Title
Source Provenance of Obsidian Artifacts from Mockingbird Gap and Socorro County Clovis Sites, New Mexico

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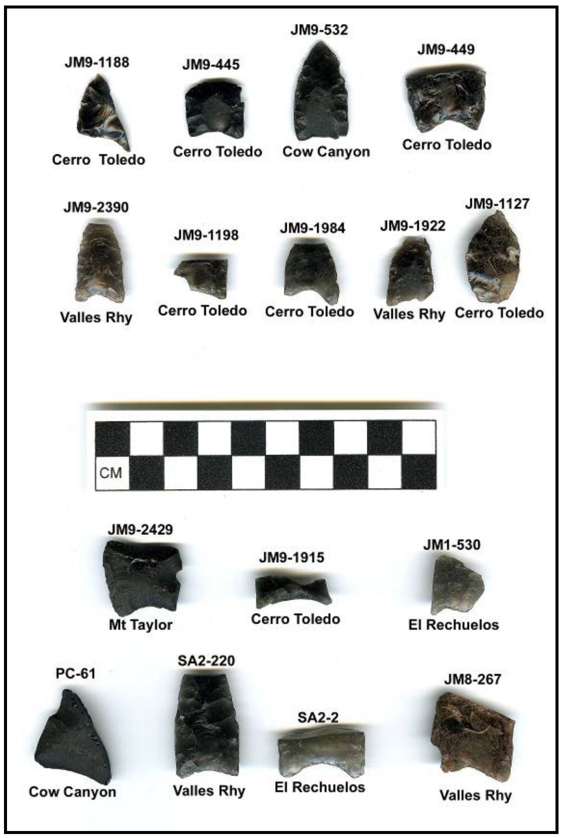

by

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Report Prepared for
Dr. Robert Weber

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INTRODUCTION

The analysis here of 16 obsidian Clovis points and fragments from the Mockingbird Gap Site and other Socorro County sites is the first large scale study of its kind in this region. The source provenance is dominated by sources from northern New Mexico and western Arizona, not significantly different from the regional procurement suggested by a similar study in northern New Mexico and southern Colorado (Shackley 2005a).

ANALYSIS AND INSTRUMENTATION

This assemblage was analyzed on a Spectrace/Thermo *QuanX* energy-dispersive x-ray spectrometer at the Archaeological XRF Laboratory, Department of Earth and Planetary Sciences at the University of California, Berkeley. All samples were analyzed whole with little or no formal preparation. 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).

The spectrometer is equipped with an electronically cooled Cu x-ray target with a 125 micron Be window, an x-ray generator that operates from 4-50 kV/0.02-2.0 mA at 0.02 increments, using an IBM PC based microprocessor and WinTrace™ reduction software. The x-ray tube is operated at 30 kV, 0.14 mA, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Kα-line data for elements titanium (Ti), manganese (Mn), iron (as Fe^T), zinc (Zn), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). Trace element intensities were converted to concentration estimates by employing a least-squares calibration line 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). Further details concerning the petrological choice of these elements in Southwest obsidians is available in Shackley (1992, 1995, 2005; also Mahood and Stimac 1990; and Hughes and Smith 1993). Specific standards used for the best fit regression calibration for elements Ti through Nb include G-2 (granite), AGV-1 (andesite), GSP-1, SY-2 (syenite), BHVO-1 (Hawaiite basalt), 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), all US Geological Survey standards, and BR-N (basalt) from the Centre de Recherches Pétrographiques et Géochimiques in France, and JR-1 and JR-2 obsidian standards from the Japan Geological Survey (Govindaraju 1994). In addition to the reported values here, Ni, Cu, Th, and Ga were measured, but these are rarely useful in discriminating glass sources and are not generally reported. Because two of the samples could either be from the Malad, Idaho source or the Cow Canyon, Arizona source, the Philips PW 2400 WXRF was used to acquire Ba that effectively discriminates these two sources (see Shackley 2005b: Appendix).

The data from both systems were translated directly into Excel™ for Windows software for manipulation and on into SPSS™ for Windows for statistical analyses. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run. An analysis of RGM-1 analyzed during the run is included in Table 1. Source nomenclature follows Shackley (1988, 1995, 1998, 2005b). Further information on the laboratory instrumentation can be found at: http://www.swxrflab.net/. Trace element data exhibited in Table 1 are reported in parts per million (ppm), a quantitative measure by weight (see also Figure 1).

SUMMARY

While it is tempting to suggest that the raw materials used to produce these bifaces was procured from the primary sources, it is not necessarily possible to determine that with a degree of confidence. It is well known that most of the sources from the Jemez Mountains (Cerro Toledo Rhyolite and El Rechuelos Rhyolite) have eroded into the Rio Grande River since the Pleistocene (at least 1.4 mya; Church 2000; Shackley 2005b; Figure 2 here). Valles Rhyolite obsidian, more commonly known as Cerro del Medio, has not yet eroded outside the caldera, and so had to have been originally procured at the dome complex or in the caldera proper (Shackley 2005b). The Mount Taylor source groups (Grants Ridge and Horace Mesa) similarly have eroded through the Rio Puerco and into the Rio Grande since the Pleistocene. I can't really say for certain that the Clovis hunters procured the obsidian from the primary sources in northern New Mexico, or in the Rio Grande Quaternary alluvium. However, I can say that the nodule sizes needed to produce the larger bifaces suggested by the basal fragments here is not generally present in the alluvium as far south as Socorro (Church 2000; Shackley 1998, 2005b; Figure 3 here). This summer we recovered a few nodules up to 70 mm in the Tijeras Wash area in southern Albuquerque, but most were in the 20-40 mm range.

More interesting here is the presence of two points produced from the Cow Canyon glass from eastern Arizona (see Shackley 1988, 1990, 2005b). This was the only obsidian recovered from the Murray Springs Clovis levels including marekanites, bipolar cores and flakes, and two Clovis points, all under 55 mm. As far as I know, there have been no other Clovis bifaces recorded from Cow Canyon material. Whether this indicates contact with or some relationship to the people who occupied Murray Springs is, of course, impossible to determine. It is, however, suggestive of that possibility. Travel through the Gila River/San Francisco River corridor up into western New Mexico during the Clovis period is certainly a possibility. Cow

Canyon obsidian was present at both a site in “Socorro County” as well as Mockinbird Gap in this collection (Table 2). If as suggested by some recent studies of “Paleoarchaic” mobility and territoriality in the Great Basin and Southwest, that raw material studies can be used to infer large scale procurement ranges (territories?) during the Paleoindian and Archaic periods, it could be argued that one or two groups inhabited Mockingbird Gap (Jones et al. 2003; Shackley 2005a and b). One group may have been focused on central and northern New Mexico, and one to the west. This is climbing out on a limb since we have little data from other raw materials, we do not know what the chronology is at the site, or really how large Paleoindian territories were in the Southwest. It has been suggested that Chuska chert from 400 km northwest is present in Paleoarchaic sites in the area which seems rational given the northern New Mexican obsidian sources present here, perhaps lending some support to a central to northern New Mexico procurement range (Elyea and Dolman 2000).

Finally, it is vexing that none of the Mule Creek sources are present in the collection (see Figure 2). It is closest to sites in the Plains of San Augustine, and dominates late period collections in the region. Perhaps the Mule Creek area is outside the procurement ranges occupied by the Clovis groups that produced this collection, or perhaps it is sampling error. With only 16 samples it’s hard to say, but an issue to keep in mind for future work.

Regardless of how the results are interpreted, this is an important contribution to our understanding of Clovis stone procurement and possibly ranges.

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Table 1. Elemental concentrations for the archaeological samples. All measurements in parts per million (ppm).

Sample	Ti	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb	Fe/Mn	Ba	Source
Mockingbird												
JM-445	866	566	9135	103	200	6	60	171	100	27.2	n.m	Cerro Toledo Rhy, NM
JM-449	853	586	9527	100	198	8	67	181	95	24.9	n.m	Cerro Toledo Rhy, NM
JM-532	1159	585	7006	47	92	83	29	119	31	17.3	1081	Cow Canyon, AZ
JM-1188	975	616	9309	92	195	7	58	174	93	22.3	n.m	Cerro Toledo Rhy, NM
JM-1127	953	544	9235	91	190	5	65	163	89	25.8	n.m	Cerro Toledo Rhy, NM
JM-1922	1127	440	9168	76	146	10	44	155	47	33.3	n.m	Valles Rhy, NM
JM-1984	935	599	9446	96	208	10	65	176	101	23.8	n.m	Cerro Toledo Rhy, NM
JM-1198	915	495	8644	94	186	9	53	162	101	26.2	n.m	Cerro Toledo Rhy, NM
JM-2390	1271	430	9391	71	149	12	35	160	46	35.3	n.m	Valles Rhy, NM
Socorro Co.												
JM9-1915	861	584	8847	110	204	5	54	156	107	22	n.m	Cerro Toledo Rhy, NM
JM1-530	1069	482	6068	38	146	13	21	69	45	15.7	n.m	El Rechuelos, NM
JM9-2429	894	890	7594	163	514	11	81	110	203	11.06	n.m	Grants Ridge, Mt. Taylor, NM
PC-61	1325	549	12504	53	125	108	19	91	29	37.5	719	Cow Canyon, AZ
JM8-267	1206	511	10320	80	148	14	42	166	58	31.8	n.m	Valles Rhy, NM
SA2-220	1011	431	8889	65	157	12	42	161	57	31.7	n.m	Valles Rhy, NM
SA2-2	1044	453	5851	35	146	11	19	68	36	15.9	n.m	El Rechuelos, NM
RGM1-S1	1623	290	12943	37	147	111	24	218	7	n.m.	1351	standard

Table 2. Crosstabulation of source by site/area.

			Sample		
			Mockingbird Gap	Socorro Co.	Total
Source	Cerro Toledo Rhy, NM	Count	6	1	7
		% within Source	85.7%	14.3%	100.0%
		% within Sample	66.7%	14.3%	43.8%
		% of Total	37.5%	6.3%	43.8%
	Valles Rhy, NM	Count	2	2	4
		% within Source	50.0%	50.0%	100.0%
		% within Sample	22.2%	28.6%	25.0%
		% of Total	12.5%	12.5%	25.0%
	El Rechuelos, NM	Count	0	2	2
		% within Source	.0%	100.0%	100.0%
		% within Sample	.0%	28.6%	12.5%
		% of Total	.0%	12.5%	12.5%
	Mt. Taylor, NM	Count	0	1	1
		% within Source	.0%	100.0%	100.0%
		% within Sample	.0%	14.3%	6.3%
		% of Total	.0%	6.3%	6.3%
	Cow Canyon, AZ	Count	1	1	2
		% within Source	50.0%	50.0%	100.0%
		% within Sample	11.1%	14.3%	12.5%
		% of Total	6.3%	6.3%	12.5%
Total		Count	9	7	16
		% within Source	56.3%	43.8%	100.0%
		% within Sample	100.0%	100.0%	100.0%
		% of Total	56.3%	43.8%	100.0%

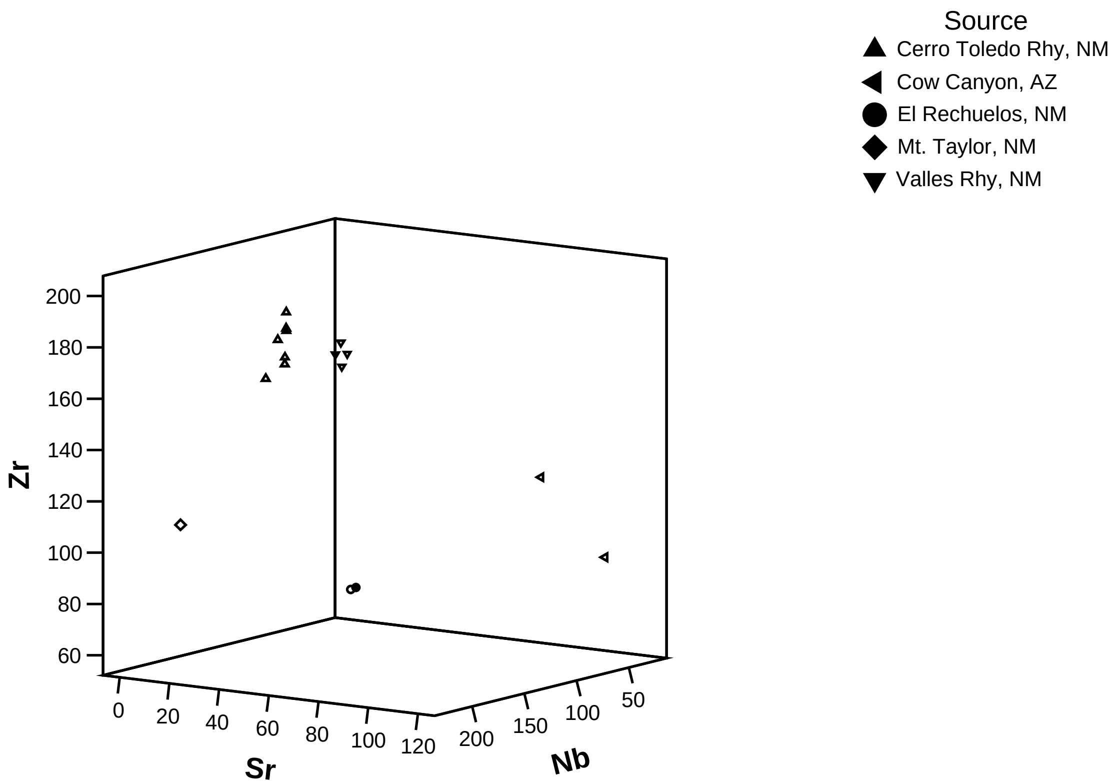

Figure 1. Zr, Sr, Nb three-dimensional plot of the archaeological specimens.

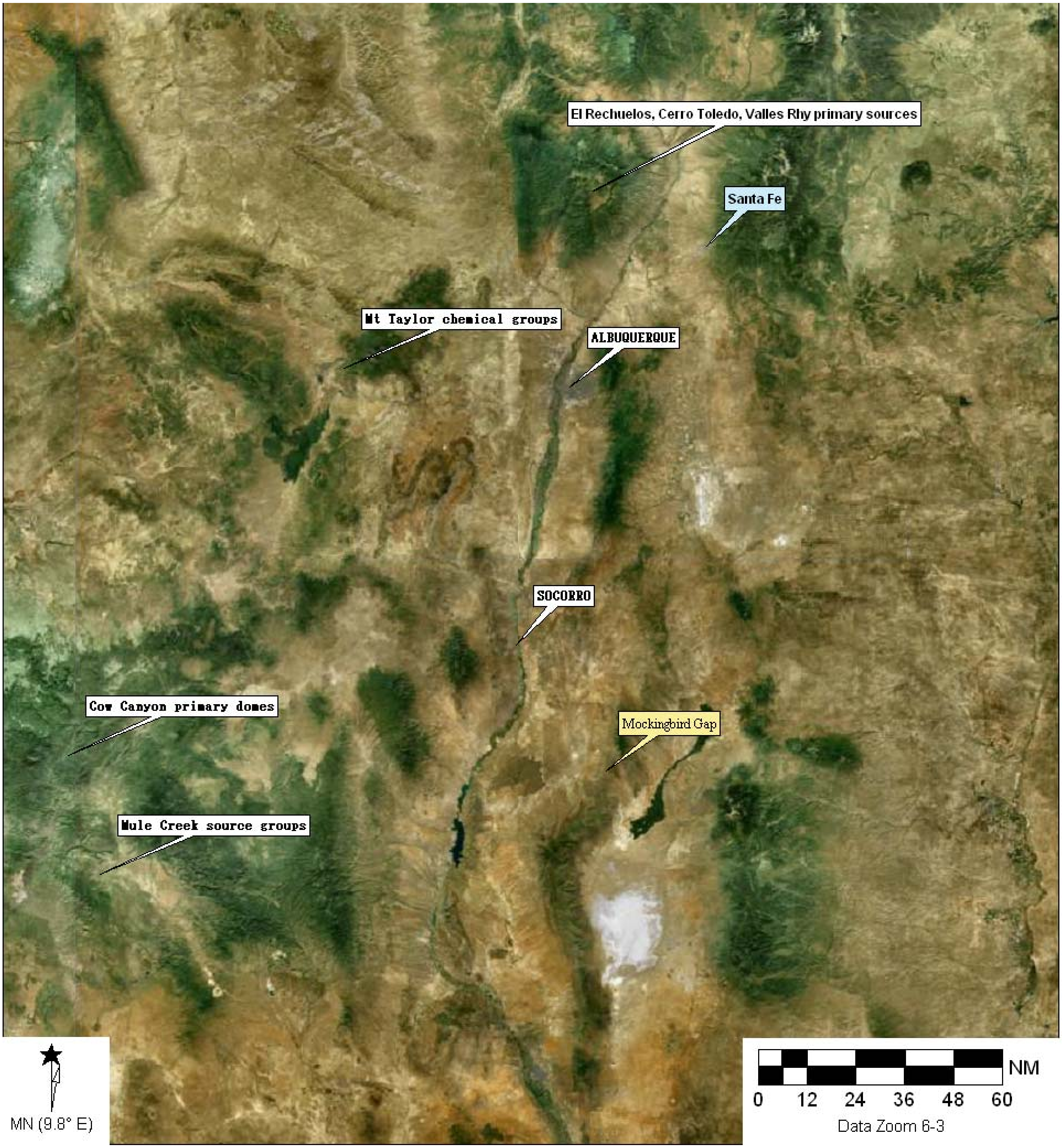

Figure 2. Digital elevation model of the location of sources present in the collection, plus Mule Creek, and Mockingbird Gap.

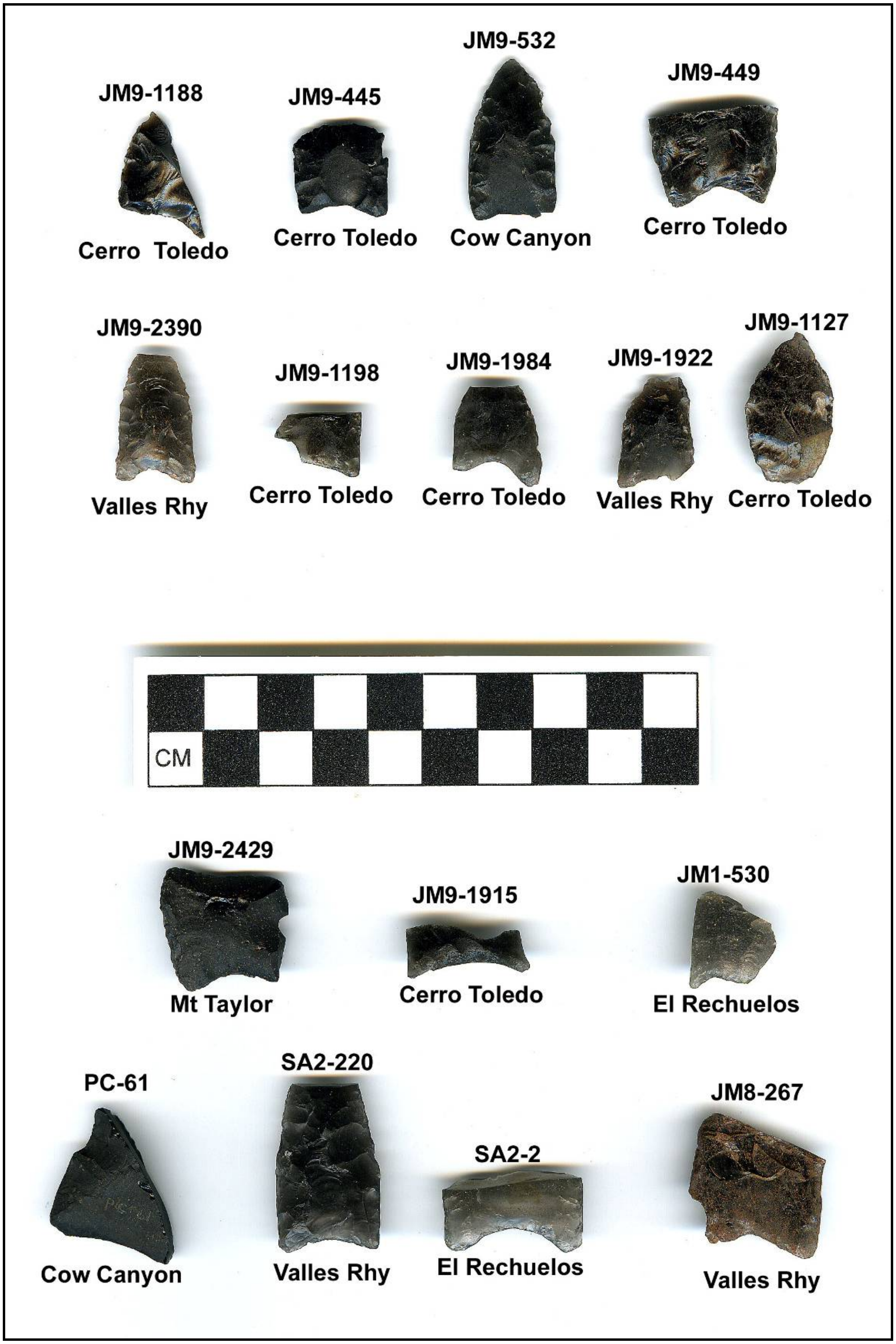

Figure 3. Clovis points and fragments with source provenance. Upper two rows from Mockingbird Gap, lower two rows from other Socorro County sites.