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Northern Fish Lake Valley and the Volcanic Tablelands of Owens Valley: Two Minor Sources of Obsidian in the Western Great Basin

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Obsidian samples from two locations in the western Great Basin, the northern Fish Lake Valley and the Volcanic Tablelands in northern Owens Valley, were collected and analyzed using Instrumental Neutron Activation Analysis. These locations had not previously been described as sources of obsidian, although they contain small, weathered nodules on the surface. Obsidian from the former provides a chemical signature distinct from all other previously documented sources in the area, while the latter is chemically similar to obsidian from the Mono Glass Mountain area. Variability in Tablelands obsidian sheds light on the distribution and availability of Mono Glass Mountain obsidian and suggests the presence of a distinct subsignature on the Tablelands. The dispersed nature and small *size of nodules in both areas probably precluded intensive use, but minor exploitation may have been important in the flaked stone economy of prehistoric inhabitants of the region. Recognizing these sources in regional obsidian studies should help refine models of prehistoric exchange and mobility.*

OBSIDIAN research in the western Great Basin has risen quickly from infancy to maturity over the last 30 years. Virtually every archaeological study in this area now contains some special analysis of obsidian, demonstrating the widespread acceptance among archaeologists of the value of obsidian analyses to archaeological research. These specialized studies usually involve hydration analysis of obsidian artifacts for determining age as well as chemical characterization to determine source provenance. Results have been invaluable in advancing our understanding of prehistoric lifeways, including the reconstruction of ancient exchange and trading systems, the documentation of past settlement and mobility patterns, and the identification of prehistoric quarrying activities.

Beginning with the pioneering work of Jack and Carmichael (1969; also see Jack 1976), researchers have systematically documented the chemical signatures of obsidian sources in the Great Basin. It now appears that most of the major obsidian sources have been geographically located and chemically characterized, particularly in eastern California and western Nevada. Indeed, even within-source variation has been documented for a number of locations (Hughes 1988, 1989, 1994; Shackley 1994), allowing archaeologists to fine-tune obsidian hydration curves and models of exchange, mobility, territoriality, and quarrying behavior. The location of major known obsidian sources in eastern California and western Nevada, including the location of the two areas of focus in this report—northern Fish Lake Valley and the Owens Valley Tablelands—are shown in Figure 1.

Extensive sourcing work with eastern California obsidians has been conducted using primarily X-ray fluorescence (XRF), but occasionally other techniques have been employed, such as Instrumental Neutron Activation Analysis (INAA) and Proton Induced X-ray Emission (PIXE). These studies show that a minor, but consistent, fraction of obsidian continues to come from "unknown" sources. For example, in an analysis of over 300 obsidian artifacts from CA-INY-30 in southern Owens Valley, Basgall and McGuire (1988) found no less than five chemical signatures that were not attributable to any known source. Although some unknowns may be due to sampling problems and/or machine error (e.g., the surface of the obsidian artifact was contaminated, the artifact was too small for reliable quantitative data, or the portion analyzed was for some reason chemically or geologically unusual), the consistency with which unknowns occur in archaeological assemblages indicates that there are several sources of obsidian that have not been geographically located. That so little obsidian comes from such unknown locations suggests that they are either located well outside the region and/or are only minor sources of obsidian.

Johnson et al. (1999) recently suggested that one of the major unknown sources in eastern California, often termed "Queen Imposter" by researchers, probably derives from Saline Valley (Fig. 1). Their work also documented two additional chemically distinct sources in Saline Valley that probably correlate to other "unknowns" found at archaeological sites in the region. Although the latter are apparently not major sources, artifacts fashioned of obsidians from these areas were moved outside of Saline Valley often enough that incorporating them into our models of prehistoric settlement and exchange patterns would add much to our understanding of prehistoric lifeways.

This report describes the results of INAA on obsidian nodules collected from two locations in eastern California/western Nevada, at the north

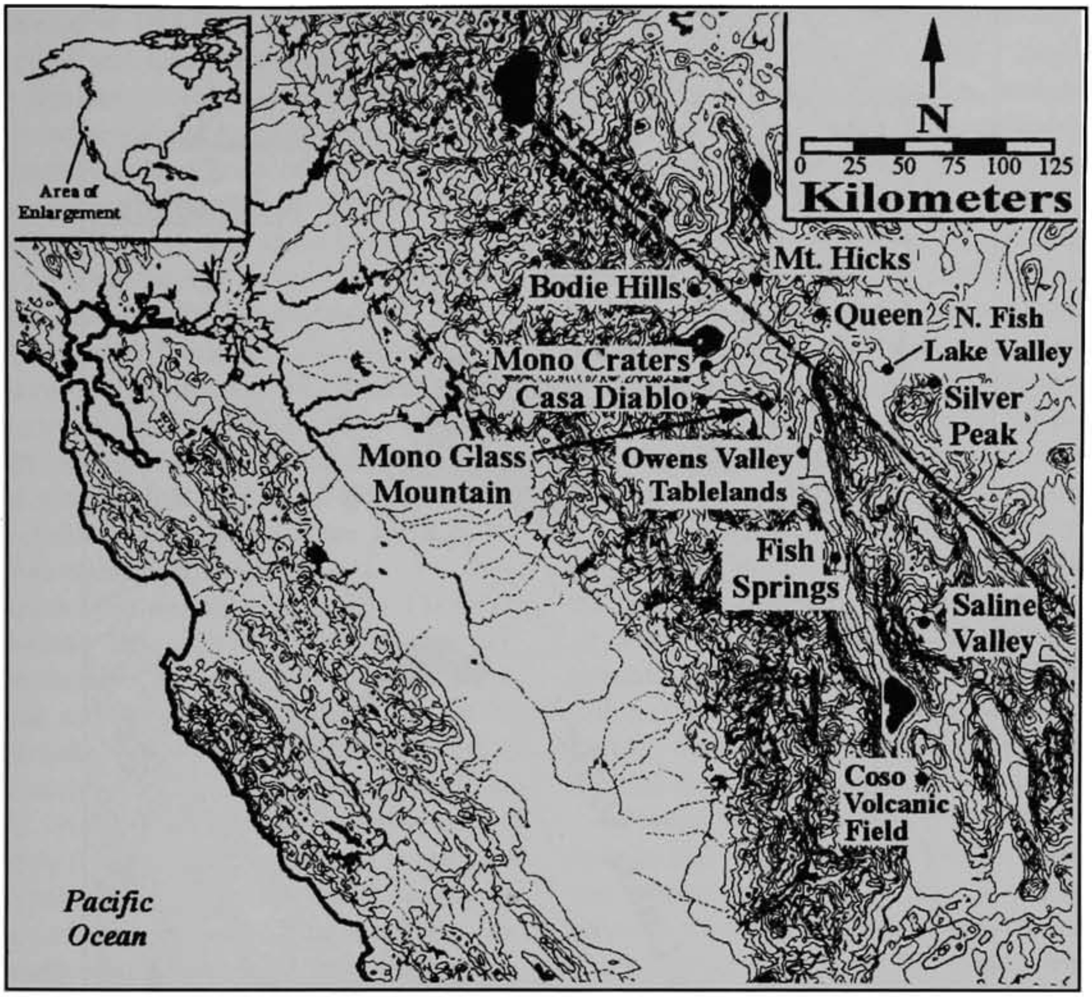

Fig. 1. Locations of northern Fish Lake Valley, the Owens Valley Volcanic Tablelands, and major obsidian sources in the region.

end of Fish Lake Valley and in the Tablelands of northern Owens Valley.[1] Neither location has previously been described as a source of obsidian and/or characterized in the published literature. However, both locations contain small nodules of obsidian dispersed over a fairly large area that could have been exploited by prehistoric occupants as a source of toolstone.

NORTHERN FISH LAKE VALLEY

During a visit to the northern Fish Lake Valley by the senior author in 1996, small nodules of obsidian were noted in a roadcut. These nodules, ranging in size from less than a centimeter to more than seven centimeters, were observed on the south-facing slope of a small set of unnamed hills overlooking the dry lake playa at the northern end of the valley, some six kilometers east of Nevada State Highway 264 towards The Crossing (see Fig. 2). They are quite dense in certain areas (up to two to four nodules per square meter), are mostly subrounded to well rounded, and appear to be secondarily deposited with other alluvial sediments. Despite the small nodule size, the quality of this obsidian is quite high. Inclusions (e.g., phenocrysts) are absent, and experimental flintknapping with the glass suggests that it flakes in a predictable and con-

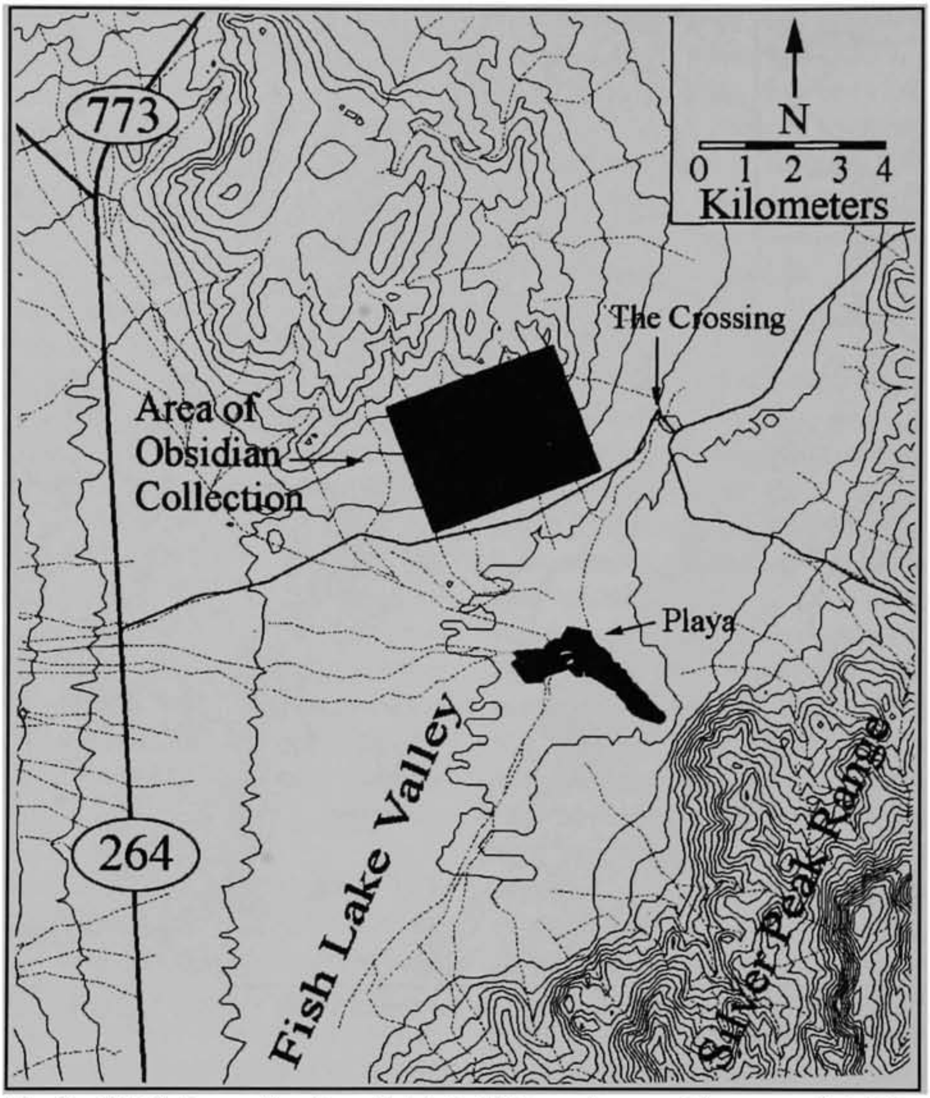

Fig. 2. Detailed map of northern Fish Lake Valley and geographic source of obsidian nodules.

trollable manner. Nodules are generally semi-translucent (slightly smoky or dark), with occasional mahogany red spots. Faint white banding is also present in many of the specimens.

During subsequent reconnaissance in the area, similar nodules, although smaller in size, were also observed for several miles to the east and west along the south-facing slope of the volcanic hills. Investigations on the north side of the volcanic hills, in drainages entering Columbus Salt Marsh, revealed little obsidian. A search for an ultimate point source—that is, an extrusive obsidian flow—was unsuccessful. Thus, the majority of workable obsidian from this area seems to consist of small, secondarily deposited nodules in alluvial sediments. The area with the densest and largest of these nodules appears to occur between 37° 51' and 37° 53' north latitude and 118° 03' and 117° 59' west longitude in northern Fish Lake Valley. The locations where these nodules were collected in northern Fish Lake Valley are shown in Figure 2.

Subsequent INAA on 14 obsidian nodules collected in this location demonstrates that the source provides a homogenous, unique, and previously undocumented chemical signature. Figure 3 displays a plot of scandium and cerium values (in parts per million [ppm]) for several nearby obsidian sources. Due to the extremely high values for Fish Springs for both elements, this obsidian source could not be included on this graph. As Figure 3 demonstrates, scandium and cerium readily differentiate all of the major obsidian sources from the region, including at least four subsources of the Coso Volcanic Field (not labeled in the graph). The figure also shows that some obsidian sources are more variable for these two elements than others.

Figure 3 further indicates that Fish Lake Valley obsidian has a distinct chemical makeup, quite unlike even the nearest sources, such as Silver Peak and Queen/Truman Meadows. Of the 14 Fish Lake Valley samples analyzed, 12 group very closely with one slightly more distant (see Fig. 3). Analysis of the other elements characterized by INAA shows that these 13 samples are closely related chemically, covarying in composition across the 27 elements characterized. The fourteenth sample does not follow this pattern, nor does it match any other known source, and could represent a second, less common center or may simply be an anomalous piece within the source zone. Other elements that tend to distinguish Fish Lake Valley obsidian from other obsidians in the region include samarium, dysprosium, terbium, zirconium (all with low ppm concentrations), and strontium (medium ppm concentrations). Table 1 gives the average abundance for these 13 samples in parts per million (ppm) for the 27 elements characterized in this study.

OWENS VALLEY TABLELANDS

Small nodules of obsidian were also noted during an investigation of the volcanic Tablelands of Owens Valley in the summer of 1994. Similar to those in Fish Lake Valley, nodules are small and can be found dispersed across a large area, particularly in the northern section. Nodule sizes range from less than one cm. to occasional items over 10 cm. in diameter, slightly larger on average than those found in Fish Lake Valley. Most are well rounded and appear to be a consequence of secondary deposition in the area (i.e., perhaps by sheet wash or erosion of obsidian-bearing parent material nearby and upslope). Although present in some samples, phenocrysts are rare, and the obsidian is quite suitable for the production of small tools. Most nodules are dark in color but slightly translucent in incandescent light, and dendritic bands appear in many samples. During a subsequent visit to the region by the authors in 1997, several nodules between 37° 38' and 37° 36' north latitude and 118° 26' west longitude were collected for chemical characterization. Sixteen were eventually submitted for INAA. The location where the samples for this analysis were collected is shown in Figure 4.

Prior to INAA, it was not known whether the nodules represented a unique and previously undocumented chemical signature. The nearest documented sources of obsidian, including the Casa Diablo source area, Mono Glass Mountain, and Queen/Truman Meadows, all lie at some distance to the Tablelands, 25 to 35 km. to the west, 28 km. to the northwest, and 35 km. to the north, respectively. This suggests that the obsidian may represent extrusive material from a fourth and chemically different volcanic event. However, the Tablelands lie at a lower elevation, and it is possible that these nodules represent a secondary deposit from one of these three known sources. For example, the Tablelands is connected to Queen/Truman Meadows by Hammil Valley, which contains a wash that carries small, well-rounded obsidian nodules as bedload, presumably from the Queen/Truman source area. However, obsidian nodules collected from the Tablelands do not visually look like obsidian from either Casa Diablo, which is generally black and

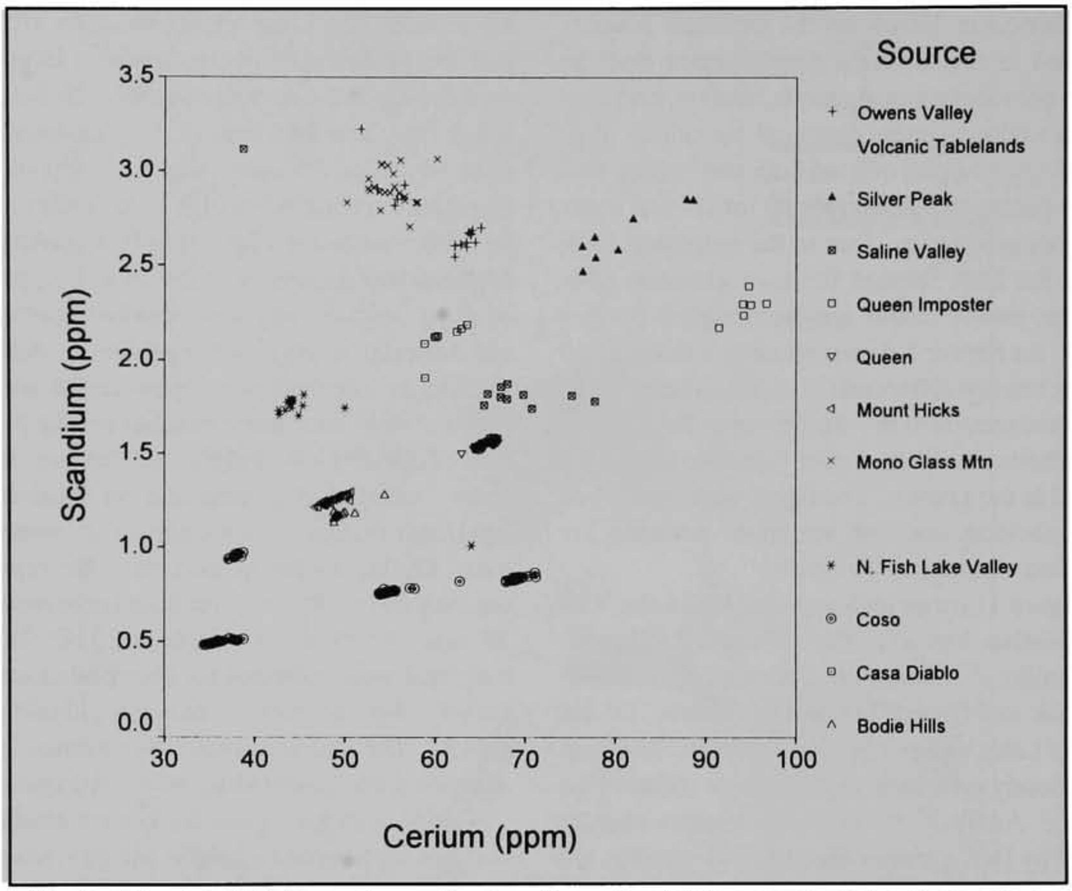

Fig. 3. Bivariate plot of scandium and cerium for major obsidian sources in the study region.

opaque, or Queen/Truman, which is generally golden brown and highly translucent (although mahogany samples are not uncommon).

The graph in Figure 3 and other chemical data presented in Table 1 suggest that Tablelands obsidian bears some resemblance to Mono Glass Mountain obsidian, and may ultimately be derived from this source. Indeed, five of the 16 samples analyzed fall within the Mono Glass Mountain cluster. How these nodules arrived within the Tablelands is beyond the scope of this report (and the authors' knowledge of the local geology), but it was noted that Chidago Canyon and several other smaller canyons that empty onto the Tablelands originate near Mono Glass Mountain. As glass from this source is at least 0.8 to 2.1 million years old (Metz and Mahood 1985, 1991), nodules have had a great deal of time to make their way downslope into secondary depositional contexts.

While the Owens Valley Tablelands obsidian bears a strong resemblance to Mono Glass Mountain, 11 of the 16 samples analyzed display a distinctive subsignature (see Fig. 3). To explore this pattern further, 22 nodules from two collection areas near Mono Glass Mountain were analyzed by INAA. Fourteen nodules came from a point termed Mono Glass 1 (37° 43' north latitude and between 118° 38' and 118° 37' west longitude), and eight samples from Mono Glass 2 (37° 41' 30" north latitude and 118° 35' 20" west longitude). Figure 5 plots the results of the INAA for manganese, antimony, and tantalum.

Figure 5 suggests that the samples can be

Table 1
CONCENTRATIONS OF ELEMENTS IN OBSIDIAN NODULES ANALYZED BY INAA

Element	Fish Lake Valley		MGM Tablelands		MGM 1		MGM 2		MGM 3	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev	mean	stdev
barium (Ba)	150.9	8.2	27.8	14.2	32.2	11.9	41.4	6.7	28.5	3.9
lanthanum (La)	31.2	1.5	30.4	0.5	24.6	1.4	23.7	0.53	23.6	1.4
lutetium (Lu)	0.28	0.01	0.413	0.011	0.458	0.018	0.529	0.006	0.37	0.008
neodymium	12.59	3.9	23.4	2.6	21.0	2.6	23.0	2.2	22.0	3.34
samarium (Sm)	1.58	0.05	4.52	0.09	4.8	0.15	5.29	0.11	4.55	0.12
uranium (U)	5.99	0.35	6.71	0.37	7.51	0.39	8.45	0.31	6.63	0.39
ytterbium (Yb)	1.19	0.05	2.25	0.17	2.52	0.17	2.93	0.15	1.99	0.09
cerium (Ce)	44.45	1.9	63.5	0.9	55.9	2.0	54.7	0.96	54.1	2.36
cobalt (Co)	0.485	0.02	0.07	0.007	0.063	0.009	0.052	0.01	0.058	0.008
cesium (Cs)	5.33	0.07	4.69	0.07	5.28	0.16	6.13	0.15	4.43	0.07
europium (Eu)	0.183	0.005	0.049	0.004	0.033	0.006	0.028	0.002	0.041	0.003
iron (Fe)	5,450.0	89.7	5,352.0	79.0	5,334.0	80.7	5,426.0	179.0	5,158.0	94.0
hafnium (Hf)	3.56	0.14	3.87	0.14	3.98	0.18	4.18	0.12	3.98	0.18
rubidium (Rb)	180.1	3.0	161.8	3.0	176.1	4.3	196.4	5.0	162.0	9.4
antimony (Sb)	0.84	0.04	0.979	0.01	1.12	0.04	1.29	0.02	0.893	0.02
scandium (Sc)	1.76	0.03	2.64	0.05	2.85	0.06	2.92	0.10	2.97	0.07
strontium (Sr)	98.4	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tantalum (Ta)	1.15	0.01	1.94	0.02	2.22	0.08	2.64	0.05	2.07	0.03
terbium (Tb)	0.122	0.04	0.566	0.03	0.653	0.03	0.748	0.02	0.553	0.03
thorium (Th)	19.8	0.31	18.0	0.27	19.2	0.46	22.0	0.44	16.8	0.24
zinc (Zn)	24.3	3.6	25.8	5.1	29.5	4.3	32.2	4.1	31.8	5.6
zirconium (Zr)	123.3	9.1	131.3	9.4	136.9	10.9	147.1	17.1	127.1	9.1
chlorine (Cl)	296.1	84.0	367.8	45.0	430.4	66.2	459.2	48.6	417.0	32.1
dysprosium (Dy)	0.622	0.24	3.67	0.33	3.9	0.37	5.04	0.88	3.29	0.33
potassium (K)	39,700.0	1,580.0	40,303.0	1,688.0	39,060.0	1,112.0	38,732.0	901.0	40,798.0	1,324.0
manganese (Mn)	440.8	16.0	249.0	7.0	278.8	13.0	353.5	11.9	299.8	5.8
sodium (Na)	27,650.0	690.0	28,192.0	873.0	29,081.0	552.0	29,581.0	629.0	28,732.0	1,392.0

grouped into at least four chemically discrete subgroups (also listed in Table 1). The first is represented only by nodules collected within the Tablelands (n = 11; termed MGM Tablelands in Table 1, indicating that they are related to MGM glass, but form a distinct subsource that is available on the Tablelands). All of the obsidian collected at Mono Glass 1 falls into a second group; however, three of the Tablelands samples and one of the Mono Glass 2 samples also fall within this chemical group (listed as MGM 1 in Table 1). Because both the Tablelands and Mono Glass 2 are located downslope from Mono Glass 1, it is likely that nodules from Mono Glass 1 were redeposited downslope through either colluvial or alluvial action. A third chemical group is composed only of samples collected at Mono Glass 2 (n = 5; listed as MGM 2 in Table 2), while the fourth group is composed of one sample from the Tablelands and eight samples from Mono Glass 2 (n = 9; listed as MGM 3 in Table 1). A final sample from the Tablelands seems to fall outside the chemical variability for all four of these groups. This piece may be part of a fifth distinct subgroup, or may represent an aberrant sample.

These results suggest, first, that Tablelands

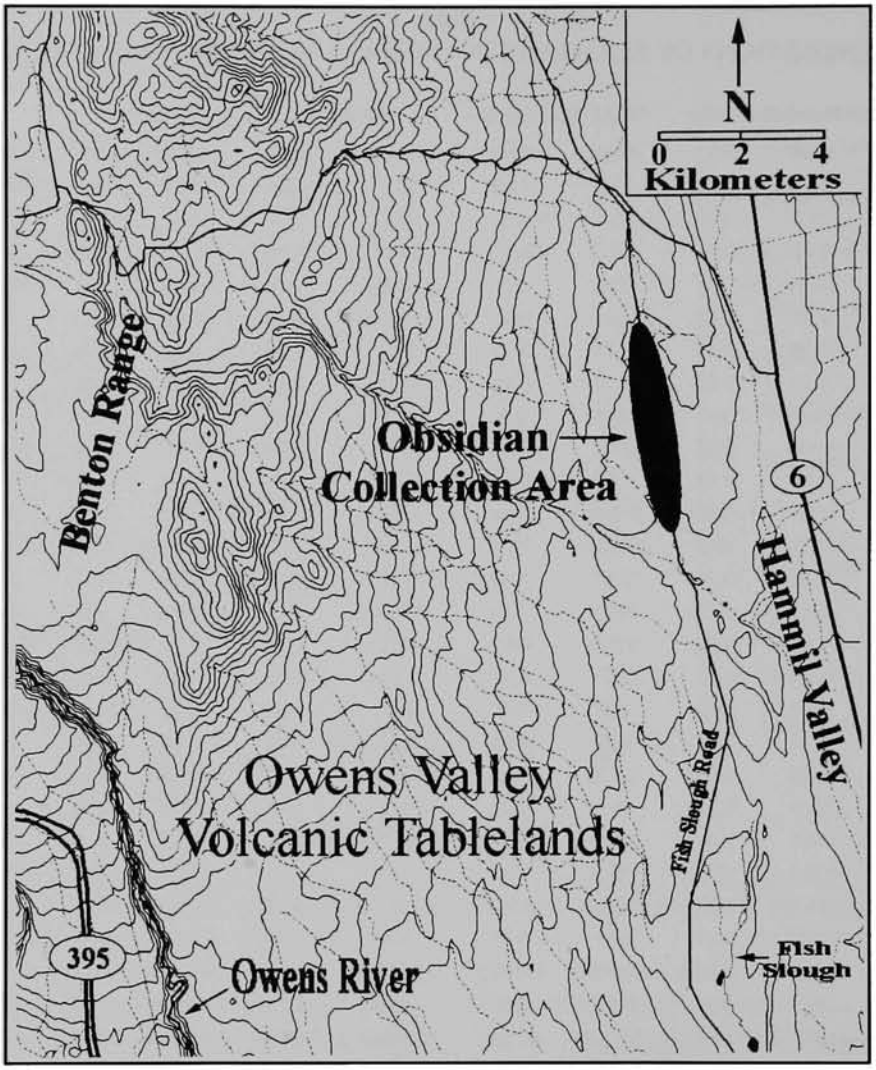

Fig. 4. Detailed map of Owens Valley Volcanic Tablelands, showing geographic source of obsidian nodules (see Fig. 1 for location within California.)

obsidian is chemically related to Mono Glass Mountain obsidian. If this is true, it would indicate that Mono Glass Mountain obsidian is available over a very large area, encompassing a minimum linear distance of over 50 km. northwest to southeast (see Hughes 1989). Second, Mono Glass Mountain, like many other sources in the area (e.g., Coso and Casa Diablo), contains numerous chemically distinct subsources. Analyses carried out by Hughes (1989) hinted that there might be distinct subsources within Mono Glass Mountain, and the current work supports this notion. Third, obsidian from the Tablelands is assignable to at least three of these subgroups. Obsidian from two of these subgroups can also be found near the main Mono Glass Mountain source to the northwest, while the third was documented only within the Tablelands. While it is possible that this third subsource is available only within the Tablelands (an important corollary, if true, for mobility and exchange studies in the region), sampling of obsidian from Mono Glass Mountain was not systematic, and additional sampling near the source may reveal the MGM

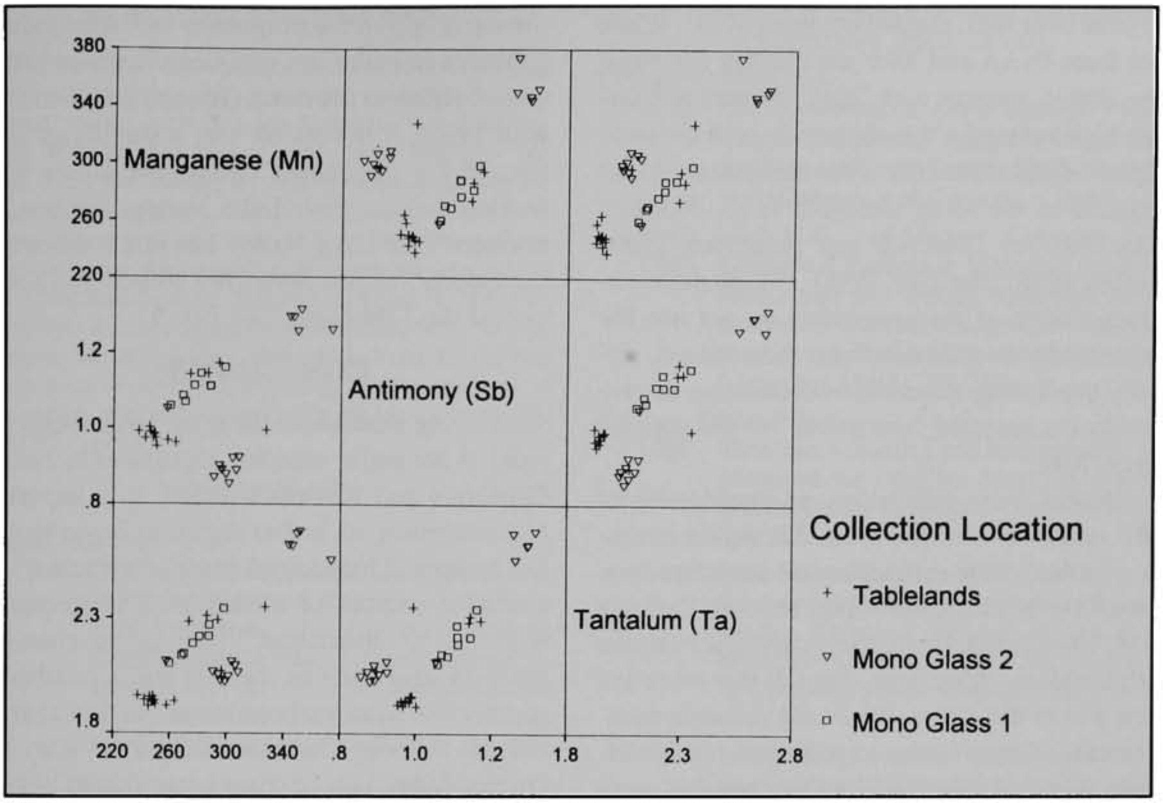

Fig. 5. Bivariate plots of manganese, antimony, and tantalum for Owens Valley Volcanic Tablelands and Mono Glass Mountain obsidian nodules. All values are in ppm.

Tablelands subsource to be present there as well. Finally, the distinct subgroups are not spatially discrete. Nodules collected in a particular location are often attributable to more than one of the subgroups, and subgroups often contain nodules collected in more than one location.

DISCUSSION

Both Fish Lake Valley and the Tablelands contain high-quality obsidian nodules that could have been exploited by prehistoric people in these areas. The small average size and dispersed nature of the obsidian nodules probably precluded intensive use of these obsidian sources, especially during earlier periods of prehistory (i.e., pre-1,350 B.P.), when the size of most formal flaked stone tools exceeded the size of even the largest nodules. However, nodules could have been used as expedient sources of toolstone for production of informal cutting and scraping tools or as raw material for smaller formal tools. The importance of these obsidian sources may have been heightened after 1,350 B.P., when it is thought that people were less mobile and access to toolstone would have been reduced (e.g., Bettinger 1982, 1989; Basgall 1989; Delacorte 1990; Basgall and Giambastiani 1995). Moreover, given the reduced size of formal tools later in time, these nodules could have been used for the production of smaller items, such as Rose Spring and Desert series projectile points. Thus, occasional exploitation, whether for expedient or more formal tools, may have been significant in the overall economy of the prehistoric inhabitants of this region.

As of this time, prehistoric use of these obsidian sources during prehistory has not been documented. Most previous obsidian studies in the area have been carried out using XRF. While data from INAA and XRF are roughly comparable—that is, sources with "high" barium will display high values for this element in both the techniques—difficulties arise when the systems do not calibrate to the same standards (e.g., RGM-1, NBS-278; see Glascock and Anderson 1993; Hughes 1998; Shackley 1998). Many older obsidian studies in the area either do not use the same standards or do not report these values, virtually precluding quantitative correlation of previously documented "unknowns" to the data reported here.

Despite these difficulties, an examination of XRF results of obsidian from this region is useful. To date, little archaeological work has been carried out in Fish Lake Valley (but see Rafferty 1988; Clay 1994), particularly chemical analyses with obsidian. Moreover, most of this work has been within the realm of cultural resource management, making access to published results difficult. On the other hand, more accessible work has been undertaken on the Tablelands. In the largest study, Basgall and Giambastiani (1995) analyzed 179 projectile points and more than 100 flakes from archaeological sites on the Tablelands by XRF. Results showed 13 of the points (7.3%) to be from the Mono Glass Mountain/ Mono Craters source (MGM/MC), while 15 (8.4%) came from unknown sources. Moreover, XRF analysis of "visually indeterminate" debitage (accounting for over half of all flakes) showed that a significant portion (20%) was assigned to the MGM/ MC source.

Unfortunately, raw data from Basgall and Giambastiani's (1995) XRF analyses were not published; thus, it was not possible to compare their MGM/MC to our Tablelands obsidian or their "unknown" specimens to our Fish Lake Valley source. However, in light of the results obtained in the current INAA analysis, it is possible—perhaps likely—that a significant fraction of this MGM/MC obsidian, particularly the debitage, was procured locally within the Tablelands. Similarly, given the propensity of Tablelands inhabitants to make use of Queen/Truman Meadows obsidian to the north (Basgall and Giambastiani 1995), it is possible that a significant fraction of the "unknown" projectile points were fashioned from Fish Lake Valley obsidian, as northern Fish Lake Valley lies just southeast of the Queen/Truman Meadows source and northeast of the Tablelands (see Fig. 1).

CONCLUSIONS

Having worked out the geographic locality of most of the major obsidian signatures in eastern California and western Nevada, it is important for archaeologists in this region to begin resolving the spatial location of some of the minor and unknown sources of obsidian. The frequency with which "unknowns" turn up in chemical analyses suggests that there is still a number of sources that have not been located and/or characterized. Although both the Fish Lake Valley and Owens Valley Tablelands sources should be considered minor in the overall pattern of obsidian use in the western Great Basin, on a smaller and more local scale, they could have provided good quality, knappable toolstone to people living in or passing through these areas.

A better and more complete understanding of how these sources were used must await future work. The use of different machines and techniques in the past, with slightly different measurements of and sensitivity to different elements, makes it very difficult to ascribe previously analyzed artifacts to one of the sources examined here. In future analyses, however, the inclusion of the two sources discussed herein should help us reconstruct the extent to which Fish Lake Valley and Owens Valley Tablelands obsidian was used.

NOTE

1. Source samples analyzed for this report, as well as additional nodules collected, are curated at Missouri University Research Reactor and are available for chemical analysis on request from the authors.

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AMS Radiocarbon Dating of Shell Beads and Ornaments from CA-ORA-378

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Accelerator mass spectrometry (AMS) dates for nine shell beads and two shell ornaments are used to test the application to Orange County of a temporal sequence developed for the Santa Barbara Channel region. Olivella *cupped,* Olivella *oblique spire-removed,* Olivella *end-removed,* Mytilus *disc, and* Megathura *small square ring and* Megathura *oval ring beads/ornaments fell within time ranges predicted by the bead/ornament chronology developed by Chester King (1981, 1990) for the Chumash area.* Olivella biplicata *barrels and caps seem not to have been occurrences of King's Late Middle or Late periods in Orange County, but rather there appears to have been a switch to Gulf of California* Olivella dama *shells for local barrel and cap manufacture.*

SYSTEMATIC bead research in southern California began in the late 1960s when King et al. (1968:75) organized bead types from the Century Ranch Project, Los Angeles, into time periods, and published a bead chart for Chumash territory. Later, by seriating grave lots from sites mostly in the Santa Barbara Channel region, King (1981, 1990) organized bead and ornament types into a chronology that he divided into three periods—Early (E), Middle (M), and Late (L)—each of which was partitioned into subphases. The sequences were developed using radiocarbon dates from both mortuary and nonmortuary contexts and by cross-dating with the general Southwest Anasazi pottery sequence (Kidder 1927; Woodbury 1979:28-29; King 1990, 1996).

After King recognized that the central California bead typology was applicable to that of the Chumash area, he hypothesized that correspondences continued southward into the coastal zone occupied historically by speakers of Takic languages. Gibson and King's (1991) analysis of about 1,400 shell, stone, and bone artifacts from 25 Orange County archaeological sites within the Newport Coast Archaeology Project (NCAP) addressed this question. Their research drew on a previous Orange County bead study (King 1986).

Application of the King (1981, 1990; also see Gibson 1992) and Bennyhoff and Hughes (1987) schemes to the NCAP bead and ornament data was attempted first without benefit of radiocar-