CURRENT RESEARCH

Prehistoric Trans-Cascade Procurement of Obsidian in Western Oregon: The Geochemical Evidence

Craig E. Skinner, University of Oregon
and
Carol J. Winkler, Willamette National Forest

INTRODUCTION

For many years, Oregon archaeologists have speculated about the timing and extent of prehistoric contact between western and central Oregon inhabitants across the Cascade Mountains. Ethnographic accounts of post-contact excursions from central Oregon into the western Cascades are known, but no convincing evidence of prehistoric trans-Cascade procurement or exchange has been forthcoming from the archaeological record until recently. In the last few years, trace element studies of obsidian artifacts from western Oregon archaeological sites have begun to provide the hard evidence needed to construct a model of prehistoric trans-Cascade obsidian procurement.

During the past ten years, obsidian trace element characterization studies of archaeological collections in western and central Oregon have come to play an increasingly important role. The relatively low number of major obsidian sources in western Oregon, when combined with a growing body of characterization data, has helped both to simplify obsidian studies and to provide a large enough database for the preliminary identification and analysis of regional patterns of use and procurement.

These western Oregon characterization studies have revealed the presence of obsidian artifacts not only from Western Oregon sources, but from several central Oregon sources. We examine here the spatial distribution of these obsidian artifacts and some of the archaeological implications of their presence in western Oregon. The data summarized in this article provide an initial glimpse of the prehistoric patterns of obsidian procurement and utilization in western Oregon, particularly those in the central Western Cascades.

THE DATA AND STUDY AREA

We currently have in our database a total of 1,941 reliably characterized obsidian artifacts from 192 Oregon archaeological sites (see figure 1). Of these artifacts, 1,071 are from 145 archaeological sites in the major Cascades drainages of western Oregon; the remainder are from scattered sites in central and south-central Oregon, the Oregon coast, and the Willamette Valley. The number of artifacts from each site ranges from one to 109. Almost all of the data originated from x-ray fluorescence (XRF) analyses by Richard E. Hughes, California State University, Sacramento; a much smaller proportion of XRF and INAA analyses came from Craig E. Skinner, University of Oregon. Most of the artifacts (99%) were characterized with XRF methods; the remaining analyses were carried out using instrumental neutron activation analysis (INAA) techniques at the Oregon State University Radiation Center, Corvallis, Oregon. Eighty-four of the artifacts came from 79 different sites in the Rogue River National Forest and are not considered further in this analysis because of a lack of reported specific geographic information and the small sample size at each site (LaLande, 1990). In this analysis, we considered only the characterization research of Hughes and Skinner.) (Sources of these characterization data can be found in Skinner, 1991; for the sake of brevity, we were not able to list all the sources of obsidian data in the bibliography of this article). Although we have XRF data for 703 artifacts from 17 sites by R.L. Sappington, for reasons of non-comparable data or methodological problems, we have chosen not to include his analytical results here.

Thanks to a vigorous test excavation program and a policy of integrating obsidian characterization studies into research designs, the Willamette National Forest has provided the greatest number of characterized samples and archaeological sites. Lesser numbers of samples were examined from the Mt. Hood, Umpqua, Winema, Ochoco, and Rogue River National Forests and several other scattered sites.

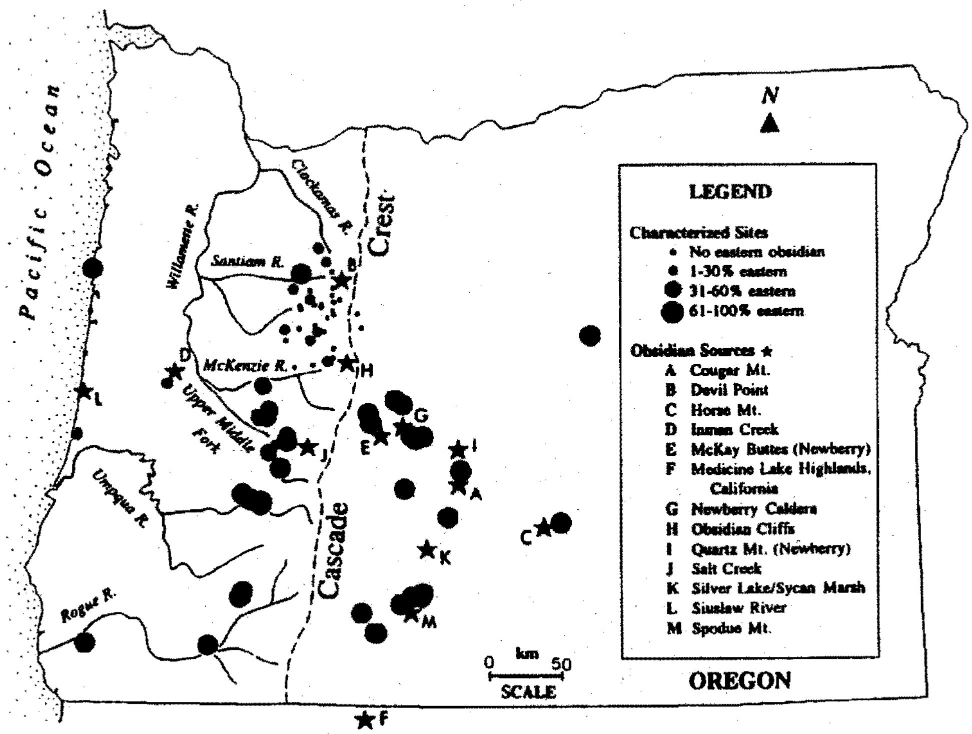


Figure 1. Distribution of archaeological sites in Oregon for which trace element obsidian characterization data by Hughes and Skinner are available. The obsidian sources indicated are those which have been correlated with characterized obsidian artifacts from western Oregon sites. The percentage of eastern Oregon sources also includes artifacts from unknown sources.

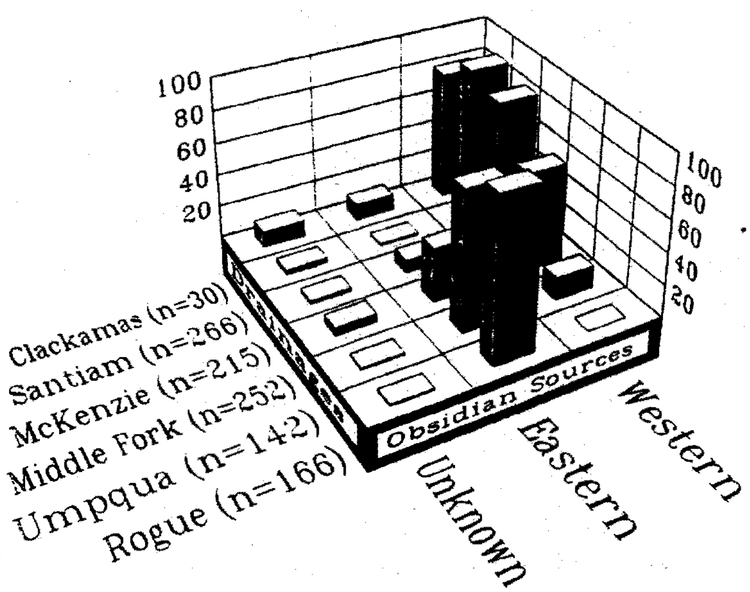


Figure 2. Percent of characterized obsidian artifacts from major western Oregon drainages that have been correlated with obsidian sources east and west of the Cascade Crest.

This preliminary investigation is a synchronic one - no attempt was made to document changes in the spatial patterning of characterized artifacts over time. Obsidian samples were selected by different excavators for different reasons and are often not well-controlled. Excavation reports sometimes did not document the provenience of the samples, making chronological studies of the artifacts difficult to impossible at this point. Obsidian hydration measurements are available for many of the characterized artifacts, however, and a careful reanalysis of the material (currently underway) may yet shed some light on the temporal dimensions of obsidian procurement in the western part of the state.

SPATIAL DISTRIBUTION OF OBSIDIAN

Much of the archaeological research to date in western Oregon has proceeded in the context of settlement and subsistence patterns within the separate basins and sub-basins of major drainages and we follow that pattern here in our analysis of the obsidian characterization data. The eastern source data includes artifacts for which no specific source was known. For the purposes of this preliminary analysis, we are assuming that most unknown sources are located in eastern Oregon.

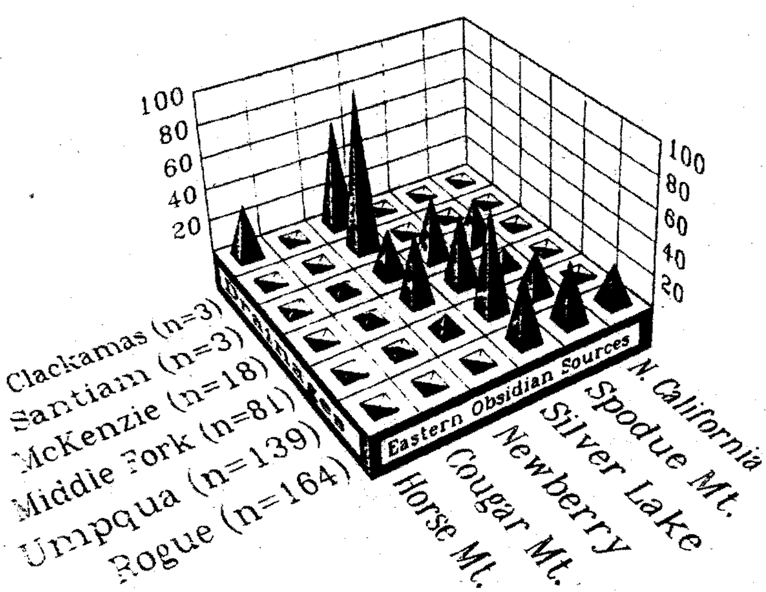
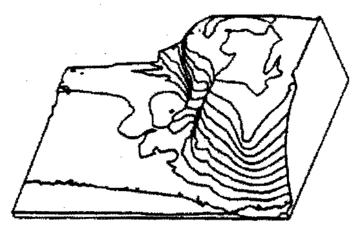


Figure 3. Percent of artifacts correlated with eastern Oregon and northern California obsidian sources found in western Oregon drainages.

Overall, from north to south, there is a marked shift in reliance from western Oregon to eastern Oregon obsidian sources beginning at the Middle Fork Willamette River drainage and continuing through other Western Cascades drainages to the south of the Middle Fork (figures 2 and 4). The contour and trend surface maps (figure 4) clearly illustrate this change though it must be kept in mind that the disparities in sample size and the very uneven geographic distribution of sites leaves these maps primarily of heuristic value. The most commonly represented sources at western Oregon archaeological sites were from the Newberry Volcano area (Newberry Caldera, Big Obsidian Flow, McKay Buttes, and Quartz Mountain), from the Silver Lake and Sycan Marsh area, and from the Spodue Mountain area along the northeastern periphery of the Klamath Lake Basin (figure 3).



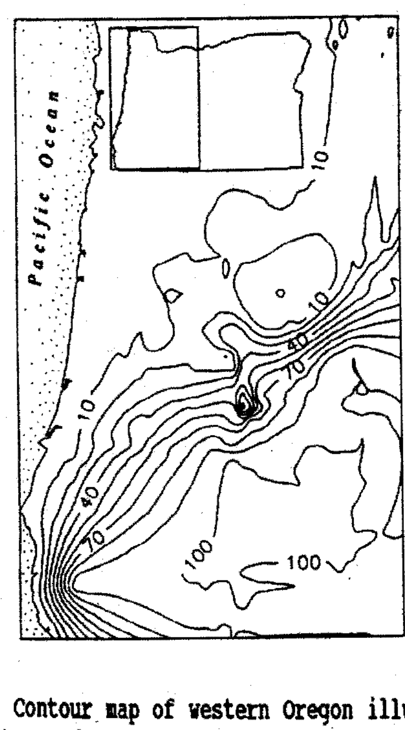


Figure 4. Contour map of western Oregon illustrating the percentage of eastern Oregon (and northern California) obsidian found in characterized archaeological sites. The trend surface map directly above provides a slightly different perspective of the same data and geographic area. The rapid shift from western to eastern Oregon sources is clearly illustrated.

The data for the Clackamas and Santiam sub-basins indicate a heavy reliance on Obsidian Cliffs material (about 72%) with a large component of a minor source, Devil Point (about 22%), less than 1% from Inman Creek, and the remainder from eastern Oregon sources. The utilization of the Devil Point obsidian appears to diminish rapidly within ten to twenty kilometers of the source.

Samples from the McKenzie sub-basin are dominated (about 85%) by glass from Obsidian Cliffs. Obsidian from this source, located at the headwaters of the McKenzie sub-basin, has been widely distributed by glacial and fluvial activity and can be found in river gravels throughout much of the Willamette Valley. About 10% of the characterized artifacts were correlated with eastern or unknown sources. Most of the remaining 5% were linked to the Inman Creek sources. These two geochemically-distinguishable groups of natural glass have been geochemically linked with several primary and secondary outcrops in the Salt Creek drainage of the Western Cascades, in the southwestern Willamette Valley, and at the mouth of the Siuslaw River at the Oregon Coast.

The Middle Fork Willamette sub-basin data, however, are strikingly different. Although the basin is geographically closer to Obsidian Cliffs than eastern Oregon sources, only 34% of the samples are from the Obsidian Cliffs source. Inman Creek obsidian comprises 28% of the characterized artifacts, while central Oregon sources including Newberry Volcano, McKay Butte, and Cougar Mountain make up 15% and the Silver Lake, Sycan Marsh, and Spodue Mountain sources make up 17% of the obsidian. The two closest obsidian sources, Obsidian Cliffs and Salt Creek (AKA Inman Creek) together make up only 62% of the artifacts. It is clear that factors other than distance to source have influenced the distribution of obsidian in this sub-basin.

The Umpqua sub-basin pattern indicates an increasing reliance on eastern Oregon sources, particularly those in the Silver Lake, Sycan Marsh, and Spodue Mountain areas (78%). Although Obsidian Cliffs is nearly equidistant from these sources, it comprises only 8% of the samples. A single sample was correlated with the Medicine Lake Highlands sources in northern California, the sources that dominate the characterized sample from the southern Cascades and Siskiyou Mountains.

In the Rogue sub-basin, a shift towards the procurement and use of obsidian from the Medicine Lake Highlands region of northern California begins with 23% of the obsidian reported from those sources. Most of the remainder of the characterized glass (74%) originated from the Silver Lake, Sycan Marsh, and Spodue Mountain sources.

The obsidian source diversity (the relationship of the number of identified sources to artifact sample size) was markedly different for many of the western Oregon drainages (figure 5). The source diversity was noted in the Middle Fork of the Willamette where multiple sources are often found represented at single sites, even those with few characterized artifacts. The lowest diversity was found in the Santiam and McKenzie drainages where the Obsidian Cliffs and locally-utilized Devil Point sources dominated the assemblages. These differences in source diversity among the different basins and sub-basins may prove especially significant when it comes to allotting limited obsidian characterization resources in future archaeological research.

We also tentatively examined the source origin frequencies of different categories of characterized artifacts from archaeological sites in the Middle Fork drainage of the Willamette River. We speculated, following the reasoning of Hughes and Bettinger (1984) in their investigation of northern California and southern Oregon utilitarian and non-utilitarian obsidian, that different classes of artifacts might reflect different procurement systems. Obsidian projectile points, for example, might be more subject to curation, long distance procurement, or exchange, and might be expected to originate from more distant

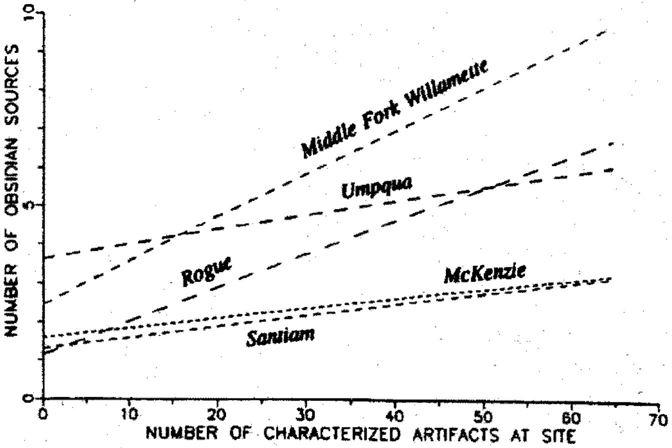


Figure 5. Obsidian source diversity (number of identified sources) plotted versus sample size for archaeological sites in western Oregon drainages. Least square regression lines with steeper slopes indicate greater diversity. Data points have been omitted. The Clackamas drainage was excluded because of the small sample size (n=2 sites).

sources than obsidian debitage. When we examined the relative frequencies of eastern and western Oregon obsidian from the Middle Fork sites, though, we found almost identical proportions of obsidian debitage and projectile points from sources on either side of the Cascade Divide with western sources used twice as often as eastern sources (figure 6). Our category of "other" tools (bifaces, utilized flakes, preforms), however, displayed a rather different pattern, with source use split evenly between eastern and western sources. While the low sample sizes provide us with a less than complete picture of differential source use for different artifact classes, the data do suggest that this is a trend worth watching in future western Oregon obsidian characterization studies.

CONCLUSIONS AND SPECULATIONS: TRANS-CASCADE OBSIDIAN PROCUREMENT

What might the spatial patterning of the central Oregon obsidian found in western Oregon archaeological sites mean in behavioral terms? It is the reconstruction of prehistoric patterns of behavior, after all, that is the ultimate objective of all this geochemical data gathering. While it is too soon for us to make any definitive judgements about the cultural or environmental processes responsible for the distribution of obsidian in western Oregon sites, we can engage in a little speculation.

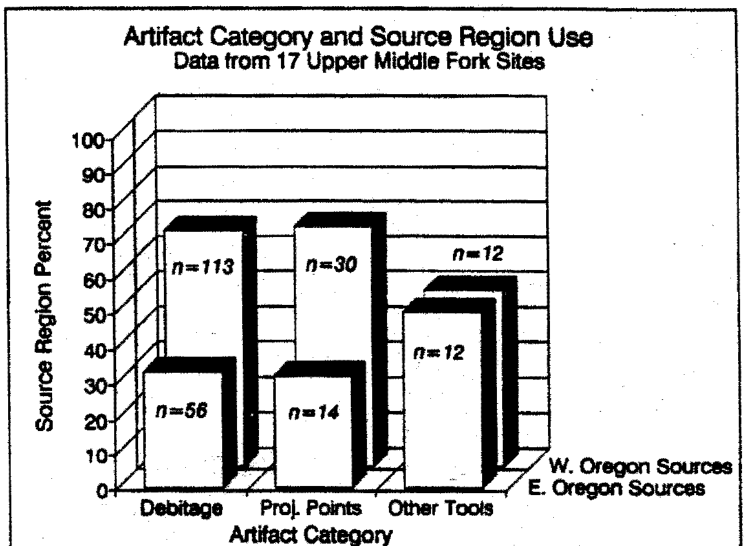


Figure 6. Comparison of the relative frequencies of types of artifacts from sites in the Middle Fork of the Willamette that have been correlated with eastern and western Oregon sources.

It is clear from trace element obsidian studies of western Oregon artifacts that obsidian from several central Oregon sources is finding its way into the western part of the state. A number of different environmental and sociocultural processes, however, can influence the spatial distribution and patterning of the obsidian. Whether the presence of eastern Oregon obsidian in western Oregon sites is due to the presence of long-distance direct procurement strategies or to the existence of trans-Cascade exchange systems is not yet clear. There also exist the possibilities of embedded obsidian procurement strategies and the curation of obsidian as part of any long-distance direct procurement system. Direct and indirect procurement systems leave many of the same archaeological traces and some other independent artifactual means may be eventually required to pinpoint the specific processes responsible for the distribution of the glass.

The north-south shift from predominantly western Oregon to eastern Oregon sources illustrated in figure 4 may be attributable to the interplay of a variety of different processes. Cultural variables could include the presence of travel corridors through the major Cascades passes (Winkler, 1990 and 1991), the existence of established trans-Cascade exchange systems, the presence of ethnic or cultural boundaries, the functions of the sites that are sampled for characterization studies, and preferences for certain sources of glass. It is tempting, for instance, to associate the abrupt rise in eastern obsidian sources (particularly those from the Medicine Lake Highlands) with the northern boundaries of the historic and late prehistoric period southern Oregon-northern California culture area that was examined in the characterization studies of Hughes and Bettinger (1984). Geographic variables such as source distance, the proximity of competing sources, and physiographic ease of access to obsidian sources are also important factors that may likely influence the spatial distribution of the glass. Other methodological variables such as the sample size of the characterized artifact collections and the uneven distribution of characterized archaeological sites may also prove to be significant in our interpretation of the data.

But it is a big jump from the identification of spatial patterns to the confident reconstruction of prehistoric human behavior. As more obsidian characterization data becomes available and as techniques for the interpretation of the spatial patterning of characterized obsidian become more sophisticated, we may be able to better sort out and identify the behavioral systems responsible for the distribution of the obsidian.

OBSIDIAN CHARACTERIZATION RESEARCH: ARCHAEOLOGICAL REFLECTIONS AND RECOMMENDATIONS

After reviewing much of the available Oregon obsidian characterization research, we would like to advance several comments and recommendations:

1. The selection of obsidian artifacts for characterization should be made with explicit research objectives in mind. Are the research objectives to explore local procurement systems, to examine long-distance procurement systems (exchange or long-distance direct access), to make inter- or intra-site comparisons, to survey a site as a synchronic unit, or to document changes over time? The selection of categories of artifacts, sample sizes, and sample provenience will all certainly depend on the choice of research objectives.

2. Considering the limited total resources available for most characterization studies, the known obsidian source diversity should play a role in future obsidian research designs. Future excavation contracts should call for larger samples in areas such as the Middle Fork of the Willamette River sub-basin where obsidian source use has been demonstrated to be more diverse. The small number of artifacts that is often prescribed in archaeological excavations (10 to 20) is simply not adequate to pick up a representative sample in areas of demonstrated high source diversity.

3. The provenience of characterized obsidian artifacts should be thoroughly documented in reports of excavations. This should include the intrasite provenience of the samples and the relationship of artifacts to other features of chronologic significance.

4. A physical description of the characterized artifacts should be included with the analytical results. This should include the type of artifact, the metric dimensions of the artifact, and a description of the visual characteristics of the glass (color, luster, inclusions, and so on).

5. We are still lacking the basic geoarchaeological background information for most Oregon obsidian sources. Ongoing geoarchaeological and geochemical studies of western Oregon obsidian sources should be carried out to document the visual, petrographic, and chemical ranges of variation, to ascertain the secondary distribution of available obsidian, and to identify any remaining western Oregon obsidian sources. Are the numerous western Oregon artifacts identified as from unknown sources from central Oregon or do they come from as yet unidentified minor sources of obsidian in western Oregon?

6. An effort should be made to provide further obsidian characterization data for areas in western Oregon in which coverage is still sparse to non-existent. At this time, only the central Western Cascades have begun to provide enough data to allow for the examination and analysis of regional procurement and exchange problems.

7. If the full value of future obsidian characterization research is to be realized, the data must be made easily accessible to the archaeological community. Most of our time in this investigation, for example, went not into the analysis of the data, but into its collection from widely scattered sources in the "gray" literature. The A.O.A. could play an important role by publishing characterization data in Current Archaeological Happenings in Oregon as an on-going service to Oregon archaeologists.

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Our database of Oregon obsidian characterization data is in a constant state of growth as we locate and incorporate new material. If you believe that you have characterization data that were not included in our initial analysis, we would be delighted to hear from you.

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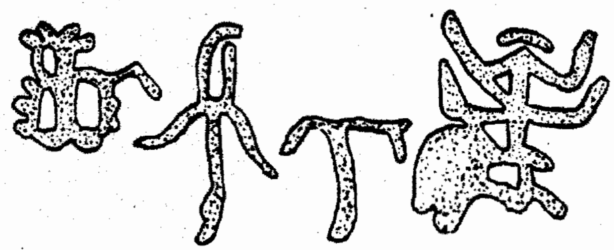

Trace Element Composition of Obsidian Artifacts from the Beaverdam Creek Site (35CR29), Central Oregon

J. Erlandson, R. E. Huges, C. E. Skinner, M. L. Moss, and J. Boughton

INTRODUCTION

In 1984, an archaeological field school sponsored jointly by Central Oregon Community College, the University of Oregon, and the Ochoco National Forest was held at the Beaverdam Creek site (35CR29) in the Ochoco Mountains of central Oregon (see Erlandson and Moss 1984; Boughton 1989). One of the analyses subsequently conducted on the recovered materials was a trace element study of a sample of obsidian artifacts from the site. This followed submittal by Moss of obsidian nodules from two Central Oregon sources (Dog Hill and Burns Butte) for geochemical characterization (Hughes 1986). After the identification of trace element profiles for the Dog Hill, Burns Butte and other nearby sources, we hoped that many of the obsidian artifacts from the Beaver Creek site would be attributable to known sources.

SAMPLING AND ANALYTICAL METHODS

With funding from the USDA Forest Service, 20 pieces of obsidian debitage from 35CR29 were analyzed by Hughes using a non-destructive energy dispersive x-ray fluorescence (XRF) technique (see Hughes 1986 for a detailed account of the XRF instruments and procedures). Samples were selected from four discrete loci within 35CR29, including two prehistoric components believed to date after about 2500 BP and two components dating between 2500 and 6000 BP (Erlandson and Moss 1984). Samples of visually distinct obsidian types (showing variation in color, translucency, texture, and phenocryst inclusions) were selected in an attempt to determine the range of sources from which the site occupants procured obsidian and if such patterns changed through time.

RESULTS

The primary goals of our obsidian characterization study were foiled when 17 of the 20 samples (85%) submitted could not be matched with any known source (Table 1). Of the three identifiable samples, two (#3 and #21) may have come from Dog Hill and one (#15) from Burns Butte, both sources located in the vicinity of Burns (Hughes 1986). As of June 15, 1991, the other 17 specimens could not be matched with any obsidian standards contained in Hughes' inventory of the region. Based on the limited data available, however, approximately five discrete obsidian sources may be represented by the 17 unidentifiable specimens. According to Hughes' letter report, Group 1 consists of sample #1, Group 2 of sample #2, Group 3 of samples 4-14 and 18-19, Group 4 of sample #16, and Group 5 of sample #20 (Table 1).

An attempt by Erlandson to visually classify the Beaverdam artifacts via macroscopic attributes met with mixed success. Only 10 of the 20 artifacts had distinctive characteristics that allowed classification into three discrete types. The 'Type A" sample consisted of specimens 3, 6, 12, 21. The "Type B" sample included specimens 9, 10, 14, and 18. The "Type C" sample consisted of specimens 1 and 16. Quantitative geochemical analysis confirmed the common origin (Dog Hill) of Type A samples 3 and 21, correctly lumped all Type B samples (the unidentified Group 3 source), and showed Type C samples 1 and 16 to be quite similar. Although this represents a success rate as high as 80%, geochemical data show no apparent association of samples 6 and 12 with Dog Hill, and visual identification did not identify the common origin of many of the artifacts (4,5,6,7,8,11,12,13,19)