Obsidian Source Characterization and Human Exchange Systems on California's Channel Islands

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Abstract

X-ray fluorescence (XRF) analysis of 69 obsidian artifacts from California's Channel Islands provides evidence of a procurement network connecting the islands to eastern California, Nevada, and possibly Oregon. Our analysis of obsidian artifacts from 28 sites on the Northern and Southern Channel Islands, along with previously reported data from San Clemente Island, suggests that Channel Islanders obtained obsidian from at least five source areas, including Coso, Casa Diablo, Obsidian Butte, Mt. Hicks, and Massacre Lake/ Guano Valley. Like the adjacent mainland, however, our data suggest that people primarily used obsidian from the Coso flows. Obsidian artifacts are relatively rare on the Channel Islands, but island Chumash and *Tongva* (Gabrielino) peoples and their ancestors obtained obsidian through down-the-line exchange from the Early through Late Holocene.

Introduction

Often traded over vast distances, obsidian was one of the most prized resources for making stone tools in many regions of the world. Obsidian is a volcanic glass that forms in relatively circumscribed areas either as discrete flows or as clasts found more widely distributed in geological deposits. Most sources of obsidian have a unique geochemical composition, making them ideal for artifact source characterization (see Glascock, Braswell, and Cobean 1998; Hughes 1998; Shackley 1998). Using macro and microscopic identification techniques, a variety of researchers have documented human exchange and procurement of obsidian throughout the Americas (e.g., Barker et al. 2002; Ericson 1977; Erlandson, Moss, and Hughes 1992) and beyond. By providing the source location from which obsidian artifacts were originally procured, geochemical obsidian studies have greatly improved our understanding of ancient human exchange systems, interaction spheres, and procurement ranges.

In California, numerous investigators have studied prehistoric obsidian procurement, tool production, and exchange (e.g., Breschini and Haversat 1982; Craig and Hughes 1988; Ericson 1977; Gilreath and Hildebrandt 1997; Hughes 1989, 1994; Hughes and True 1985; Jackson and Ericson 1994; Koerper et al. 1986; Singer and Ericson 1977). Compared to most interior portions of the state, obsidian is relatively rare on the California coast and Channel Islands (Gilreath and Hildebrandt 1997; Glassow 1996), but obsidian artifacts in coastal sites have been correlated with a variety of California and Nevada sources (Fig. 1). While many obsidian source studies have been conducted on the California coastal mainland, less is known about the origin of obsidian found in sites on the Channel Islands (but see Bouey 2000; Scalise

Fig. 1. Location of obsidian sources discussed in the text.

1994, 2000). Much of the problem stems from the facts that obsidian artifacts are relatively rare on the Channel Islands, and a high percentage of the recovered debitage is often too small for precise provenance analysis.

To document obsidian exchange on California's Channel Islands (Fig.2), we obtained 78 samples for non-destructive X-ray fluorescence (XRF) analysis from museum collections, Channel Islands' archaeologists, and our own recent research. Specimens from Anacapa, San Miguel, Santa Rosa, Santa Cruz, and San Nicolas islands, along with previously analyzed specimens from San Clemente Island (Bouey 2000; Scalise 2000), suggest that Channel Islanders were involved in obsidian exchange and procurement networks extending from California to Nevada and possibly Oregon. In this paper, we summarize the results of our recent research and discuss the implications for the nature of obsidian exchange in coastal southern California. We begin with a brief discussion of the analyzed samples, as well as our research methods and techniques.

Channel Islands Obsidian Artifacts

Despite the relative dearth and small size of most obsidian artifacts found in southern California coastal sites, obsidian artifacts have been recovered from at least seven of the eight Channel Islands, including San Clemente, Santa Catalina, San Nicolas, Anacapa, Santa Cruz, Santa Rosa, and San Miguel. The lack of documented obsidian artifacts on Santa Barbara Island is probably due to the relatively limited archaeological research conducted. The presence of obsidian artifacts in burial contexts, residential localities, and in midden deposits attests to the high value placed on obsidian by coastal peoples.

Bouey (2000: 50-51) and Scalise (1994; 2000: 47) recently presented the only systematic source characterization studies of obsidian artifacts from the Channel Islands, providing data for 45 obsidian artifacts (40 identified to known sources) from six San Clemente Island sites. Most of these specimens (93%, n=37) came from the Coso area in Inyo County, with over 7% (n=3) from Obsidian Butte in Imperial County (Bouey 2000). An additional four specimens contained similar trace element concentrations but were not consistent with any known source, and another specimen could not be successfully character-

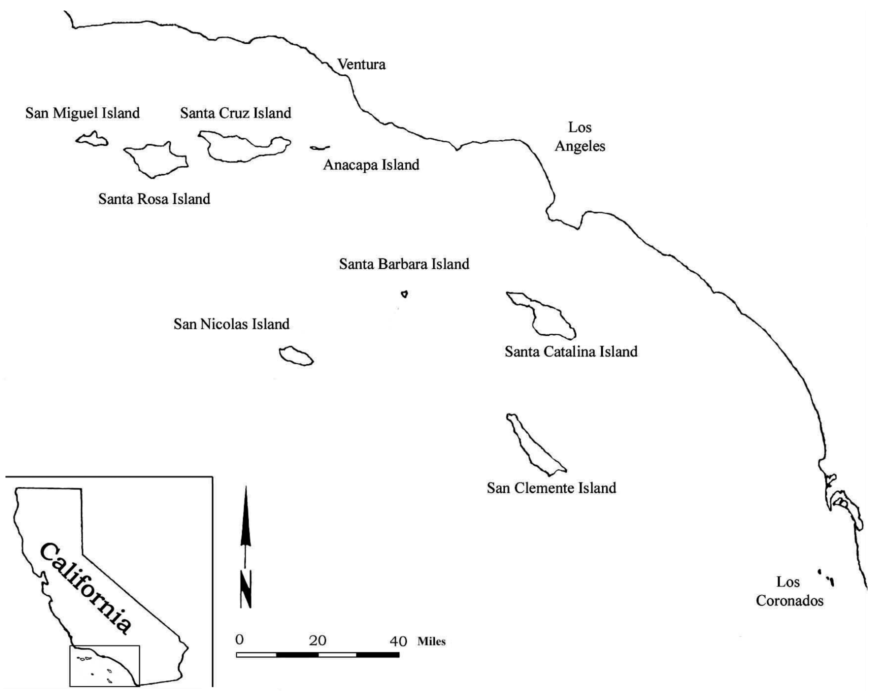

Fig. 2. Southern California coast and the Channel Islands.

ized (Bouey 2000: 49). Scalise (1994) also reported a specimen from Santa Catalina Island that was not successfully identified. Additional source locations have been reported for obsidian artifacts from San Nicolas, San Miguel, and Santa Rosa islands (Scalise 1994: 64), but many of these artifacts were reanalyzed for this study.

To increase our understanding of obsidian use and exchange on the Channel Islands, we obtained obsidian artifacts from local museums, universities, researchers, and our own recent fieldwork. We successfully characterized 69 artifacts to known sources using non-destructive XRF techniques. Our identified sample includes nine specimens from San Nicolas Island, three from Anacapa, 25 from Santa Cruz, 10 from Santa Rosa, and 22 from San Miguel. These obsidian artifacts come from 28 Channel Islands sites, a variety of archaeological contexts, and a wide range of time periods. When combined with the 40 specimens from San Clemente Island, a total of 109 obsidian specimens from the Channel Islands now have been assigned to known obsidian sources.

We attempted to make our sample as inclusive as possible, but a number of gaps persist in our data set. These include an absence of readings from Santa Catalina and Santa Barbara islands, as well as a small number of analyzed artifacts from Anacapa (n=3), Santa Rosa (n=10), and San Nicolas (n=9) islands. The data in our study, however, represent the largest currently available obsidian sample from the islands.

Analytical Procedures

C.E. Skinner analyzed the artifacts at Northwest Research Obsidian Studies Laboratory in Corvallis, Oregon. Of the 69 artifacts successfully characterized, 53 specimens produced reliable quantitative estimates of trace element concentrations. Trace element data (Ti, Mn, Fe_2O_3, Zn, Ga, Rb, Sr, Y, Zr, Nb, and Ba) were obtained using a Spectrace 5000 energy dispersive X-ray fluorescence spectrometer equipped with a Si(Li) detector with a resolution of 155 eV FHWM for 5.9 keV X-rays (at 1000 counts per second) in an area 30 mm^2. The minimum optimal sample size for analysis has been found to be approximately 10 mm in diameter and 1.5-2.0 mm thick.

Using a technique modified for small specimens that works best in areas where obsidian sources are few in number and well known, 14 obsidian flakes from Santa Cruz, one from Santa Rosa, and one from San Miguel were characterized. These 16 artifacts were analyzed using a collimated X-ray beam operated at a higher tube voltage. Because of the small size of the artifacts and the potential for somewhat inaccurate parts per million (ppm) values, no quantitative trace element values are reported for these specimens. Although early descriptions of artifacts originating from the Coso Volcanic Field consider it as a single source, Hughes (1988) documented the presence of four geochemically distinguishable flows. When possible, we have distinguished among these varieties within the Coso source area.

The diagnostic trace element values and ratios used to characterize the samples were compared to those for known obsidian sources reported in the literature and with unpublished trace element data collected through analysis of geologic source samples. Artifacts are correlated to a parent obsidian source or chemical source group if diagnostic trace element values fall within about two standard deviations of the analytical uncertainty of the known upper and lower limits of chemical variability recorded for the source. Additional details about specific analytical methods and procedures for the analyses reported here are available at the Northwest Research Obsidian Studies Laboratory website at *http://www.obsidianlab.com*.

The results of our analyses are presented in Table 1, including information on site and provenience, catalog number, type of artifact analyzed, trace element concentrations, inferred source, and site chronology. Many of our specimens are from museum collections based on excavation and reconnaissance projects conducted by early researchers and collectors and consequently lack detailed provenience. Our site chronologies are based on one-

sigma calibrated calendar age ranges from radiocarbon dates obtained for most of the archaeological sites in our study. Since many of our specimens are surface finds or have limited provenience, our chronology primarily indicates age ranges for site deposits as a whole. Consequently, many of these age estimates should be treated as general approximations rather than definitive chronological indicators.

Obsidian Sources and the Channel Islands

Our analysis of Channel Islands obsidian artifacts provides evidence for use of obsidian from four distinct California and Nevada sources located 300 km or more from the islands. Not surprisingly, the vast majority (93%, n=64) of the obsidian in our sample comes from the Coso Volcanic Field [Sugarloaf Mountain (10%, n=7), West Sugarloaf (61%, n=42), and Coso indeterminate (22%, n=15)]—the closest high quality source of obsidian to the islands. This is followed by Casa Diablo (4%, n=3), with one artifact (1%) each from Mt. Hicks in Nevada and the Massacre Lake/Guano Valley along the Oregon, California, and Nevada border (see Hughes 1986), the most distant source in our study. This last artifact, currently housed at the Santa Barbara Museum of Natural History (SBMNH), has very limited provenience information, making precise site determination difficult.

Bouey (2000) showed that 40 identified specimens from San Clemente Island were dominated by Coso

Table 1. XRF analysis of Channel Islands obsidian samples.

Site	Catalog number	Artifact	Trace Element Concentrations (parts per million)						Ratios		Artifact Source	Calibrated ^{14}C Age Range
			Rb	Sr	Y	Zr	Nb	Ba	Fe:Mn	Fe:Ti		
San Nicolas Island												
SNI-8	8-3	Debitage	241	9	49	130	45	NM	48.2	99.9	Coso (Sugarloaf Mountain)	3830-3640?
			± 4	± 7	± 3	± 7	± 2	NM				
SNI-10	10-1	Util. flake	272	9	57	140	45	NM	52.8	109.9	Coso (West Sugarloaf)	Unknown
			± 4	± 7	± 3	± 7	± 2	NM				
SNI-10	3588	Drill	274	10	57	143	51	17	42	88.5	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
SNI-25	25-21	Debitage	246	10	46	123	41	NM	51	96	Coso (Sugarloaf Mountain)	600-540
			± 4	± 7	± 3	± 7	± 2	NM				
SNI-168	168-151	Debitage	243	13	50	150	40	NM	28.7	60.9	Coso (West Sugarloaf)	4840-310
			± 4	± 7	± 3	± 7	± 2	NM				
SNI-171	171-9	Biface	239	11	48	123	44	NM	48.7	76.3	Coso (Sugarloaf Mountain)	4050-2250
			± 4	± 7	± 3	± 7	± 2	NM				
SNI-351	31-1466	Util. flake	263	9	53	136	51	NM	42.2	74	Coso (West Sugarloaf)	5870-690
			± 4	± 7	± 3	± 7	± 2	NM				
SNI-?	NA-CA-SNI-1-3	Biface	292	10	56	148	49	22	44.1	99.8	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
SNI-?	NA-CA-SNI-3A-14	Biface	291	9	55	150	49	15	33.4	89.1	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
Anacapa Island												
ANI-?	NA-CA-129-3A-14	Proj. pt.	273	14	51	163	44	4	49.4	92.3	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
ANI-?	NA-CA-129-3A-15	Proj. pt.	171	100	17	192	16	975	44.7	49.7	Casa Diablo (Lookout Mountain)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 28				
ANI-?	NA-CA-129-3A-16	Proj. pt.	272	10	52	141	51	0	31.4	105.2	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
Santa Cruz Island												
SCRI-1	3138	Proj. pt.	151	27	12	83	21	50	14.8	33.9	Mt. Hicks	2560 to ?
			± 4	± 7	± 3	± 7	± 2	± 13				
SCRI-191	881-2585	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso (West Sugarloaf)	1980-300
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-191	881-1383	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Casa Diablo	1980-300
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		

Table 1. XRF analysis of Channel Islands obsidian samples, continuted.

Site	Catalog number	Artifact	Trace Element Concentrations (parts per million)						Ratios		Artifact Source	Calibrated ^{14}C Age Range
			Rb	Sr	Y	Zr	Nb	Ba	Fe:Mn	Fe:Ti		
SCRI-191	881-1008	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso (West Sugarloaf)	1980-300
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-191	881-1040A	Debitage	274	9	55	143	53	NM	47.2	106.6	Coso (West Sugarloaf)	1980-300
			± 4	± 6	± 2	± 6	± 2	NM				
SCRI-191	881-1040B	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1980-300
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-191	881-1110A	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1980-300
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-191	881-1110B	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1980-300
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-236	885-1317	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1710-540
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-236	885-2518	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1710-540
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-240	880-7275	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	3210-500
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-257	156-3A-2	Proj. pt.	267	12	54	140	47	NM	22.3	94.8	Coso (West Sugarloaf)	Unknown
			± 4	± 7	± 3	± 7	± 2	NM				
SCRI-257	156-3A-7	Debitage	272	9	52	138	48	NM	25.1	86.3	Coso (West Sugarloaf)	Unknown
			± 4	± 7	± 3	± 7	± 2	NM				
SCRI-474	884-679	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1170-940
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-474	884-827	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1170-940
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-474	884-874A	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1530-1310
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-474	884-874B	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1530-1310
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-474	884-874C	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	1530-1310
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SCRI-?	130-3A-3	Core?	206	33	85	548	27	6	22.6	43.7	Massacre Lake/Guano Valley	Unknown
			± 4	± 19	± 3	± 7	± 2	± 12				

Table 1. XRF analysis of Channel Islands obsidian samples, contintued.

Site	Catalog number	Artifact	Trace Element Concentrations (parts per million)						Ratios		Artifact Source	Calibrated ^{14}C Age Range
			Rb	Sr	Y	Zr	Nb	Ba	Fe:Mn	Fe:Ti		
SCRI-?	1.1718/ 3082	Util. flake	263	6	50	119	45	14	25.7	114.5	Coso (Sugarloaf Mountain)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
SCRI-?	1.1718/ 3082	Util. flake	265	12	52	142	47	27	53.7	80.8	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
SCRI-?	1.1718/ 3082	Biface	267	13	55	140	48	16	28.3	109.8	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
SCRI-?	NA-CA-SCRI-XX-3A-2	Proj. pt.	267	12	53	146	48	23	35.8	75.3	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
SCRI-?	NA-CA-130-3A-1	Proj. pt.	268	11	57	138	47	28	49.1	108.6	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
SCRI-?	NA-CA-130-3A-1	Proj. pt.	280	9	53	141	47	27	47.1	109.3	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				
Santa Rosa Island												
SRI-2	4255	Proj. pt.	273	10	59	145	49	NM	34.3	114.7	Coso (West Sugarloaf)	2000-200
			± 4	± 6	± 3	± 5	± 2	NM				
SRI-3	4005	Biface	274	8	55	140	51	28	50.7	61.5	Coso (West Sugarloaf)	8300-2360
			± 4	± 7	± 3	± 7	± 2	± 13				
SRI-4	—	Proj. pt.	244	7	50	137	46	21	49	101.1	Coso (West Sugarloaf)	7400-2100
			± 4	± 6	± 3	± 5	± 2	± 27				
SRI-4	3834	Util. flake	279	12	58	143	49	41	49.2	95.2	Coso (West Sugarloaf)	7400-2100
			± 4	± 7	± 3	± 7	± 2	± 13				
SRI-9	4094	Biface	253	9	51	145	52	27	29.4	33.1	Coso (West Sugarloaf)	680-510
			± 4	± 6	± 2	± 6	± 2	± 27				
SRI-19	—	Biface	254	9	53	142	44	0	47.6	103.1	Coso (West Sugarloaf)	2960-2690
			± 4	± 6	± 2	± 6	± 2	± 27				
SRI-60	3351A	Proj. pt.	284	10	61	143	49	26	45.1	114	Coso (West Sugarloaf)	650-230
			± 4	± 7	± 3	± 7	± 2	± 13				
SRI-60	3351B	Biface	275	10	56	142	46	19	45.3	116	Coso (West Sugarloaf)	650-230
			± 4	± 7	± 3	± 7	± 2	± 13				
SRI-131	—	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	Unknown
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SRI-147	—	Debitage	243	8	51	134	47	4	48.2	99.8	Coso (West Sugarloaf)	7400-5580
			± 4	± 6	± 2	± 6	± 2	± 27				

Table 1. XRF analysis of Channel Islands obsidian amples, continuted.

Site	Catalog number	Artifact	Trace Element Concentrations (parts per million)						Ratios		Artifact Source	Calibrated ^{14}C Age Range
			Rb	Sr	Y	Zr	Nb	Ba	Fe:Mn	Fe:Ti		
San Miguel Island												
SMI-1	6678	Debitage	283	10	59	150	51	NM	50.8	80.6	Coso (West Sugarloaf)	7100-3250
			± 4	± 6	± 3	± 5	± 2	NM				
SMI-1	6679	Debitage	243	9	49	121	45	NM	44.6	43.2	Coso (Sugarloaf Mountain)	7100-3250
			± 4	± 6	± 3	± 5	± 2	NM				
SMI-1	6680	Debitage	249	7	47	123	43	NM	39.9	103.5	Coso (Sugarloaf Mountain)	7100-3250
			± 4	± 6	± 3	± 5	± 2	NM				
SMI-1	6681	Debitage	185	8	36	98	30	NM	50.7	82.2	Coso Volcanic Field	7100-3250
			± 4	± 6	± 3	± 5	± 2	NM				
SMI-1	6682	Debitage	149	11	30	77	25	NM	53.7	54.7	Coso Volcanic Field?	7100-3250
			± 4	± 6	± 3	± 5	± 3	NM				
SMI-110	2062	Biface	263	9	58	146	46	NM	36.8	102	Coso (West Sugarloaf)	Unknown
			± 3	± 6	± 3	± 5	± 2	NM				
SMI-163	—	Debitage	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Coso Volcanic Field	320-270
			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
SMI-172	1	Debitage	278	12	54	147	53	NM	49.2	105.3	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2					
SMI-172	2	Debitage	278	13	59	167	49	NM	51.1	102.8	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2	NM				
SMI-172	3	Debitage	315	11	57	150	53	NM	51	112.2	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2	NM				
SMI-172	4	Debitage	255	12	54	152	48	NM	50.7	95.3	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2	NM				
SMI-172	5	Debitage	252	15	54	148	40	NM	49.4	86.1	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2	NM				
SMI-172	6	Debitage	282	11	60	147	51	NM	49.7	89.8	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2	NM				
SMI-172	7	Debitage	265	11	52	149	48	NM	52.3	77.9	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2	NM				
SMI-172	8	Debitage	254	14	44	153	45	NM	57.4	81.6	Coso (West Sugarloaf)	6440-6270
			± 4	± 7	± 3	± 7	± 2	NM				
SMI-231	2671	Debitage	260	11	56	136	42	NM	54.4	102.8	Coso (West Sugarloaf)	Unknown
			± 4	± 6	± 3	± 5	± 2	NM				

Table 1. XRF analysis of Channel Islands obsidian samples, continuted.

Site	Catalog number	Artifact	Trace Element Concentrations (parts per million)						Ratios		Artifact Source	Calibrated ^{14}C Age Range
			Rb	Sr	Y	Zr	Nb	Ba	Fe:Mn	Fe:Ti		
SMI-257	6719	Proj. pt.	256	8	51	123	47	NM	33.1	98.9	Coso (Sugarloaf Mountain)	Unknown
			± 4	± 6	± 3	± 5	± 2	NM				
SMI-464	2066	Biface	268	8	58	146	49	NM	26.7	108.5	Coso (West Sugarloaf)	Unknown
			± 3	± 6	± 3	± 5	± 2	NM				
SMI-528	4717	Debitage	302	7	61	149	49	NM	49.6	79.6	Coso (West Sugarloaf)	1480-1120
			± 5	± 7	± 4	± 7	± 3	NM				
SMI-528	4719	Proj. Pt.	303	14	59	153	49	8	44.7	100.6	Coso (West Sugarloaf)	1480-1120
			± 4	± 7	± 3	± 7	± 2	± 40				
SMI-528	4729	Proj. Pt.	162	101	17	191	15	980	52.6	51.1	Casa Diablo (Lookout Mountain)	1480-1120
			± 3	± 7	± 3	± 7	± 2	± 13				
SMI-?	IP 3139	Biface	267	11	53	144	49	9	27.9	90.4	Coso (West Sugarloaf)	Unknown
			± 4	± 9	± 3	± 7	± 1	± 27				

(93%), with the other 7% from Obsidian Butte. An additional five specimens provided reliable trace element data, but could not be tied to any known source. Of the 109 Channel Islands artifacts now attributed to a specific obsidian source, 93% are from Coso (n=101), followed by Obsidian Butte at roughly 3% (n=3), Casa Diablo with about 3% (n=3), while Mt. Hicks (n=1) and Massacre Lake/Guano Valley (n=1) each account for about 1% of the sample. The distribution of obsidian broken down by each island also indicates a dominance of obsidian from the Coso Volcanic Field (Table 2). All 19 specimens from San Nicolas and Santa Rosa, 92% (n=37) of the San Clemente specimens, 95% (n=21) of the San Miguel samples, and 88% (n=22) of the Santa Cruz samples are from the Coso area (Fig. 3).

Since many of the obsidian artifacts in our study are from contexts with limited provenience, determining clear changes through time in obsidian exchange to the islands remains speculative. The oldest well-dated obsidian in our study is from SRI-147 located in Jolla Vieja Canyon on Santa Rosa Island, from a stratum located just above one that produced a date of roughly 7400 to 7230 cal yrs BP (see Kennett 1998). Since this level has not been dated, however, the range of this date extends from roughly 7400-5580 cal yrs BP. The SRI-147 specimen was characterized to Coso.

Specimens from SRI-3, SRI-4, and SMI-1 could also be as old as 8000 to 7000 cal BP. Each of these sites contains archaeological deposits spanning the Early and Middle Holocene, however, and SMI-1 also may have a Late Holocene component (Erlandson 1991).

Interestingly, one of the largest concentrations of obsidian from a single site is from SMI-172, a "red abalone" site dated to about 6440-6270 cal yrs BP, where Erlandson found eight West Sugarloaf artifacts in a relatively small area (about 10-by-10 m) on the site surface. Specimens from SNI-168, SNI-171, and SNI-351 may be Middle Holocene in age, although

Table 2. Number of obsidian artifacts from source by Island*

	San Clemente*	Anacapa	San Nicolas	Santa Cruz	Santa Rosa	San Miguel
Source	Number (percent)	Number (percent)	Number (percent)	Number (percent)	Number (percent)	Number (percent)
Casa Diablo (Lookout Mountain)	—	1 (33%)	—	1 (4%)	—	1 (5%)
Coso (Sugarloaf Mountain)	—	—	3 (33%)	1 (4%)	—	3 (14%)
Coso (West Sugarloaf)	—	2 (67%)	6 (67%)	10 (40%)	9 (90%)	15 (68%)
Coso Volcanic Field	37 (93%)	—	—	11 (44%)	1 (10%)	3 (14%)
Massacre Lake/ Guano Valley	—	—	—	1 (4%)	—	—
Mt. Hicks	—	—	—	1 (4%)	—	—
Obsidian Butte	3 (8%)	—	—	—	—	—
Total	40 (100%)	3 (100%)	9 (100%)	25 (100%)	10 (100%)	22 (100%)

* Based on Bouey (2000). Please note that due to rounding, the totals are not always 100%.

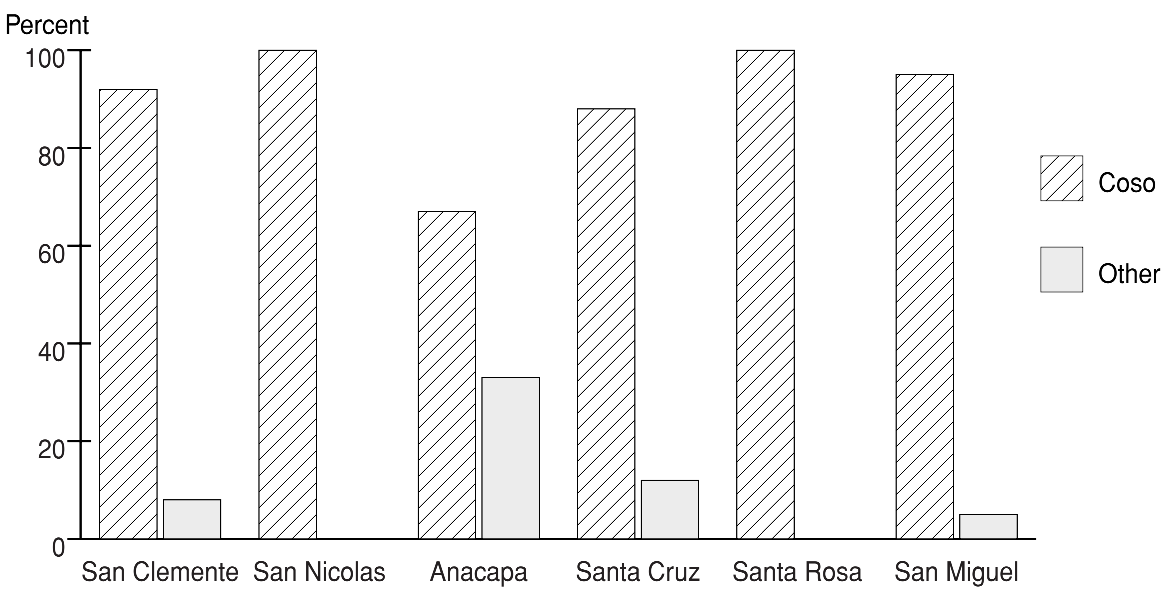

Fig. 3. Percentages of obsidian by source for the Channel Islands.

some of these sites also contain Late Holocene deposits.

Of our characterized specimens, ten are from deposits that are clearly Late Holocene in age (SNI-25, SCRI-191, SCRI-236, SCRI-240, SCRI-474, SRI-2, SRI-9, SRI-19, SRI-60, and SMI-528), with most probably dating to the late Middle or Late Periods. The specimens from SRI-60, SMI-163, and SNI-25 date to either the Late or Historic periods. Although data on changes in obsidian procurement through time are limited, our data illustrate that obsidian from Coso dominates island assemblages during all time periods represented by our samples. This appears to be true for both Chumash and *Tongva* areas where discrete cultural interaction spheres may have developed as much as 6000 years ago (Raab and Howard 2000; Vellanoweth 2001).

Table 3 presents the source location of the 69 artifacts organized by artifact type. Of our sample, 38 were debitage, 24 were projectile points or bifaces, five were utilized or retouched flakes, one was a small drill, and one was probably a core (Figs. 4 and 5). Thirty-seven pieces of debitage were from Coso (97%), with one specimen from Casa Diablo. Twenty-one of the projectile points or bifaces were from Coso (88%), with two from Casa Diablo (8%), and one from Mt. Hicks (4%). Finally, all five of the utilized flakes and drill were from Coso sources, and a possible core originated from the Massacre Lake/ Guano Valley source.

Discussion

Similar to the adjacent coastal mainland, most of our Channel Islands obsidian comes from the Coso Volcanic Field. Obsidian was probably often exchanged to the area in the form of finished tools, which were repeatedly resharpened, so that most of the obsidian artifacts in the area consist of small pressure flakes (Glassow 1996:141). Craig and Hughes (1988:113) indicate that Chumash people were known to have direct contact with several tribes who had access to Coso obsidian and may have obtained much of it from Yokuts peoples. Obsidian, however, remains relatively rare throughout the coast and ranks far behind various cherts, which were the dominant material for making stone tools.

In the Santa Barbara Channel region, a number of researchers have obtained detailed source data, but to

Table 3. Source locations for Channel Island obsidian by artifact type.*

	Projectile Point/ Biface	Utilized Flake	Debitage	Other
Source	Number (percent)	Number (percent)	Number (percent)	Number (percent)
Casa Diablo	2 (8%)	—	1 (3%)	—
Coso Volcanic Field	21 (88%)	5 (100%)	37 (97%)	1 (50%)
Massacre Lake/ Guano Valley	—	—	—	1 (50%)
Mt. Hicks	1 (4%)	—	—	—
Total	24 (100%)	5 (100%)	38 (100%)	2 (100%)

* Does not include specimens from San Clemente Island.

Fig. 4. Obsidian projectile points from Anacapa Island (left to right NA-CA-129-3A-14, NA-CA-129-3A-15, NA-CA-129-3A-16).

Fig. 5. Obsidian bifaces and projectile points from Santa Cruz and San Miguel Island (left to right 3588, IP3139, NA-CA-SNI-1-3, NA-CA-SCRI-XX-3A-2, NA-CA-SNI-3-14).

our knowledge this data has never been adequately synthesized. To contextualize our Channel Islands data, we briefly summarize obsidian source data from the southern California coast presented in various CRM reports, dissertations, and publications. Although this summary does not include all of the characterized obsidian from coastal sites, it is based on a sample of over 860 source determinations, suggesting it is relatively representative of the southern and central coasts as a whole.

On the central California coast, Jones (1995:199, 257-261) presented geochemical data for 191 obsidian artifacts from eight Monterey County sites. Eight source locations were identified, including Annadel, Bodie, Casa Diablo, Coso, Hicks/Queen, Mono, Napa, and Queen. Casa Diablo was the dominant source followed by Napa, and Coso ranked third. Obsidian hydration data for these artifacts suggest that obsidian exchange was most intense during the Early and Middle Periods and may have been closely linked to trade of sea otter pelts (Jones 1995:200). Interestingly, obsidian exchange in the central California coast was virtually non-existent during the Late Period, when shell bead exchange was at its highest on other parts of the California Coast. Since at least three of our characterized specimens (SNI-25, SMI-163, and SRI-60) clearly date to the Late Period, this pattern may not hold true for the Channel Islands. Further research, however, is needed to more accurately assess this assertion.

Erlandson et al. (1993) presented one of the larger obsidian source studies for the southern California coast, including 109 artifacts from 17 sites along the western Santa Barbara Coast that span the Holocene. Their data indicate that 97 (89%) obsidian artifacts originated from Coso, with three (2.9%) from Bodie Hills, two (1.9%) from Casa Diablo, one (0.9%) from Napa, one (0.9%) from Mono Craters/Glass Mountain, one (0.9%) from Fish Springs, and four (3.9%) from unknown sources. Obsidian from Coso dominates all time periods represented. Additional data for SBA-2087 located in Gaviota Canyon provided sources for 17 other obsidian artifacts, including eight Coso, five Casa Diablo, two Queen, and two unknown sources (Cooley, Carrico, and Santoro 1987).

The data from the western Santa Barbara Coast also provide one of the largest coastal assemblages of obsidian dated to the Early Holocene, suggesting that obsidian was exchanged or transported to the California coast by at least 8500 to 9000 years ago (Erlandson 1994:265). At SBA-1807, an Early Holocene site, geochemical data for 11 obsidian artifacts, include nine from Coso and two from an unidentified source (Erlandson 1994:90). Four obsidian flakes from the Early Holocene site of SBA-2061 all originated from the Coso Volcanic Field (Erlandson 1994:128). SBA-1951, an Early and Middle Holocene site on the western Santa Barbara Coast, also produced four artifacts from Coso (Erlandson 1994:175). SBA-1912, an Early Holocene site just north of Point Conception, produced 11 specimens from Coso and one that could not be determined (Erlandson 1994:176).

Lebow et al. (2001) reported source determinations for three obsidian artifacts at SBA-246, an Early Holocene site on Vandenberg Air Force Base, including one specimen from Mono Glass Mountain, one from Casa Diablo, and one that may have come from Annadel in Sonoma County. Craig and Hughes (1988) present source characterizations for 11 obsidian artifacts obtained from SBA-1213, an Early and Middle period site located in Montecito. All of their specimens were from the Coso Volcanic Field, including two from Sugarloaf Mountain, eight from West Sugarloaf, and one from the Coso Volcanic Field. Four obsidian artifacts in an Early Period context at SBA-1900 and three obsidian artifacts from SBA-2149 dated to roughly 2600 to 650 BP are all from Coso (Santoro et al. 1993). At SBA-16, a Millingstone site located in Summerland, Macko and

Erlandson (1980) reported XRF data for three obsidian artifacts, one from Coso and two from unidentified sources. Santoro, Toren, and Hazeltine (1992) reported three obsidian artifacts from Coso at SBA-31, an Early, Middle, and Late Period site near Santa Barbara City College.

We also recently analyzed 61 obsidian artifacts from Tecolote Canyon near Goleta, including finished projectile points, bifaces, expedient tools, and debitage. The Tecolote Canyon obsidian is primarily Late Holocene in age, but some of it may also come from Middle and Early Holocene contexts. The Tecolote materials are dominated by Coso specimens (n=50), but 11 samples were from Casa Diablo. For the Santa Barbara Coast, the data presented by Craig and Hughes, Erlandson, and others clearly show that obsidian exchange predates the intensive Late Period bead exchange documented in the area.

Researchers working in Orange and San Diego counties have produced a number of studies on obsidian source characterization and hydration, including roughly 225 artifacts assigned to known obsidian sources (see Ericson et al. 1989; Koerper et al. 1986). Current evidence suggests that obsidian from the Coso Volcanic Field was the dominant obsidian used during the Early and Middle Holocene in Orange County (Ericson et al. 1989; Koerper et al. 1986; Mason, Koerper, and Langenwalter 1996:48). At some point during the Late Holocene, obsidian from Obsidian Butte appears to dominate late assemblages (see Mason, Koerper, and Langenwalter 1996:50). This pattern may suggest that Obsidian Butte was largely submerged under the Salton Sea earlier in time (Mason, Koerper, and Langenwalter 1996:51). Since only three obsidian artifacts of the 109 analyzed Channel Islands specimens have been correlated with Obsidian Butte, it is not possible to determine if this pattern also occurs on the Channel Islands. Macko, Couch, and Koerper (2002) also recently reported an obsidian biface from ORA-64 that was characterized to the Buck Mountain source in northeastern California.

Analysis of 231 obsidian artifacts from 29 sites in San Diego, San Bernardino, and Riverside counties, provided source determinations from four distinct sources, including Obsidian Butte, Coso, Casa Diablo, and Queen (Hughes and True 1985). Most of these (75%) were from Obsidian Butte, followed by Coso (18%; Hughes and True 1985: 332). Hughes and True (1985:333) argued that sites on the coast were dominated by Coso, while those on the interior contained higher amounts of Obsidian Butte. Similarly, the amount of Coso materials increased northward towards Los Angeles County. This pattern is corroborated by our analysis of obsidian artifacts from the Channel Islands, a sample dominated by Coso (93%) with only three Obsidian Butte artifacts on San Clemente Island. This suggests that obsidian on the Channel Islands may have first made its way to the coast in Los Angeles, Santa Barbara, Ventura, and Orange counties following exchange routes along the coast and interior. This pattern attests to the strength of coastal exchange networks which, facilitated by the use of boats, appear to have thrived throughout much of the Holocene.

Conclusions

Chumash and *Tongva* peoples on California's Channel Islands were heavily involved in exchange of shell beads and ornaments and a variety of other artifacts over the last several millennia. Obsidian artifacts are relatively rare on the Channel Islands and adjacent coastal mainland, but XRF analysis of 109 obsidian artifacts from the islands illustrates that obsidian was another prized commodity for coastal peoples. Obsidian from Coso dominates much of the coastal mainland and Channel Islands, suggesting that obsidian probably made its way through "down-the-line" exchange practices (Renfrew 1972) from the Coso Range into the Los Angeles Basin, then along the coast to the Channel Islands and adjacent mainland areas from San Diego to Santa Barbara counties and beyond. On a more limited basis, specimens from Obsidian Butte, Casa Diablo, Mt. Hicks, possibly Massacre Lake/Guano Valley, and several other sources in western North America also made their way to the islands. Clearly, obsidian procurement and exchange crossed numerous tribal territories and provide further evidence for the high degree of interaction between Native peoples on the coast and in the Great Basin.

Synthesis of over 950 source determinations from the southern and central California Coast and Channel Islands indicate three fairly distinct patterns. The Santa Barbara Channel region and Channel Islands are clearly dominated by Coso, while the central California Coast from Monterey County and north is dominated by Casa Diablo and contains a higher diversity of obsidian from more northerly sources. Finally, Late Holocene sites in San Diego and to an extent Orange County contain a high degree of Obsidian Butte artifacts. These patterns suggest that, although there was interaction between all of these areas, each region had distinct trade and procurement networks shaped largely by their proximity to people who had access to a given obsidian source.

Obsidian is found in Channel Island sites that appear to span much of the Holocene. The exchange of obsidian clearly preceded the intensive bead exchange of the Late Period (Craig and Hughes 1988). Ultimately, the exchange of obsidian to the Channel Islands and a variety of goods (e.g., shell beads) to the interior are a testament to the wide-reaching and relatively ancient exchange networks and interaction spheres of Native American peoples.

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