CHAPTER 14

Obsidian Use in the Willamette Valley and Adjacent Western Cascades of Oregon

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Introduction

Interaction spheres recognized throughout the Plateau (Hayden and Schulting 1997) and Pacific Northwest Coast (Ames and Maschner 1999; Carlson 1994; Galm 1994; Hughes and Connolly 1999) have been seen as critical in the evolution of the complex Northwest Coast cultural expression (Ames 1994:213). Tracking such exchange archaeologically is complicated to the extent that it involved perishable or consumable goods that have left no trace. But commodities such as obsidian, which is both commonly present in archaeological contexts in the region and easily traceable to source, provide an important tool in mapping long-distance economic links.

Previous obsidian characterization studies have speculated that the distribution of obsidian in western Oregon was due to direct procurement and trade (Musil and O'Neill 1997; Skinner and Winkler 1991, 1994). Ames (1994) argues that the maintenance and persistence of Chinook corporate households along the Columbia River required the acquisition and production of many resources to attract and retain members (Ames and Maschner 1999:148). Chiefs and other elites of the household were dependent on a prestige-based socio-economic system to expand their influence (Ames 2006; Silverstein 1990). One vital route to increased prestige was the control of trade, particularly in wealth and sumptuary goods. Such goods are "often of exotic or rare raw materials…not locally available or only in small amounts" (Ames and Maschner 1999:180). On the Northwest Coast, one such material is obsidian, which is visually distinctive, easily redistributed, and could be used to create more prestige goods for the household's elites.

Because of its trackability, obsidian characterization studies have been integral to defining interaction spheres extending well into prehistory (Ames 1994:223). The issue we explore here is the extent to which people of the Willamette Valley participated in the regional exchange networks. The large site-to-site variations seen in the frequencies of Inman Creek and Obsidian Cliffs obsidians, especially in the lower Willamette Valley, imply their distribution as commodities, rather than natural deposition. The implication is that Willamette Basin peoples were active participants in regional socio-economic interaction spheres

The basis for this analysis is a large body of obsidian geochemical characterization data from the Willamette Basin of northwest Oregon (Figure 14-1). The bulk of the obsidian data was collected by the Northwest Research Obsidian Studies Laboratory (Skinner 2011), but was then augmented from various published and unpublished sources. Archaeological investigations sponsored by the Willamette National Forest (Kelly 2001; Lindberg-Muir 1989), a gas pipeline through the

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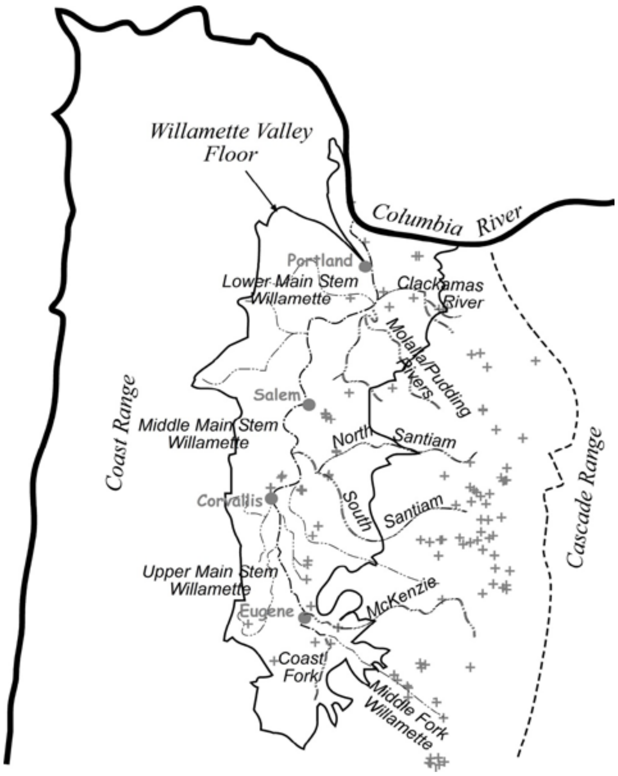

Figure 14-1. Location of the Willamette Basin study area with subbasins, cities, and sites (+) noted. The Willamette Valley is outlined at approximately 150 m (500 ft) elevation.

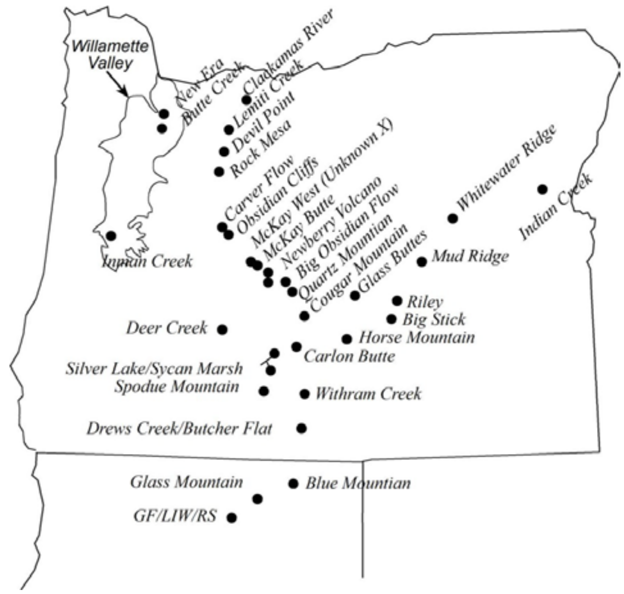

Figure 14-2. Location of obsidian sources identified in the study assemblage.

valley (Fagan et al. 1996), and a number of highway projects (Connolly nd; O'Neill et al. 2004) produced the majority of the data. It is generally true that these data were largely collected opportunistically to address resource management concerns rather than to meet the criteria of an overarching research design. Thus sampling criteria varied, coming from well controlled excavations, reconnaissance shovel probes, and single-visit surface collections, and the artifacts include both debitage and shaped-tools.

We drew on a total of 5624 specimens from 251 sites and isolates representing 32 known sources that were available for this study. However, because we rely on proportional data for this study, we eliminated sites with fewer than ten sampled specimens, a tactic which reduced the total to 5240 artifacts from 116 sites, representing 27 sources (Tables 14-1, 14-2, and 14-3).

Within the study assemblage, 45 percent of the obsidian is from Obsidian Cliffs in the Cascade Range, 31 percent is from the Willamette Valley's Inman Creek geochemical type, and 15 percent comes from five smaller Willamette Basin sources. Together, 90 percent of the characterized obsidian comes from sources in the Willamette hydrologic basin (Figure 14-2).

The Setting

The Willamette Valley is a large structural basin which lies between the Cascade and Coast mountain ranges in northwest Oregon. Beginning in the south at an elevation of about 120 m (400 ft), the river meanders north for approximately 209 km (130 mi) to its confluence with the Columbia River in the Portland Basin. Along the way it collects the outflow of 14 tributary rivers, nine from the Cascades, and five from the Coast Range. The extremely flat plane, which varies from 32 to 64 km (20-40 mi) wide, is the bottom of Pleistocene Lake Allison formed by Missoula Flood waters which repeatedly inundated the valley between 15,500 and 13,000 years ago (Orr et al. 1992). As Pleistocene glaciers retreated, lake levels declined, and great volumes of outwash cut a new course for the Willamette River as it deposited outwash gravels. Scattered within the gravels of the Middle Fork, McKenzie and main-stem Willamette Rivers are cobbles and pebbles of Inman Creek and Obsidian Cliffs obsidian. The extent of the secondary dispersal of Inman Creek and Obsidian Cliffs obsidian is not completely understood, but pebbles

Table 14-1. Frequency of Geochemical Obsidian Sources Represented in the Assemblage.

Geographic Source Group	Geo. Src Grp Overall Count	Geo. Src Grp Study Count[1]	Obsidian Types	All Sourced Artifacts Count	All Sourced Artifacts percent Group	All Sourced Artifacts percent Total	Study Assemblage Count	Study Assemblage percent Group	Study Assemblage percent Total
Willamette Valley	1780	1665	Inman Creek	1719	97	30.6	1608	97	30.7
	31.7%	31.8%	Butte Creek	59	3.3	1.05	57	3.4	1.09
			New Era	2	0.1	0.04	0		
Cascade Range	3282	3066	Obsidian Cliffs[2]	2489	76	44.3	2330	76	44.5
	58.4%	58.5%	Devil Point	476	15	8.46	436	14	8.32
			Clackamas River	267	8.1	4.75	259	8.4	4.94
			Carver Flow	34	1	0.6	33	1.1	0.63
			Rock Mesa	8	0.2	0.14	8	0.3	0.15
			Lemiti Creek	8	0.2	0.14	0		
Upper Deschutes Basin	222	197	Newberry Volcano	126	57	2.24	110	56	2.1
	3.95%	3.76%	Quartz Mountain	30	14	0.53	26	13	0.5
			Cougar Mountain	28	13	0.5	26	13	0.5
			McKay Butte	24	11	0.43	22	11	0.42
			McKay Butte West	11	5	0.2	11	5.6	0.21
			Big Obsidian Flow	3	1.4	0.05	2	1	0.04
Klamath Basin	226	220	Silver Lake/Sycan Marsh	172	76	3.06	170	77	3.24
	4.02%	4.2%	Spodue Mountain	47	21	0.84	43	20	0.82
			Deer Creek	4	1.8	0.07	4	1.8	0.08
			Drews Creek/Butcher Flat	1	0.4	0.02	1	0.5	0.02
			Carlon (Bald Butte)	1	0.4	0.02	1	0.5	0.02
			Witham Creek	1	0.4	0.02	1	0.5	0.02
Harney Basin	11	7	Big Stick	3	27	0.05	3	43	0.06
	0.2%	0.13%	Glass Buttes	4	36	0.07	2	29	0.04
			Riley	2	18	0.04	1	14	0.02
			Horse Mountain	1	9.1	0.02	1	14	0.02
			Mud Ridge	1	9.1	0.02	0		
NE Oregon	6	2	Whitewater Ridge	4	67	0.07	2	100	0.04
	0.11%	0.04%	Indian Creek	1	17	0.02	0		
			Wolf Creek	1	17	0.02	0		
NE California	8	8	Glass Mountain	4	50	0.07	4	50	0.08
	0.14%	0.15%	GF/LIW/RS	3	38	0.05	3	38	0.06
			Blue Mountain	1	13	0.02	1	13	0.02
Unknown	89	75	Unknown	89	100	1.58	75	100	1.43
	1.58%	1.43%							
Total	5624	5240		5624			5240		
Percent	100	100			100	100		100	100

[1]The study subset consists of only those sites with a sample of 10 or more characterized artifacts.
[2]Secondary source of Obsidian Cliffs and Carver Flow obsidians are the McKenzie and Willamette Rivers gravels.

Table 14-2. Percent of Subbasin[1] Obsidian By Obsidian Type.

Obsidian Type	Lower Willamette	Tualatin	Middle Willamette	Upper Willamette	Coast Fork	Clackamas	Molalla - Pudding	North Santiam	South Santiam	McKenzie	Middle Fork Will.	Total
Willamette Valley												
Inman Creek	67.81	31.6	88	64.2	43.9	0.62	22.7	23.4	1.9	1.11	22	
Butte Creek			1.2			0.62	21.3					
Cascade Range												
Obsidian Cliffs	14.59	36.8	6.77	31.6	48.5	30	51.1	43.6	83.9	87.6	37.9	
Carver Flow	0.858		1	2.7		0.21				0.48	0.11	
Rock Mesa										1.27		
Devil Point	1.717		1.59	0.64		5.97	3.11	30.3	13.5	7.62		
Clackamas River	3.004					51.6	0.44					
Upper Deschutes												
McKay Butte								0.23		0.48	2.22	
Newberry Volcano	1.29	31.6	0.2	0.26	1.52	3.09	0.44	0.23	0.57		8.09	
Big (Buried) Obs. flow											0.22	
Quartz Mountain	0.43					0.41					2.55	
Cougar Mountain									0.19		2.77	
McKay Butte West (Unk X)						2.26						
Klamath Basin												
Deer Creek											0.44	
Silver Lake/Sycan Marsh	0.43		0.4	0.39							18.2	
Spodue Mountain	1.72		0.2								4.21	
Witham Creek											0.11	
Drews Creek/Butcher Flat											0.11	
Carlon (Bald) Butte								0.11				
Harney Basin												
Horse Mountain						0.21						
Glass Buttes	0.86											
Big Stick	1.29											
Riley			0.2									
NE Oregon												
Whitewater Ridge						0.41						
NE California												
GF/LIW/RS	0.86		0.2									
Glass Mountain	1.72											
Blue Mountain											0.11	
Unknown	3.43		0.2	0.26	6.06	4.53	0.89	2.07		1.43	1	
Total Percent	100	100	100	100	100	100	100	100	100	100	100	
Total Study Sample	233	19	502	779	66	486	225	871	527	630	902	5240
Percent Study Assemblage	4.45	0.36	9.58	14.9	1.26	9.27	4.29	16.6	10.1	12	17.2	100
Number of Sites	5	1	7	15	3	12	2	22	11	19	19	116

[1]Willamette Basin subbasins arranged west side, north to south, then east side, north to south starting with Clackamas.

Table 14-3. Percent of Obsidian Type by Subbasin.

Obsidian Type	Lower Willamette	Tualatin	Middle Willamette	Upper Willamette	Coast Fork	Clackamas	Molalla – Pudding	North Santiam	South Santiam	McKenzie	Middle Fork Will.	Number of Sites	Total
Willamette Valley													
Inman Creek	9.83	0.37	27.5	31.1	1.8	0.19	3.17	12.7	0.62	0.44	12.3	61	100
Butte Creek			10.5			5.26	84.2					5	100
Cascade Range													
Obsidian Cliffs	1.46	0.3	1.46	10.6	1.37	6.27	4.94	16.3	19	23.7	14.7	106	100
Carver Flow	6.06		15.2	63.6		3.03				9.09	3.03	10	100
Rock Mesa										100		1	100
Devil Point	0.92		1.83	1.15		6.65	1.61	60.6	16.3	11		42	100
Clackamas River	2.7					96.9	0.39					10	100
McKay Butte								9.09			90.9	9	100
Upper Deschutes													
Newberry Volcano	2.73	5.45	0.91	1.82	0.91	13.6	0.91	1.82	2.73	2.73	66.4	35	100
Big (Buried) Obs. Flow											100	2	100
Quartz Mountain	3.85					7.69					88.5	10	100
Cougar Mountain									3.85		96.2	10	100
McKay Butte West (UnkX)								100				1	100
Klamath Basin													
Deer Creek											100	2	100
Silver Lake/Sycan Marsh	0.59		1.18	1.76							96.5	19	100
Spodue Mountain	9.3		2.33								88.4	11	100
Witham Creek											100	1	100
Drews Creek/Butcher Flat											100	1	100
Harney Basin													
Carlon (Bald) Butte								100				1	100
Horse Mountain						100						1	100
Glass Buttes	100											2	100
Big Stick	100											1	100
Riley			100									1	100
NE Oregon													
Whitewater Ridge						100						1	100
NE California													
GF/LIW/RS	66.7		33.3									2	100
Glass Mountain	100											1	100
Blue Mountain											100	1	100
Unknown	10.7		1.33	2.67	5.33	29.3	2.67	24		12	12	31	100

[1]Willamette Basin subbasins arranged west side, north to south, then east side, north to south starting with Clackamas.

and cobbles were carried far down the valley (Skinner 2011).

The Willamette Valley is bordered on the east by the Cascade Range, which includes the very old, deeply eroded Western Cascades and the much younger volcanic rocks of the High Cascades. There are well over 150 volcanic vents in the high Cascades, a number of which are associated with obsidian sources (Orr et al. 1992:141-148).

At the time of contact, the Willamette Valley was home to at least 13 named Kalapuyan groups whose tribal territories coincided closely with the Willamette River tributary subbasins. The dialects of the lower valley have been grouped into the Tualatin-Yamhill language, the Central Kalapuya language which included eight to twelve dialects, and the Southern Kalapuya language of the upper Willamette Valley and northern Umpqua River Basin grouped the dialects of the Yoncalla (Jacobs et al. 1945; Zenk 1990). Each dialect was localized in a cluster of winter villages established along a creek or in a restricted area near the Willamette River. These groups constituted autonomous economic, cultural, and political units and were identified by name (Jacobs et al. 1945:145). Access rights to certain resources were limited to members of the winter village group, but the territory of the larger community provided access to riverine, lowland, and upland habitats (Zenk 1976:17-18).

As reported, the local exchange center that served as a point of contact between the Kalapuya and Clackamas River Chinook was at Willamette Falls, the location of modern day Oregon City. The area was controlled by the Clackamas Chinook, the easternmost of four Lower Columbia River Chinook tribes. In the Portland Basin lived the Multnomah Chinook, and the Cathlamet and Lower Chinook downriver to the west (Silverstein 1990:533-535).

The Tualatin and other Kalapuya groups, Chinookans, and northern Oregon coastal groups, participated in a regional economic and political network (Zenk 1976:5). Such trade gave the Kalapuya access to fisheries not available above the falls in the Willamette Valley (Zenk 1976:34). Various ethnographic informants emphasized the importance of trade and listed the foodstuffs exchanged by tribe to include the Kalapuya's camas, the Tualatin's wapato, the Molala's smoke-dried meat, and the Clackamas' smoke-dried fish, eels, and pounded dried salmon (Zenk 1976:35-36). Trade is also noted in historic accounts, such as the observation by Alexander Henry (the Younger), who, upon entering the Willamette valley on January 22, 1814, reports encountering a group of seven "Yam he las" on their way to the falls with "bags of raw Cammoss" to trade. This same party was met three days later, "this time loaded with dried salmon" (Coues 1897:812, 819). Other commodities traded at Willamette Falls included *Dentalium* shells, bone and shell beads, ornamental jewelry including feathers, tobacco, animal skins, and slaves (Zenk 1976:52). As Zenk (1976:5-6) notes, the Tualatin "brokered in slave trading" and "occasionally conducted slave-raiding expeditions to the southern Willamette Valley and the central Oregon coast."

The archaeological record also provides evidence of sophisticated interaction and exchange between the Kalapuya and surrounding peoples. In 1922 George Wright described the contents of a mound near Albany, in the upper valley. In addition to a necklace of copper beads was a 55.8 cm (22 in) long bone "sword or sacrificial knife" shaped like a "canoe paddle" with a handle decorated with faces resembling "Alaskan art" (Wright 1922). Wright was certainly clearly describing a whale bone club, an iconic Northwest Coast artifact. At Fuller and Fanning Mounds on the Yamhill River in the lower valley some burials displayed the high status mark of cranial flattening, and exotic grave goods, including two whale bone clubs (Murdy and Wentz 1975:349-374; Woodward et al. 1975:402), and a ceremonial blade made of Klamath Basin Silver Lake/Sycan Marsh obsidian (Hughes 1990:51, 54). At a Harrisburg mound in the upper valley, *Dentalium* and other marine shell beads, as well as copper beads and possibly a bearskin robe, accompanied an individual with a flattened cranium, while at a mound near Shedd, also in the upper valley, grave goods included an obsidian ceremonial blade which measured 25.5 cm long (Laughlin 1941). At the nearby Calapooia Midden site, two males were buried with a whalebone club (Roulette et al. 1996). At the Lingo Site, near Junction City in the upper valley, burials were excavated which were accompanied by *Olivella* shell beads, and pendants of abalone and other marine shell (Cordell 1975). While preservation in the acidic Willamette Valley soils has been a problem, the archaeological record, like the ethnographic record, clearly indicates that the Kalapuya participated in regional exchange, including exotic prestige items. Importantly, not all excavated sites have produced exotic artifacts, indicating differential access, and signaling local social status inequality, exclusive trading partnerships, or both.

Obsidian Frequency in the Valley

Willamette Valley

Inman Creek, Butte Creek, and New Era obsidians occur in the study area, but no New Era obsidian is represented in the Study Assemblage (Table 14-1). The exact location of the primary source of <u>Inman Creek obsidian</u> is thought to have been in the Mount David Douglas region of the High Cascades, but has yet to be found, and may be buried or entirely eroded. The secondary source of Inman Creek obsidian is the gravels of the Middle Fork and main-stem Willamette Rivers, where it has been found as far north as the Clackamas River (Skinner 2011). Inman Creek obsidian was first characterized from obsidian obtained at Inman Creek, a small stream in the southwest corner of the Valley, where a deposit of obsidian nodules ranging from 1 to 15 cm in diameter was found. It has two chemically distinct forms, Inman Creek A and

Inman Creek B (Skinner 1983:306), but these appear to almost always co-occur and are treated here as a single type. It is the second most frequent archaeological obsidian in the Basin, and is identified at 61 of the 116 sites in the study assemblage (at 29 of 34 sites below 150 m (500 ft) elevation). Sites in the Middle Fork, Upper, and Middle Willamette River subbasins produced 68 percent of the Inman Creek obsidian artifacts. Butte Creek obsidian is reported from five sites on the Clackamas and Middle Willamette main-stem rivers, and from one site on Butte Creek, a tributary of the Pudding River. It accounts for less than 3 percent of obsidian at four sites, but rises to 36 percent of obsidian at a site on Butte Creek, so that it represents 21 percent of the archaeological obsidian from the Mollala-Pudding Rivers subbasin. The presence of a large proportion of cortex, and its limited distribution, suggested the as yet un-located source is on Butte Creek.

Many High Cascades sites are mid-range biface blank reduction localities for Obsidian Cliffs material (Connolly et al. 2008), and at Newberry Volcano large bifaces were also commonly produced (Connolly 1999). Caches of Obsidian Cliffs and Newberry Volcano biface blanks have been found in the Western Cascades and Central Oregon (Bennett-Rogers 1993; Winthrop and Gray 1985). Biface blank production reduced volume and weight for foot-transport. The river gravel source of Inman Creek obsidian suggests that cortex was present due to local acquisition, but it can be speculated that transport of obsidian by canoe would make volume and weight less critical factors. The generally held idea that the presence of cortex flakes at a site is evidence of a relatively local source may be true for Obsidian Cliffs obsidian, but may not reliably indicate local procurement for obsidians that are more likely to have been moved by water transport.

Cascade Range

Obsidian Cliffs obsidian is the most frequently identified obsidian type in the basin, accounting for 45 percent of archaeological obsidian. As a group, Cascade Range obsidians account for 59 percent of the study assemblage (Table 14-1). Obsidian Cliffs obsidian was quarried at the primary source, a flow on the northwest slope of the North Sister peak, and collected from glacial till deposits and McKenzie River gravels. It was one of the most important obsidian sources in the Pacific Northwest because of its quantity and quality. Obsidian Cliffs is a massive Pleistocene obsidian-rhyolite flow approximately 2.4 km (1.5 mi) long with 70 to 90 m (230-300 ft) high terminal cliffs (Fierstein et al. 2003; Skinner 1983:265). Obsidian Cliffs obsidian appears at 106 of the 116 sites in the study (at 28 of 34 sites at less than 152 m (<500 ft) in elevation and is the highest percentage of obsidian in eight of the ten subbasins in the Willamette Valley. Devil Point obsidian is a major source in a small area of the Western Cascades, appearing at 42 of the 116 study sites. It has been found at a small primary source in the North Santiam drainage, about 8 km (5 mi) west of Mount Jefferson, and at a single secondary location a few kilometers away at Grizzly Creek. The majority of this regionally minor source is reported from sites within a 35 km^2 (13.5 mi^2) area centered on the primary source location. Some 85 percent of Devil Point obsidian was found above 914 m (3000 ft) in elevation. Clackamas River obsidian is named for the northeast Willamette Valley subbasin where it was first reported, but its source has since been located on the east side of the East Fork of Hood River, northeast of Mount Hood, about 41 km (25 mi) from the Clackamas River headwaters. It has been identified at ten sites, all in the northern valley, in the Clackamas, Lower Willamette River, and Molalla-Pudding Rivers subbasins. Ninety-seven percent of the Clackamas River obsidian in the Willamette Basin was found in the Clackamas River subbasin, where it ranges from 39-82 percent of site obsidian at four sites, and is 52 percent of archaeological obsidian in the Clackamas subbasin. Carver Flow obsidian has been found at ten sites located throughout the basin, but never rises to more than 3 percent of the obsidian in any subbasin. The majority, 64 percent, was recovered in the Upper Willamette River subbasin. Rock Mesa obsidian has been found at a single site, which lies above 914 m (3000 ft) in the McKenzie drainage; here it accounted for 13 percent of the site's obsidian.

Upper Deschutes Basin

These obsidians constitute less than 4 percent of the study assemblage, but include a number of regionally important sources. None are present in the Willamette Basin in large frequencies. Newberry Volcano obsidian was found at 35 sites. Twenty three percent of Newberry Volcano obsidian is found at 13 sites in the lower valley, 5 percent at 3 sites in mid-valley, and 73 percent at 19 sites in the upper valley. At 23 of the 35 sites it is less than 10 percent of site obsidian. At three sites it is more than 20 percent of site obsidian, one in the Upper Valley, and two in the Lower Valley. Quartz Mountain obsidian is reported from ten sites, with 12 percent of it at the north end of the valley and 88 percent at the south end in the Middle Fork Willamette River drainage. McKay Butte obsidian is found at nine sites, one in the North Santiam subbasin and eight in the Middle Fork subbasin. Big (Buried) Obsidian Flow obsidian is found at two sites in the Middle Fork Willamette River subbasin and McKay Butte West obsidian at one site in the Clackamas drainage. Cougar Mountain obsidian was reported from one site in the South Santiam drainage and nine sites in the Middle Fork Willamette River drainage. Altogether, of the obsidians associated with the upper Deschutes drainage, 69 percent were found in the Middle Fork Willamette subbasin.

Klamath Basin obsidians are also very important regionally, but are only minimally present in the Willamette Basin where they account for just over 4 percent of the study assemblage. Ninety-six percent of the Klamath Basin obsidian was found in the Middle Fork drainage. The most important source was Silver Lake-Sycan Marsh obsidian. It appears at 19 sites and represents 77 percent of Klamath Basin obsidians. All other obsidians from that area co-occur with Silver Lake–Sycan Marsh obsidian, except at a single site in the Middle Willamette River subbasin where Spodue Mountain obsidian was found. Spodue Mountain obsidian accounts for 20 percent of these obsidians, and is reported from 11 sites. All these obsidians occur in sites south of the Middle Willamette except for one site in the Lower Willamette subbasin where Klamath Basin obsidians accounted for 10 percent of site obsidian.

Harney Basin obsidians are represented by seven artifacts recovered from four sites. All are in the lower valley.

Northeast Oregon obsidians are represented by two Whitewater Ridge artifacts recovered from one site in the Clackamas drainage.

Northeast California obsidians number eight artifacts reported from three sites, one each in the Lower, Middle, and Middle Fork Willamette River subbasins.

The obsidians from the Harney Basin, Northeast Oregon and Northeast California are present in the Willamette Basin in very small amounts – 17 artifacts at seven sites. Of these, ten were found at the Meier site, a Chinook village site in the Portland Basin. Future obsidian data will give further hints as to the mode and vector of arrival of these pieces, but it can be speculated that larger more important sites will have attracted a wider variety of these exotic obsidians, especially if they are located near a major thoroughfare like the Columbia River.

Inman Creek and Obsidian Cliffs Obsidian

At 31 percent and 45 percent respectively of all characterized obsidian, Inman Creek and Obsidian Cliffs obsidians are clearly the most important archaeological obsidian sources in the Willamette Basin. All other obsidians are limited in frequency or distribution. As mentioned earlier, archaeological obsidian often follows a distance decay model, becoming less frequent with distance from the source. This has been connected with down-the-line exchange, obsidian decreasing as some is kept and the excess moved on. Defining the distance to the source in the Willamette Valley is complicated by the fact that Inman Creek and Obsidian Cliffs obsidians are found throughout the gravels of the Middle Fork Willamette, McKenzie, and main-stem Willamette Rivers. However, the primary sources of those obsidians were in the Cascades at the head-waters of the Middle Fork Willamette and McKenzie Rivers. If their distribution followed only hydrologic laws of particle deposition, then nodules should be smaller and fewer with downstream-distance, reducing the frequencies of both Inman Creek and Obsidian Cliffs obsidians at sites in the lower valley. We suggest that an explanation is required for perturbations to a linear down-the-line decrease in their distributions, the most parsimonious being human agency.

In order to test for linearity in distance-to-source frequency, correlation coefficients for obsidian frequency by site location for the 116 sites in the study assemblage were calculated. Using the UTM Northing position for each site, linear correlation coefficients for Inman Creek and Obsidian Cliffs obsidian frequencies are calculated at $r^2=0.14$ and $r^2=0.05$ respectively. Correlations this close to zero are strong evidence that the frequencies of these two obsidians are not following a natural hydrologic distribution.

Contour Mapping by Source Frequency at Sites

The study sample consists of 5240 samples from 116 sites. Of these, 10 sites have no Obsidian Cliffs obsidian, 55 sites have no Inman Creek obsidian, and 52 sites have both sources present. Using Golden Software's Surfer 8 program, contour maps using the frequency of the three categories of Inman Creek, Obsidian Cliffs and All Other were prepared.

The frequency of Inman Creek obsidian generally increases to the west of the basin (Figure 14-3). In the south it fluctuates between 20 percent and 80 percent, at Corvallis it is 80-100 percent, at Salem it ranges from 40-70 percent, drops to as low as 20 percent at the confluence of the Clackamas River, then Jumps to 70-80 percent in the Portland Basin. At some northern valley sites the Inman Creek and Obsidian Cliffs frequencies are about equal.

As would be expected, the two major obsidian types in some ways appear to mirror one another (Figure 14-4). The distribution of Obsidian Cliffs obsidian is relatively high, 70-80 percent, between Eugene and Corvallis, and is very high in the upper McKenzie and South Santiam drainages where it is 100 percent of obsidian at some sites. It drops off in the North Santiam subbasin, and to the north of that is spotty, growing at specific sites to as much as 70 percent, but being almost absent at others. This pattern is also seen on the Willamette main-stem north of Corvallis where Obsidian Cliffs obsidian drops at most sites to a frequency of 30 percent or less, and drops even lower in the Portland Basin.

The distributions of all other obsidians show four foci: the Upper Middle Fork Willamette River drainage, the North Santiam River headwaters, the Molalla-Pudding Rivers subbasin and Clackamas River subbasin (Figure 14-5). As stated above, 80 percent of Klamath Basin obsidians, and 88 percent of the Upper Deschutes Basin obsidians are reported to occur at archaeological sites in the Middle Fork Willamette River drainage. The Central Western Cascades of Oregon is the source

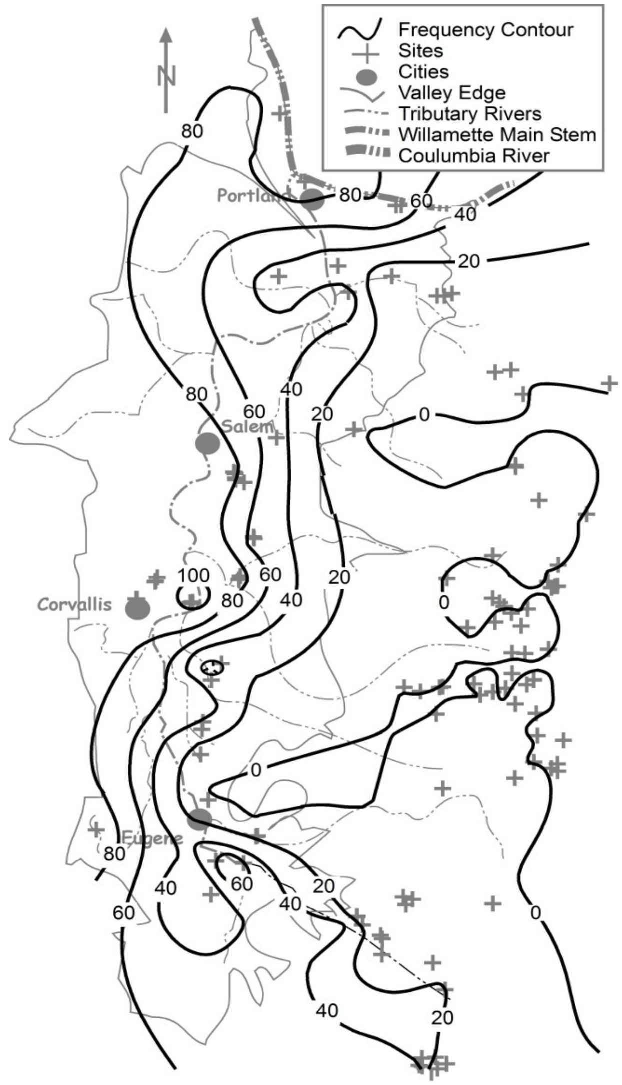

Figure 14-3. Distribution of Inman Creek obsidian across 116 sites in the Willamette Basin. Inman Creek obsidian is focused along the Willamette River, but shows considerable variation between neighboring sites, and is dominant in the Portland Basin.

location and single use area of Devil Point obsidian, 84 percent of Butte Creek obsidian is reported from archaeological sites in the Molalla-Pudding Rivers subbasin, and 97 percent of Clackamas River obsidian was reported from Clackamas River subbasin archaeological sites.

To this point the analysis of the distribution of obsidian types in the Willamette Basin has no temporal control. Within this study assemblage 93 sites include obsidian hydration measurements. Various researchers have developed hydration rates for obsidians found within the Willamette Basin

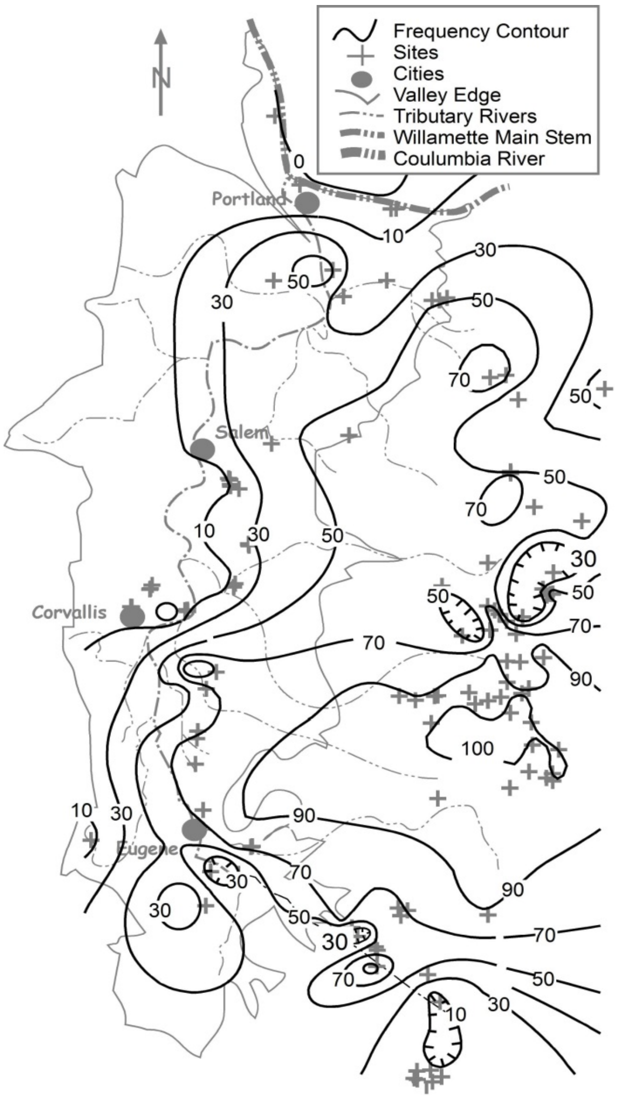

Figure 14-4. Distribution of Obsidian Cliffs obsidian across 116 sites in the Willamette Basin. Obsidian Cliffs obsidian is focused in the Cascades in the eastern basin, but shows considerable variation between neighboring sites. It is 70-90 percent of obsidian at some sites in the upper valley, drops below 30 percent in mid-valley and gains to frequencies as high as 50 percent at some sites in the lower (northern) valley.

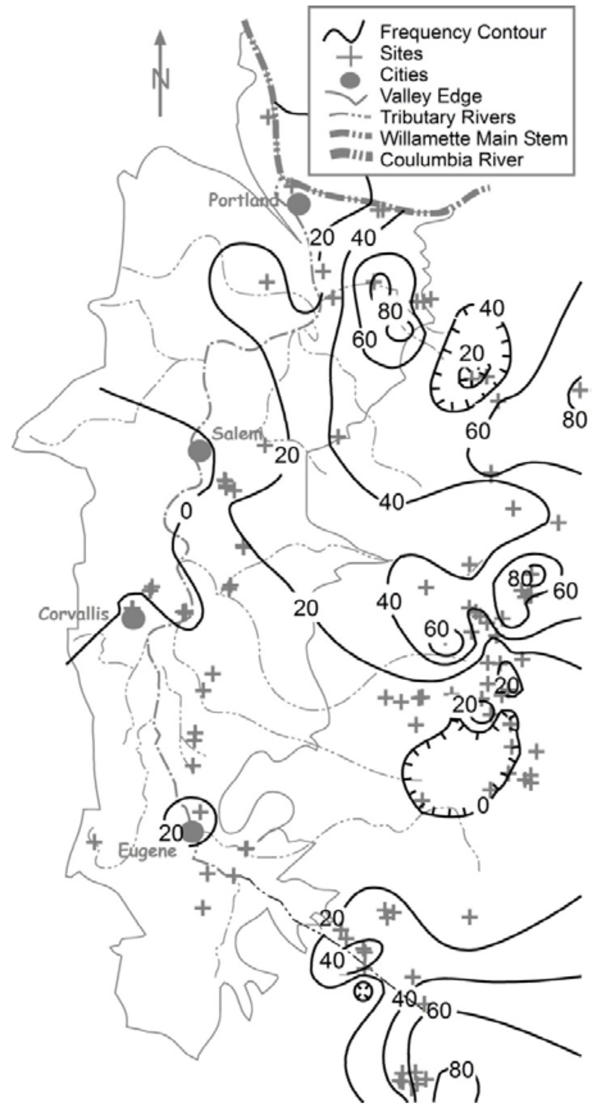

Figure 14-5. Distribution of all obsidians other than Inman Creek and Obsidian Cliffs obsidians across 116 sites in the Willamette Basin. These obsidians are most frequent in the upper valley in the Middle Fork subbasin, in mid-valley in the upper reaches of the North Santiam subbasin, and in the lower valley in the Mollala, Pudding River and Clackamas subbasins.

(Baxter 2008; Burchard 1994; Connolly n.d.; Connolly and Byram 1999; Jenkins 2000; Minor 1985; Pettigrew and Hodges 1995; Skinner 1995; Wilson 1994). Unfortunately, micro-environmental variation makes a basin wide application of hydration rates untenable at this time.

However, on the valley floor, larger projects at the south end of the valley (O'Neill et al. 2004:208), at mid-valley (Connolly n.d.), and at various locations on the valley floor (Wilson 1994), have worked out hydration constants for Obsidian Cliffs and Inman Creek obsidians which can be applied with at least some confidence. O'Neill et al. (2004:208) found that Inman Creek obsidian hydrated at $1.9\mu^2$/1000 years at the south end of the

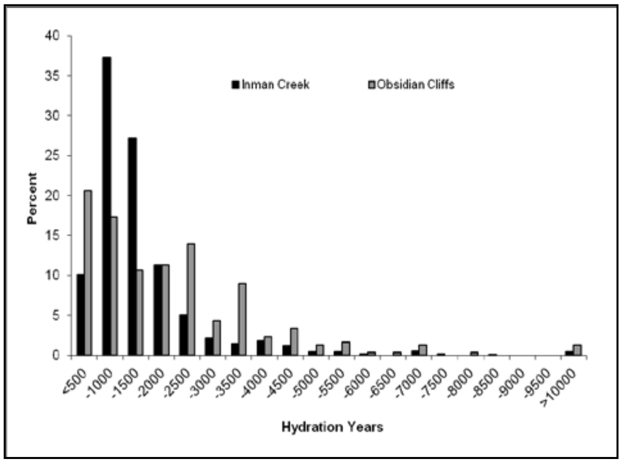

Figure 14-6. Frequency of Inman Creek and Obsidian Cliffs obsidian on the valley floor (<500 ft elevation) by hydration years.

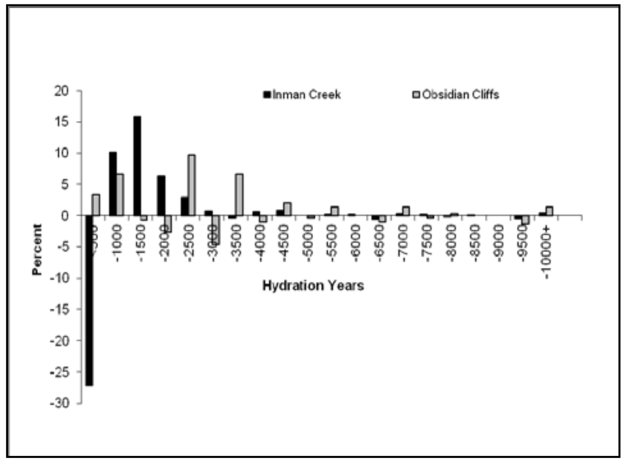

Figure 14-7. The average increase of each obsidian type by 500 year increment at valley floor sites (calculated by subtracting the previous 500 year increment frequency from the next increment frequency).

valley. At Salem, the rate was also found to be about 1.9μ^2/1000 years (Connolly n.d.). Obsidian Cliffs obsidian has been shown to hydrate at a much faster rate, with hydration constants estimated at 4.0μ^2/1000 years (Wilson 1984:20) and 3.6μ^2/1000 years (Connolly n.d.).

In order to make some estimates about obsidian distribution in the basin over time, this study will confine itself to the valley floor below 152 m (500 ft) in elevation. Within that limitation, there are 34 sites with source obsidian that has also been submitted for hydration rim measurement. Looking at only Inman Creek and Obsidian Cliffs obsidians, within the 34 sites on the valley floor, Inman Creek obsidian (n=892 artifacts) measurements comprise 74.8 percent of the measured hydration rims, while Obsidian Cliffs rims (n=301 artifacts) make up 25.2 percent of the total.

Hydration rim measurements, using the hydration constants of 1.9μ^2/1000 years for Inman Creek obsidian, and 3.6 μ^2 /1000 years constant for Obsidian Cliffs obsidian were compared (Figure 14-6). Of the total Inman Creek archaeological obsidian, 91.6 percent occurs during the last 2500 years, while of the Obsidian Cliffs archaeological obsidian, 73.7 percent appears during that time. Between 2500 and 500 years ago, Inman Creek obsidian use on the valley floor increased 11 fold (>2500 = 8.4 percent, ≤2500 = 91.6 percent) while Obsidian Cliffs obsidian use just about tripled (>2500 = 26.3 percent, ≤2500 = 73.7 percent). A combined 87 percent of the Inman Creek and Obsidian Cliffs obsidian on the valley floor appears between 2500 and 500 years ago.

The average increase of each obsidian type by 500 year increments shows variation between the two obsidian types (Figure 14-7). Obsidian Cliffs obsidian use jumped about 3500 years ago but then has an uneven presence after that. Inman Creek obsidian use steadily increased beginning at 2500 years ago, and dominated between 2000 and 500 years ago. However, after 500 years ago, while demand for all obsidian declines, Inman Creek obsidian use drops precipitously. It may be too facile to see this as a proxy for the valley's well known population decline, but it is intriguing.

Contour mapping of obsidian frequencies for the 34 valley floor sites shows the same patterns as were seen in the entire 116 site study (Figure 14-3). In the upper valley the two dominant obsidians are present in high frequencies, depending on the particular site, in the mid-valley it is almost entirely Inman Creek obsidian, and in the Lower Valley again the dominance varies by individual site. At both ends of the valley, other obsidians are a factor, being as much as 30 percent of site obsidian at particular sites in the upper valley and as much as 80-90 percent at particular sites in the lower valley.

These contours demonstrate that obsidian frequency at any given site is not dependent on local obsidian. Unmistakably, different sites in the lower valley are being supplied with differing obsidian types. If site obsidians are not obtained locally, the great site-to-site differences suggest social behavior, perhaps village-to-village connections in the form of trading partners.

Evidence for this can be found at the Chinook village sites of Cathlapotle, Meier, and Clahclellah (obsidian characterization data for these three sites comes from the Northwest Research Obsidian Laboratory data base). The Meier site is one of the 116 sites in this study. It lies northwest of the City of Portland, west of the Multnomah channel, near Sauvie Island. At that site, 75 percent of archaeological obsidian is Inman Creek. Across the Columbia River in Washington at the village of Cathlapotle, Inman Creek obsidian accounts for 86 percent of site obsidian, and 64 km (40 mi) upstream at Clahclellah, 43 percent of site obsidian is Inman Creek obsidian.

Further, Obsidian Cliffs obsidian is less than 1 percent of site obsidian at the Meier site and Cathlapotle, but constitutes 22 percent of obsidian at the upstream Clahclellah village. Clackamas River obsidian, so prominent at 52 percent of the Clackamas River subbasin obsidian, is just 4 percent of the Meier site obsidian, 3 percent at Cathlapotle, and strangely, it is just 4 percent at Clahclellah which is quite near the source. All of these Chinook village occupations date to after 1000 years ago, when the dramatic increase in obsidian frequencies began to occur.

Summary and Discussion

This paper has summarized the obsidian characterization data from 5240 artifacts collected from 116 sites in the Willamette Basin. Clearly the people of the Willamette Basin had contacts with far flung regions, but local resources were the core of the obsidian used, such that if the Willamette Valley and Cascade Range sources are grouped, they account for over 90 percent of obsidian use in the Willamette Basin.

Obsidian type distribution does not conform to a classic distance-decay model, suggesting that human transport was an important factor in the distribution of cultural obsidian. Contour mapping of obsidian frequencies of the 116 site sample showed that in the Lower Valley frequencies of Obsidian Cliffs and Inman Creek obsidians could be about equal at some villages, but at others, one obsidian type could be very high and the other low or missing.

This uneven distribution at sites was further investigated by applying obsidian hydration dating to a sample of 34 sites. Using obsidian hydration rates developed on the valley floor, it is estimated that 84 percent of the valley's obsidian use occurred after 2500 years ago. At that time Inman Creek obsidian use increased dramatically, but plummeted within the last ca. 500 years. Obsidian Cliffs obsidian followed a similar, but less spectacular trajectory, although with an earlier rise in use, beginning perhaps 1000 years prior to the precipitous rise in Inman Creek obsidian use. Contouring obsidian distribution at those 34 valley floor sites showed the valley's site-specific, uneven obsidian use distribution even more clearly.

Long distance movement of resources in organized Interaction Spheres moved various goods, including obsidian, throughout the region (Ames and Maschner 1999; Anastasio 1972; Carlson 1994; Galm 1994; Ray 1939). The "trackability" of obsidian through geochemical trace element characterization has mapped the movement of obsidian significant distances, and the frequencies of distant obsidian types over more local obsidians has shown that it was a commodity, not just a resource.

The high frequency of specific obsidian types at different Lower Willamette and Portland Basin sites can be explained as the use of an as yet unlocated source of obsidian nodules or as a function of the system of exchange which was being employed. The economic system involved may not have been simply down-the-line exchange, but rather one of redistribution. The frequency of obsidian at the Chinook sites suggests obsidian was a sought-after trade commodity. Chinook society was ranked and political organization was headed by a hereditary Chief, who's leadership rights and duties lay in a single village, but "through proper marriage alliances, control of trade and skillful and effective diplomacy, an individual chief could exert influence over a wide area" (Silverstein1990:541).

At Clahclellah, only 1074 obsidian flakes were recovered, while the assemblage contained 342,317 CCS flakes (Minor et al. 1989). Households at Clahclellah were obtaining obsidian from remote locations, but obviously not simply to fulfill a utilitarian toolstone need. A comparison of household use of obsidian at Cathlapotle and Clahclellah (Sobel 2006; 2011) showed that all households at both sites had access to obsidian and used it in the same way. This fact, on its face, might suggest that obsidian was not a prestige item. However, higher prestige households "acquired and consumed more obsidian than did lower prestige households" implying that access to and local distribution of obsidian was not even across the social landscape, and "that household prestige was intimately related to household involvement in long distance exchange systems" (Sobel 2006:192). Obsidian itself may or may not have been regarded as a prestige item, but its uneven distribution among houses of different status serves to mark households with greater amounts of obsidian as prestigious by virtue of their greater access to exotic exchange products. Long-distance trade increased household prestige by giving it access to prestige items and resources that could be turned into prestige items, as well as encouraging regional alliances that increased household prestige (Sobel 2006:192).

Large households evolved in an economically diverse landscape that required synchronized task organization, but to make them persist, they had to be seen as successful so as to attract new members (Ames 2006:31). Success breeds success. This understanding of Chinook political, social and economic organization argues that involvement in economic activities at the community, local, and regional levels was not a choice, but a necessity. Household survival depended on household prestige (Ames and Maschner 1999:150). The acquisition and redistribution of prestige items such as obsidian, a toolstone that is visually easily identified, added to the ability of households to attract and keep members.

Among the Kalapuya, exchange was accomplished as reciprocal gift-giving. Upon arrival, visitors presented goods to the village headman or host, who kept some and dispersed the rest to the villagers. Before departure, villagers presented "gifts" to the headman or host, who passed them on to the visitors. Returned home, the visitors shared the "gifts" with their village (Zenk 1976:52-53). It is likely that exchange-based relationships existed between specific villages where headmen were trading partners. The use of the term "gifts" highlights a greater truth, that the exchange was not strictly an economic transaction, but a negotiation of status; on some level the obsidian, shells, and woodpecker scalps were only the medium. Aside from any utilitarian advantage that might be present in obsidian, the fact that Chinook elites and commoners, and in a down-the-line manner, the Headmen and members of surrounding tribes, could raise their status by contact with prestige items must have been a powerful inducement to increase obsidian frequency in one's village.

Creating stable, long term economic relationships to ensure household survival was in the best interests of all concerned. About 2500 years ago in the Willamette Valley, obsidian use began to increase in frequency, and it can be speculated, in value as a medium of prestige. Villages with local access to obsidian accordingly rose in importance, while others worked to increase access through organized quarrying parties and trade alliances.

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