Title

SOURCE PROVENANCE OF OBSIDIAN PROJECTILE POINTS FROM SANTEE GREENS (CA-SDI-5669), WESTERN SAN DIEGO COUNTY, CALIFORNIA

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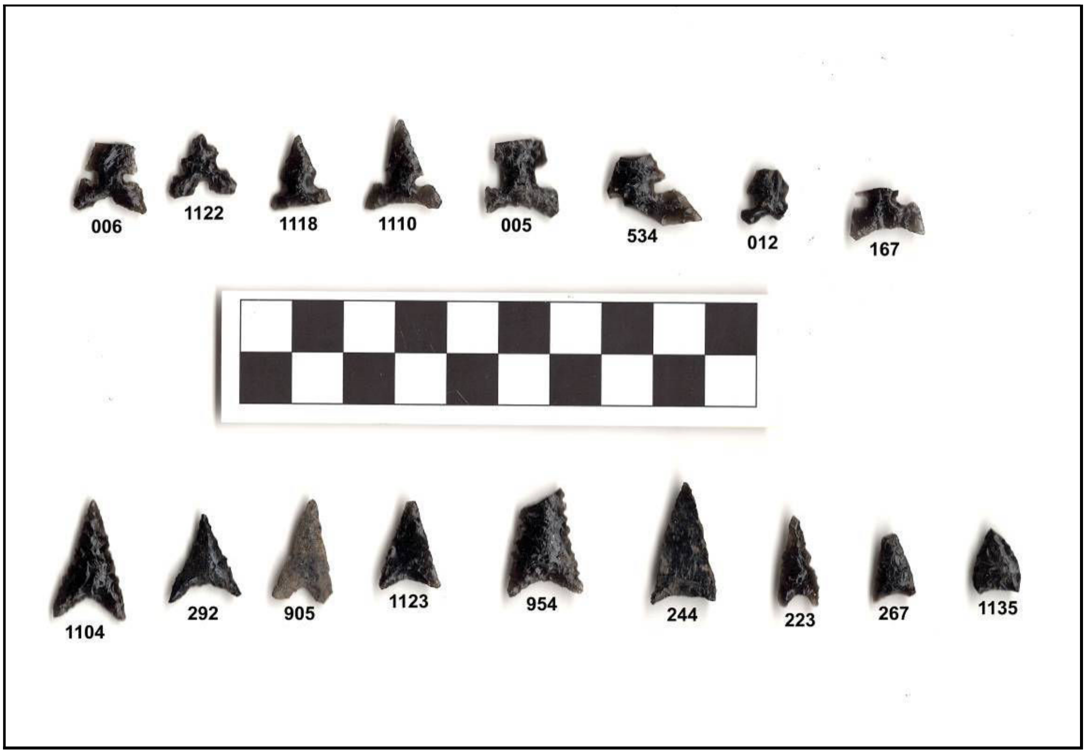

Obsidian Desert Side-Notched and Cottonwood Triangular Projectile Points from Santee Greens (see text).

by

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INTRODUCTION

The analysis here of 71 obsidian projectile points and fragments from the Santee Greens (CA-SDI-5669) prehistoric/historic site in western San Diego County indicates production predominantly from the Obsidian Butte source in Imperial County, southeastern California with one projectile point produced from the Tinajas source in northern Baja California. Both these sources are present in Late Prehistoric contexts throughout the southern San Diego and Imperial Counties of Alta California, and northern Baja California (Panich et al. 2012, 2015, 2017; Shackley 2019a). A discussion of the source provenance, source descriptions and obsidian projectile point style and technology follows a discussion of the instrumental methodology.

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

All archaeological samples are analyzed whole. The results presented here are quantitative in that they are derived from "filtered" intensity values ratioed to the appropriate x-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (McCarthy and Schamber 1981; Schamber 1977). Or more essentially, these data through the analysis of international rock standards, allow for inter-instrument comparison with a predictable degree of certainty (Hampel 1984; Shackley 2011b).

All analyses for this study were conducted on a ThermoScientific *Quant'X* energy-dispersive x-ray fluorescence spectrometer (EDXRF), located at the Geoarchaeological XRF Laboratory, Albuquerque, New Mexico. It is equipped with a thermoelectrically Peltier cooled solid-state Si(Li) X-ray detector, with a 50 kV, 50 W, ultra-high-flux end window bremsstrahlung, Rh target X-ray tube and a 76 µm (3 mil) beryllium (Be) window (air cooled), that runs on a power supply operating from 4-50 kV/0.02-1.0 mA at 0.02 increments. The spectrometer is equipped with a 200 l min^{-1} Edwards vacuum pump, allowing for the analysis of lower-atomic-weight elements between sodium (Na) and titanium (Ti). Data acquisition is accomplished with a pulse processor and an analogue-to-digital converter. Elemental composition is identified with digital filter background removal, least squares empirical peak deconvolution, gross peak intensities and net peak intensities above background.

Trace Element Analysis

The analysis for mid Zb condition elements Ti-Nb, Pb, Th, the x-ray tube is operated at 30 kV, using a 0.05 mm (medium) Pd primary beam filter in an air path at 100 seconds livetime to generate x-ray intensity Kα_1-line data for elements titanium (Ti), manganese (Mn), iron (as $Fe_2O_3^T$), cobalt (Co), nickel (Ni), copper, (Cu), zinc, (Zn), gallium (Ga), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), lead (Pb), and thorium (Th). Not all these elements are reported since their values in many volcanic rocks are very low. Trace element intensities were converted to concentration estimates by employing a linear calibration line ratioed to the Compton scatter established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the US. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). Line fitting is linear (XML) for all elements. When barium (Ba) is analyzed in the High Zb condition, the Rh tube is operated at 50 kV and up to 1.0 mA, ratioed to the bremsstrahlung region (see Davis 2011; Shackley 2011). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1988, 1995, 2005; also Mahood and Stimac 1991; and Hughes and Smith 1993). Nineteen specific pressed powder standards are used for the best fit regression calibration for elements Ti-Nb, Pb, Th, and Ba, and include G-2 (basalt), AGV-2 (andesite), GSP-2 (granodiorite), SY-2 (syenite), BHVO-2 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), NOD-A-1 and NOD-P-1 (manganese) all US Geological Survey standards, NIST-278 (obsidian), U.S. National Institute of Standards and Technology, BE-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2 (obsidian) from the Geological Survey of Japan (Govindaraju 1994).

The data from the WinTrace^{TM} software were translated directly into Excel for Windows software for manipulation and on into SPSS, ver. 21 for Windows and/or JMP 12.01 for statistical analyses as appropriate. RGM-1 a USGS rhyolite standard is analyzed during each sample run of ≤20 for obsidian artifacts to check machine calibration (Table 1).

Source assignments were made by reference to the laboratory data base (see also Panich et al. 2017; Shackley 2019a). Further information on the laboratory instrumentation and source data can be found at: http://www.swxrflab.net. Trace element data exhibited here are reported in parts per million (ppm).

DISCUSSION

Sources of Archaeological Obsidian in the Assemblage

Obsidian Butte. The obsidian source used most commonly to produced chipped stone tools, especially projectile points in the Late Prehistoric period in southern Alta California, Obsidian Butte in the Imperial Valley of southeastern California, has recently been re-examined geologically and archaeologically (Panich et al. 2012, 2017; Schmitt et al. 2019; Shackley 2019a; Figure 1 here). The source, erupted about 2.5 ka during the Late Archaic, is the dominant obsidian source in southern Alta California and less so in northern Baja California (Panich et al. 2012; Schmitt et al. 2019). It is a volumetrically large obsidian source, and although slightly vitrophyric with sparse sanidine phenocrysts, it still was a valuable tool stone source in Late Prehistory likely controlled by the ancestors of the Kumeyaay of San Diego and Imperial Counties, California and adjacent Baja California (see Figure 1). Obsidian Butte was intermittently unavailable during high stands of Lake Cahuilla in Imperial Valley at least five times during the late Holocene (Philobosian et al. 2011). A recently reported XRF analysis of over 500 obsidian artifacts from Late Prehistoric sites in San Diego and western Imperial Counties noted that over 94% of the artifacts were produced from Obsidian Butte obsidian (Shackley 2019b:28-29). This is likely mainly due Obsidian Butte as the largest obsidian source in ancestral Kumeyaay territory other than the marekanite source of Tinajas, and the large volume of glass at the source, as well as its quality as a tool stone.

Tinajas. For decades the source most commonly referenced from northern Baja California was the San Felipe marekanite source located as secondary deposits south of the town by the same name (Banks 1971; Bouey 1984; Douglas 1981; Hughes 1986). All of the known sources in northern Baja California are Neogene marekanite sources, not volumetrically large Quaternary sources like Obsidian Butte or Valle del Azufre farther south in the peninsula (see Shackley et al. 1996). Recently due to the efforts of Antonio Porcayo and Lee Panich, the character of obsidian sources in the northern part of the Baja peninsula have become more clear (Panich et al. 2012, 2015, 2017; see also http://swxrflab.net/nbajasrcs.htm). Discriminating the sources in this region is frustrated, in part, due to the similarity in elemental composition between especially San Felipe and the newly discovered Tinajas source, best discriminated on barium (Panich et al. 2017). Indeed, many of the artifacts north of the border that had been assigned to San Felipe, are actually from the newly discovered source of Tinajas, nearer the border in Baja California and the southeastern part of Kumeyaay territory (Panich et al. 2017; Figure 1 here).

The obsidian chemical group referred to here as Tinajas obsidian was first noted in an archaeological assemblage from Mission Santa Catalina (dated ca. 1797–1840) in the southern Sierra Juárez of Baja California (Panich 2009). As discussed above it appears to have been common throughout the region; a small sample of obsidian artifacts (n=9) from the mission was originally misattributed to the San Felipe obsidian group (Panich 2009:233–234). However, an expanded XRF analysis of an additional 27 obsidian artifacts from the mission suggested the presence of an as yet unknown source of obsidian with a chemical composition that is slightly different from San Felipe glass, also discussed above (Panich 2009). This hypothesis has been borne out by further provenance studies of archaeological and geological obsidian in the region (Panich et al. 2012, 2015, 2017). Recent research has provided clues to the location of the primary geological source locality (or localities) of the Tinajas chemical group. Panich and Porcayo's reconnaissance surveys of secondary geological deposits in the San Felipe-Puertecitos region between 2010 and 2014 suggested that Tinajas obsidian is not geologically available south of the Sierra Juárez. In late 2015 and early 2016, Porcayo collected small nodules (measuring < 4 cm in maximum dimension) matching this chemical group from secondary geological deposits in and around the Sierra de las Tinajas, with a particularly rich area of nodules near Tres Pozos at the southwestern extent of the modern Laguna Salada. This zone is roughly halfway between San Felipe and Obsidian Butte, putting the apparent geological source of this obsidian much closer to the modern international border and near the boundary between the Kumeyaay and Cucapá ethnolinguistic provinces. Given the variation in elemental values from archaeological and geological specimens that were examined for the 2017 study (Panich et al. 2017), Tinajas obsidian may ultimately represent multiple discrete subsources, typical for Neogene rhyolite systems in western North America (Shackley 2005; Shackley et al. 2018). The recent study of over 500 obsidian artifacts from San Diego and western Imperial Counties, California indicated that while Obsidian Butte overwhelmingly dominated late prehistoric assemblages, Tinajas and a lesser extent San Felipe was also present in these sites (Shackley 2019a). While Tinajas represented only about 2% of the obsidian assemblages (there was one San Felipe from a site in Pine Valley, eastern San Diego County) out of 535 samples from sites from the coast to the Colorado Desert, at Indian Hill (CA-SDI-2537) on the eastern edge of the Peninsular Ranges in far eastern San Diego County over 4% were produced from Tinajas. Artifacts produced from Tinajas obsidian were recovered from sites from western San Diego County into the Peninsular Ranges including prehistoric Kumeyaay mountain sites that were part of the fall gathering of Kumeyaay clans and where obsidian was certainly exchanged with other Kumeyaay including clan relatives (Shackley 2019a). While southern Great Basin sources do occur in late prehistoric sites in the region (i.e Coso Volcanic Field and Casa Diablo obsidian), at least some of that could have been scavenged from Archaic occupations, sometimes below the late prehistoric levels as at Indian Hill. Indeed, some of the Tinajas obsidian recovered in mountain sites were finished projectile points that could have been brought to the mountains during the fall as arrows for the deer hunting and acorn gathering season that certainly occurred at this time. So, it appears that Tinajas was a significant source for Kumeyaay knappers and was distributed throughout Kumeyaay territory indicating contact between desert, mountain, and coastal clans (*cimul*). One Cottonwood Triangular projectile point at Santee Greens was produced from the Tinajas source (Cat. # 1135). Analysis of the debitage from Santee Greens would likely produce more from this source, unless it appears in San Diego County sites mainly as finished projectile points from transported arrows and not as raw material, a pattern not yet clear.

Results of the XRF Analysis. As discussed above, all but one of the projectile points and fragments in this assemblage were produced from Obsidian Butte, a pattern typical in San Diego County sites (Shackley 2019a; Figure 2 here). At the Rancho Fanita site (CA-SDI-204), located downstream along the San Diego River, the assemblage analyzed was also dominated by Obsidian Butte (n=22). This large site is likely generally contemporaneous with Santee Greens, but was not professionally investigated, and there are no dates available from the site.

Nevertheless, the dominance of Obsidian Butte is apparent at Rancho Fanita as well. Another relatively nearby site at Sycamore Canyon to the north (CA-SDI-13811) also exhibited one Obsidian Butte produced artifact, but also one projectile point produced from the West Sugarloaf locality in the Coso Volcanic Field in Inyo County, California (Shackley 2019a:28). It is certainly possible that artifacts produced from other sources will also be evident in the analysis of obsidian debitage from Santee Greens.

Projectile Point Technology. The two general types of Late Prehistoric projectile points produced in San Diego County sites are Cottonwood Triangular and Desert Side-Notched. The latter originally defined by Baumhoff and Byrne in 1959, mainly from areas of California north of San Diego County. The types defined by them, including those produced from obsidian, are commonly found in San Diego County sites, including Santee Greens. Baumhoff and Byrne were mainly interested in Desert Side-Notched points as time markers as well as some interest in technology and style (1959). The dating of the style in 1959 was based on conventional ^{14}C dates and were all recovered in contexts dating after about AD 1000 up into the historic period, certainly overlapping dates from Santee Greens. There is a cultural/stylistic significance of the Desert Side-Notched style for this region. Baumhoff and Byrne noted that the style "did not diffuse north of San Diego County" also noted by True and others working in both Kumeyaay sites in southern San Diego County and Luiseno (Takic) sites in northern San Diego County (Baumhoff and Byrne 1959:59; True 1970; True et al. 1974; see also Shackley 2019a; Justice 2002). Desert Side-Notched point styles, however, are common in the western Great Basin (Thomas 1981).

All the forms of Desert Side-Notched points described by Baumhoff and Byrne (1959), as mentioned above are present in this assemblage and throughout Late Prehistoric sites in San Diego County. The General, Sierra, and Delta sub-types are present in the Santee Greens obsidian point forms (see Figure 3). The Sierra type with a notch in a u-shaped base is present as two specimens (Figure 3, Cat. #'s 006 and 1122). This type almost always produced from obsidian seems most common in Peninsular Range sites (i.e. Cuyamaca and Laguna Mountain sites), and was noted as such by True at the Dripping Springs site (CA-SDI-860) in Cuyamaca Rancho State Park. In the Shackley study this style was recovered at Laguna Meadow (SDI-8566), Noble Creek (SDI-9441), Arrowmakers Ridge (SDI-913) all mountain sites, and Dehesa (SDI-10540), and Rose Canyon (SDI-12557). The latter two sites are in the foothills and along the coast, but all were produced from obsidian (Shackley 2019a:Supplement). There is no technological advantage for this style. The basal notch is embedded within the haft and both unseen and not of any real use in hunting. The form is purely stylistic, and why it is more common in the mountain sites is likely due to a social function within Kumeyaay society during the fall acorn harvest where groups from all areas (coast, foothill, desert) came together (Cuero 1970; Gamble and King 2011; Gifford 1931, Lee 1978; True 1970; see Shackley 2005 for a similar pattern among Preclassic Hohokam). The presence of this style west of the mountains is likely due to kin relationships and exchange during this season and simply carrying the points/arrows back to homes to the west of the mountains.

The relationship between Cottonwood Triangular styles and Desert Side-Notched has received some scrutiny (see Christenson 1997; Loendorf et al. 2018, 2019;). While it is certainly possible to produce a side-notched point from a triangular form simply by pressing notches in the basal element, many hafted Cottonwood Triangular points have been recovered in dry contexts, so they are not merely preforms for side-notched points (Rozaire 1962). Cottonwood Triangular is mainly classified into v-shaped and u-shaped haft elements, both of which are in this collection (Figure 3). Chronologically, Cottonwood Triangular points appear to be somewhat older than Desert Side-Notched styles, and there is some indication that there are some earlier Late Prehistoric sites in San Diego County, possibly pre-dating the introduction ceramic technology, that do not exhibit Desert-Side Notched styles. This could be an effect of pre-dating the "intrusion" of ceramic producing Patayan groups from Arizona and the Lake Cahuilla region, but the evidence, given that few sites date between the Archaic and introduction of ceramics, is scarce (Cooley 1998; Shackley 2019b).

Finally, the obsidian projectile point breakage patterns and rejuvenation suggest an active bow and arrow hunting assemblage. Points like Cat. # 1122, and 012 are likely in-haft rejuvenations typical of active hunting behavior (Loendorf et al. 2018, 2019). Hunting along the San Diego River basin and beyond is certainly evident in the obsidian projectile point assemblage.

The analysis here of the obsidian projectile points from Santee Greens should be seen as a first step in the understanding of obsidian procurement, exchange, and social networking in the history of the site. Research in the Great Basin has found that obsidian debitage including biface thinning flakes, due to in-haft rejuvenation, carried throughout the territory often indicates greater diversity of sources and greater distance to source than the projectile points themselves (Eerkens et al. 2007). It is entirely possible that the same pattern will occur in the Santee Greens obsidian debitage assemblage.

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Table 1. Elemental concentrations for the archaeological specimens and USGS RGM-1 rhyolite standard. Measurements in parts per million (ppm).

Cat#	Ti	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb	Ba	Pb	Th	Source
5	1353	372	16971	118	137	34	110	343	25	603	13	38	Obsidian Butte, CA
6	1380	378	17551	142	132	34	111	321	38	554	13	21	Obsidian Butte, CA
10	1456	418	19292	99	144	40	118	391	37	625	14	24	Obsidian Butte, CA
12	1440	379	17425	163	127	36	95	323	32	575	19	20	Obsidian Butte, CA
32	1415	385	18092	114	142	32	116	322	33	587	14	20	Obsidian Butte, CA
40	1637	447	20072	145	140	42	107	383	30	597	15	27	Obsidian Butte, CA
42	1322	347	17015	126	145	33	116	333	25	572	12	31	Obsidian Butte, CA
43	1350	392	17636	168	134	36	113	348	32	546	18	30	Obsidian Butte, CA
93	1312	382	16913	145	136	35	115	318	30	578	23	25	Obsidian Butte, CA
98	1427	401	16770	140	147	32	116	307	25	587	14	18	Obsidian Butte, CA
101	1447	394	18258	135	139	40	112	341	27	559	13	21	Obsidian Butte, CA
114	1555	416	20608	113	138	37	117	334	28	620	18	19	Obsidian Butte, CA
116	1564	372	16806	188	130	32	108	309	27	519	16	12	Obsidian Butte, CA
131	1427	407	18161	103	144	34	110	344	26	623	11	20	Obsidian Butte, CA
167	1419	367	16648	118	137	27	113	313	25	521	13	16	Obsidian Butte, CA
223	1390	433	18355	138	137	34	108	329	29	605	16	22	Obsidian Butte, CA
244	1290	343	16139	84	124	41	104	334	28	733	11	19	Obsidian Butte, CA
249	1366	372	17498	101	141	30	121	330	34	647	20	21	Obsidian Butte, CA

259	1310	397	17771	135	146	32	111	318	32	620	13	32	Obsidian Butte, CA
264	1293	383	17247	140	140	26	113	320	24	561	14	25	Obsidian Butte, CA
267	1707	405	18885	129	124	49	96	372	26	676	8	8	Obsidian Butte, CA
272	1396	380	17981	150	140	37	105	323	23	591	11	20	Obsidian Butte, CA
292	1327	377	16904	125	135	29	111	309	26	571	12	15	Obsidian Butte, CA
349	1266	393	17007	215	146	32	115	293	24	454	15	26	Obsidian Butte, CA
369	1350	350	17163	87	147	34	118	337	28	599	13	21	Obsidian Butte, CA
450	1285	413	17602	138	146	36	115	324	26	544	15	32	Obsidian Butte, CA
465	1448	412	18429	124	139	34	114	339	31	632	13	23	Obsidian Butte, CA
493	1274	380	17216	90	139	33	118	339	31	684	11	21	Obsidian Butte, CA
497	1796	403	18854	170	120	46	101	371	26	706	9	15	Obsidian Butte, CA
507	1435	400	18371	185	141	34	115	322	29	555	15	25	Obsidian Butte, CA
508	1360	409	17653	100	140	36	110	345	32	612	10	20	Obsidian Butte, CA
521	1373	359	16353	112	127	32	112	312	30	686	15	22	Obsidian Butte, CA
Cat#	**Ti**	**Mn**	**Fe**	**Zn**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Ba**	**Pb**	**Th**	**Source**
525	1289	374	16782	134	133	26	115	316	24	559	8	24	Obsidian Butte, CA
534	1420	417	18267	120	143	36	113	350	30	648	14	17	Obsidian Butte, CA
537	1424	378	18401	107	140	38	113	346	28	663	12	26	Obsidian Butte, CA
542	1385	409	17913	147	132	41	106	332	25	590	12	33	Obsidian Butte, CA
580	1409	384	16958	118	136	33	112	324	28	568	13	16	Obsidian Butte, CA
587	1530	437	18254	96	133	42	102	362	21	693	9	30	Obsidian Butte,

													CA
608	1241	387	17241	119	146	31	117	311	37	604	23	24	Obsidian Butte, CA
639	1489	416	18862	117	134	44	113	359	29	594	14	18	Obsidian Butte, CA
646	1313	387	16938	103	134	31	112	322	28	647	14	22	Obsidian Butte, CA
649	1365	396	17142	101	139	33	108	327	37	572	12	23	Obsidian Butte, CA
658	1486	370	17409	132	143	30	112	318	30	531	16	40	Obsidian Butte, CA
670	1536	393	17922	151	132	34	106	337	25	613	12	20	Obsidian Butte, CA
689	1376	377	17058	150	140	33	113	296	32	518	13	15	Obsidian Butte, CA
698	1293	377	17192	134	133	27	114	317	28	635	11	27	Obsidian Butte, CA
703	1331	415	17880	100	146	33	113	327	31	596	20	39	Obsidian Butte, CA
732	1408	387	17777	181	141	36	109	312	32	473	12	27	Obsidian Butte, CA
770	1344	386	17354	90	135	37	111	355	28	657	8	16	Obsidian Butte, CA
785	1518	414	18275	120	147	40	119	365	31	597	15	28	Obsidian Butte, CA
824	1486	402	18392	109	139	42	106	346	28	661	13	24	Obsidian Butte, CA
873	1504	386	17732	124	134	36	105	320	25	654	18	28	Obsidian Butte, CA
905	1707	420	18363	320	154	38	110	298	29	607	17	21	Obsidian Butte, CA
908	1551	414	18203	119	131	40	102	365	27	618	17	23	Obsidian Butte, CA
941	1626	400	18408	195	129	36	95	349	26	533	22	13	Obsidian Butte, CA
944	1543	458	18467	143	149	38	111	336	25	533	14	20	Obsidian Butte, CA
954	1339	403	18012	93	136	34	114	371	24	661	16	22	Obsidian Butte, CA
962	1404	371	18095	148	147	31	115	321	29	491	19	21	Obsidian Butte,

													CA
963	1564	401	17909	136	134	36	104	325	25	597	17	20	Obsidian Butte, CA
981	1305	392	16970	122	135	25	114	318	32	651	14	21	Obsidian Butte, CA
986	1376	356	16973	124	138	32	110	315	23	578	11	23	Obsidian Butte, CA
1016	1325	399	18963	156	145	31	114	310	26	640	22	24	Obsidian Butte, CA
1104	1168	349	15628	99	128	30	116	315	23	643	11	25	Obsidian Butte, CA
1107	1540	456	19813	161	147	32	118	314	34	512	20	33	Obsidian Butte, CA
1110	1274	366	17588	116	147	33	112	332	32	614	13	37	Obsidian Butte, CA
1118	1265	363	16851	122	139	28	110	312	32	600	9	16	Obsidian Butte, CA
Cat#	**Ti**	**Mn**	**Fe**	**Zn**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Ba**	**Pb**	**Th**	**Source**
1122	1485	403	18138	140	132	35	111	354	31	665	17	36	Obsidian Butte, CA
1123	1322	378	16956	96	137	39	111	333	27	699	14	25	Obsidian Butte, CA
1135	1032	286	10801	109	148	44	35	117	8	1183	18	15	Tinajas, Baja CA
1137	1366	396	18277	118	139	38	114	365	27	660	12	21	Obsidian Butte, CA
1150	1355	368	17736	145	137	30	112	320	31	557	14	17	Obsidian Butte, CA
RGM1-S4	1574	305	13131	39	150	105	22	225	9	807	23	22	standard
RGM1-S4	1578	288	13267	46	149	107	26	219	6	817	22	18	standard
RGM1-S4	1570	292	13165	43	148	105	26	216	14	817	23	11	standard

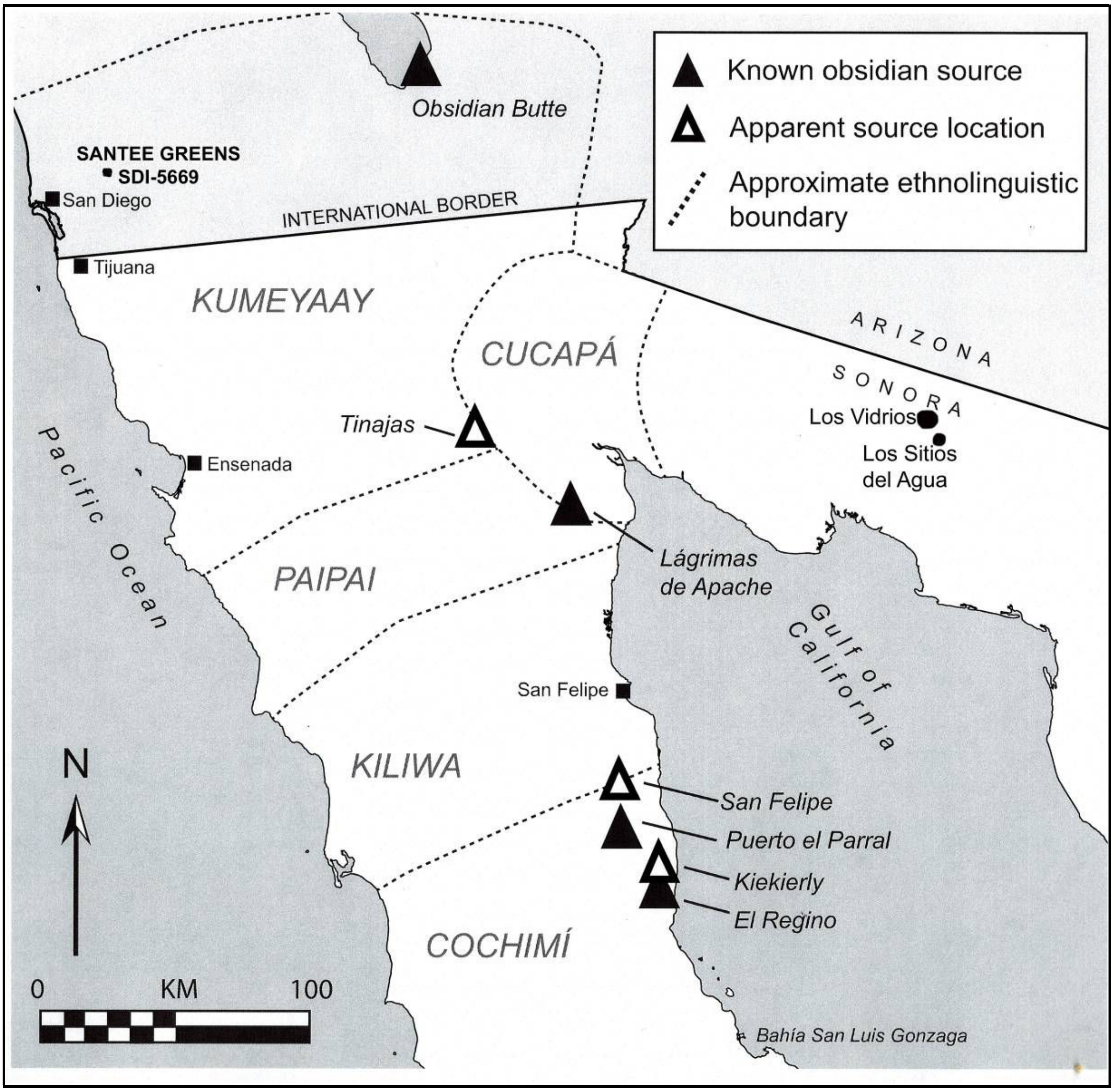

Figure 1. Sources of archaeological obsidian in the southern Alta California, northern Baja California, and northwestern Sonora region and the approximate location of the Santee Greens site (adapted from Martynec 2011; Panich et al. 2017; Shackley 2005, 2019b).

Figure 2. Ba/Y and Zr/Sr bivariate plots of the archaeological specimens and Obsidian Butte and Tinajas source standard data. Confidence ellipses at 95%. Compare to Shackley 2019a: Figures 4 and 7).

Figure 3. Selected obsidian Desert Side-notched (DSN; top row) and Cottonwood Triangular (bottom row) projectile points from Santee Greens (see text). All produced from the Obsidian Butte source except #1135 produced from the Tinajas source in northern Baja California (Catalog numbers as in Table 1). Specimens 006 and 1122 (top row) with notched base would be classified as Sierra sub-type of DSN in the Baumhoff and Byrne typology (1959; Justice 2002) and are typically more common in Peninsular Range (mountain) sites in San Diego County than in the western portion of the county and generally produced from obsidian (Shackley 2019a; True 1970). Specimen 905 is a burned point, but the elemental concentrations of burned obsidian does not necessarily affect the elemental composition (Shackley and Dillian 2002).