PREHISTORIC TRANS-CASCADE PROCUREMENT OF OBSIDIAN IN WESTERN OREGON: A PRELIMINARY LOOK AT THE GEOCHEMICAL EVIDENCE

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ABSTRACT

Recent obsidian characterization data from western Oregon archaeological sites were examined for evidence of trans-Cascade obsidian procurement. Analysis of the spatial distribution and frequency of 1,071 characterized artifacts from major Western Cascades drainages resulted in the identification of several trends of central Oregon obsidian use in the region west of the Cascade Divide. Numerous eastern Oregon obsidian sources, particularly those in the Newberry Volcano, Silver Lake, and Spodue Mountain vicinities, were represented at many western Oregon archaeological sites. While found in varying frequencies in all major Western Cascade drainages, the proportion of glass from eastern Oregon rises dramatically in drainages including and south of the Willamette River Middle Fork. This shift from predominantly western Oregon to eastern Oregon sources may be attributable to the interplay of a variety of different processes including the presence of trans-Cascade travel corridors and procurement systems, the existence of trans-Cascade exchange systems, artifact curation behavior, ethnic or cultural boundaries, and geographic variables such as source distance and ease of access. An analysis of the relationship of artifact sample size and the number of identified obsidian sources (source diversity) indicates that source diversity differs considerably from drainage to drainage. Examination of a subset of characterized artifacts from the Willamette River Middle Fork drainage also suggests that the proportion of characterized artifacts originating from eastern and western sources may vary by artifact category. Several suggestions regarding sampling strategies and future directions in western Oregon obsidian characterization research are made.

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 food procurement excursions from central Oregon into the western Cascades are known (Rarick 1962:32; Henn 1975; Murdock 1980; Minor 1987:23-24; Silvermoon 1988:18), as are rather poorly-documented trans-Cascade trail systems (Minto 1903; Vernon 1934; Rarick 1962; Minor and Pecor 1977:154-157; Starr 1983). While limited artifactual evidence suggests the possibility of trans-Cascade interactions (see Tuohy 1986, for an example), little 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 rapidly 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 STUDY AREA

The Sources of the Data

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, 1,155 are from 145 archaeological sites located 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) trace element analyses by Richard E. Hughes; a much smaller proportion of XRF and instrumental neutron activation analyses (INAA) came from Craig E. Skinner. Most of the artifacts (99%) were characterized with XRF methods; the remaining analyses were carried out using 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. 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.

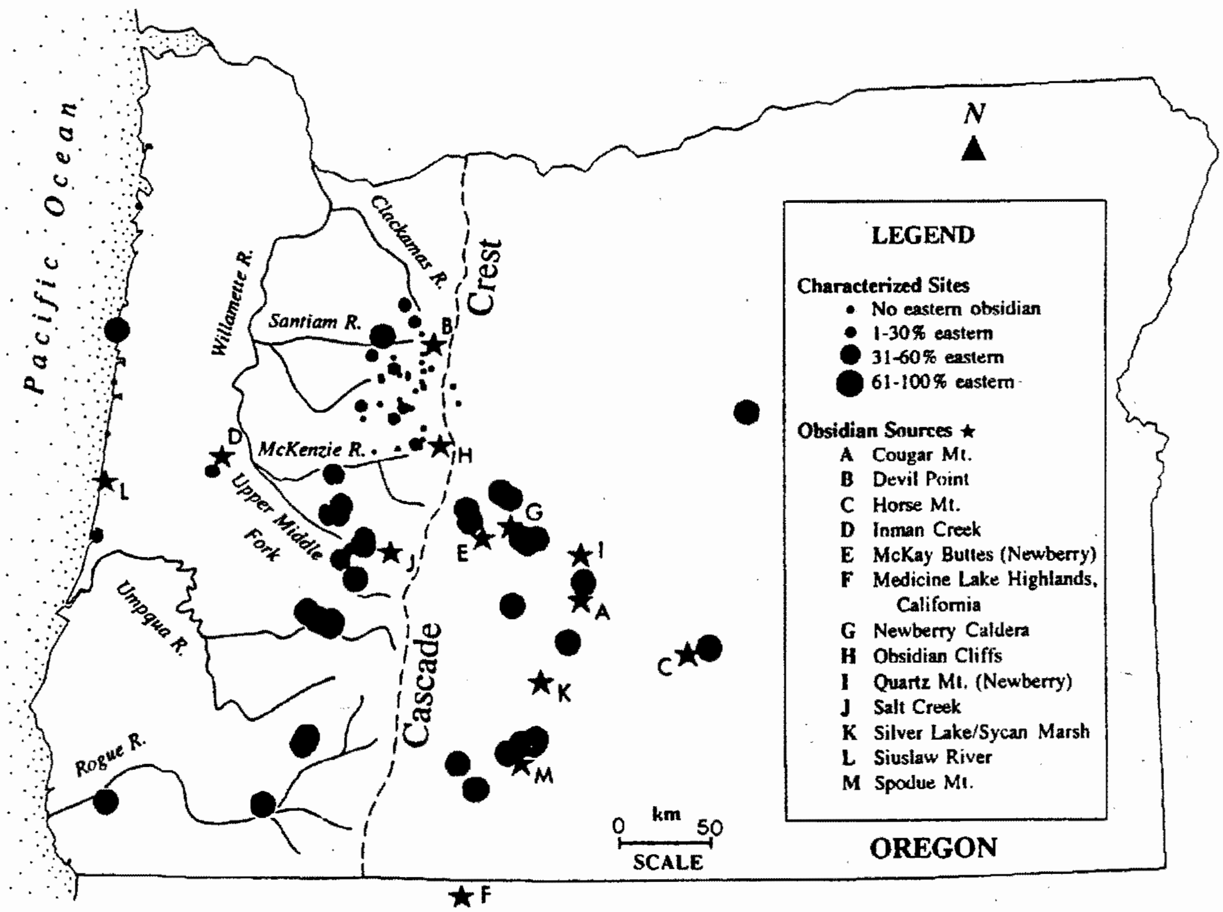


Figure 1. Distribution of archaeological sites in Oregon for which trace element obsidian characterization data by Hughes and Skinner are available. The obsidian sources indicated are those which have been correlated with characterized obsidian artifacts from western Oregon sites.

The XRF and INAA data used in the present investigation have been culled from many published and unpublished literature sources. For the sake of brevity, we have not listed all the sources of information used to compile this article, but refer you to Skinner (1991a) for a complete listing of Oregon obsidian-related references. Descriptions of most of the obsidian sources mentioned here can be found in Skinner (1983, 1986, 1991b) and Hughes (1986). Obsidian from the Inman Creek and Siuslaw River alluvial and river gravel sources are geochemically identical and share the same primary source, a probable Miocene obsidian flow near Salt Creek in the Middle Fork Willamette sub-basin (Skinner 1991b). The Inman Creek glass is found in two geochemically-identifiable varieties and is referred to here as the Inman Creek chemical groups.

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. As we write this article, the available database of characterized Oregon obsidian artifacts has more than doubled, thanks to archaeological research associated with the construction of a natural gas pipeline through central Oregon.

This preliminary investigation is a synchronic one - no attempt was made to document changes in the spatial patterning of characterized artifacts over time. Excavation reports sometimes did not document the provenience of the samples, making chronological studies of the artifacts impossible without consulting excavation and laboratory documentation. Such reanalysis is currently underway and since obsidian hydration measurements are available for many of the characterized artifacts, some light may yet be shed on the temporal dimensions of obsidian procurement in the western part of the state.

SPATIAL DISTRIBUTION OF OBSIDIAN

The Sub-basins

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 in our analysis of the obsidian characterization data. The eastern obsidian source data also include 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.

Overall, from north to south in the Willamette Basin, there is a marked shift in

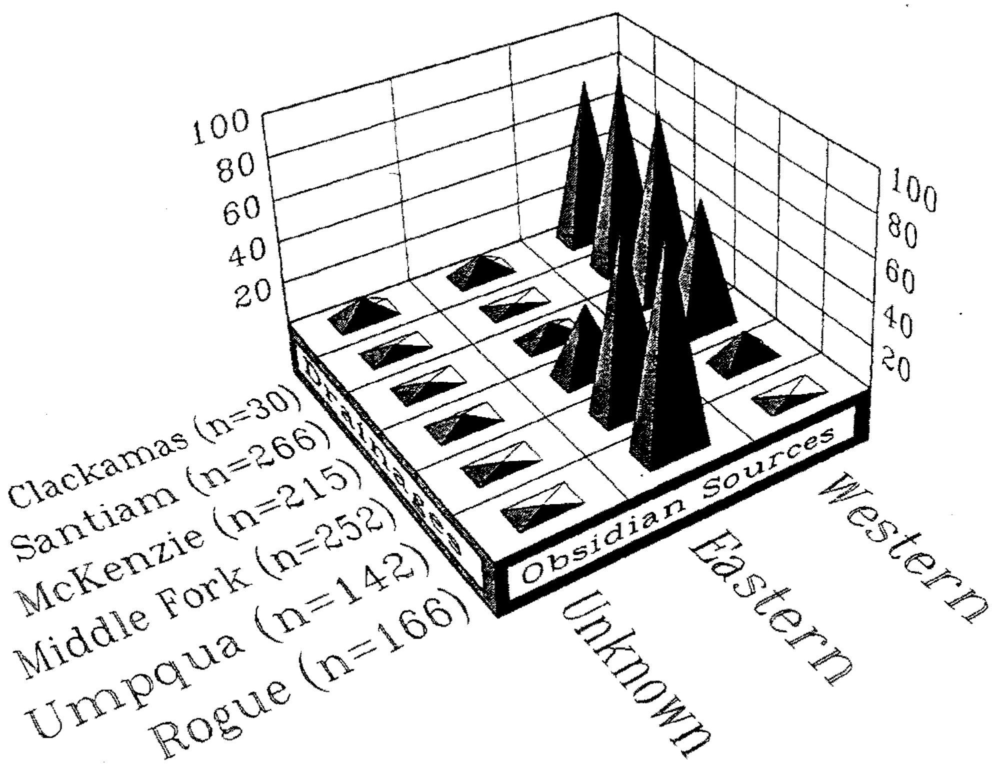
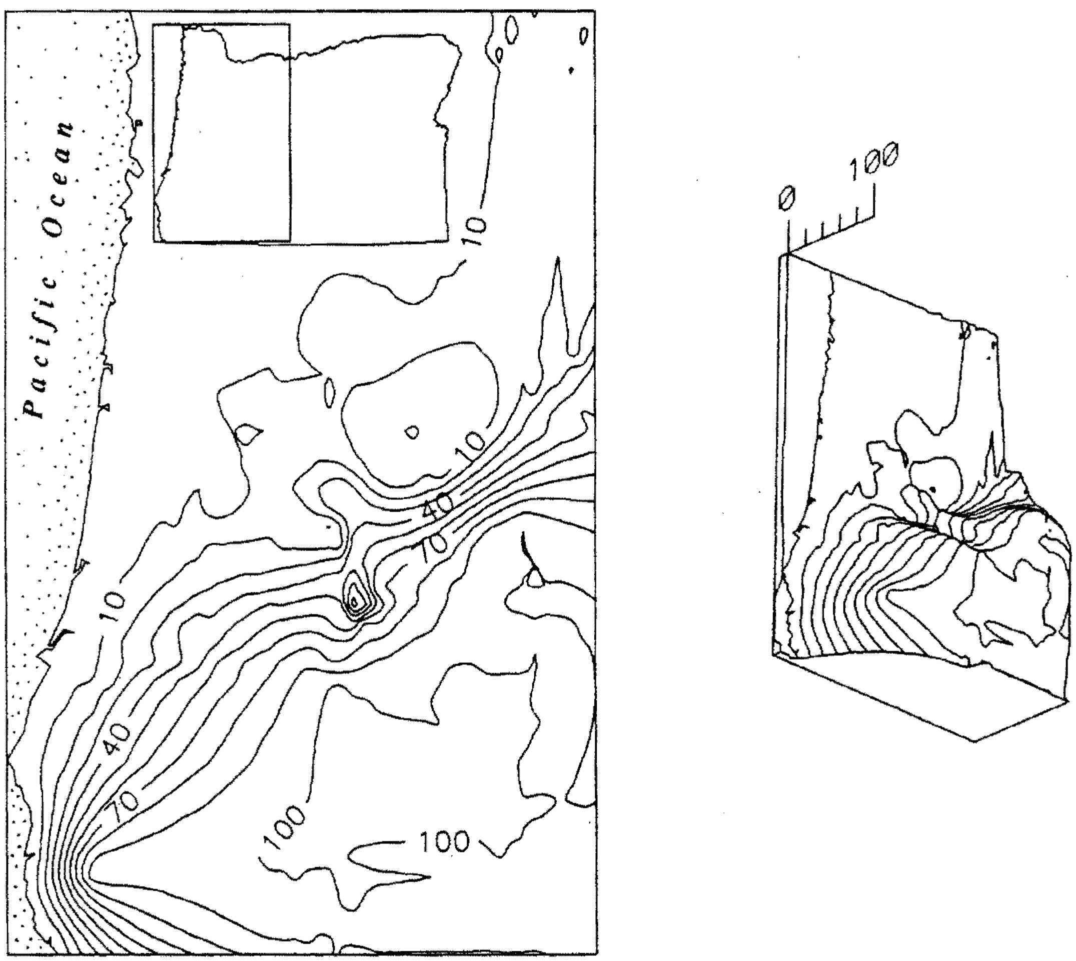


Figure 2. Percent of obsidian artifacts from major western Oregon drainages that have been assigned to obsidian sources east and west of the Cascade Crest.

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 3) clearly illustrate this change though it must be kept in mind that the considerable disparities in sample sizes and the very uneven geographic distribution of sites leaves these maps primarily of heuristic value. The most commonly represented eastern obsidian sources at western Oregon archaeological sites were in the Newberry Volcano area (Newberry Caldera, Big Obsidian Flow, McKay Butte, and Quartz Mountain), the Silver Lake and Sycan Marsh area, and the Spodue Mountain area along the northeastern periphery of the Klamath Lake Basin (Figure 4). Data used in our analysis of the characterized artifacts are summarized in Tables 1 and 2.

Clackamas and Santiam Sub-Basins. The data for the Clackamas and Santiam sub-basins indicate a heavy reliance on Obsidian Cliffs material (about 72%) with a



A B

Figure 3. Contour map (A) of western Oregon illustrating the percentage of eastern Oregon (and northern California) obsidian found in characterized archaeological sites. The trend surface map (B) (note coastline for orientation) provides a slightly different perspective of the same data and geographic area. The rapid shift from western to eastern Oregon sources in the Middle Fork Willamette sub-basin is clearly illustrated.

significant 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. It appears that procurement of natural glass from the Devil Point source was very locally restricted, due perhaps to the marginal quality and small nodule size of the obsidian, the relative inaccessibility of the source, and the existence of glass of much higher quality at Obsidian Cliffs to the south.

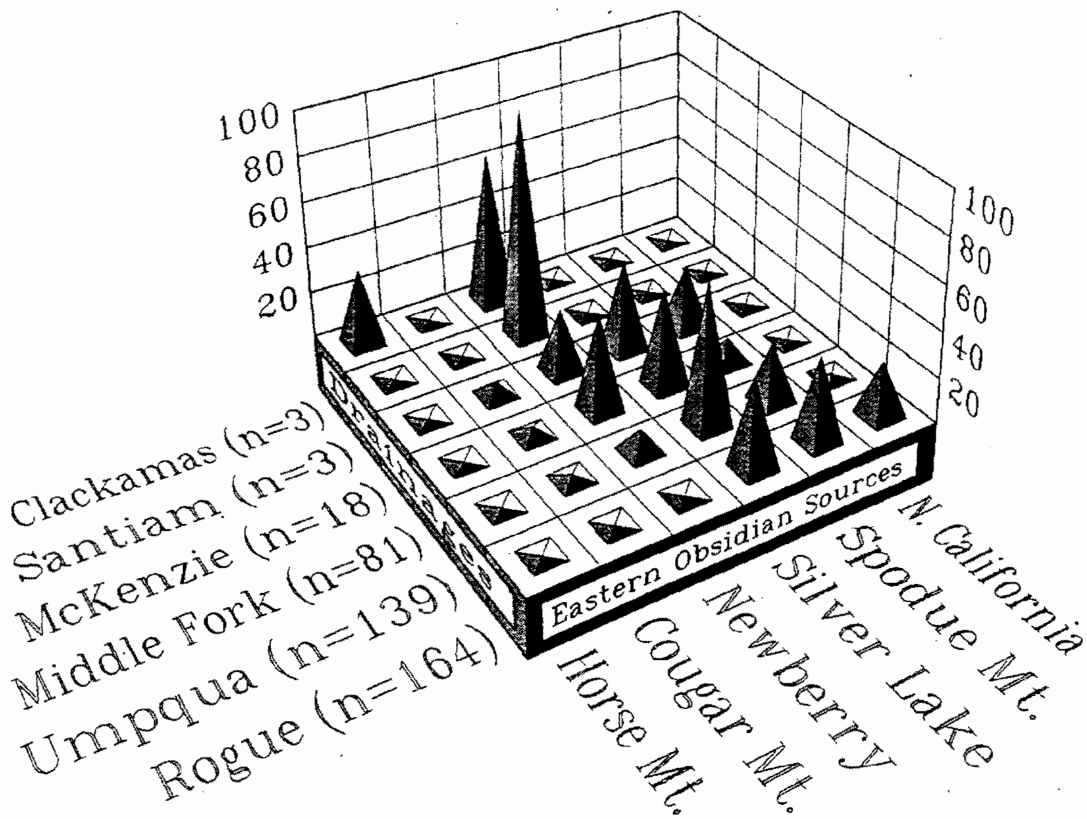


Figure 4. Percent of artifacts from western Oregon drainages correlated with eastern Oregon and northern California obsidian sources.

Table 1. Number and percent of characterized obsidian artifacts from western Oregon drainages which correlate with sources east and west of the Cascade Crest.

	OBSIDIAN SOURCES			
Drainage	Western	Eastern	Unknown	Total
Clackamas	24 (80%)	3 (10%)	3 (10%)	30 (3%)
Santiam	255 (96%)	3 (1%)	8 (3%)	266 (25%)
McKenzie	193 (90%)	18 (8%)	4 (2%)	215 (20%)
Middle Fork	155 (62%)	83 (33%)	14 (5%)	252 (24%)
Umpqua	20 (14%)	121 (85%)	1 (1%)	142 (13%)
Rogue	0 (0%)	164 (99%)	2 (1%)	166 (15%)
Total	647 (60%)	392 (37%)	32 (3%)	1071

* - See Figure 2 for a graphical representation of the data.

McKenzie Sub-Basin. Samples from the McKenzie sub-basin are dominated (about 85%) by glass from Obsidian Cliffs, the most extensive of the western Oregon prehistoric obsidian quarries. 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 (Skinner 1986). About 10% of the characterized artifacts were correlated with eastern or unknown sources. Most of the

Table 2. Number and percent of characterized artifacts from western Oregon drainages correlated with eastern Oregon and northern California obsidian sources.

	EASTERN OBSIDIAN SOURCES						
Drainage	Horse Mt.	Cougar Mt.	Newberry Volcano	Silver Lake	Spodue Mt.	Northern Calif.	Total
Clackamas	1 (33%)	0 (0%)	2 (67%)	0 (0%)	0 (0%)	0 (0%)	3 (1%)
Santiam	0 (0%)	0 (0%)	3 (100%)	0 (0%)	0 (0%)	0 (0%)	3 (1%)
McKenzie	0 (0%)	1 (6%)	5 (28%)	7 (39%)	5 (28%)	0 (0%)	18 (4%)
Middle Fork	0 (0%)	3 (4%)	34 (42%)	35 (43%)	9 (11%)	0 (0%)	81 (20%)
Umpqua	0 (0%)	3 (2%)	14 (10%)	86 (62%)	36 (26%)	1 (1%)	140 (34%)
Rogue	0 (0%)	0 (0%)	0 (0%)	62 (38%)	61 (37%)	40 (24%)	163 (40%)
Total	1 (0%)	7 (2%)	58 (14%)	190 (47%)	111 (27%)	41 (10%)	408

* - See figure 4 for a graphical representation of the data.

remaining 5% were linked to the Inman Creek sources. The two geochemically-distinguishable groups of natural glass that make up the Inman Creek chemical groups have been geochemically correlated 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.

Middle Fork Willamette Sub-Basin. The Middle Fork Willamette sub-basin data, however, are strikingly different. Although the basin is geographically closer to Obsidian Cliffs than the 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 (Inman Creek chemical group) 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.

Umpqua 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 area in northern California, the source area that dominates the characterized samples from the southern Cascades and Siskiyou Mountains.

Rogue Sub-Basin. In the Rogue sub-basin, a shift begins towards the procurement and use of obsidian from the Medicine Lake Highlands region of northern California 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.

Sub-Basins and Source Diversity

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 greatest 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.

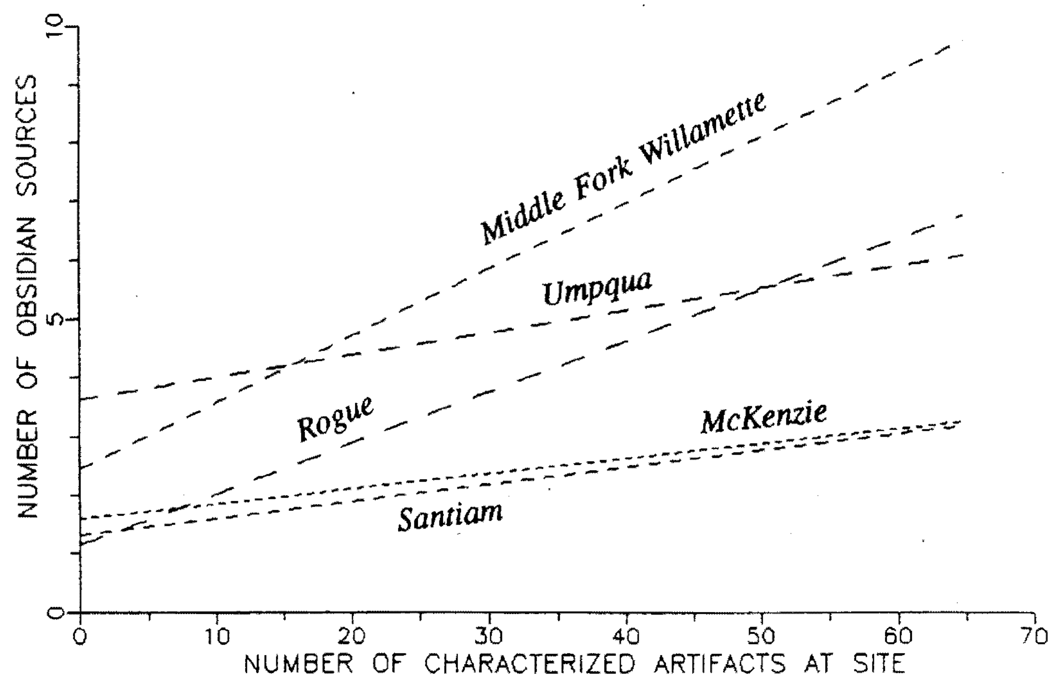


Figure 5. Obsidian source diversity (number of identified sources) plotted versus sample size for archaeological sites in western Oregon drainages. Linear regression lines with steeper slopes indicate greater diversity. Data points have been omitted. The Clackamas drainage was excluded because of the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

Differential Source Use and Formal Artifact Categories

We also examined the source frequencies of different categories of characterized artifacts from 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 sources than obsidian debitage. However, when we examined the relative frequencies of debitage and projectile points, the proportion of western obsidian to eastern obsidian was about two to one in both artifact categories. Our "other tool" category (bifaces, utilized flakes, preforms) showed a different pattern, with both eastern and western sources being used in equal frequencies (figure 6). While the low sample sizes provide us with a less than complete picture of differential source use for different artifact classes, the data suggest that this is an area worth exploring in future western Oregon obsidian characterization studies.

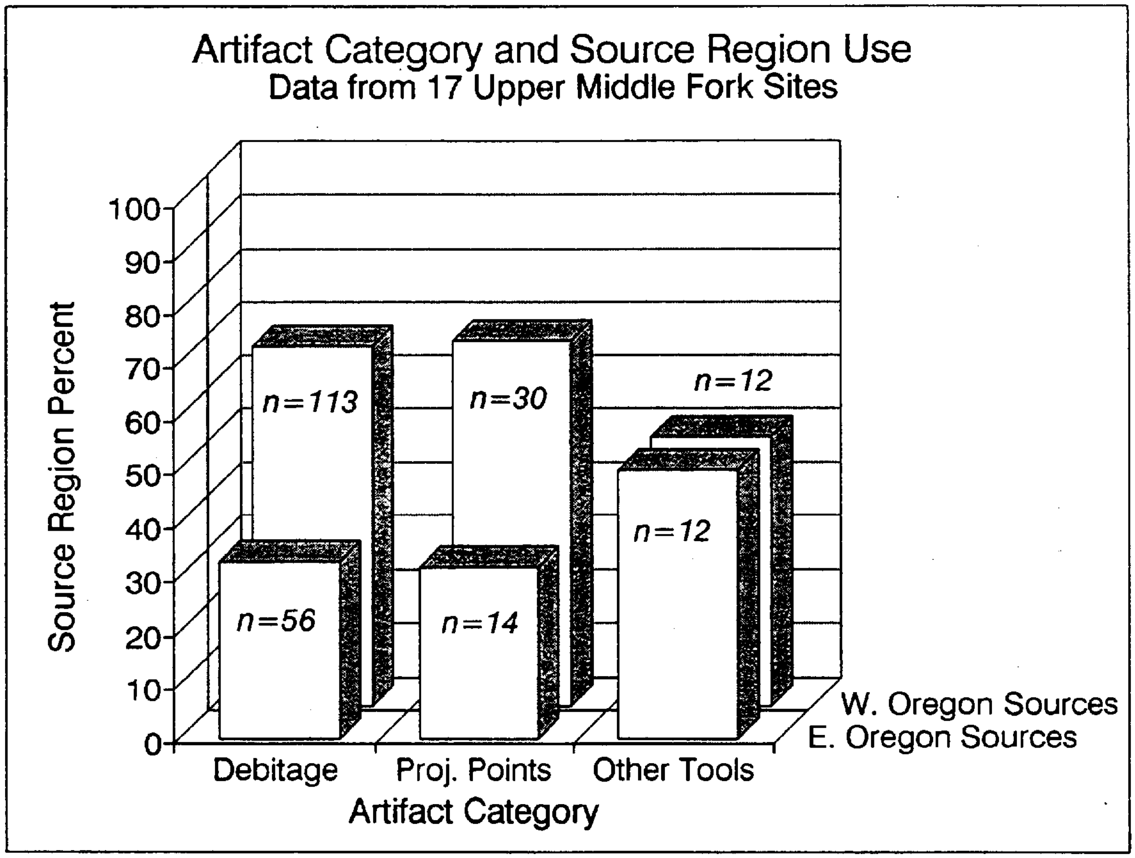


Figure 6. Comparison of the relative frequencies of types of artifacts from sites in the Middle Fork of the Willamette that have been correlated with eastern and western Oregon sources.

CONCLUSIONS AND SPECULATIONS

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 here in a little speculation.

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, may influence the spatial distribution and patterning of the obsidian. Whether the occurrence 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 trans-Cascade 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 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.

RECOMMENDATIONS FOR FUTURE OBSIDIAN CHARACTERIZATION STUDIES

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, particularly when only small sample sizes are available. 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 these 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 (typically 10 to 20) that is often prescribed in archaeological excavations may often prove inadequate to pick up a representative sample in areas of demonstrated high source diversity.

3. The provenance 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 may include the type of artifact, the metric dimensions of the artifact, and the visual characteristics of the glass (color, luster, inclusions, and so on). Artifact sizes may provide clues about the original geologic and geomorphic contexts of some source material while a record of megascopic attributes will help in defining the visual range of variation in glass from specific sources.

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 must 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 being 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. We recommend that an effort be made to make data such as these more widely available to interested archaeologists.

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