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X-RAY FLUORESCENCE ANALYSIS OF OBSIDIAN ARTIFACTS FROM THE AK CHIN PROJECT

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INTRODUCTION

The following is a report of an x-ray fluorescence (XRF) analysis of 44 obsidian artifacts from the Ak Chin Archaeological Project in central Arizona. Probable sources ranged from southwestern New Mexico to northern Sonora. The majority of the material is from two or three unlocated sources most likely in the central Arizona region (see discussion below).

Methodology

All obsidian debitage, flake tools and projectile points were subjected to the same analytic conditions. High temperture melt incompatible trace elements were utilized to attempt source determination.

The samples were analyzed for rubidium (Rb), strontium (Sr), zirconium (Zr), and niobium (Nb) 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, and NbKa 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 proportions are plotted in a ternary system for comparison to known obsidian sources in the Southwest. The solid incompatible elements Rb, Sr, and Zr, and Nb are quite sensitive in separating rhyolite glass sources (Cann 1983; Zielinski et. al. 1977). Niobium (Nb) is normally utilized when strontium values are low and two or more sources overlap with strontium solution. The niobium plot indicates that one piece is from the Antelope Wells source in southwestern New Mexico and northwestern Chihuahua.

Discussion

While a few of the specimens are assignable to sources in Sonora and southwestern New Mexico/Chihuahua, the majority of the obsidian artifacts are from two (or possibly one highly variable) unlocated sources that are most likely in the central Arizona region (see Table 1 and Figure 1). Figure 1 exhibits the data and the elemental positions of known Southwestern glass sources (see also Shackley 1986). Many of the unlocated source specimens exhibit a high proportion of

cortex suggesting that the material is from a nearby source. Research in Archaic contexts suggests that a high proportion of cortex on obsidian and core remnants is an indication of the close proximity of sources. Both Harquahala Valley sites and Hankat Cave are located within 30 km of obsidian sources (Vulture and Superior respectively) and exhibit a pattern of cortical remnants similar to many Ak Chin specimens (Shackley 1986, and in preparation). Additionally, two sources have been reported both north and south of Gila Bend (Gila Bend Mtns. and Sauceda Mtns.). These two have not yet been investigated and may be two of the unknowns in the collection. The lack of significant known source material north, south, east or west further suggests a more local derivation.

Interestingly, no material was recovered from the San Francisco Volcanic Field. Obsidian artifacts from this region are generally common in pre-classic Hohokam contexts in central Arizona, but not in this collection (Shackley 1986). It may be that the sources are so close that the northern Arizona material never entered the system. Alternatively, the material may be mainly from Classic contexts, similar to Marana and Brady Wash (Shackley 1986).

The Ak Chin project provides further evidence that the consistently unlocated sources are in the central or south-central Arizona region. The 'unknown' sources outlined on Figure 1 are the same used by Shackley (1986).

REFERENCES/BIBLIOGRAPHY

Cann, J. R.
1983 Petrology of Obsidian Artefacts. In The *Petrology of Archaeolgical 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.

Findlow, Frank J., and Marisa Bolognese
1982 Regional Modeling of Obsidian Procurement in the American Southwest. In *Contexts for Prehistoric Exchange*, edited by J. E. Ericson and T.K. Earle, pp. 53-81. Academic Press, New York.

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.

Newman, Jay R., and Roger L. Nielsen
1985 Initial Notes on the X-Ray Fluorescence Sourcing of Northern New Mexico Obsidians. *Journal of Field Archaeology* 12:377-383.

Shackley, M. Steven
1985 Lithic Raw Material Procurement and Hunter-Gatherer Mobility Strategies in the Southwest Archaic. Paper Presented at the 50th Annual Meeting of the Society for American Archaeology, Denver.

1986 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.

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 DATA FOR OBSIDIAN ARTIFACTS FROM THE AK CHIN PROJECT

SAMPLE #	Rb/Rb	Sr/Rb	Zr/Rb	SUM	Rb%	Sr%	Zr%	PROBABLE SOURCE
AZ T:16:17								
AC-3	1.00	0.8493	1.4109	3.2602	0.3067	0.2605	0.4328	Probable d
AC-5	1.00	0.0793	2.2949	3.3742	0.2964	0.0235	0.6801	Unknown x
AC-1	1.00	0.9298	1.6618	3.5916	0.2784	0.2589	0.4627	~~Unknown x~~ Sauc A
AC-4	1.00	0.1368	7.5495	8.6863	0.1151	0.0158	0.8691	Antelope Wells, NM
AC-9	1.00	1.0635	1.7483	3.8118	0.2623	0.2790	0.4587	~~Unknown x~~ Sauc A
AC-2	1.00	0.8648	1.6400	3.5048	0.2853	0.2467	0.4679	Unknown x Sauc A
AC-10	1.00	0.4199	1.6800	3.0999	0.3226	0.1355	0.5420	Unknown x Sauc B
AC-8	1.00	0.7490	1.8630	3.6120	0.2769	0.2074	0.5158	Probable a
AC-6	1.00	0.6100	1.7240	3.3340	0.2999	0.1830	0.5171	Probable a
AC-7	1.00	0.4770	1.7500	3.2271	0.3099	0.1478	0.5423	Probable b

Rb/Nb/Zr Data for Samples Depleted in Strontium

	Rb/Rb	Nb/Rb	Zr/Rb	SUM	Rb%	Nb%	Zr%	
AC-5	1.00	0.4201	2.2949	3.7150	0.2692	0.1131	0.6177	Unknown x
AC-4	1.00	0.4653	7.5495	9.0148	0.1109	0.0516	0.8375	Antelope Wells, NM

	Rb/Rb	Sr/Rb	Zr/Rb	SUM	Rb%	Sr%	Zr%	
AZ T:16:23								
AC-19	1.00	0.0676	2.4335	3.5010	0.2856	0.0193	0.6951	Unknown x
AC-18	1.00	0.0289	1.4066	2.4355	0.4106	0.0119	0.5775	Los Vidrios, Sonora
AC-17	1.00	0.0651	2.7407	3.8059	0.2628	0.0171	0.7201	Unknown x
AC-16	1.00	0.5932	1.9985	3.5917	0.2784	0.1652	0.5564	Probable b
AC-20	1.00	0.8743	1.8155	3.6898	0.2710	0.2369	0.4920	Probable b
AC-15	1.00	0.8161	2.2768	4.0928	0.2443	0.1994	0.5563	Unknown x
AC-21	1.00	0.5732	1.8360	3.4091	0.2933	0.1681	0.5385	Probable b
AZ T:16:55								
AC-23	1.00	0.8356	1.9850	3.8206	0.2617	0.2187	0.5196	Probable a
AC-22	1.00	0.8422	1.7414	3.5837	0.2790	0.2350	0.4859	Probable a
AC-24	1.00	0.9113	1.9088	3.8200	0.2618	0.2386	0.4997	Probable a
AZ T:16:75								
AC-36	1.00	0.6778	1.5716	3.2494	0.3077	0.2086	0.4837	Unknown x
AC-35	1.00	0.8298	2.1182	3.9481	0.2533	0.2102	0.5365	Probable b
AZ T:16:83								
AC-37	1.00	0.9991	2.1411	4.1402	0.2415	0.2413	0.5172	Unknown * Sauc a
AC-38	1.00	0.7055	2.4326	4.1381	0.2417	0.1705	0.5879	Unknown x Sauc b
AC-39	1.00	0.2721	2.0313	3.3034	0.3027	0.0824	0.6149	Unknown x

AZ T:16:20

AC-11	1.00	0.6251	2.4700	4.0950	0.2442	0.1526	0.6032	Probable b
AC-13	1.00	0.0913	2.5398	3.6311	0.2754	0.0252	0.6995	Unknown x
AC-12	1.00	0.7480	2.1089	3.8568	0.2593	0.1939	0.5468	Probable a

AZ T:16:22

AC-14	1.00	0.8392	2.0227	3.8619	0.2589	0.2173	0.5238	Probable a

AZ T:16:60

AC-25	1.00	0.8793	1.8883	3.7676	0.2654	0.2334	0.5012	Probable a

AZ T:16:62

AC-27	1.00	0.9896	2.0711	4.0607	0.2463	0.2437	0.5100	Probable a
AC-26	1.00	0.5498	1.9495	3.4993	0.2858	0.1571	0.5571	Probable b

AZ T:16:67

AC-28	1.00	0.6097	2.0077	3.6174	0.2764	0.1685	0.5550	Probable b
AC-29	1.00	0.7448	2.3810	4.1257	0.2424	0.1805	0.5771	~~Unknown~~ x Source b

AZ T:16:71

AC-31	1.00	0.0987	1.4535	2.5522	0.3918	0.0387	0.5695	Los Vidrios, Sonora?
AC-34	1.00	0.7746	1.9789	3.7535	0.2664	0.2064	0.5272	Probable a
AC-32	1.00	0.4534	1.6163	3.0697	0.3258	0.1477	0.5265	~~Unknown~~ x Source B
AC-33	1.00	0.6006	1.6635	3.2641	0.3064	0.1840	0.5096	~~Unknown x~~ Source B
AC-30	1.00	0.7869	1.7425	3.1340	0.3191	0.2284	0.4525	Unknown x Source A

AZ T:16:86

AC-41	1.00	0.7158	1.4182	3.5293	0.2833	0.2229	0.4937	Unknown x Source A
AC-40	1.00	0.7680	1.5035	3.2716	0.3057	0.2348	0.4596	~~Unknown x~~ Source A

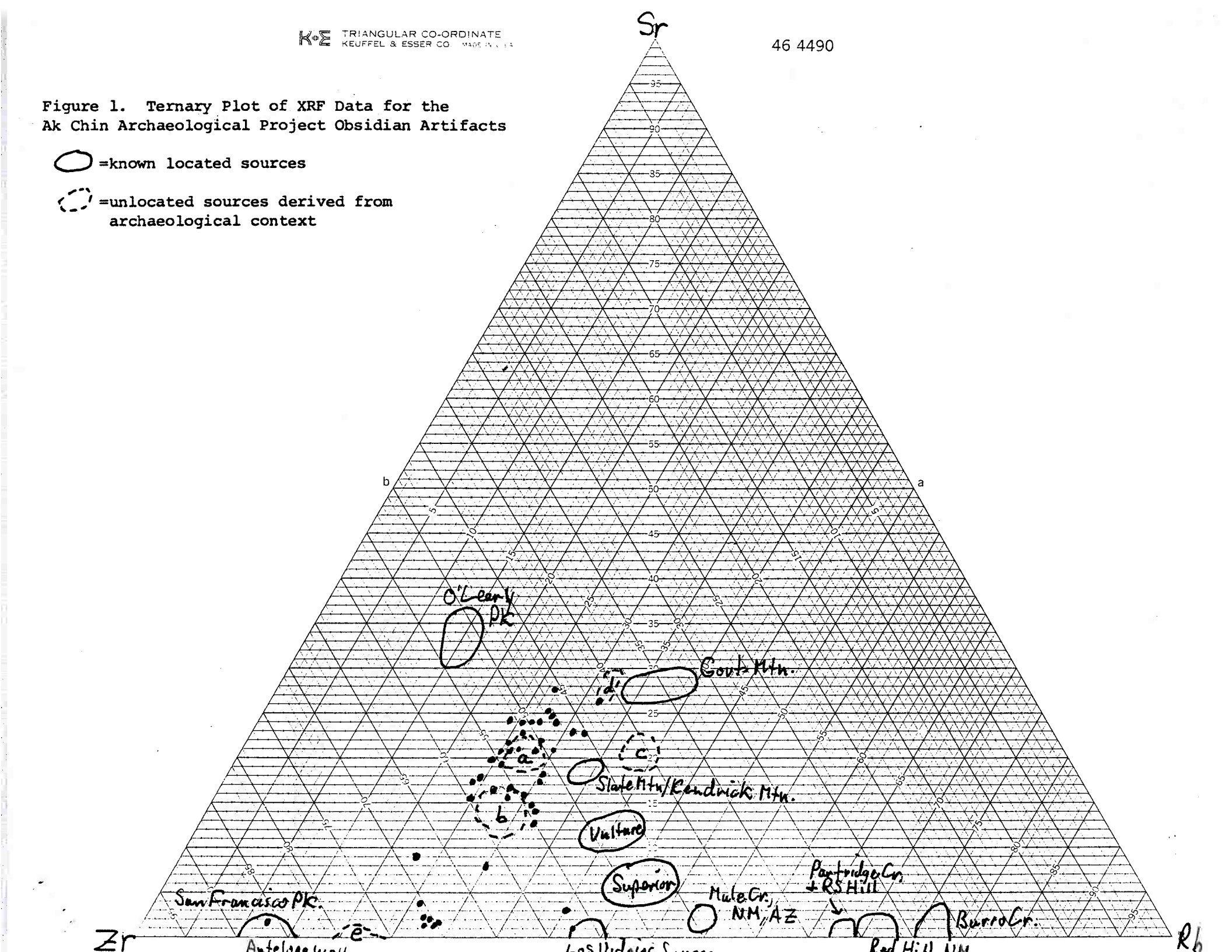
AZ T:16:95

AC-44	1.00	0.0886	2.5176	3.6062	0.2773	0.0246	0.6981	Unknown x
AC-42	1.00	0.1594	2.7793	3.9388	0.2539	0.0405	0.7056	Unknown x
AC-43	1.00	0.3813	2.8256	4.2069	0.2377	0.0906	0.6717	Unknown x

Figure 1. Ternary Plot of XRF Data for the Ak Chin Archaeological Project Obsidian Artifacts

=known located sources

=unlocated sources derived from archaeological context



ADDENDUM TO AN X-RAY FLUORESCENCE ANALYSIS OF OBSIDIAN ARTIFACTS FROM THE AK CHIN PROJECT

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Since the completion of the above report, two obsidian sources have been discovered in south-central and east-central Arizona that solve most of the 'unknown source' problem identified in the previous work.

A small nodule Quaternary Period rhyolite/obsidian source was located in western Greenlee County, Arizona west of the middle Blue River and is now called the *Cow Canyon* source. This source has also been recovered at the Late Archaic sites in Harquahala Valley and the Murray Springs Clovis Site in the San Pedro Valley, Arizona. The 'Unknown d' source in the Ak Chin collection (AC-3) is most probably from this source.

In late September an extensive rhyolite glass source was discovered in the southern Sauceda Mountains in southwestern Maricopa County, Arizona, and will be called the *Sauceda Mountain* source. This mid-Tertiary source is quite extensive and covers several hundred square kilometers and is eroding into the Sauceda Wash toward the Gila drainage system. This source is geochemically bimodal along the strontium (Sr) and zirconium (Zr) axes and comprises the previously designated 'Unknown a and b' sources. This source has been recovered

from Archaic through Classic period Hohokam contexts in central Arizona, including Ventana Cave, Picacho-Arroyo Site, the Brady Wash Hohokam Complex, and the Marana Hohokam Complex. This source is a major glass source in central Arizona. Both the above sources were previously unreported. Complete geochemical, geographical and archaeological descriptions of these and other sources are forthcoming.

Addendum Figure 1 exhibits the source specimen geometric envelopes for these sources on the Zr, Sr, Rb ternary system.