	
493		.	.	.		-	Browns Bench	1.0000	
494		.	.	.		-	Browns Bench	1.0000	
495		.	.	.		-	Browns Bench	1.0000	
496		.	.	.		-	Browns Bench	1.0000	
497		.	.	.		-	Browns Bench	0.9999	
498		.	.	.		-	Browns Bench	1.0000	
499		.	.	.		-	Browns Bench	1.0000	
500		.	.	.		-	Browns Bench	1.0000	
501		.	.	.		-	Malad	1.0000	
502		.	.	.		-	Browns Bench	1.0000	
503		.	.	.		-	Browns Bench	1.0000	
504		.	.	.		-	Browns Bench	1.0000	
505		.	.	.		-	Browns Bench	1.0000	
506		.	.	.		-	Browns Bench	1.0000	
507		.	.	.		-	Browns Bench	1.0000	
508		.	.	.		-	Browns Bench	1.0000	
509		.	.	.		-	Big Southern Butte	1.0000	
510		.	.	.		-	Big Southern Butte	1.0000	
511		.	.	.		-	Malad	1.0000	
512		.	.	.		-	Browns Bench	1.0000	
513		.	.	.		-	Browns Bench	1.0000	
514		.	.	.		-	Browns Bench	1.0000	
515		.	.	.		-	Browns Bench	1.0000	
516		.	.	.		-	Browns Bench	1.0000	
517		.	.	.		-	Browns Bench	1.0000	
518		.	.	.		-	Browns Bench	0.9999	
519		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
520		.	.	.		-	Browns Bench	1.0000	
521		.	.	.		-	Walcott	0.9925	
522		.	.	.		-	Browns Bench	1.0000	
523		.	.	.		-	Browns Bench	1.0000	
524		.	.	.		-	Browns Bench	1.0000	
525		.	.	.		-	Browns Bench	1.0000	
526		.	.	.		-	Browns Bench	0.9978	
527		.	.	.		-	Browns Bench	1.0000	
528		.	.	.		-	Browns Bench	1.0000	
529		.	.	.		-	Walcott	0.9999	
530		.	.	.		-	Browns Bench	1.0000	
531		.	.	.		-	Browns Bench	1.0000	
532		.	.	.		-	Browns Bench	1.0000	
533		.	.	.		-	Browns Bench	1.0000	
534		.	.	.		-	Browns Bench	1.0000	
535		.	.	.		-	Browns Bench	1.0000	
536		.	.	.		-	Browns Bench	1.0000	
537		.	.	.		-	Browns Bench	1.0000	
538		.	.	.		-	Browns Bench	1.0000	
539		.	.	.		-	Browns Bench	1.0000	
540		.	.	.		-	Browns Bench	1.0000	
541		.	.	.		-	Browns Bench	1.0000	
542		.	.	.		-	Browns Bench	1.0000	
543		.	.	.		-	Browns Bench	1.0000	
544		.	.	.		-	Browns Bench	1.0000	
545		.	.	.		-	Browns Bench	1.0000	
546		.	.	.		-	Browns Bench	1.0000	
547		.	.	.		-	Browns Bench	1.0000	
548		.	.	.		-	Browns Bench	1.0000	
549		.	.	.		-	Browns Bench	1.0000	
550		.	.	.		-	Browns Bench	1.0000	
551		.	.	.		-	Browns Bench	1.0000	
552		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
553		.	.	.		-	Browns Bench	1.0000	
554		.	.	.		-	Browns Bench	1.0000	
555		.	.	.		-	Browns Bench	1.0000	
556		.	.	.		-	Browns Bench	1.0000	
557		.	.	.		-	Browns Bench	1.0000	
558		.	.	.		-	Browns Bench	1.0000	
559		.	.	.		-	Big Southern Butte	1.0000	
560		.	.	.		-	Browns Bench	1.0000	
561		.	.	.		-	Browns Bench	1.0000	
562		.	.	.		-	Browns Bench	1.0000	
563		.	.	.		-	Browns Bench	1.0000	
564		.	.	.		-	Browns Bench	1.0000	
565		.	.	.		-	Browns Bench	1.0000	
566		.	.	.		-	Browns Bench	1.0000	
567		.	.	.		-	Browns Bench	1.0000	
568		.	.	.		-	Browns Bench	1.0000	
569		.	.	.		-	Browns Bench	1.0000	
570		.	.	.		-	Browns Bench	0.9999	
571		.	.	.		-	Browns Bench	1.0000	
572		.	.	.		-	Browns Bench	1.0000	
573		.	.	.		-	Conant Creek	1.0000	
574		.	.	.		-	Conant Creek	1.0000	
575		.	.	.		-	Conant Creek	1.0000	
576		.	.	.		-	Browns Bench	1.0000	
577		.	.	.		-	Browns Bench	1.0000	
578		.	.	.		-	Browns Bench	1.0000	
579		.	.	.		-	Browns Bench	1.0000	
580		.	.	.		-	Browns Bench	1.0000	
581		.	.	.		-	Browns Bench	1.0000	
582		.	.	.		-	Browns Bench	1.0000	
583		.	.	.		-	Browns Bench	0.9998	
584		.	.	.		-	Browns Bench	1.0000	
585		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
586		.	.	.		-	Browns Bench	1.0000	
587		.	.	.		-	Browns Bench	1.0000	
588		.	.	.		-	Browns Bench	1.0000	
589		.	.	.		-	Browns Bench	1.0000	
590		.	.	.		-	Browns Bench	1.0000	
591		.	.	.		-	Browns Bench	0.9999	
592		.	.	.		-	Browns Bench	0.9981	
593		.	.	.		-	Browns Bench	1.0000	
594		.	.	.		-	Browns Bench	1.0000	
595		.	.	.		-	Browns Bench	1.0000	
596		.	.	.		-	Browns Bench	1.0000	
597		.	.	.		-	Browns Bench	1.0000	
598		.	.	.		-	Browns Bench	1.0000	
599		.	.	.		-	Browns Bench	1.0000	
600		.	.	.		-	Browns Bench	1.0000	
601		.	.	.		-	Browns Bench	1.0000	
602		.	.	.		-	Browns Bench	1.0000	
603		.	.	.		-	Browns Bench	1.0000	
604		.	.	.		-	Browns Bench	1.0000	
605		.	.	.		-	Browns Bench	1.0000	
606		.	.	.		-	Browns Bench	1.0000	
607		.	.	.		-	Browns Bench	1.0000	
608		.	.	.		-	Browns Bench	1.0000	
609		.	.	.		-	Browns Bench	1.0000	
610		.	.	.		-	Browns Bench	1.0000	
611		.	.	.		-	Browns Bench	1.0000	
612		.	.	.		-	Browns Bench	0.9999	
613		.	.	.		-	Browns Bench	0.9984	
614		.	.	.		-	Browns Bench	1.0000	
615		.	.	.		-	Browns Bench	1.0000	
616		.	.	.		-	Browns Bench	1.0000	
617		.	.	.		-	Browns Bench	1.0000	
618		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
619		.	.	.		-	Browns Bench	1.0000	
620		.	.	.		-	Browns Bench	1.0000	
621		.	.	.		-	Browns Bench	1.0000	
622		.	.	.		-	Browns Bench	1.0000	
623		.	.	.		-	Browns Bench	1.0000	
624		.	.	.		-	Browns Bench	1.0000	
625		.	.	.		-	Browns Bench	1.0000	
626		.	.	.		-	Browns Bench	1.0000	
627		.	.	.		-	Browns Bench	1.0000	
628		.	.	.		-	Browns Bench	1.0000	
629		.	.	.		-	Browns Bench	1.0000	
630		.	.	.		-	Browns Bench	1.0000	
631		.	.	.		-	Browns Bench	1.0000	
632		.	.	.		-	Browns Bench	1.0000	
633		.	.	.		-	Browns Bench	1.0000	
634		.	.	.		-	Browns Bench	1.0000	
635		.	.	.		-	Browns Bench	1.0000	
636		.	.	.		-	Browns Bench	1.0000	
637		.	.	.		-	Browns Bench	0.9968	
638		.	.	.		-	Browns Bench	1.0000	
639		.	.	.		-	Browns Bench	1.0000	
640		.	.	.		-	Packsaddle	0.9965	
641		.	.	.		-	Browns Bench	1.0000	
642		.	.	.		-	Browns Bench	1.0000	
643		.	.	.		-	Browns Bench	1.0000	
644		.	.	.		-	Browns Bench	1.0000	
645		.	.	.		-	Browns Bench	1.0000	
646		.	.	.		-	Browns Bench	1.0000	
647		.	.	.		-	Browns Bench	1.0000	
648		.	.	.		-	Browns Bench	1.0000	
649		.	.	.		-	Browns Bench	1.0000	
650		.	.	.		-	Browns Bench	1.0000	
651		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
652		.	.	.		-	Browns Bench	1.0000	
653		.	.	.		-	Browns Bench	1.0000	
654		.	.	.		-	Browns Bench	1.0000	
655		.	.	.		-	Browns Bench	1.0000	
656		.	.	.		-	Browns Bench	1.0000	
657		.	.	.		-	Browns Bench	1.0000	
658		.	.	.		-	Browns Bench	1.0000	
659		.	.	.		-	Browns Bench	1.0000	
660		.	.	.		-	Browns Bench	1.0000	
661		.	.	.		-	Browns Bench	1.0000	
662		.	.	.		-	Browns Bench	1.0000	
663		.	.	.		-	Browns Bench	0.9256	
664		.	.	.		-	Browns Bench	1.0000	
665		.	.	.		-	Browns Bench	1.0000	
666		.	.	.		-	Browns Bench	1.0000	
667		.	.	.		-	Browns Bench	0.9448	
668		.	.	.		-	Browns Bench	1.0000	
669		.	.	.		-	Browns Bench	0.9981	
670		.	.	.		-	Walcott	0.9938	
671		.	.	.		-	Browns Bench	1.0000	
672		.	.	.		-	Browns Bench	0.9973	
673		.	.	.		-	Browns Bench	1.0000	
674		.	.	.		-	Browns Bench	1.0000	
675		.	.	.		-	Browns Bench	1.0000	
676		.	.	.		-	Browns Bench	1.0000	
677		.	.	.		-	Walcott	0.8200	Owyhee 0.18
678		.	.	.		-	Browns Bench	1.0000	
679		.	.	.		-	Browns Bench	1.0000	
680		.	.	.		-	Browns Bench	1.0000	
681		.	.	.		-	Browns Bench	1.0000	
682		.	.	.		-	Browns Bench	0.9998	
683		.	.	.		-	Browns Bench	1.0000	
684		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
685		.	.	.		-	Browns Bench	1.0000	
686		.	.	.		-	Browns Bench	1.0000	
687		.	.	.		-	Browns Bench	1.0000	
688		.	.	.		-	Browns Bench	1.0000	
689		.	.	.		-	Browns Bench	1.0000	
690		.	.	.		-	Browns Bench	1.0000	
691		.	.	.		-	Browns Bench	1.0000	
692		.	.	.		-	Browns Bench	1.0000	
693		.	.	.		-	Browns Bench	1.0000	
694		.	.	.		-	Browns Bench	1.0000	
695		.	.	.		-	Browns Bench	1.0000	
696		.	.	.		-	Browns Bench	1.0000	
697		.	.	.		-	Browns Bench	1.0000	
698		.	.	.		-	Browns Bench	1.0000	
699		.	.	.		-	Browns Bench	1.0000	
700		.	.	.		-	Browns Bench	1.0000	
701		.	.	.		-	Browns Bench	1.0000	
702		.	.	.		-	Browns Bench	1.0000	
703		.	.	.		-	Browns Bench	1.0000	
704		.	.	.		-	Browns Bench	1.0000	
705		.	.	.		-	Browns Bench	1.0000	
706		.	.	.		-	Browns Bench	1.0000	
707		.	.	.		-	Browns Bench	1.0000	
708		.	.	.		-	Walcott	0.8389	Conant Creek 0.16
709		.	.	.		-	Browns Bench	1.0000	
710		.	.	.		-	Browns Bench	1.0000	
711		.	.	.		-	Browns Bench	1.0000	
712		.	.	.		-	Browns Bench	1.0000	
713		.	.	.		-	Browns Bench	1.0000	
714		.	.	.		-	Chesterfield	1.0000	
715		.	.	.		-	Browns Bench	1.0000	
716		.	.	.		-	Browns Bench	1.0000	
717		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
718		.	.	.		-	Browns Bench	1.0000	
719		.	.	.		-	Browns Bench	0.9996	
720		.	.	.		-	Browns Bench	1.0000	
721		.	.	.		-	Browns Bench	0.9995	
722		.	.	.		-	Browns Bench	1.0000	
723		.	.	.		-	Browns Bench	1.0000	
724		.	.	.		-	Browns Bench	1.0000	
725		.	.	.		-	Browns Bench	1.0000	
726		.	.	.		-	Browns Bench	1.0000	
727		.	.	.		-	Browns Bench	1.0000	
728		.	.	.		-	Browns Bench	1.0000	
729		.	.	.		-	Browns Bench	1.0000	
730		.	.	.		-	Browns Bench	1.0000	
731		.	.	.		-	Browns Bench	1.0000	
732		.	.	.		-	Browns Bench	1.0000	
733		.	.	.		-	Browns Bench	1.0000	
734		.	.	.		-	Browns Bench	1.0000	
735		.	.	.		-	Browns Bench	1.0000	
736		.	.	.		-	Browns Bench	1.0000	
737		.	.	.		-	Bear Gulch	1.0000	
738		.	.	.		-	Browns Bench	1.0000	
739		.	.	.		-	Browns Bench	1.0000	
740		.	.	.		-	Browns Bench	1.0000	
741		.	.	.		-	Browns Bench	1.0000	
742		.	.	.		-	Browns Bench	1.0000	
743		.	.	.		-	Browns Bench	1.0000	
744		.	.	.		-	Browns Bench	1.0000	
745		.	.	.		-	Browns Bench	1.0000	
746		.	.	.		-	Browns Bench	1.0000	
747		.	.	.		-	Browns Bench	1.0000	
748		.	.	.		-	Browns Bench	1.0000	
749		.	.	.		-	Browns Bench	1.0000	
750		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
751		.	.	.		-	Browns Bench	0.9999	
752		.	.	.		-	Browns Bench	1.0000	
753		.	.	.		-	Browns Bench	1.0000	
754		.	.	.		-	Browns Bench	1.0000	
755		.	.	.		-	Browns Bench	1.0000	
756		.	.	.		-	Browns Bench	1.0000	
757		.	.	.		-	Browns Bench	1.0000	
758		.	.	.		-	Browns Bench	1.0000	
759		.	.	.		-	Browns Bench	1.0000	
760		.	.	.		-	Bear Gulch	1.0000	
761		.	.	.		-	Browns Bench	1.0000	
762		.	.	.		-	Browns Bench	1.0000	
763		.	.	.		-	Browns Bench	1.0000	
764		.	.	.		-	Browns Bench	1.0000	
765		.	.	.		-	Browns Bench	1.0000	
766		.	.	.		-	Browns Bench	1.0000	
767		.	.	.		-	Browns Bench	1.0000	
768		.	.	.		-	Browns Bench	1.0000	
769		.	.	.		-	Browns Bench	1.0000	
770		.	.	.		-	Browns Bench	1.0000	
771		.	.	.		-	Browns Bench	1.0000	
772		.	.	.		-	Browns Bench	1.0000	
773		.	.	.		-	Browns Bench	1.0000	
774		.	.	.		-	Browns Bench	1.0000	
775		.	.	.		-	Browns Bench	1.0000	
776		.	.	.		-	Browns Bench	1.0000	
777		.	.	.		-	Browns Bench	1.0000	
778		.	.	.		-	Browns Bench	1.0000	
779		.	.	.		-	Browns Bench	1.0000	
780		.	.	.		-	Browns Bench	1.0000	
781		.	.	.		-	Browns Bench	1.0000	
782		.	.	.		-	Browns Bench	1.0000	
783		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
784		.	.	.		-	Browns Bench	1.0000	
785		.	.	.		-	Browns Bench	1.0000	
786		.	.	.		-	Browns Bench	1.0000	
787		.	.	.		-	Browns Bench	1.0000	
788		.	.	.		-	Browns Bench	0.8430	Packsaddle 0.16
789		.	.	.		-	Browns Bench	1.0000	
790		.	.	.		-	Browns Bench	1.0000	
791		.	.	.		-	Browns Bench	1.0000	
792		.	.	.		-	Browns Bench	1.0000	
793		.	.	.		-	Browns Bench	1.0000	
794		.	.	.		-	Browns Bench	1.0000	
795		.	.	.		-	Browns Bench	1.0000	
796		.	.	.		-	Browns Bench	1.0000	
797		.	.	.		-	Browns Bench	1.0000	
798		.	.	.		-	Browns Bench	1.0000	
799		.	.	.		-	Browns Bench	1.0000	
800		.	.	.		-	Browns Bench	1.0000	
801		.	.	.		-	Browns Bench	1.0000	
802		.	.	.		-	Browns Bench	1.0000	
803		.	.	.		-	Browns Bench	1.0000	
804		.	.	.		-	Browns Bench	1.0000	
805		.	.	.		-	Browns Bench	1.0000	
806		.	.	.		-	Browns Bench	1.0000	
807		.	.	.		-	Browns Bench	1.0000	
808		.	.	.		-	Browns Bench	0.9988	
809		.	.	.		-	Browns Bench	1.0000	
810		.	.	.		-	Browns Bench	1.0000	
811		.	.	.		-	Browns Bench	0.9915	
812		.	.	.		-	Browns Bench	1.0000	
813		.	.	.		-	Browns Bench	1.0000	
814		.	.	.		-	Browns Bench	1.0000	
815		.	.	.		-	Browns Bench	1.0000	
816		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
817		.	.	.		-	Browns Bench	1.0000	
818		.	.	.		-	Browns Bench	1.0000	
819		.	.	.		-	Browns Bench	0.9974	
820		.	.	.		-	Browns Bench	1.0000	
821		.	.	.		-	Browns Bench	1.0000	
822		.	.	.		-	Browns Bench	1.0000	
823		.	.	.		-	Browns Bench	1.0000	
824		.	.	.		-	Browns Bench	1.0000	
825		.	.	.		-	Browns Bench	1.0000	
826		.	.	.		-	Browns Bench	1.0000	
827		.	.	.		-	Browns Bench	1.0000	
828		.	.	.		-	Browns Bench	1.0000	
829		.	.	.		-	Browns Bench	1.0000	
830		.	.	.		-	Browns Bench	1.0000	
831		.	.	.		-	Browns Bench	1.0000	
832		.	.	.		-	Browns Bench	1.0000	
833		.	.	.		-	Browns Bench	1.0000	
834		.	.	.		-	Browns Bench	1.0000	
835		.	.	.		-	Browns Bench	1.0000	
836		.	.	.		-	Browns Bench	1.0000	
837		.	.	.		-	Browns Bench	1.0000	
838		.	.	.		-	Browns Bench	1.0000	
839		.	.	.		-	Browns Bench	1.0000	
840		.	.	.		-	Browns Bench	0.9998	
841		.	.	.		-	Browns Bench	1.0000	
842		.	.	.		-	Browns Bench	1.0000	
843		.	.	.		-	Browns Bench	1.0000	
844		.	.	.		-	Browns Bench	1.0000	
845		.	.	.		-	Browns Bench	1.0000	
846		.	.	.		-	Browns Bench	1.0000	
847		.	.	.		-	Browns Bench	1.0000	
848		.	.	.		-	Browns Bench	1.0000	
849		.	.	.		-	Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
850		.	.	.		-	Browns Bench	1.0000	
851		.	.	.		-	Browns Bench	1.0000	
852		.	.	.		-	Browns Bench	1.0000	
853		.	.	.		-	Browns Bench	1.0000	
854		.	.	.		-	Browns Bench	1.0000	
855		.	.	.		-	Teton Pass 1	1.0000	
856		.	.	.		-	Browns Bench	1.0000	
857		.	.	.		-	Browns Bench	1.0000	
858		.	.	.		-	Browns Bench	1.0000	
859		.	.	.		-	Browns Bench	0.6195	Packsaddle 0.38
860		.	.	.		-	Browns Bench	1.0000	
861		.	.	.		-	Browns Bench	1.0000	
862		.	.	.		-	Browns Bench	1.0000	
863		.	.	.		-	Browns Bench	1.0000	
864		.	.	.		-	Browns Bench	1.0000	
865		.	.	.		-	Browns Bench	1.0000	
866		.	.	.		-	Browns Bench	0.9999	
867		.	.	.		-	Browns Bench	1.0000	
868		.	.	.		-	Browns Bench	1.0000	
869		.	.	.		-	Browns Bench	1.0000	
870		.	.	.		-	Browns Bench	1.0000	
871		.	.	.		-	Browns Bench	1.0000	
872		.	.	.		-	Browns Bench	1.0000	
873		.	.	.		-	Browns Bench	1.0000	
874		.	.	.		-	Browns Bench	1.0000	
875		.	.	.		-	Browns Bench	1.0000	
876		.	.	.		-	Browns Bench	1.0000	
877		.	.	.		-	Browns Bench	1.0000	
878		.	.	.		-	Browns Bench	0.9995	
879		.	.	.		-	Browns Bench	1.0000	
880		.	.	.		-	Browns Bench	1.0000	
881		.	.	.		-	Browns Bench	1.0000	
882		.	.	.		-	Wedge Butte	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
883		.	.	.		-	Browns Bench	1.0000	
884		.	.	.		-	Browns Bench	1.0000	
885		.	.	.		-	Browns Bench	1.0000	
886		.	.	.		-	Browns Bench	1.0000	
887		.	.	.		-	Walcott	0.9657	
888		.	.	.		-	Browns Bench	1.0000	
889		.	.	.		-	Browns Bench	1.0000	
890		.	.	.		-	Browns Bench	1.0000	
891		.	.	.		-	Browns Bench	1.0000	
892		.	.	.		-	Browns Bench	1.0000	
893		.	.	.		-	Browns Bench	1.0000	
894	Bear Gulch	2.7753	1.0000	0.000			Bear Gulch	1.0000	
895	Bear Gulch	5.6989	1.0000	0.000			Bear Gulch	1.0000	
896	Bear Gulch	5.4902	1.0000	0.000			Bear Gulch	1.0000	
897	Bear Gulch	4.6158	1.0000	0.000			Bear Gulch	1.0000	
898	Bear Gulch	3.5307	1.0000	0.000			Bear Gulch	1.0000	
899	Bear Gulch	2.9128	1.0000	0.000			Bear Gulch	1.0000	
900	Bear Gulch	2.1500	1.0000	0.000			Bear Gulch	1.0000	
901	Bear Gulch	2.1798	1.0000	0.000			Bear Gulch	1.0000	
902	Bear Gulch	6.6755	1.0000	0.000			Bear Gulch	1.0000	
903	Bear Gulch	6.8512	1.0000	0.000			Bear Gulch	1.0000	
904	Bear Gulch	2.6298	1.0000	0.000			Bear Gulch	1.0000	
905	Bear Gulch	9.4900	1.0000	0.000			Bear Gulch	1.0000	
906	Bear Gulch	23.9279	1.0000	0.000			Bear Gulch	1.0000	
907	Bear Gulch	6.1109	1.0000	0.000			Bear Gulch	1.0000	
908	Bear Gulch	7.2686	1.0000	0.000			Bear Gulch	1.0000	
909	Bear Gulch	20.8285	1.0000	0.000			Bear Gulch	1.0000	
910	Bear Gulch	2.3044	1.0000	0.000			Bear Gulch	1.0000	
911	Bear Gulch	1.9769	1.0000	0.000			Bear Gulch	1.0000	
912	Bear Gulch	1.8989	1.0000	0.000			Bear Gulch	1.0000	
913	Bear Gulch	2.6421	1.0000	0.000			Bear Gulch	1.0000	
914	Bear Gulch	3.3294	1.0000	0.000			Bear Gulch	1.0000	
915	Bear Gulch	5.1695	1.0000	0.000			Bear Gulch	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
916	Bear Gulch	3.0660	1.0000	0.000			Bear Gulch	1.0000	
917	Bear Gulch	1.7809	1.0000	0.000			Bear Gulch	1.0000	
918	Bear Gulch	12.4087	1.0000	0.000			Bear Gulch	1.0000	
919	Bear Gulch	1.8960	1.0000	0.000			Bear Gulch	1.0000	
920	Bear Gulch	9.6721	1.0000	0.000			Bear Gulch	1.0000	
921	Bear Gulch	1.1606	1.0000	0.000			Bear Gulch	1.0000	
922	Bear Gulch	6.2998	1.0000	0.000			Bear Gulch	1.0000	
923	Bear Gulch	6.7299	1.0000	0.000			Bear Gulch	1.0000	
924	Bear Gulch	1.7230	1.0000	0.000			Bear Gulch	1.0000	
925	Bear Gulch	2.6185	1.0000	0.000			Bear Gulch	1.0000	
926	Bear Gulch	6.4821	1.0000	0.000			Bear Gulch	1.0000	
927	Bear Gulch	2.0452	1.0000	0.000			Bear Gulch	1.0000	
928	Bear Gulch	10.1432	1.0000	0.000			Bear Gulch	1.0000	
929	Bear Gulch	1.4177	1.0000	0.000			Bear Gulch	1.0000	
930	Bear Gulch	11.6861	1.0000	0.000			Bear Gulch	1.0000	
931	Bear Gulch	4.9403	1.0000	0.000			Bear Gulch	1.0000	
932	Bear Gulch	4.2723	1.0000	0.000			Bear Gulch	1.0000	
933	Bear Gulch	4.4069	1.0000	0.000			Bear Gulch	1.0000	
934	Bear Gulch	7.0870	1.0000	0.000			Bear Gulch	1.0000	
935	Bear Gulch	1.9342	1.0000	0.000			Bear Gulch	1.0000	
936	Bear Gulch	6.3871	1.0000	0.000			Bear Gulch	1.0000	
937	Bear Gulch	7.4501	1.0000	0.000			Bear Gulch	1.0000	
938	Bear Gulch	3.4184	1.0000	0.000			Bear Gulch	1.0000	
939	Bear Gulch	9.4227	1.0000	0.000			Bear Gulch	1.0000	
940	Bear Gulch	9.8311	1.0000	0.000			Bear Gulch	1.0000	
941	Bear Gulch	7.8822	1.0000	0.000			Bear Gulch	1.0000	
942	Bear Gulch	1.8663	1.0000	0.000			Bear Gulch	1.0000	
943	Bear Gulch	1.3872	1.0000	0.000			Bear Gulch	1.0000	
944	Bear Gulch	5.8171	1.0000	0.000			Bear Gulch	1.0000	
945	Bear Gulch	3.1391	1.0000	0.000			Bear Gulch	1.0000	
946	Bear Gulch	5.7821	1.0000	0.000			Bear Gulch	1.0000	
947	Bear Gulch	6.0119	1.0000	0.000			Bear Gulch	1.0000	
948	Bear Gulch	2.6172	1.0000	0.000			Bear Gulch	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
949	Bear Gulch	3.2147	1.0000	0.000			Bear Gulch	1.0000	
950	Bear Gulch	8.3539	1.0000	0.000			Bear Gulch	1.0000	
951	Bear Gulch	11.1948	1.0000	0.000			Bear Gulch	1.0000	
952	Bear Gulch	12.1751	0.9998	0.000			Bear Gulch	0.9998	
953	Bear Gulch	58.5382	1.0000	0.000			Bear Gulch	1.0000	
954	Bear Gulch	4.0775	1.0000	0.000			Bear Gulch	1.0000	
955	Bear Gulch	3.5477	1.0000	0.000			Bear Gulch	1.0000	
956	Big Southern Butte	2.9211	1.0000	0.000			Big Southern Butte	1.0000	
957	Big Southern Butte	5.3309	1.0000	0.000			Big Southern Butte	1.0000	
958	Big Southern Butte	2.3353	1.0000	0.000			Big Southern Butte	1.0000	
959	Big Southern Butte	3.5586	1.0000	0.000			Big Southern Butte	1.0000	
960	Big Southern Butte	13.4634	1.0000	0.000			Big Southern Butte	1.0000	
961	Big Southern Butte	8.1891	1.0000	0.000			Big Southern Butte	1.0000	
962	Big Southern Butte	8.2253	1.0000	0.000			Big Southern Butte	1.0000	
963	Big Southern Butte	6.5419	1.0000	0.000			Big Southern Butte	1.0000	
964	Big Southern Butte	5.3507	1.0000	0.000			Big Southern Butte	1.0000	
965	Big Southern Butte	3.3672	1.0000	0.000			Big Southern Butte	1.0000	
966	Big Southern Butte	5.2973	1.0000	0.000			Big Southern Butte	1.0000	
967	Big Southern Butte	5.7064	1.0000	0.000			Big Southern Butte	1.0000	
968	Big Southern Butte	5.8208	1.0000	0.000			Big Southern Butte	1.0000	
969	Big Southern Butte	17.2507	1.0000	0.000			Big Southern Butte	1.0000	
970	Big Southern Butte	5.8839	1.0000	0.000			Big Southern Butte	1.0000	
971	Big Southern Butte	4.1151	1.0000	0.000			Big Southern Butte	1.0000	
972	Big Southern Butte	7.0688	1.0000	0.000			Big Southern Butte	1.0000	
973	Big Southern Butte	1.7662	1.0000	0.000			Big Southern Butte	1.0000	
974	Big Southern Butte	7.4122	1.0000	0.000			Big Southern Butte	1.0000	
975	Big Southern Butte	15.3124	1.0000	0.000			Big Southern Butte	1.0000	
976	Big Southern Butte	7.5214	1.0000	0.000			Big Southern Butte	1.0000	
977	Big Southern Butte	30.0895	1.0000	0.000			Big Southern Butte	1.0000	
978	Big Southern Butte	6.2088	1.0000	0.000			Big Southern Butte	1.0000	
979	Big Southern Butte	31.5894	1.0000	0.000			Big Southern Butte	1.0000	
980	Big Southern Butte	6.5044	1.0000	0.000			Big Southern Butte	1.0000	
981	Big Southern Butte	76.2233	1.0000	0.000			Big Southern Butte	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
982	Big Southern Butte	5.3820	1.0000	0.000			Big Southern Butte	1.0000	
983	Big Southern Butte	9.1495	1.0000	0.000			Big Southern Butte	1.0000	
984	Big Southern Butte	3.5036	1.0000	0.000			Big Southern Butte	1.0000	
985	Big Southern Butte	7.2847	1.0000	0.000			Big Southern Butte	1.0000	
986	Big Southern Butte	8.5216	1.0000	0.000			Big Southern Butte	1.0000	
987	Big Southern Butte	4.7718	1.0000	0.000			Big Southern Butte	1.0000	
988	Big Southern Butte	11.0949	1.0000	0.000			Big Southern Butte	1.0000	
989	Big Southern Butte	17.0919	1.0000	0.000			Big Southern Butte	1.0000	
990	Browns Bench	29.4787	1.0000	0.000			Browns Bench	1.0000	
991	Browns Bench	18.9525	1.0000	0.000			Browns Bench	1.0000	
992	Browns Bench	29.0385	1.0000	0.000			Browns Bench	1.0000	
993	Browns Bench	13.2217	1.0000	0.000			Browns Bench	1.0000	
994	Browns Bench	4.2126	1.0000	0.000			Browns Bench	1.0000	
995	Browns Bench	5.5175	1.0000	0.000			Browns Bench	1.0000	
996	Browns Bench	10.7629	1.0000	0.000			Browns Bench	1.0000	
997	Browns Bench	11.0131	1.0000	0.000			Browns Bench	1.0000	
998	Browns Bench	7.6686	1.0000	0.000			Browns Bench	1.0000	
999	Browns Bench	17.3837	1.0000	0.000			Browns Bench	1.0000	
1000	Browns Bench	3.1895	1.0000	0.000			Browns Bench	1.0000	
1001	Browns Bench	7.0498	1.0000	0.000			Browns Bench	1.0000	
1002	Browns Bench	7.7365	1.0000	0.000			Browns Bench	1.0000	
1003	Browns Bench	6.5110	1.0000	0.000			Browns Bench	1.0000	
1004	Browns Bench	13.5690	1.0000	0.000			Browns Bench	1.0000	
1005	Browns Bench	14.2154	1.0000	0.000			Browns Bench	1.0000	
1006	Browns Bench	9.0742	1.0000	0.000			Browns Bench	1.0000	
1007	Browns Bench	12.9294	1.0000	0.000			Browns Bench	1.0000	
1008	Browns Bench	23.1036	1.0000	0.000			Browns Bench	1.0000	
1009	Browns Bench	16.7599	1.0000	0.000			Browns Bench	1.0000	
1010	Browns Bench	24.1718	1.0000	0.000			Browns Bench	1.0000	
1011	Browns Bench	28.6158	1.0000	0.000			Browns Bench	1.0000	
1012	Browns Bench	10.6430	1.0000	0.000			Browns Bench	1.0000	
1013	Browns Bench	15.5900	1.0000	0.000			Browns Bench	1.0000	
1014	Browns Bench	12.2478	1.0000	0.000			Browns Bench	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1015	Browns Bench	16.7207	1.0000	0.000			Browns Bench	1.0000	
1016	Browns Bench	5.8469	1.0000	0.000			Browns Bench	1.0000	
1017	Browns Bench	5.1360	1.0000	0.000			Browns Bench	1.0000	
1018	Browns Bench	5.2261	1.0000	0.000			Browns Bench	1.0000	
1019	Browns Bench	10.4668	1.0000	0.000			Browns Bench	1.0000	
1020	Browns Bench	11.6924	1.0000	0.000			Browns Bench	1.0000	
1021	Browns Bench	3.5671	1.0000	0.000			Browns Bench	1.0000	
1022	Browns Bench	9.4300	1.0000	0.000			Browns Bench	1.0000	
1023	Browns Bench	6.7411	1.0000	0.000			Browns Bench	1.0000	
1024	Browns Bench	7.5652	1.0000	0.000			Browns Bench	1.0000	
1025	Browns Bench	9.8895	1.0000	0.000			Browns Bench	1.0000	
1026	Browns Bench	8.4301	1.0000	0.000			Browns Bench	1.0000	
1027	Browns Bench	5.3763	1.0000	0.000			Browns Bench	1.0000	
1028	Browns Bench	6.3815	1.0000	0.000			Browns Bench	1.0000	
1029	Browns Bench	7.3084	1.0000	0.000			Browns Bench	1.0000	
1030	Browns Bench	20.7400	0.9990	0.001			Browns Bench	0.9990	
1031	Browns Bench	17.5661	1.0000	0.000			Browns Bench	1.0000	
1032	Browns Bench	4.0112	1.0000	0.000			Browns Bench	1.0000	
1033	Browns Bench	5.7391	1.0000	0.000			Browns Bench	1.0000	
1034	Browns Bench	7.6252	1.0000	0.000			Browns Bench	1.0000	
1035	Browns Bench	6.2170	1.0000	0.000			Browns Bench	1.0000	
1036	Browns Bench	10.3067	1.0000	0.000			Browns Bench	1.0000	
1037	Browns Bench	4.9729	1.0000	0.000			Browns Bench	1.0000	
1038	Browns Bench	40.0470	1.0000	0.000			Browns Bench	1.0000	
1039	Browns Bench	37.0904	1.0000	0.000			Browns Bench	1.0000	
1040	Browns Bench	9.1182	1.0000	0.000			Browns Bench	1.0000	
1041	Browns Bench	8.3772	1.0000	0.000			Browns Bench	1.0000	
1042	Browns Bench	12.5228	1.0000	0.000			Browns Bench	1.0000	
1043	Browns Bench	4.2666	1.0000	0.000			Browns Bench	1.0000	
1044	Browns Bench	8.6952	1.0000	0.000			Browns Bench	1.0000	
1045	Browns Bench	4.9427	1.0000	0.000			Browns Bench	1.0000	
1046	Cannonball Mt II	21.0282	0.9711	0.029			Cannonball Mt II	0.9711	
1047	Cannonball Mt II	18.0207	0.9557	0.045			Cannonball Mt II	0.9557	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1048	Cannonball Mt II	25.4760	0.9759	0.024			Cannonball Mt II	0.9759	
1049	Cannonball Mt II	19.1625	0.9931	0.007			Cannonball Mt II	0.9931	
1050	Cannonball Mt II	20.1299	0.1951	1.634		*	Cannonball Mt I	0.8049	
1051	Cannonball Mt II	17.1433	0.5219	0.650			Cannonball Mt II	0.5219	Cannonball Mt I 0.48
1052	Cannonball Mt II	24.6727	0.8345	0.181			Cannonball Mt II	0.8345	Cannonball Mt I 0.17
1053	Cannonball Mt II	22.1938	0.3472	1.058		*	Cannonball Mt I	0.6528	
1054	Cannonball Mt II	17.1380	0.4040	0.906		*	Cannonball Mt I	0.5960	
1055	Cannonball Mt II	22.5343	0.6962	0.362			Cannonball Mt II	0.6962	Cannonball Mt I 0.30
1056	Cannonball Mt II	21.7865	0.5005	0.692			Cannonball Mt II	0.5005	Cannonball Mt I 0.50
1057	Cannonball Mt II	20.0982	0.3955	0.928		*	Cannonball Mt I	0.6045	
1058	Cannonball Mt II	20.2740	0.9811	0.019			Cannonball Mt II	0.9811	
1059	Cannonball Mt II	16.7766	0.9019	0.103			Cannonball Mt II	0.9019	
1060	Cannonball Mt II	19.0946	0.9986	0.001			Cannonball Mt II	0.9986	
1061	Cannonball Mt II	14.2142	0.9865	0.014			Cannonball Mt II	0.9865	
1062	Cannonball Mt II	21.2681	0.9802	0.020			Cannonball Mt II	0.9802	
1063	Chesterfield	2.1603	1.0000	0.000			Chesterfield	1.0000	
1064	Chesterfield	1.4313	1.0000	0.000			Chesterfield	1.0000	
1065	Chesterfield	3.1517	1.0000	0.000			Chesterfield	1.0000	
1066	Chesterfield	2.0825	1.0000	0.000			Chesterfield	1.0000	
1067	Chesterfield	9.8518	1.0000	0.000			Chesterfield	1.0000	
1068	Chesterfield	11.5362	1.0000	0.000			Chesterfield	1.0000	
1069	Chesterfield	1.9184	1.0000	0.000			Chesterfield	1.0000	
1070	Chesterfield	8.4747	1.0000	0.000			Chesterfield	1.0000	
1071	Chesterfield	2.9656	1.0000	0.000			Chesterfield	1.0000	
1072	Chesterfield	1.2177	1.0000	0.000			Chesterfield	1.0000	
1073	Chesterfield	3.5958	1.0000	0.000			Chesterfield	1.0000	
1074	Chesterfield	5.5628	1.0000	0.000			Chesterfield	1.0000	
1075	Chesterfield	12.7628	1.0000	0.000			Chesterfield	1.0000	
1076	Chesterfield	4.3450	1.0000	0.000			Chesterfield	1.0000	
1077	Chesterfield	9.9465	1.0000	0.000			Chesterfield	1.0000	
1078	Chesterfield	3.7281	1.0000	0.000			Chesterfield	1.0000	
1079	Conant Creek	2.6236	0.9838	0.016			Conant Creek	0.9838	
1080	Conant Creek	6.5198	0.9565	0.044			Conant Creek	0.9565	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1081	Conant Creek	2.1763	0.9901	0.010			Conant Creek	0.9901	
1082	Conant Creek	7.2261	0.9349	0.067			Conant Creek	0.9349	
1083	Conant Creek	1.6275	0.9655	0.035			Conant Creek	0.9655	
1084	Conant Creek	1.7562	0.9920	0.008			Conant Creek	0.9920	
1085	Conant Creek	2.7452	0.9931	0.007			Conant Creek	0.9931	
1086	Conant Creek	4.7443	0.9942	0.006			Conant Creek	0.9942	
1087	Conant Creek	3.3586	0.9705	0.030			Conant Creek	0.9705	
1088	Conant Creek	2.6930	0.9444	0.057			Conant Creek	0.9444	
1089	Conant Creek	3.9148	0.9926	0.007			Conant Creek	0.9926	
1090	Conant Creek	4.5369	0.9881	0.012			Conant Creek	0.9881	
1091	Conant Creek	1.9149	0.9780	0.022			Conant Creek	0.9780	
1092	Conant Creek	1.9315	0.9735	0.027			Conant Creek	0.9735	
1093	Conant Creek	3.3121	0.9431	0.059			Conant Creek	0.9431	
1094	Conant Creek	7.6713	0.9860	0.014			Conant Creek	0.9860	
1095	Conant Creek	4.4207	0.9763	0.024			Conant Creek	0.9763	
1096	Conant Creek	4.2207	0.9842	0.016			Conant Creek	0.9842	
1097	Conant Creek	2.0874	0.9538	0.047			Conant Creek	0.9538	
1098	Conant Creek	1.2381	0.9784	0.022			Conant Creek	0.9784	
1099	Conant Creek	2.7699	0.9633	0.037			Conant Creek	0.9633	
1100	Conant Creek	3.2978	0.9001	0.105			Conant Creek	0.9001	
1101	Conant Creek	3.4615	0.9917	0.008			Conant Creek	0.9917	
1102	Conant Creek	2.6549	0.9605	0.040			Conant Creek	0.9605	
1103	Conant Creek	1.7824	0.9201	0.083			Conant Creek	0.9201	
1104	Conant Creek	6.2002	0.9533	0.048			Conant Creek	0.9533	
1105	Conant Creek	11.7552	0.7862	0.241			Conant Creek	0.7862	Walcott 0.19
1106	Conant Creek	1.5349	0.9919	0.008			Conant Creek	0.9919	
1107	Conant Creek	5.2556	0.6237	0.472			Conant Creek	0.6237	Walcott 0.37
1108	Conant Creek	6.9555	0.9479	0.053			Conant Creek	0.9479	
1109	Conant Creek	6.0759	0.5307	0.634			Conant Creek	0.5307	Kelly Canyon 0.47
1110	Conant Creek	3.8914	0.7958	0.228			Conant Creek	0.7958	Walcott 0.19
1111	Conant Creek	4.1888	0.9819	0.018			Conant Creek	0.9819	
1112	Conant Creek	4.1485	0.9431	0.059			Conant Creek	0.9431	
1113	Conant Creek	5.8918	0.9602	0.041			Conant Creek	0.9602	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1114	Conant Creek	7.2770	0.9899	0.010			Conant Creek	0.9899	
1115	Conant Creek	2.2732	0.9721	0.028			Conant Creek	0.9721	
1116	Conant Creek	3.7343	0.8461	0.167			Conant Creek	0.8461	Walcott 0.14
1117	Kelly Canyon	3.2794	0.9630	0.038			Kelly Canyon	0.9630	
1118	Kelly Canyon	3.7902	0.9545	0.047			Kelly Canyon	0.9545	
1119	Kelly Canyon	3.4302	0.8559	0.156			Kelly Canyon	0.8559	Conant Creek 0.12
1120	Kelly Canyon	1.6870	0.9867	0.013			Kelly Canyon	0.9867	
1121	Kelly Canyon	1.8447	0.9700	0.030			Kelly Canyon	0.9700	
1122	Kelly Canyon	3.0670	0.9290	0.074			Kelly Canyon	0.9290	
1123	Kelly Canyon	3.9078	0.9502	0.051			Kelly Canyon	0.9502	
1124	Kelly Canyon	7.8512	0.9516	0.050			Kelly Canyon	0.9516	
1125	Kelly Canyon	3.9287	0.9932	0.007			Kelly Canyon	0.9932	
1126	Kelly Canyon	1.1242	0.9913	0.009			Kelly Canyon	0.9913	
1127	Kelly Canyon	1.7166	0.9892	0.011			Kelly Canyon	0.9892	
1128	Kelly Canyon	2.3703	0.9929	0.007			Kelly Canyon	0.9929	
1129	Kelly Canyon	0.7936	0.9911	0.009			Kelly Canyon	0.9911	
1130	Kelly Canyon	5.8304	0.9498	0.052			Kelly Canyon	0.9498	
1131	Kelly Canyon	13.7884	0.9935	0.007			Kelly Canyon	0.9935	
1132	Kelly Canyon	9.5968	0.9930	0.007			Kelly Canyon	0.9930	
1133	Malad	2.1563	1.0000	0.000			Malad	1.0000	
1134	Malad	1.7108	1.0000	0.000			Malad	1.0000	
1135	Malad	1.2408	1.0000	0.000			Malad	1.0000	
1136	Malad	2.4526	1.0000	0.000			Malad	1.0000	
1137	Malad	1.1756	1.0000	0.000			Malad	1.0000	
1138	Malad	2.3204	1.0000	0.000			Malad	1.0000	
1139	Malad	1.6033	1.0000	0.000			Malad	1.0000	
1140	Malad	3.7275	1.0000	0.000			Malad	1.0000	
1141	Malad	1.6619	1.0000	0.000			Malad	1.0000	
1142	Malad	3.2601	1.0000	0.000			Malad	1.0000	
1143	Malad	1.7234	1.0000	0.000			Malad	1.0000	
1144	Malad	1.0916	1.0000	0.000			Malad	1.0000	
1145	Malad	10.1389	1.0000	0.000			Malad	1.0000	
1146	Malad	1.6447	1.0000	0.000			Malad	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1147	Malad	3.5878	1.0000	0.000			Malad	1.0000	
1148	Malad	1.2936	1.0000	0.000			Malad	1.0000	
1149	Malad	1.5644	1.0000	0.000			Malad	1.0000	
1150	Malad	5.9312	1.0000	0.000			Malad	1.0000	
1151	Malad	2.0861	1.0000	0.000			Malad	1.0000	
1152	Malad	9.0023	1.0000	0.000			Malad	1.0000	
1153	Malad	8.6312	1.0000	0.000			Malad	1.0000	
1154	Malad	13.6305	1.0000	0.000			Malad	1.0000	
1155	Malad	4.5866	1.0000	0.000			Malad	1.0000	
1156	Malad	4.5226	1.0000	0.000			Malad	1.0000	
1157	Malad	7.7514	1.0000	0.000			Malad	1.0000	
1158	Malad	6.8207	1.0000	0.000			Malad	1.0000	
1159	Malad	4.8735	1.0000	0.000			Malad	1.0000	
1160	Malad	5.5435	1.0000	0.000			Malad	1.0000	
1161	Malad	8.7777	1.0000	0.000			Malad	1.0000	
1162	Malad	7.8912	1.0000	0.000			Malad	1.0000	
1163	Malad	1.5220	1.0000	0.000			Malad	1.0000	
1164	Malad	2.1586	1.0000	0.000			Malad	1.0000	
1165	Malad	5.1742	1.0000	0.000			Malad	1.0000	
1166	Malad	3.8954	1.0000	0.000			Malad	1.0000	
1167	Malad	7.0411	1.0000	0.000			Malad	1.0000	
1168	Malad	7.0940	1.0000	0.000			Malad	1.0000	
1169	Malad	2.1644	1.0000	0.000			Malad	1.0000	
1170	Malad	3.6918	1.0000	0.000			Malad	1.0000	
1171	Malad	3.7918	1.0000	0.000			Malad	1.0000	
1172	Malad	7.6197	1.0000	0.000			Malad	1.0000	
1173	Obsidian Cliffs	2.7131	1.0000	0.000			Obsidian Cliffs	1.0000	
1174	Obsidian Cliffs	3.2190	1.0000	0.000			Obsidian Cliffs	1.0000	
1175	Obsidian Cliffs	2.4893	1.0000	0.000			Obsidian Cliffs	1.0000	
1176	Obsidian Cliffs	3.9862	1.0000	0.000			Obsidian Cliffs	1.0000	
1177	Obsidian Cliffs	5.5413	1.0000	0.000			Obsidian Cliffs	1.0000	
1178	Obsidian Cliffs	4.3558	1.0000	0.000			Obsidian Cliffs	1.0000	
1179	Obsidian Cliffs	10.3868	1.0000	0.000			Obsidian Cliffs	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1180	Obsidian Cliffs	4.4350	1.0000	0.000			Obsidian Cliffs	1.0000	
1181	Obsidian Cliffs	0.7624	1.0000	0.000			Obsidian Cliffs	1.0000	
1182	Obsidian Cliffs	1.8061	1.0000	0.000			Obsidian Cliffs	1.0000	
1183	Obsidian Cliffs	8.3731	1.0000	0.000			Obsidian Cliffs	1.0000	
1184	Obsidian Cliffs	11.6957	1.0000	0.000			Obsidian Cliffs	1.0000	
1185	Obsidian Cliffs	2.7038	1.0000	0.000			Obsidian Cliffs	1.0000	
1186	Obsidian Cliffs	4.9785	1.0000	0.000			Obsidian Cliffs	1.0000	
1187	Obsidian Cliffs	3.4578	1.0000	0.000			Obsidian Cliffs	1.0000	
1188	Obsidian Cliffs	3.8322	1.0000	0.000			Obsidian Cliffs	1.0000	
1189	Obsidian Cliffs	1.3873	1.0000	0.000			Obsidian Cliffs	1.0000	
1190	Obsidian Cliffs	18.2206	0.9997	0.000			Obsidian Cliffs	0.9997	
1191	Teton Pass 1	3.0639	1.0000	0.000			Teton Pass 1	1.0000	
1192	Teton Pass 1	1.4356	1.0000	0.000			Teton Pass 1	1.0000	
1193	Teton Pass 1	1.1759	1.0000	0.000			Teton Pass 1	1.0000	
1194	Teton Pass 1	2.6981	1.0000	0.000			Teton Pass 1	1.0000	
1195	Teton Pass 1	3.6928	1.0000	0.000			Teton Pass 1	1.0000	
1196	Teton Pass 1	3.4251	1.0000	0.000			Teton Pass 1	1.0000	
1197	Teton Pass 1	58.3246	1.0000	0.000			Teton Pass 1	1.0000	
1198	Teton Pass 1	5.5663	1.0000	0.000			Teton Pass 1	1.0000	
1199	Teton Pass 1	0.6864	1.0000	0.000			Teton Pass 1	1.0000	
1200	Teton Pass 1	0.8868	1.0000	0.000			Teton Pass 1	1.0000	
1201	Teton Pass 1	2.9322	1.0000	0.000			Teton Pass 1	1.0000	
1202	Teton Pass 1	1.7043	1.0000	0.000			Teton Pass 1	1.0000	
1203	Teton Pass 1	3.8184	1.0000	0.000			Teton Pass 1	1.0000	
1204	Teton Pass 1	3.3291	1.0000	0.000			Teton Pass 1	1.0000	
1205	Teton Pass 1	6.9616	1.0000	0.000			Teton Pass 1	1.0000	
1206	Teton Pass 1	3.5913	1.0000	0.000			Teton Pass 1	1.0000	
1207	Teton Pass 1	14.0717	1.0000	0.000			Teton Pass 1	1.0000	
1208	Teton Pass 1	7.2479	1.0000	0.000			Teton Pass 1	1.0000	
1209	Teton Pass 1	6.2921	1.0000	0.000			Teton Pass 1	1.0000	
1210	Teton Pass 1	13.9212	1.0000	0.000			Teton Pass 1	1.0000	
1211	Teton Pass 1	4.5008	1.0000	0.000			Teton Pass 1	1.0000	
1212	Teton Pass 1	5.9556	1.0000	0.000			Teton Pass 1	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1213	Teton Pass 1	4.2799	1.0000	0.000			Teton Pass 1	1.0000	
1214	Teton Pass 1	5.7459	1.0000	0.000			Teton Pass 1	1.0000	
1215	Teton Pass 1	4.4956	1.0000	0.000			Teton Pass 1	1.0000	
1216	Teton Pass 1	6.7957	1.0000	0.000			Teton Pass 1	1.0000	
1217	Walcott	2.7957	0.9989	0.001			Walcott	0.9989	
1218	Walcott	1.4554	0.9980	0.002			Walcott	0.9980	
1219	Walcott	4.2890	0.9988	0.001			Walcott	0.9988	
1220	Walcott	5.5615	0.9994	0.001			Walcott	0.9994	
1221	Walcott	2.3378	0.9892	0.011			Walcott	0.9892	
1222	Walcott	2.2979	0.9972	0.003			Walcott	0.9972	
1223	Walcott	4.6068	0.9972	0.003			Walcott	0.9972	
1224	Walcott	3.7844	0.9955	0.005			Walcott	0.9955	
1225	Walcott	3.1978	0.9813	0.019			Walcott	0.9813	
1226	Walcott	0.6235	0.9947	0.005			Walcott	0.9947	
1227	Walcott	2.4191	0.9955	0.004			Walcott	0.9955	
1228	Walcott	2.0853	0.9980	0.002			Walcott	0.9980	
1229	Walcott	4.8317	0.9903	0.010			Walcott	0.9903	
1230	Walcott	1.1696	0.9922	0.008			Walcott	0.9922	
1231	Walcott	2.6551	0.9620	0.039			Walcott	0.9620	
1232	Walcott	6.9574	0.9997	0.000			Walcott	0.9997	
1233	Cannonball Mt I	18.6124	0.8598	0.151			Cannonball Mt I	0.8598	Cannonball Mt II 0.14
1234	Cannonball Mt I	23.4684	0.9851	0.015			Cannonball Mt I	0.9851	
1235	Cannonball Mt I	17.3062	0.9281	0.075			Cannonball Mt I	0.9281	
1236	Cannonball Mt I	29.9571	0.8362	0.179			Cannonball Mt I	0.8362	Cannonball Mt II 0.16
1237	Cannonball Mt I	25.8044	0.0543	2.913		*	Cannonball Mt II	0.9457	
1238	Cannonball Mt I	24.9572	0.0271	3.607		*	Cannonball Mt II	0.9729	
1239	Cannonball Mt I	31.8829	0.0416	3.179		*	Cannonball Mt II	0.9584	
1240	Cannonball Mt I	27.1288	0.0173	4.055		*	Cannonball Mt II	0.9827	
1241	Cannonball Mt I	22.1149	0.4464	0.807		*	Cannonball Mt II	0.5536	
1242	Cannonball Mt I	16.6824	0.9429	0.059			Cannonball Mt I	0.9429	
1243	Cannonball Mt I	24.3761	0.8911	0.115			Cannonball Mt I	0.8911	Cannonball Mt II 0.11
1244	Cannonball Mt I	18.1876	0.8724	0.136			Cannonball Mt I	0.8724	Cannonball Mt II 0.13
1245	Cannonball Mt I	26.5650	0.9995	0.001			Cannonball Mt I	0.9995	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1246	Cannonball Mt I	19.9496	0.9951	0.005			Cannonball Mt I	0.9951	
1247	Cannonball Mt I	31.8756	0.9998	0.000			Cannonball Mt I	0.9998	
1248	Cannonball Mt I	27.6732	0.9999	0.000			Cannonball Mt I	0.9999	
1249	Cedar Butte	8.0771	1.0000	0.000			Cedar Butte	1.0000	
1250	Cedar Butte	8.5946	1.0000	0.000			Cedar Butte	1.0000	
1251	Cedar Butte	191.7996	0.0000	91.343		*	Conant Creek	0.8610	Kelly Canyon 0.14
1252	Cedar Butte	191.3107	0.0000	90.435		*	Conant Creek	0.9759	
1253	Cedar Butte	68.0041	1.0000	0.000			Cedar Butte	1.0000	
1254	Cedar Butte	79.8587	1.0000	0.000			Cedar Butte	1.0000	
1255	Cedar Butte	26.8965	1.0000	0.000			Cedar Butte	1.0000	
1256	Cedar Butte	19.9882	1.0000	0.000			Cedar Butte	1.0000	
1257	Cedar Butte	10.0540	1.0000	0.000			Cedar Butte	1.0000	
1258	Cedar Butte	10.2138	1.0000	0.000			Cedar Butte	1.0000	
1259	Cedar Butte	12.2489	1.0000	0.000			Cedar Butte	1.0000	
1260	Cedar Butte	31.7827	1.0000	0.000			Cedar Butte	1.0000	
1261	Cedar Butte	8.5572	1.0000	0.000			Cedar Butte	1.0000	
1262	Cedar Butte	7.8369	1.0000	0.000			Cedar Butte	1.0000	
1263	Cedar Butte	20.0780	1.0000	0.000			Cedar Butte	1.0000	
1264	Cedar Butte	30.4375	1.0000	0.000			Cedar Butte	1.0000	
1265	Cedar Butte	21.3627	1.0000	0.000			Cedar Butte	1.0000	
1266	Cedar Butte	16.6889	1.0000	0.000			Cedar Butte	1.0000	
1267	Cedar Butte	10.8055	1.0000	0.000			Cedar Butte	1.0000	
1268	Cedar Butte	10.8913	1.0000	0.000			Cedar Butte	1.0000	
1269	Owyhee	3.2772	1.0000	0.000			Owyhee	1.0000	
1270	Owyhee	10.4126	1.0000	0.000			Owyhee	1.0000	
1271	Owyhee	20.1053	1.0000	0.000			Owyhee	1.0000	
1272	Owyhee	3.4554	1.0000	0.000			Owyhee	1.0000	
1273	Owyhee	1.0002	1.0000	0.000			Owyhee	1.0000	
1274	Owyhee	0.8732	1.0000	0.000			Owyhee	1.0000	
1275	Owyhee	2.6941	1.0000	0.000			Owyhee	1.0000	
1276	Owyhee	1.3749	1.0000	0.000			Owyhee	1.0000	
1277	Owyhee	3.5163	1.0000	0.000			Owyhee	1.0000	
1278	Owyhee	1.7760	1.0000	0.000			Owyhee	1.0000	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1279	Owyhee	2.9861	1.0000	0.000			Owyhee	1.0000	
1280	Owyhee	3.8081	1.0000	0.000			Owyhee	1.0000	
1281	Owyhee	7.5335	1.0000	0.000			Owyhee	1.0000	
1282	Owyhee	7.6889	1.0000	0.000			Owyhee	1.0000	
1283	Owyhee	4.8670	1.0000	0.000			Owyhee	1.0000	
1284	Owyhee	8.7955	1.0000	0.000			Owyhee	1.0000	
1285	Owyhee	4.0132	1.0000	0.000			Owyhee	1.0000	
1286	Owyhee	2.6552	1.0000	0.000			Owyhee	1.0000	
1287	Owyhee	6.6223	1.0000	0.000			Owyhee	1.0000	
1288	Owyhee	5.5257	1.0000	0.000			Owyhee	1.0000	
1289	Owyhee	7.5269	1.0000	0.000			Owyhee	1.0000	
1290	Owyhee	5.2471	1.0000	0.000			Owyhee	1.0000	
1291	Owyhee	3.4683	1.0000	0.000			Owyhee	1.0000	
1292	Owyhee	4.0408	1.0000	0.000			Owyhee	1.0000	
1293	Packsaddle	7.3245	0.9998	0.000			Packsaddle	0.9998	
1294	Packsaddle	5.8585	1.0000	0.000			Packsaddle	1.0000	
1295	Packsaddle	4.8879	1.0000	0.000			Packsaddle	1.0000	
1296	Packsaddle	3.7479	0.9991	0.001			Packsaddle	0.9991	
1297	Packsaddle	4.5093	0.9990	0.001			Packsaddle	0.9990	
1298	Packsaddle	5.2985	0.9967	0.003			Packsaddle	0.9967	
1299	Packsaddle	10.1235	0.9998	0.000			Packsaddle	0.9998	
1300	Packsaddle	4.9804	0.9988	0.001			Packsaddle	0.9988	
1301	Packsaddle	8.4960	0.4389	0.824			Packsaddle	0.4389	Kelly Canyon 0.14 Walcott 0.39
1302	Packsaddle	3.7447	0.9963	0.004			Packsaddle	0.9963	
1303	Packsaddle	8.6719	0.4812	0.731			Packsaddle	0.4812	Kelly Canyon 0.46
1304	Packsaddle	3.4999	0.9785	0.022			Packsaddle	0.9785	
1305	Packsaddle	18.5093	0.9362	0.066			Packsaddle	0.9362	
1306	Packsaddle	9.2162	0.8821	0.125			Packsaddle	0.8821	
1307	Packsaddle	9.2458	0.9982	0.002			Packsaddle	0.9982	
1308	Packsaddle	9.3112	1.0000	0.000			Packsaddle	1.0000	
1309	Packsaddle	10.7868	1.0000	0.000			Packsaddle	1.0000	
1310	Packsaddle	11.8107	1.0000	0.000			Packsaddle	1.0000	
1311	Packsaddle	10.7982	0.2595	1.349		*	Kelly Canyon	0.7369	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1312	Packsaddle	5.2765	0.9712	0.029			Packsaddle	0.9712	
1313	Packsaddle	2.1641	0.9991	0.001			Packsaddle	0.9991	
1314	Packsaddle	3.3909	1.0000	0.000			Packsaddle	1.0000	
1315	Packsaddle	5.5788	0.9999	0.000			Packsaddle	0.9999	
1316	Packsaddle	1.7775	1.0000	0.000			Packsaddle	1.0000	
1317	Packsaddle	24.2400	0.7502	0.287			Packsaddle	0.7502	Kelly Canyon 0.25
1318	Packsaddle	7.3330	0.9999	0.000			Packsaddle	0.9999	
1319	Packsaddle	3.4329	0.9978	0.002			Packsaddle	0.9978	
1320	Packsaddle	1.6108	0.9973	0.003			Packsaddle	0.9973	
1321	Packsaddle	13.9883	0.9931	0.007			Packsaddle	0.9931	
1322	Packsaddle	9.8610	0.9985	0.002			Packsaddle	0.9985	
1323	Packsaddle	13.9494	0.9997	0.000			Packsaddle	0.9997	
1324	Packsaddle	8.5798	1.0000	0.000			Packsaddle	1.0000	
1325	Packsaddle	7.1285	0.9999	0.000			Packsaddle	0.9999	
1326	Packsaddle	7.6626	1.0000	0.000			Packsaddle	1.0000	
1327	Packsaddle	4.0771	0.9989	0.001			Packsaddle	0.9989	
1328	Packsaddle	3.7418	1.0000	0.000			Packsaddle	1.0000	
1329	Packsaddle	7.3641	0.7373	0.305			Packsaddle	0.7373	Kelly Canyon 0.19
1330	Packsaddle	2.9346	0.9954	0.005			Packsaddle	0.9954	
1331	Packsaddle	30.2467	0.0106	4.546		*	Walcott	0.8904	
1332	Packsaddle	28.0010	0.0437	3.131		*	Walcott	0.5690	Conant Creek 0.38
1333	Packsaddle	8.4636	0.8408	0.173			Packsaddle	0.8408	Kelly Canyon 0.11
1334	Packsaddle	12.6139	0.9782	0.022			Packsaddle	0.9782	
1335	Packsaddle	3.1752	0.9939	0.006			Packsaddle	0.9939	
1336	Packsaddle	5.3842	0.9996	0.000			Packsaddle	0.9996	
1337	Packsaddle	10.4134	0.9996	0.000			Packsaddle	0.9996	
1338	Packsaddle	9.5250	1.0000	0.000			Packsaddle	1.0000	
1339	Packsaddle	5.3392	0.9984	0.002			Packsaddle	0.9984	
1340	Packsaddle	7.1935	0.9956	0.004			Packsaddle	0.9956	
1341	Packsaddle	9.2885	0.9959	0.004			Packsaddle	0.9959	
1342	Packsaddle	4.9930	0.9994	0.001			Packsaddle	0.9994	
1343	Packsaddle	7.8178	0.9990	0.001			Packsaddle	0.9990	
1344	Packsaddle	6.2139	0.9998	0.000			Packsaddle	0.9998	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1345	Packsaddle	3.1807	0.9824	0.018			Packsaddle	0.9824	
1346	Packsaddle	6.7242	0.9999	0.000			Packsaddle	0.9999	
1347	Packsaddle	5.1774	0.8488	0.164			Packsaddle	0.8488	Kelly Canyon 0.14
1348	Packsaddle	5.0216	0.9873	0.013			Packsaddle	0.9873	
1349	Packsaddle	4.2042	0.9225	0.081			Packsaddle	0.9225	
1350	Packsaddle	7.1161	0.9475	0.054			Packsaddle	0.9475	
1351	Packsaddle	5.7964	0.9779	0.022			Packsaddle	0.9779	
1352	Packsaddle	6.5529	0.8927	0.113			Packsaddle	0.8927	
1353	Wedge Butte	3.6016	1.0000	0.000			Wedge Butte	1.0000	
1354	Wedge Butte	9.5315	1.0000	0.000			Wedge Butte	1.0000	
1355	Wedge Butte	7.8799	1.0000	0.000			Wedge Butte	1.0000	
1356	Wedge Butte	3.8130	1.0000	0.000			Wedge Butte	1.0000	
1357	Wedge Butte	4.3396	1.0000	0.000			Wedge Butte	1.0000	
1358	Wedge Butte	10.3112	1.0000	0.000			Wedge Butte	1.0000	
1359	Wedge Butte	11.6882	1.0000	0.000			Wedge Butte	1.0000	
1360	Wedge Butte	7.0855	1.0000	0.000			Wedge Butte	1.0000	
1361	Wedge Butte	8.3843	1.0000	0.000			Wedge Butte	1.0000	
1362	Wedge Butte	8.6993	1.0000	0.000			Wedge Butte	1.0000	
1363	Wedge Butte	7.7318	1.0000	0.000			Wedge Butte	1.0000	
1364	Wedge Butte	7.4401	1.0000	0.000			Wedge Butte	1.0000	
1365	Wedge Butte	1.8707	1.0000	0.000			Wedge Butte	1.0000	
1366	Wedge Butte	1.2939	1.0000	0.000			Wedge Butte	1.0000	
1367	Wedge Butte	2.0712	1.0000	0.000			Wedge Butte	1.0000	
1368	Walcott	0.8313	0.9962	0.004			Walcott	0.9962	
1369	Walcott	1.7036	0.9923	0.008			Walcott	0.9923	
1370	Walcott	9.5093	0.6900	0.371			Walcott	0.6900	Conant Creek 0.30
1371	Walcott	3.2415	0.9985	0.002			Walcott	0.9985	
1372	Walcott	8.8463	0.2480	1.394		*	Conant Creek	0.7213	
1373	Walcott	6.7893	0.9958	0.004			Walcott	0.9958	
1374	Walcott	5.1217	0.9740	0.026			Walcott	0.9740	
1375	Walcott	3.1714	0.9943	0.006			Walcott	0.9943	
1376	Walcott	3.0900	0.8200	0.198			Walcott	0.8200	Conant Creek 0.18
1377	Walcott	4.2962	0.9985	0.001			Walcott	0.9985	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1378	Browns Bench	17.9811	1.0000	0.000			Browns Bench	1.0000	
1379	Browns Bench	23.6465	1.0000	0.000			Browns Bench	1.0000	
1380	Browns Bench	34.8689	1.0000	0.000			Browns Bench	1.0000	
1381	Browns Bench	11.6540	1.0000	0.000			Browns Bench	1.0000	
1382	Browns Bench	19.7667	1.0000	0.000			Browns Bench	1.0000	
1383	Browns Bench	25.0014	1.0000	0.000			Browns Bench	1.0000	
1384	Browns Bench	26.9789	1.0000	0.000			Browns Bench	1.0000	
1385	Browns Bench	6.2829	1.0000	0.000			Browns Bench	1.0000	
1386	Browns Bench	27.2757	0.9714	0.029			Browns Bench	0.9714	
1387	Browns Bench	20.2962	0.9998	0.000			Browns Bench	0.9998	
1388	Browns Bench	29.5627	1.0000	0.000			Browns Bench	1.0000	
1389	Browns Bench	37.9745	0.0002	8.607		*	Packsaddle	0.9998	
1390	Browns Bench	28.2317	0.9992	0.001			Browns Bench	0.9992	
1391	Browns Bench	9.2865	1.0000	0.000			Browns Bench	1.0000	
1392	Browns Bench	4.2683	1.0000	0.000			Browns Bench	1.0000	
1393	Browns Bench	18.8103	1.0000	0.000			Browns Bench	1.0000	
1394	Browns Bench	5.8169	1.0000	0.000			Browns Bench	1.0000	
1395	Browns Bench	14.4271	1.0000	0.000			Browns Bench	1.0000	
1396	Browns Bench	7.8273	1.0000	0.000			Browns Bench	1.0000	

APPENDIX C: Additional JMP Discriminant Analysis data

This figure shows the data generated from the Stepwise discriminant analysis, including the generated Eigenvalues and various Tests.

Canonical Details

Canonical Details calculated from the overall pooled within-group covariance matrix.

Eigenvalue	Percent	Cum Percent	Canonical Corr	Likelihood Ratio	Approx. F	NumDF	DenDF	Prob>F
120.505144	52.5986	52.5986	0.99587645	5.44509e-9	232.8238	150	4026	<.0001*
47.7619251	20.8473	73.4459	0.98969298	6.61607e-7	158.6210	126	3673.4	<.0001*
33.0017949	14.4048	87.8506	0.98518515	3.22612e-5	111.2791	104	3316.4	<.0001*
17.5627055	7.6658	95.5165	0.97269139	0.00109694	71.8352	84	2953.9	<.0001*
7.48637633	3.2677	98.7841	0.9392359	0.02036217	41.9176	66	2584.6	<.0001*
1.96884033	0.8594	99.6435	0.81435136	0.17280101	20.7175	50	2206.2	<.0001*
0.61541169	0.2686	99.9121	0.6172218	0.5130186	9.8315	36	1815.5	<.0001*
0.17105767	0.0747	99.9868	0.38219248	0.82873624	3.9235	24	1407.2	<.0001*
0.02563012	0.0112	99.9980	0.15808109	0.97049793	1.0474	14	972	0.4030
0.00464961	0.0020	100.0000	0.06803007	0.99537191	0.3774	6	487	0.8934

Test	Value	Approx. F	NumDF	DenDF	Prob>F
Wilks' Lambda	5.4451e-9	232.8238	150	4026	<.0001*
Pillai's Trace	5.9899642	48.4969	150	4870	<.0001*
Hotelling-Lawley	229.10353	727.5516	150	2747.2	<.0001*
Roy's Max Root	120.50514	3912.4003	15	487	<.0001*

Within Matrix

	MnKa1	FeKa1	ZnKa1	GaKa1	ThLa1	RbKa1	SrKa1 (adjusted)	YKa1	ZrKa1	NbKa1
MnKa1	4584.6154	69599.827	381.98373	23.584046	8.066497	95.725311	-15.24771	233.7984	-340.6621	264.41562
FeKa1	69599.827	3422518.4	15071.021	697.58559	416.29452	1571.0029	1353.1562	6805.8584	-25237.34	8607.0263
ZnKa1	381.98373	15071.021	309.03669	8.5387816	11.112258	97.647544	-17.94736	137.46365	93.940141	171.02841
GaKa1	23.584046	697.58559	8.5387816	3.774725	0.8598713	8.1558019	-0.68514	6.5396694	-0.013319	6.9152344
ThLa1	8.066497	416.29452	11.112258	0.8598713	7.3730871	16.314357	-1.611618	10.141044	28.845475	12.697747
RbKa1	95.725311	1571.0029	97.647544	8.1558019	16.314357	156.315	-14.9038	87.90873	205.20278	105.07393
SrKa1 (adjusted)	-15.24771	1353.1562	-17.94736	-0.68514	-1.611618	-14.9038	24.343687	-13.75727	29.368018	-14.80698
YKa1	233.7984	6805.8584	137.46365	6.5396694	10.141044	87.90873	-13.75727	118.13951	223.37012	146.83369
ZrKa1	-340.6621	-25237.34	93.940141	-0.013319	28.845475	205.20278	29.368018	223.37012	2767.2566	327.079
NbKa1	264.41562	8607.0263	171.02841	6.9152344	12.697747	105.07393	-14.80698	146.83369	327.079	209.15465

Between Matrix

	MnKa1	FeKa1	ZnKa1	GaKa1	ThLa1	RbKa1	SrKa1 (adjusted)	YKa1	ZrKa1	NbKa1
MnKa1	7661.647	340575.53	3833.9614	135.79006	233.70184	2584.0962	-191.8283	1908.8606	10828.277	2601.7558
FeKa1	340575.53	28095836	215909.42	6772.3255	23980.982	181196.31	-57834.16	98185.481	934510.84	123477.11
ZnKa1	3833.9614	215909.42	4995.1552	222.58389	263.11733	3661.071	-1482.008	3653.231	7423.8356	5072.5769
GaKa1	135.79006	6772.3255	222.58389	11.6728	15.627893	215.0565	-79.7666	190.12453	244.40427	249.18619
ThLa1	233.70184	23980.982	263.11733	15.627893	62.267769	565.631	-199.6822	230.29543	851.6172	193.67289
RbKa1	2584.0962	181196.31	3661.071	215.0565	565.631	6289.1263	-2009.045	3194.3469	6340.8293	3406.9399
SrKa1 (adjusted)	-191.8283	-57834.16	-1482.008	-79.7666	-199.6822	-2009.045	1728.9078	-1298.82	-2936.688	-1577.129
YKa1	1908.8606	98185.481	3653.231	190.12453	230.29543	3194.3469	-1298.82	3213.0623	3702.2311	4259.0499
ZrKa1	10828.277	934510.84	7423.8356	244.40427	851.6172	6340.8293	-2936.688	3702.2311	32290.146	4795.8663
NbKa1	2601.7558	123477.11	5072.5769	249.18619	193.67289	3406.9399	-1577.129	4259.0499	4795.8663	6131.4135

Scoring Coefficients

	MnKa1	FeKa1	ZnKa1	GaKa1	ThLa1	RbKa1	SrKa1 (adjusted)	YKa1	ZrKa1	NbKa1
Canon1	-0.003138	0.0005245	-0.001661	-0.015038	-0.013248	0.0368021	-0.203984	-0.048655	0.016003	-0.032684
Canon2	-0.001606	-0.000244	-0.0098	0.0430707	-0.056504	-0.017343	-0.07166	0.0035	-0.011101	0.0837797
Canon3	0.0000391	-0.000131	-0.01636	-0.108028	-0.008616	0.0806565	0.0687709	0.1112892	-0.010259	-0.070891
Canon4	-0.00025	0.0001493	0.0290858	0.018828	-0.072175	0.0327905	0.0797374	-0.094182	0.006577	0.06627
Canon5	-0.004499	0.0001692	-0.017892	-0.004963	0.0870372	-0.062067	0.0120103	0.2525458	0.0051321	-0.12611
Canon6	-0.00614	0.0003016	-0.06869	0.0006767	0.0728792	0.0100482	0.0118413	-0.041515	8.4242e-5	0.0776655
Canon7	0.0159753	-0.00021	-0.028963	0.0316773	0.0300908	-0.002503	-0.006195	0.0028845	0.004148	0.0139981
Canon8	0.0018469	-0.000183	0.0247897	-0.106195	0.3868557	-0.023931	0.0087585	-0.053704	-0.00319	0.0299034
Canon9	0.0002367	0.0002042	-0.004482	0.3952402	0.0799116	-0.010885	-0.004414	-0.022503	-0.006764	0.0067423
Canon10	-0.002335	-0.000303	0.0100911	0.3672639	0.0288364	-0.005582	0.0079446	-0.012606	0.0084048	-0.009769

Standardized Scoring Coefficients

	MnKa1	FeKa1	ZnKa1	GaKa1	ThLa1	RbKa1	SrKa1 (adjusted)	YKa1	ZrKa1	NbKa1
Canon1	-0.212449	0.9704066	-0.029199	-0.029216	-0.035973	0.4601216	-1.006442	-0.528836	0.8418346	-0.472681
Canon2	-0.10873	-0.45183	-0.172281	0.0836805	-0.153427	-0.216827	-0.353565	0.0380426	-0.583963	1.2116372
Canon3	0.002648	-0.241627	-0.287608	-0.209884	-0.023395	1.0084154	0.339311	1.2096241	-0.539679	-1.025239
Canon4	-0.016905	0.2762645	0.5113115	0.0365804	-0.195979	0.4099659	0.3934188	-1.023678	0.3459828	0.9584086
Canon5	-0.304651	0.3130117	-0.314529	-0.009642	0.2363359	-0.775996	0.0592578	2.7449712	0.2699739	-1.823824
Canon6	-0.415732	0.5579908	-1.207536	0.0013147	0.197892	0.125629	0.0584243	-0.451235	0.0044315	1.1232132
Canon7	1.0816846	-0.388996	-0.50916	0.0615446	0.0817068	-0.031296	-0.030566	0.0313518	0.2182046	0.202443
Canon8	0.1250523	-0.339211	0.4357889	-0.206323	1.0504459	-0.299195	0.0432141	-0.58372	-0.167789	0.4324681
Canon9	0.0160284	0.3776938	-0.078794	0.7678984	0.2169873	-0.136091	-0.02178	-0.244587	-0.355831	0.0975076
Canon10	-0.158092	-0.560174	0.1773964	0.7135443	0.0783008	-0.069794	0.0391981	-0.137021	0.4421331	-0.141281

This section shows only the items where there is disagreement/confusion over which source the obsidian comes from. This is especially true for the two Cannonball Mt sources, which for this study's purposes we will count as one source, especially since they are in close geographical proximity.

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
27		.	.	.		-	Bear Gulch	0.5455	Browns Bench 0.45
112		.	.	.		-	Packsaddle	0.8191	Browns Bench 0.18
206		.	.	.		-	Browns Bench	0.8005	Packsaddle 0.20
226		.	.	.		-	Owyhee	0.7876	Walcott 0.21
259		.	.	.		-	Browns Bench	0.8957	Packsaddle 0.10
314		.	.	.		-	Browns Bench	0.5551	Packsaddle 0.44
663		.	.	.		-	Browns Bench	0.9256	
667		.	.	.		-	Browns Bench	0.9448	
677		.	.	.		-	Walcott	0.8200	Owyhee 0.18
708		.	.	.		-	Walcott	0.8389	Conant Creek 0.16
788		.	.	.		-	Browns Bench	0.8430	Packsaddle 0.16
859		.	.	.		-	Browns Bench	0.6195	Packsaddle 0.38
1050	Cannonball Mt II	20.1299	0.1951	1.634		*	Cannonball Mt I	0.8049	
1051	Cannonball Mt II	17.1433	0.5219	0.650			Cannonball Mt II	0.5219	Cannonball Mt I 0.48
1052	Cannonball Mt II	24.6727	0.8345	0.181			Cannonball Mt II	0.8345	Cannonball Mt I 0.17
1053	Cannonball Mt II	22.1938	0.3472	1.058		*	Cannonball Mt I	0.6528	
1054	Cannonball Mt II	17.1380	0.4040	0.906		*	Cannonball Mt I	0.5960	
1055	Cannonball Mt II	22.5343	0.6962	0.362			Cannonball Mt II	0.6962	Cannonball Mt I 0.30
1056	Cannonball Mt II	21.7865	0.5005	0.692			Cannonball Mt II	0.5005	Cannonball Mt I 0.50
1057	Cannonball Mt II	20.0982	0.3955	0.928		*	Cannonball Mt I	0.6045	
1059	Cannonball Mt II	16.7766	0.9019	0.103			Cannonball Mt II	0.9019	
1082	Conant Creek	7.2261	0.9349	0.067			Conant Creek	0.9349	
1088	Conant Creek	2.6930	0.9444	0.057			Conant Creek	0.9444	
1093	Conant Creek	3.3121	0.9431	0.059			Conant Creek	0.9431	
1100	Conant Creek	3.2978	0.9001	0.105			Conant Creek	0.9001	
1103	Conant Creek	1.7824	0.9201	0.083			Conant Creek	0.9201	
1105	Conant Creek	11.7552	0.7862	0.241			Conant Creek	0.7862	Walcott 0.19
1107	Conant Creek	5.2556	0.6237	0.472			Conant Creek	0.6237	Walcott 0.37
1108	Conant Creek	6.9555	0.9479	0.053			Conant Creek	0.9479	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1109	Conant Creek	6.0759	0.5307	0.634			Conant Creek	0.5307	Kelly Canyon 0.47
1110	Conant Creek	3.8914	0.7958	0.228			Conant Creek	0.7958	Walcott 0.19
1112	Conant Creek	4.1485	0.9431	0.059			Conant Creek	0.9431	
1116	Conant Creek	3.7343	0.8461	0.167			Conant Creek	0.8461	Walcott 0.14
1119	Kelly Canyon	3.4302	0.8559	0.156			Kelly Canyon	0.8559	Conant Creek 0.12
1122	Kelly Canyon	3.0670	0.9290	0.074			Kelly Canyon	0.9290	
1130	Kelly Canyon	5.8304	0.9498	0.052			Kelly Canyon	0.9498	
1233	Cannonball Mt I	18.6124	0.8598	0.151			Cannonball Mt I	0.8598	Cannonball Mt II 0.14
1235	Cannonball Mt I	17.3062	0.9281	0.075			Cannonball Mt I	0.9281	
1236	Cannonball Mt I	29.9571	0.8362	0.179			Cannonball Mt I	0.8362	Cannonball Mt II 0.16
1237	Cannonball Mt I	25.8044	0.0543	2.913		*	Cannonball Mt II	0.9457	
1238	Cannonball Mt I	24.9572	0.0271	3.607		*	Cannonball Mt II	0.9729	
1239	Cannonball Mt I	31.8829	0.0416	3.179		*	Cannonball Mt II	0.9584	
1240	Cannonball Mt I	27.1288	0.0173	4.055		*	Cannonball Mt II	0.9827	
1241	Cannonball Mt I	22.1149	0.4464	0.807		*	Cannonball Mt II	0.5536	
1242	Cannonball Mt I	16.6824	0.9429	0.059			Cannonball Mt I	0.9429	
1243	Cannonball Mt I	24.3761	0.8911	0.115			Cannonball Mt I	0.8911	Cannonball Mt II 0.11
1244	Cannonball Mt I	18.1876	0.8724	0.136			Cannonball Mt I	0.8724	Cannonball Mt II 0.13
1251	Cedar Butte	191.7996	0.0000	91.343		*	Conant Creek	0.8610	Kelly Canyon 0.14
1252	Cedar Butte	191.3107	0.0000	90.435		*	Conant Creek	0.9759	
1301	Packsaddle	8.4960	0.4389	0.824			Packsaddle	0.4389	Kelly Canyon 0.14 Walcott 0.39
1303	Packsaddle	8.6719	0.4812	0.731			Packsaddle	0.4812	Kelly Canyon 0.46
1305	Packsaddle	18.5093	0.9362	0.066			Packsaddle	0.9362	
1306	Packsaddle	9.2162	0.8821	0.125			Packsaddle	0.8821	
1311	Packsaddle	10.7982	0.2595	1.349		*	Kelly Canyon	0.7369	
1317	Packsaddle	24.2400	0.7502	0.287			Packsaddle	0.7502	Kelly Canyon 0.25
1329	Packsaddle	7.3641	0.7373	0.305			Packsaddle	0.7373	Kelly Canyon 0.19
1331	Packsaddle	30.2467	0.0106	4.546		*	Walcott	0.8904	
1332	Packsaddle	28.0010	0.0437	3.131		*	Walcott	0.5690	Conant Creek 0.38
1333	Packsaddle	8.4636	0.8408	0.173			Packsaddle	0.8408	Kelly Canyon 0.11
1347	Packsaddle	5.1774	0.8488	0.164			Packsaddle	0.8488	Kelly Canyon 0.14
1349	Packsaddle	4.2042	0.9225	0.081			Packsaddle	0.9225	

Row	Actual	SqDist(Actual)	Prob(Actual)	-Log(Prob)			Predicted	Prob(Pred)	Others
1350	Packsaddle	7.1161	0.9475	0.054			Packsaddle	0.9475	
1352	Packsaddle	6.5529	0.8927	0.113			Packsaddle	0.8927	
1370	Walcott	9.5093	0.6900	0.371			Walcott	0.6900	Conant Creek 0.30
1372	Walcott	8.8463	0.2480	1.394		*	Conant Creek	0.7213	
1376	Walcott	3.0900	0.8200	0.198			Walcott	0.8200	Conant Creek 0.18
1389	Browns Bench	37.9745	0.0002	8.607		*	Packsaddle	0.9998	

This figure includes the Score Summary JMP data, showing the elements used in the Stepwise Discriminant analysis and the results from the training data.

Score Summaries

Columns
MnKa1
FeKa1
ZnKa1
GaKa1
ThLa1
RbKa1
SrKa1 (adjusted)
YKa1
ZrKa1
NbKa1

Source	Count	Number Misclassified	Percent Misclassified	Entropy RSquare	-2LogLikelihood
Training	503	16	3.18091	0.82553	460.042

Training

Actual	Predicted Count															
Source	Bear Gulch	Big Southern Butte	Browns Bench	Cannonball Mt I	Cannonball Mt II	Cedar Butte	Chesterfield	Conant Creek	Kelly Canyon	Malad	Obsidian Cliffs	Owyhee	Packsaddle	Teton Pass 1	Walcott	Wedge Butte
Bear Gulch	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Southern Butte	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Browns Bench	0	0	74	0	0	0	0	0	0	0	0	0	1	0	0	0
Cannonball Mt I	0	0	0	11	5	0	0	0	0	0	0	0	0	0	0	0
Cannonball Mt II	0	0	0	4	13	0	0	0	0	0	0	0	0	0	0	0
Cedar Butte	0	0	0	0	0	18	0	2	0	0	0	0	0	0	0	0
Chesterfield	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0
Conant Creek	0	0	0	0	0	0	0	38	0	0	0	0	0	0	0	0
Kelly Canyon	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0
Malad	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0
Obsidian Cliffs	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0
Owyhee	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0
Packsaddle	0	0	0	0	0	0	0	0	1	0	0	0	57	0	2	0
Teton Pass 1	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0
Walcott	0	0	0	0	0	0	0	1	0	0	0	0	0	0	25	0
Wedge Butte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15

Groups

Source	Count
Bear Gulch	62
Big Southern Butte	34
Browns Bench	75
Cannonball Mt I	16
Cannonball Mt II	17
Cedar Butte	20
Chesterfield	16
Conant Creek	38
Kelly Canyon	16
Malad	40
Obsidian Cliffs	18
Owyhee	24
Packsaddle	60
Teton Pass 1	26
Walcott	26
Wedge Butte	15