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X-RAY FLUORESCENCE (XRF) ANALYSIS OF OBSIDIAN ARTIFACTS FROM THE MARANA HOHOKAM COMPLEX, SOUTH CENTRAL ARIZONA

by

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Introduction

The following is a report of a x-ray fluorescence analysis of 70 obsidian artifacts from the Marana Hohokam Complex in south central Arizona. The analysis indicates that 68 of the artifacts were procured from the Sauceda Mountains source to the west near Gila Bend. The remainin two specimens are projectile points produced from Superior (Picketpost Mountain) obsidian north of the Gila River. The source provenience is similar to other Classic Hohokam contexts in central Arizona (see Shackley 1986a and 1986b).

Methodology

All obsidian debitage, and projectile points were subjected to the same analytic conditions. Melt incompatible trace elements were used to determine the source.

The samples were analyzed for rubidium (Rb), strontium (Sr), zirconium (Zr) using the semi-quantitative rapid scan method (Jack and Carmichael 1969) on a manual Philips PW 1410 wavelength x-ray spectrometer with a Philips power supply, ratemeter and teletype in the Chemistry Department at Arizona State University. A tungsten (W) x-ray tube, scintillation counter and LiF (200) crystal were used operated in a vacuum path at 45Kv and 45mA for 80 live-seconds per element. The intensity values for all elements were computed for ratios of RbKa, SrKa, ZrKa radiation lines. The data were reduced through specific programs with a Zenith Z-161 Data Systems microprocessor. The elemental proportions are divided by the rubidium peak intensity and summed. These results are then divided by the summed intensities and the resulting element ratios are plotted in a ternary system for comparison to known obsidian sources in the Southwest (see Table 1 and Figure 1). The solid incompatible elements Rb, Sr, Zr, and Nb are quite sensitive in separating rhyolite glass sources (Cann 1983; Cox et al. 1979; Zielinski et al. 1977). Niobium (Nb) is normally utilized when strontium values are low. In this study, niobium was not necessary to confidently assign the artifacts to the two sources.

Some samples were so small that they could not be analyzed. These were mainly small flakes and shatter from the trash pit in Locus H. The specimens are megascopically similar to Sauceda and the other pieces in the locus and are most likely from Sauceda.

Discussion

The dominance of a single obsidian source at Marana is an apparently common pattern in Classic period contexts (Shackley 1986a). Locus H exhibited the largest quantity of obsidian, all from the Sauceda source. This locus included debitage, and reduced and unreduced nodules suggesting lithic production. Biface fragments and preforms also occurred here, further suggesting production of obsidian in the Locus H area. The obsidian in the other site areas may have originated from the knapper in this locus, but the geochemical data are insufficient to substantiate this behavior.

The geochemical results from the site obsidian overlap the Slate Mountain (Wallace Tank) source material, but the Slate Mountain obsidian is quite different from Sauceda (Figure 1). Slate Mountain is vitrophyric, containing relatively large phenocrysts of plagioclase and frequently the glass is a mahogany brown (Shackley 1986c). The site obsidian is megascopically identical to Sauceda, both in nodule form (marekanites) and color and opacity. Further chemical analyses were not considered necessary to determine the Sauceda origin.

The Sauceda source is chemically bimodal (previous Unknown a and b; Shackley 1986a). The nodules are mixed within a conglomerate and alluvium near the Sauceda rhyolite and perlite/vitrophyre domes (Shackley 1986c). The nodules at the rhyolite domes were completely expended prehistorically, and archaeological assemblages tend to be more heterogeneous exhibiting more of one mode than the other.

The nodules at Marana could have been collected in a single visit to the source. The production focus in Locus H seems similar to the Sauceda origin obsidian production at Brady Wash where Sauceda B predominates (Shackley 1986a). None of the Tertiary obsidian sources in central Arizona exhibit any evidence of physical control by any prehistoric group. If obsidian was "controlled" in the Classic period, it must have been at the sites, or was present as social boundary defense where groups were on their 'honor' to pay tribute to the owners (see Hewlett et al. 1982). This, of course, is difficult to detect in the archaeological record. Brady Wash and Ak Chin sites also exhibited large proportions of Sauceda obsidian. This may be simply due to the excellent medium for tool production presented by the Sauceda obsidian (Shackley 1986c).

REFERENCES/BIBLIOGRAPHY

Cann, J. R.
1983 Petrology of Obsidian Artefacts. In The *Petrology of Archaeological Artefacts*, edited by D.R.C. Kempe and A.P. Harvey, pp. 227-255. Clarendon Press, Oxford.

Cox, K.G., J.D. Bell, and R.J. Pankhurst
1979 *The Interpretation of Igneous Rocks*. George Allen & Unwin, London.

Hewlett, b., J.M.H. van de Koopel, and L.L. Cavalli-Sforza
1982 Exploration Ranges of the Aka Pygmies of the Central African Republic. *Man* 17:418-430.

Jack, Robert N.
1971 The Source of Obsidian Artifacts in Northern Arizona. *Plateau* 43(1):103-114.

Jack, Robert N., and I.S.E. Carmichael
1969 The Chemical 'Fingerprinting' of Acid Volcanic Rocks. *California Division of Mines and Geology*, Special Report 100, pp. 17-32.

Shackley, M. Steven
1986a Diachronic and Spatial Variability of Obsidian Procurement in the American Southwest: A Trace Element Exploration of Southwest Obsidian Sources. Paper Presented at the 51st Annual Meeting of the Society for American Archaeology, New Orleans.

1986b Obsidian Geochemistry and Lithic Technology: Inferences for Archaic Hunter-Gatherer Procurement Ranges. In *Prehistoric Hunter-Gatherers of South Central Arizona: The Picacho Reservoir Archaic Project*, edited by Frank E. Bayham, Donald H. Morris, and M. Steven Shackley. Anthropological Field Studies No. 13, pp. 171-190. Arizona State University.

1986c Sources of Archaeological Obsidian in the Southwest: An Archaeological, Petrological, and Geochemical Study. Manuscript submitted to *American Antiquity*, November, 1986.

Zielinski, R. A., P.W. Lipman and H.T. Millard
1977 Minor Element Abundances in Obsidian, Perlite and Felsite of Calc-Alkalic Rhyolites. *American Minerologist* 62:426-437.

Table 1. X-ray fluorescence net intensity ratios for obsidian artifacts from the Marana Hohokam Complex.

SAMPLE NO.	Rb/Rb	Sr/Rb	Zr/Rb	SUM	Rb	Sr	Zr	PROBABLE SOURCE
Surface								
1158	1.00	0.7097	1.6194	3.3290	0.3004	0.2132	0.4864	All Sauceda Mts A except where noted
No locus specified								
3073	1.00	0.8170	1.8550	3.6721	0.2723	0.2225	0.5052	
732-1	1.00	0.7493	1.7579	3.5072	0.2851	0.2136	0.5012	
732-2	1.00	0.7877	1.7324	3.5201	0.2841	0.2238	0.4921	
Locus A								
3506	1.00	0.8388	1.8458	3.6846	0.2714	0.2277	0.5009	
3065	1.00	0.7099	1.6399	3.3499	0.2985	0.2119	0.4896	
3271	1.00	0.7170	1.5854	3.3024	0.3028	0.2171	0.4801	
Locus D								
1022	1.00	0.7732	1.8923	3.6655	0.2728	0.2109	0.5163	
7857	1.00	0.1176	1.0209	2.1385	0.4676	0.0550	0.4774	SUPERIOR
7840	1.00	0.1767	0.9552	2.1320	0.4691	0.0829	0.4481	SUPERIOR
Locus E								
3401	1.00	0.5795	2.0378	3.6172	0.2765	0.1602	0.5634	SAUCEDA MTS B
3032	1.00	0.7729	1.7260	3.4989	0.2858	0.2209	0.4933	
6263	1.00	0.7922	1.8098	3.6020	0.2776	0.2199	0.5024	
11788	1.00	0.7650	1.8514	3.6164	0.2765	0.2115	0.5119	
Locus F								
1018	1.00	0.8001	1.7351	3.5352	0.2829	0.2263	0.4908	
Locus H								
687-1	1.00	0.7395	1.7373	3.4768	0.2876	0.2127	0.4997	
687-2	1.00	0.7295	1.7654	3.4949	0.2861	0.2087	0.5051	
687-3	1.00	0.7581	1.7613	3.5194	0.2841	0.2154	0.5004	
687-4	1.00	0.6404	1.5130	3.1534	0.3171	0.2031	0.4798	
720	1.00	0.7319	1.5956	3.3275	0.3005	0.2200	0.4795	
695-1	1.00	0.6408	1.5720	3.2128	0.3113	0.1994	0.4893	
695-2	1.00	0.6942	1.6496	3.3438	0.2991	0.2076	0.4933	
695-3	1.00	0.7667	1.6432	3.4099	0.2933	0.2248	0.4819	
695-4	1.00	0.7294	1.6172	3.3466	0.2988	0.2180	0.4832	
695-5	1.00	0.7224	1.6379	3.3603	0.2976	0.2150	0.4874	
695-6	1.00	0.7032	1.5780	3.2812	0.3048	0.2143	0.4809	
695-7	1.00	0.6135	1.3997	3.0133	0.3319	0.2036	0.4645	
695-8	1.00	0.7723	1.6564	3.4286	0.2917	0.2252	0.4831	
695-9	1.00	0.7372	1.6554	3.3926	0.2948	0.2173	0.4879	
695-10	1.00	0.8761	1.8034	3.6795	0.2718	0.2381	0.4901	
695-11	1.00	0.7181	1.6814	3.3995	0.2942	0.2112	0.4946	

Locus H (cont.)

SAMPLE NO.	Rb/Rb	Sr/Rb	Zr/Rb	SUM	Rb	Sr	Zr	PROBABLE SOURCE
695-12	1.00	0.7058	1.6816	3.3874	0.2952	0.2084	0.4964	
695-13	1.00	0.7164	1.7670	3.4834	0.2871	0.2057	0.5073	
695-14	1.00	0.7158	1.7970	3.5127	0.2847	0.2038	0.5116	
695-15	1.00	0.7069	1.8024	3.5093	0.2850	0.2014	0.5136	
695-16	1.00	0.7340	1.6928	3.4268	0.2918	0.2142	0.4940	
695-17	1.00	0.7545	1.7260	3.4805	0.2873	0.2168	0.4959	
695-18	1.00	0.6948	1.6523	3.3471	0.2988	0.2076	0.4937	
695-19	1.00	0.7504	1.7346	3.4850	0.2869	0.2153	0.4977	
695-20	1.00	0.7870	1.7546	3.5416	0.2824	0.2222	0.4954	
695-21	1.00	0.6794	1.7667	3.4461	0.2902	0.1972	0.5127	
695-22	1.00	0.7938	1.9194	3.7132	0.2693	0.2138	0.5169	
695-23	1.00	0.7948	1.9703	3.7651	0.2656	0.2111	0.5233	
695-24	1.00	0.7015	1.8306	3.5322	0.2831	0.1986	0.5183	
695-25	1.00	0.7235	1.7251	3.4486	0.2900	0.2098	0.5002	
695-26	1.00	0.7499	1.7473	3.4972	0.2859	0.2144	0.4996	
695-27	1.00	0.7471	1.7418	3.4889	0.2866	0.2141	0.4992	
695-28	1.00	0.7603	1.7717	3.5320	0.2831	0.2153	0.5016	
695-29	1.00	0.7181	1.7651	3.4832	0.2871	0.2062	0.5068	
695-1B	1.00	0.8098	1.6989	3.5087	0.2850	0.2308	0.4842	
695-2B	1.00	0.7238	1.6202	3.3439	0.2991	0.2164	0.4845	
695-3B	1.00	0.7566	1.6102	3.3669	0.2970	0.2247	0.4783	
696	1.00	0.7253	1.6221	3.3473	0.2987	0.2167	0.4846	
790-1	1.00	0.7374	1.6478	3.3852	0.2954	0.2178	0.4868	
790-2	1.00	0.7832	1.6201	3.4034	0.2938	0.2301	0.4760	
793-A	1.00	0.7448	1.6781	3.4229	0.2922	0.2176	0.4902	
793-B	1.00	0.6866	1.4725	3.1592	0.3165	0.2173	0.4661	
793-C	1.00	0.7488	1.5021	3.2509	0.3076	0.2303	0.4620	
793-D	1.00	0.7126	1.5771	3.2897	0.3040	0.2166	0.4794	
793-E	1.00	0.7744	1.6200	3.3944	0.2946	0.2281	0.4773	
793-F	1.00	0.7269	1.4582	3.1851	0.3140	0.2282	0.4578	
793-G	1.00	0.7312	1.5151	3.2463	0.3080	0.2252	0.4667	
793-H	1.00	0.7531	1.4561	3.2093	0.3116	0.2347	0.4537	
793-I	1.00	0.7199	1.5028	3.2227	0.3103	0.2234	0.4663	
793-J	1.00	0.7596	1.5250	3.2846	0.3045	0.2313	0.4643	
793-K	1.00	0.6692	1.3802	3.0494	0.3279	0.2195	0.4526	
793-L	1.00	0.6985	1.5686	3.2671	0.3061	0.2138	0.4801	
3086-1	1.00	0.7395	1.5830	3.3225	0.3010	0.2226	0.4764	
3086-2	1.00	0.7933	1.6617	3.4549	0.2894	0.2296	0.4810	
11894	1.00	0.7616	1.7188	3.4804	0.2873	0.2188	0.4938	

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Figurel. Ternary plot of Zr,Sr,Rb net intensity ratios for selected Southwestern obsidians and obsidian artifacts from the Marana Hohokam Complex