Pre-Classic Hohokam Obsidian in the Tucson Basin: Examing Patterns in Procurement and Use

PRE-CLASSIC HOHOKAM OBSIDIAN IN THE TUCSON BASIN: EXAMING PATTERNS IN PROCUREMENT AND USE

by

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ABSTRACT

Obsidian source attribution has become an important tool in examining many aspects of prehistoric lifeways including exchange, identity, social and economic boundaries, and many others. This thesis provides a comprehensive look at obsidian spatial distributions in the Tucson Basin Hohokam Pre-Classic period, ca. A.D. 750 – 1150. By examining currently available data and providing new data from three sites in the northern Tucson Basin conclusions about trends in spatial and temporal use of obsidian are made. Obsidian procurement and spatial distribution in the Tucson Basin appears to be distinct from neighboring regions and continuity with later Classic period, ca. A.D. 1150 – 1450 obsidian use is likely. There appears to be a clear preference for western obsidian sources in the northern Tucson basin, while the southern basin may have a slight preference for materials to the east. The limited obsidian data for the Colonial period, ca. A.D. 750 – 950 suggests that its distribution was controlled by similar processes to those observed in the Sedentary period, ca. A.D. 950 – 1150. This research further suggests that strong avenues are open for future research.

CHAPTER 1 - INTRODUCTION

1.1 Problem Statement

The use of obsidian XRF data has become a crucial tool in understanding prehistoric social networks and organization in the North American Southwest (Mills et al. 2013; Shackley 2005). The Hohokam of central and southern Arizona highly valued obsidian as a raw material, as indicated by its procurement from source areas hundreds of kilometers away (Bayman 1995; Peterson et al. 1997). The spatial distribution of obsidian in the Tucson Basin of southern Arizona is particularly interesting because there isn't a source in close proximity. The closest source is approximately 90 km away, suggesting that social factors are important for understanding its distribution throughout the basin. Unfortunately, the current understanding of obsidian circulation in the Hohokam Pre-Classic period within the Tucson Basin is poorly studied in comparison to the neighboring Phoenix Basin or the subsequent Classic Period when obsidian circulation dramatically increased (Bayman 1995; Bayman and Shackley 1999; Doyel 1987, 1996; Marshall 2002; Mills et al. 2013; Peterson et al. 1997; Shackley 2005). Although many Pre-Classic sites within the Tucson Basin have been studied, the total current sample of XRF obsidian data, including those from my own sampled sites, include only slightly more than 100 source attributed pieces (Della Croce 2004:Table 31; O'Brien et al. 2013; Ryan 2013; Shackley 1999a, 1999b, 2000, 2004, 2006, 2007, 2008, 2012, 2013). Nonetheless, by comparing the Pre-Classic to the Classic period and placing the Tucson Basin in regional context, these differences can be better understood.

The archaeological and anthropological questions associated with this project are many and will be more clearly focused as more obsidian source data are generated. However, some key questions of interest are readily apparent.

(1) What are the primary sources of obsidian being utilized by the Hohokam in the Tucson Basin ca. A.D. 750-1150? How do finished artifacts, like projectile points, compare to raw materials in source

distributions for the Pre-Classic in the Tucson Basin? That is, was it direct procurement of the raw material or were the items coming in as finished products?

(2) How does the exploitation of different obsidian sources during the Pre-Classic period contrast with the Classic Period? Previous studies have identified key source locations for the Tucson Basin immediately following the Pre-Classic period (Bayman 1995). Is there continuity that can be observed? What sources are more consistent over the pivotal Sedentary period? Previous research has indicated, there is notable change in social organization between the Pre-Classic and Classic periods and whether or not this is observed in obsidian distributions could reflect a change in the social interaction spheres of the Tucson Basin.

(3) Are there observable differences in obsidian distribution between the Tucson and Phoenix basins? The Phoenix Basin is substantially closer to some key obsidian sources, especially the Superior source. The Superior source is also the closest source to the Tucson Basin and should be equally well-represented in the Tucson Basin. If there are differences, what might account for these differences in obsidian use?

1.2 Hohokam Background

The Hohokam cultural sequence in the Tucson Basin is comprised of four large segments of time (Table 1.1). The Pioneer Period, sometimes referred to as the Early Formative period, saw the continuation of previous Early Agricultural life ways with a gradual transition to a more Hohokam-like center cumulating with the introduction of Snaketown phase (A.D. 700-750) ceramic traditions from the Gila Basin (Deaver and Ciolek-Torrello 1995).

PERIOD	Tucson Basin Phase	Date Ranges
Classic	Tucson	A.D. 1300-1450
	Tanque Verde	A.D. 1150-1300
Sedentary	Late Rincon	A.D. 1100-1150
	Middle Rincon 3	A.D. 1080-1100
	Middle Rincon 2	A.D. 1040-1080
	Middle Rincon 1	A.D. 1000-1040
	Early Rincon	A.D. 950-1000
Colonial	Rillito	A.D. 850-950
	Cañada del Oro	A.D. 750-850
Pioneer	Snaketown	A.D. 700-750
	Tortolita	A.D. 475-700

Table 2.1 Hohokam Chronology for the Tucson Basin (adapted from Wallace 2012).

The Snaketown phase marked the transition to the emerging Hohokam regional tradition and the development of the Tucson Basin as a node in an expanding population with increased social complexity marking the beginning the Colonial Period (Deaver and Ciolek-Torrello 1995).

In the Colonial Period site structure was more formalized, courtyard groups developed out of more vaguely defined house clusters, ballcourts began to emerge and with it a new social/regional system of organization, and Tucson Basin Brown Ware (red-on-brown in contrast to the Phoenix Basin's red-on-buff) was in use (Bayman 2001; Heidke 1995). Inferences about site types in the Cañada del Oro phase are limited by the lack of strong diagnostics for site dating (Doelle and Wallace 1991). That being said, at least three ballcourts have been identified during this phase and most sites suggest continuity with the previous Pioneer period. The Rillito and Early Rincon phases show a large increase in site distribution in the Tucson Basin with several larger villages developing, most with associated ballcourts. During this period the largest populations were focused along the western margins of the Santa Cruz River, differentiating it from the previous phase (Doelle and Wallace 1991).

The Sedentary period marked a continuation of the patterns observed in the Colonial Period, with growth in both village frequency and size in some areas (Craig and Woodson 2014). This period also saw the rise and collapse of a complex exchange system associated with the ballcourts in the Phoenix Basin (Abbott et. al. 2007). With the cessation of the ballcourts and its use as public architecture the Sedentary period came to a close. The Sedentary period in the Tucson Basin showed continuity with the previous period, but by the Middle Rincon phase reorganization of settlement patterns had occurred; rather than the large villages of the Early Rincon, the Middle Rincon was characterized by a much more dispersed settlement system. This dispersed pattern has been attributed to both social and environmental factors, but it is likely that changes in the Santa Cruz River's hydrology played a large role (Doelle and Wallace 1991). The Late Rincon phase consisted of further change in population distributions. The area west of the Santa Cruz had continued settlement, but at lower densities. The areas east of the Santa Cruz and in some of the Santa Cruz floodplains saw a growth in population. During this period nonriverine areas east of the Santa Cruz saw a significant increase in rock features similar to those identified as agave cultivation and processing area in the north (Doelle and Wallace 1991). It is during the Late Rincon that a large-scale settlement shift in site location and population aggregation apparent during the subsequent Classic Period was initiated (Elson and Cook 2011; Wallace 2012).

The Classic Period is seen as a time of massive social reorganization with changes in material culture, traditions, and architecture. It saw the replacement of ballcourts with platform mounds as centers (Bayman 2001). It also marked the shift from pithouse courtyard groups to above-ground adobe rooms, often surrounded by compound walls. The Classic period saw a major shift in settlement pattern, in some cases with new settlements forming as centers that were previously unseen in the Pre-Classic (Fish et. al. 1992). The Classic Period in the Tucson Basin also saw an intensification of agave cultivation and processing strategies that arose in the Late Rincon (Doelle and Wallace 1991).

1.3 Thesis Organization

This thesis is divided into five chapters addressing obsidian distributions within the Tucson Basin in context of the research questions posed above. Chapter 2 describes the methods and theoretical framework that guided analysis. Chapter 3 describes the current understanding of obsidian research in the Pre-Classic and Classic periods as well as its use in a larger regional context. Chapter 4 introduces and discusses the sites and results of this study. Chapter 5 analyzes the data and addresses the questions brought forth in Chapter 1. Chapter 5 also includes possible avenues for further research.

CHAPTER 2 – RESEARCH METHODS AND THEMES

2.1 Methods: XRF and Sampling

Before delving into the anthropological and archaeological problems of material procurement, exchange, social interaction networks, and cultural and regional identity it is first important to understand why the spatial distribution of obsidian is able to make a significant contribution to understanding these topics. Due to its vitreous quality, obsidian has a homogeneous structure with no preferred fracturing tendencies. This makes for a valuable and reliable flint knapping material capable of holding extremely sharp edges. Additionally, obsidian is found in relatively rare provenances, all of them relating to volcanism, as it requires a combination of limiting conditions to geologically form (Shackley 2005:10). These limiting factors of formation combined with differing ratios of "incompatible" elements within the stone allow for the identification of source origins in any given region where obsidian is present (Shackley 2005:10-11). Obsidian's value as a cultural material and the limiting factors in its formation make for an excellent material for scientific analysis using X-ray fluorescence (XRF).

XRF, particularly the energy-dispersive (EDXRF) method, allows for a strong application in archaeological provenance studies for a number of reasons. The benefits and history of the method in archaeology are well established (see Shackley 2005: 95-96; 2011:7-10). In short, the method requires minimal preparation and provides an easy to use, fast, and importantly a non-destructive form of analysis that is reliable when sampling strategy and calibration of equipment are carefully considered. There are two primary methods of XRF, EDXRF and wavelength XRF (WXRF). Both methods are capable of doing essentially the same thing, however, WXRF is the older and more precise method. WXRF is the preferred method for many geology studies where an order of precision higher than what EDXRF can provide is required (Shackley 2011). This is particularly useful for light elements. The X-ray source between methods is quite similar, the difference lies in the way the energy is analyzed.

WXRF examines individual elements while EDXRF separates the energy into individual channels and then into elemental data through preamplification. For the purposes of archaeological obsidian studies it is well established that EDXRF is the preferred method (Davis et al. 1998; Shackley 2011).

The sampling strategy for artifact selection utilized within this project had four primary criteria, in order of importance: (1) confidence in the dated context; (2) variety of obsidian artifact types (i.e., projectile points, cores, and general debitage); (3) size of the flake/debitage; and (4) selection for any obvious visual distinctions. Obsidian, being a difficult substance to reliably directly date (see Shackley 2005:4-6), requires other materials to supplement this shortcoming; for the purposes of this thesis, reliably dated contexts (i.e., contexts with clear ceramic temporal associations) were selected and examined for obsidian. Additionally, in order to address the variety of questions pertinent to this research, samples were preferentially chosen to display an array of artifact types in hope of discerning any notable patterns between raw and worked materials. Beyond dated contexts, the only other limiting factor for selection of samples was obsidian debris size, samples must be >10 mm in smallest dimension and >2-mm thick to be optimal for EDXRF (Shackley 2011:9). Megascopic source identification of obsidian in the Southwest has had limited success (Shackley 2005:101-105). Despite this, if visual distinctions could be made they were selected for in hopes of analyzing truly representative samples from sites. However, for reasons elaborated on below, in most cases if obsidian was found within a reliably dated context it was selected for analysis.

The sampling strategy utilized for site selection followed its own set of criteria, independent from artifact selection. The primary factor for selection was availability; Pre-Classic period obsidian in the Tucson Basin is a particularly sparse resource and so selection was for areas that could expand the previous area coverage. This resulted in the northern Tucson Basin being sampled to a higher degree and provided a good comparative base for some Classic period sites in the northern basin.

In order to assess procurement patterns, Renfrew's (1977) Law of Monotonic Decay is utilized to examine the obsidian source attribution results. The Law of Monotonic Decay, sometimes referred to as

Distance-Decay) states that in conditions where uniform loss or deposition occurs, artifacts from a given source material, in this case obsidian outcrops, will occur in steadily decreasing proportions as the distance from the source increases. In the Tucson Basin several sources were utilized, but Superior is the closest obsidian source averaging about 90 km from most sites in this study (Figure 2.1). This law is essentially a “null” model to which the actual spatial distributions are compared.

2.2 Theoretical Themes

The theoretical themes that guide this project focus on both social and economic factors to assess the nature of obsidian procurement in the Tucson Basin during the Colonial, Sedentary, and Early Classic periods. Divisions of time are discussed primarily at the period level, but when phase-level time segments are present (i.e., Early, Middle, and Late Rincon phase) they are examined to assess patterns and changes in spatial distribution, with the caveat that overall obsidian sample sizes may be small within these temporal divisions. Researchers have established that exchange occurs at a variety of levels and artifact types and a single overarching

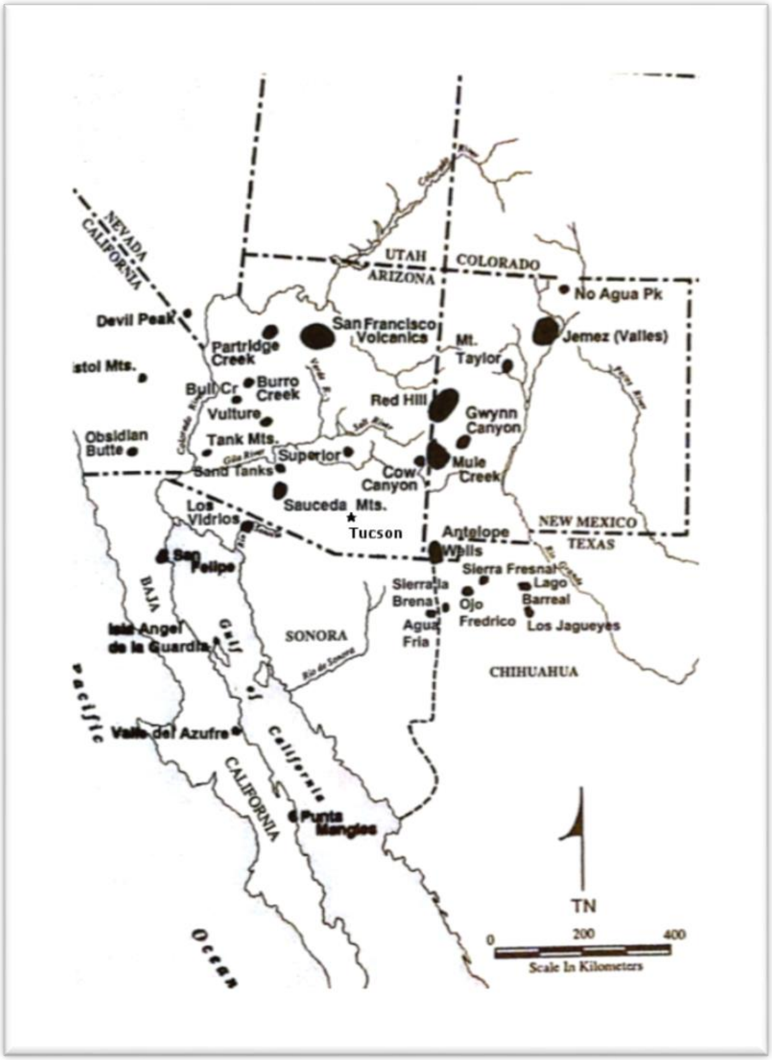

Figure 2.1 Map of Obsidian Sources, after Shackley (2005: Figure 1).

mode of exchange is not a likely scenario, especially when individual objects of exchange have yet to be thoroughly examined (Crown 1991; Peterson et. al. 1997; Polanyi 1957; Renfrew 1977). To track these systems, attention must be focused on both acquisition and spatial distribution of materials. Obsidian is again particularly well suited to do this as the variables available for analysis include: geological source data, artifact morphology, and spatial distributions. I will use these variables to establish the likely procurement and exchange strategies associated with obsidian from each site examined in relation to one another.

Although the Pre-Classic period obsidian data do not reach sufficient quantities for a formal social network analysis, the questions are still approached with these ideas in mind in order to establish intra- and inter-regional systems of obsidian use in the Tucson Basin. This is done by looking at a number of variables, namely: (1) raw material source data, (2) differences between formal tools and debitage, and (3) geographical distributions across the Tucson Basin. Given the constraints of the sourced sample, discussed later, the analysis will only be applied in time segments of the period level between the Colonial and Sedentary period and/or on the phase level within the Sedentary period. Data generated from this analysis will then be compared to the work done by Shackley (2005:147-171) on the same period in the Phoenix Basin.

The acquisition of obsidian was unlikely to have been the result of a single resource gathering event as the cost of doing so required travel of distances over 100 km in most situations and the quantities represented in the Pre-Classic are extremely low. Obsidian acquisition would likely be "embedded" in other working systems, such as the gathering of materials like salt or shell (Bayman 1995; Binford 1979). Western sources of obsidian, like Sauceda, Sand Tanks, and the Mexican sources all fall within reasonable distances of the routes to the coast. Martynec and Martynec (2014) identified several of these trail routes for salt, shell, and obsidian and suggested their likely tie to a larger Hohokam exchange system.

Although previously applied to highly mobile groups, Kuhn (1995:24), in line with Binford's (1979) previous work, presents the idea that situational tool kits likely contain raw material as it, "can potentially serve a wider range of functions than finished implements…" Obsidian from extremely distant sources that does not occur as a formal tool and is found in relatively low numbers may, therefore, be the result of "incidental procurement" or the moving of materials across the landscape as a versatile tool resource while traveling. This then begs the question of how distant obsidian sources enter a given locality, be it as raw materials that could be situationally flaked and used or as formal tools like projectile points.

Understanding resource procurement, exchange networks, regional identity, and social boundaries are all contingent on an understanding of how patterns in the archaeological record are identified and interpreted. Obsidian presents a single avenue to examine these by looking at how the spatial distributions of the material are represented and change across a landscape.

CHAPTER 3 – OBSIDIAN RESEARCH IN THE TUCSON BASIN

3.1 Pre-Classic Period

Previously tested Pre-Classic Tucson Basin obsidian is, unfortunately, rarely abundant enough to meet optimal discussion criteria with some sites being represented by single pieces of sourced obsidian. This all makes for little comparative data, and makes analysis especially difficult when the abundance of key obsidian sources seems to differentiate the Tucson Basin from a majority of the Phoenix Basin sites, excluding sites near Gila Bend (Doyel 1996).

A search for current obsidian source data for the Pre-Classic Tucson Basin indicates that sourced obsidian is extremely limited with the total XRF sourced assemblage consisting of 65 samples from 11 different sites (Table 3.1) (Della Croce 2004; O'Brien et al 2013; Ryan 2009; Shackley 1999a, 1999b, 2000, 2004, 2006, 2007, 2008; Sliva 2000). This total represents all known data in the Tucson Basin prior to this thesis and is included in later discussion. This data has come almost exclusively from cultural resource management projects and an all-encompassing synthesis has yet to be attempted.

The closest thing to a Tucson basin-wide examination of the distribution of obsidian in this period comes from the flaked stone chapter of the report from Honey Bee Village, a large village site in the northern Tucson Basin (Sliva and Ryan 2012). In this report the analysis noted that a wide variety of obsidian sources were utilized and that evidence for exchange networks or resource procurement trips are evident in the Honey Bee assemblage. Sliva and Ryan also describe an apparent difference in source utilization between sites located on the floodplain along the Santa Cruz and Honey Bee Village and the nearby Sleeping Snake site, both located in the northern basin.

Site Name	Reference	Total Sample	Antelope Wells	Sand Tanks	Los Sitios del Agua	Cow Canyon	Tank Mountains	Mule Creek/Antelope Creek/Mule Mountains	Sauceda	Superior	Government Mountains
Honey Bee Village	Sliva and Ryan 2012	24	0	0	0	1	1	1	17	3	**1**
Sunset Mesa	Shackley 1999a, 2000	11	0	2	2	1	0	3	1	2	**0**
West Branch	Della Croce 2004, Shackley	5	0	0	0	2	0	1	1	0	**1**
Valencia Vieja	Shackley 2008	6	0	0	0	6	0	0	0	0	**0**
Valencia	Shackley 2007	5	3	0	0	0	1	0	1	0	**0**
Tanque Verde Wash	Shackley 2006	2	0	0	0	1	0	1	0	0	**0**
Sleeping Snake	Sliva and Ryan 2012	5	0	0	0	0	0	1	1	3	**0**
Hardy Site	Ryan 2013	1	0	0	0	0	0	0	0	1	**0**
La Cholla Locus	O'Brien et al. 2013	1	0	0	0	0	0	0	1	0	**0**
Julian Wash	Shackley 1999b	5	0	0	0	0	0	2	2	1	**0**
Total Counts		65	3	2	2	11	2	9	24	10	**2**

Table 3.2 Pre-Classic obsidian previously XRF sourced in the Tucson Basin

Excluding the results from Honey Bee Village, there appears to be a focus on eastern obsidian sources from sites along the Santa Cruz River, specifically Cow Canyon and Mule Creek (Sliva and Ryan 2012). Source attributions from these floodplain sites indicate that approximately 52 percent of obsidian originated from these eastern sources. It is suggested that these sources could be the result of direct procurement or from exchange networks with groups to the east of the Tucson Basin.

Prior to the work on Honey Bee Village, obsidian from Sauceda occurred at a rate of less than 13 percent in the Tucson Basin (Sliva and Ryan 2012:471). Previously, it has been observed that Sauceda obsidian did not become common until after the abandonment of the Gatlin site (AZ Z:2:1 [ASM]) between A.D. 1100-1200 (Doyel 1996). Sliva and Ryan (2012) point out that the limited representation of Sauceda before A.D. 1100 may be underestimated, noting that Snaketown's sourced sample consists of 20 percent Sauceda material. All of this considered, the preponderance of Sauceda obsidian at Honey Bee Village was an unexpected result. They concluded that the Sauceda obsidian acquisition could be the result of procurement embedded with the gathering shell or could have been acquired through exchange networks linked to groups residing in the Phoenix area located closer to the source (Sliva and Ryan 2012).

On the larger basin scale, Sliva and Ryan noted that none of the sources entered the region solely as finished products. However, the Superior source occurs most frequently as finished projectile points and a case has been made, despite small sourced sample size (n=9), that Sedentary Serrated projectile points may be entering the Tucson Basin as finished projectile points (Sliva and Ryan 2012:474).

It is evident that differential access to obsidian occurred on the regional scale, Honey Bee Village stands out as an anomaly, indicating an apparent western source preference when compared to the several sites located in the floodplains. It is pointed out that Honey Bee Village more closely resembles Classic period sites, namely Yuma Wash and the Marana Community, rather than contemporary Sedentary sites sampled to date (Sliva and Ryan 2012:475).

3.2 Classic Period

Throughout the Hohokam sequence there is a general trend to more widespread use of obsidian as a raw material. The Early Classic period (ca. A.D. 1150 – 1300) has obsidian in greater frequency and source variety than previous periods on a notable scale (Bayman and Shackley 1999; Fertelmes et al. 2012; Marshall 2002; Peterson et al. 1997; Shackley 1989, 1995). However, the highest frequency and most widespread use of obsidian is not realized until the Late Classic Period (ca. A.D. 1300 – 1450), when studies showing the vast social networks of the Southwest reached a point that facilitated widespread exchange of the material, and quantities of obsidian in artifact assemblages increased drastically (Mills et al. 2013:5788). During this period, it was found that obsidian procurement and exchange increased 10-fold with a higher emphasis on the movement of raw materials and a decrease in the movement of finished tools. Also of major significance, it was found that the proportion of sites that deviated from distance decay nearly doubled in southern and central Arizona. Sites that contained high amounts of Mule Creek and Cow Canyon obsidian were most significantly affected (Mills et al. 2013).

3.3 Obsidian Research in Regional Context

Previous research on Hohokam obsidian procurement has been primarily focused on the Phoenix Basin area (Bayman and Shackley 1999; Doyel 1996; Fertelmes et al. 2012; Shackley 2005). Work in the Phoenix Basin identified three tool traditions strongly associated with obsidian provenance data and projectile point attributes (Hoffman 1997; Shackley 2005). This work showed that certain key obsidian source locations were utilized nearly exclusively for the production of certain point forms. These forms were tethered to specific regions in the Phoenix area and were rarely found outside of their respective ranges. When associated obsidian sources did leave their respective ranges the obsidian was almost always found as completed formal tools.

Some of the most informative studies on Pre-Classic obsidian in the Phoenix Basin are derived from sites near source areas where overall obsidian sample sizes are large (Bayman and Shackley 1999;

Doyel 1996; Shackley 2005). However, sites in Hoffman's (1997) Solares Tradition, namely La Cuidad, Las Colinas, and Palo Verde Ruin differ from this pattern with their dependence on sources from northern Arizona (Fertelmes et al. 2012; Shackley 2005).

Overall, Shackley concluded (2005) that obsidian in the Pre-Classic period, specifically the Sedentary period, may have been tied to activities associated with the ballcourt complex. After the decline of the ballcourt system, exchange and use of obsidian persisted, but in a transformed manner.

Obsidian in Phoenix Basin during the Classic period began to increase in both frequency and variety (Bayman and Shackley 1999; Marshall 2002; Peterson et al. 1997). Sauceda obsidian, in particular, sees an increase in use across the greater Hohokam area as through time during the Classic period (Bayman and Shackley 1999; Fertelmes et al. 2012).

There are currently two competing models that characterize obsidian movement and distribution in the Classic period. The first, put forward by Peterson et al. (1997), is that reciprocal ties were the primary mechanism in which obsidian was moved. The second, put forward primarily by Bayman (1995, 2001), is that a segment of elites controlled the acquisition and distribution of obsidian. Fertelmes et al. (2012) came to the conclusion that the distribution of obsidian was closely linked to platform mounds and that elite segments of the population may have controlled its acquisition. Additionally, in a summary by Shackley (2005), it was suggested that the Salado phenomenon created a difference in obsidian availability between elites within the area of the platform mound and those outside of them. Those outside of the platform mounds may have had access to a greater variety of sources fueled by communities outside of the elite system.

CHAPTER 4 – TUCSON BASIN PRE-CLASSIC PERIOD OBSIDIAN ANALYSIS

This chapter describes the results of the new obsidian analyses that were conducted and the sites that were sampled for obsidian for XRF source attribution. I also include a summary of the other sites in the Tucson Basin for which there are Pre-Classic obsidian XRF analyses available.

4.1 New Sites Analyzed

The new sampling area consists of three sites of varying sizes from the northeastern portion of the Tucson Basin (Figure 4.1) (Shackley 2012, 2013). As these sites lack any previously published information, a brief discussion of each is provided. All date associations for these XRF sampled obsidian were determined from ceramic data associated with the same contexts (Table 4.1).

Twenty-Nine Wash AZ BB:5:47(ASM)

The Twenty-Nine Wash site, a Hohokam habitation site in the northern Tucson Basin, is currently the focus of Pima Community College's (PCC) Centre for Archaeological Field Training Fall Semester program. The site encompasses both the Colonial and Sedentary periods (ca. A.D. 750-1150) and is located approximately 17 km southwest of Oracle, Arizona on the periphery of the Tucson Basin. The XRF sourced pieces are derived from the fill of two middens and five pithouses from a site of over 40 currently named features, which include pithouses, middens, and variable types of pits.

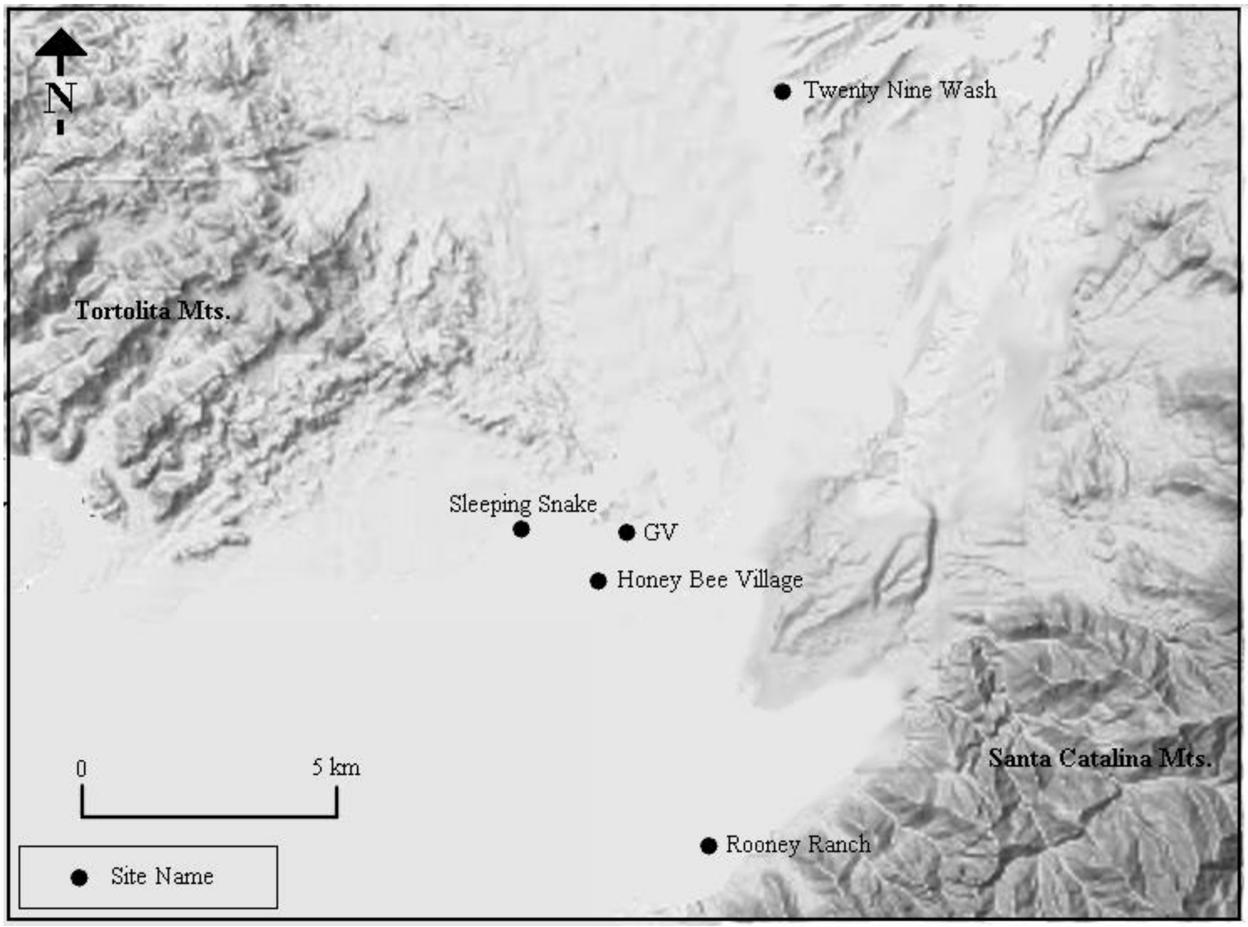

Figure 4.1. Locations of newly sampled sites with reference to nearby previously reported on sites.

Source analysis of 28 obsidian samples, including projectile points and debitage, identified five distinct sources areas. The majority (64.2 %) are sourced to the Sauceda Mountains, approximately 160 km to the west. The remaining pieces were sourced to Superior (17.8 %), Mule Creek (7.1 %), Government Mountain (3.5 %), and the Tank Mountains (3.5 %). A single piece of obsidian (3.5 %) did not resemble any currently identified sources (Shackley 2013).

Of the 28 sourced samples, three are projectile points from the Superior, Mule Creek, and Tank Mountain sources and two are bifaces from the Sauceda and Mule Creek source areas. Of the six pieces that retain cortical surfaces, five were from Sauceda and one was from Superior.

GV site AZ BB:9:169 (ASM)

The GV site is a satellite of Honey Bee Village, AZ BB:9:88 (ASM), and is approximately 1 km northeast of the site's core area. The site was excavated by PCC through their field school in 1999, 2001, and 2002. Features that yielded obsidian for this study included one pithouse, one roasting pit, and one pit feature. All excavated features fall within the Middle Rincon phase (ca. A.D. 1000-1100) according to ceramic data (Helen O'Brien, personal communication, January 2012). Source analysis of 11 obsidian samples, including a single biface and the remainder as debitage, indicates that all material came from the Sauceda Mountains source. Of the 11 tested pieces, five retain cortical surfaces.

Rooney Ranch AZ BB:9:3 (ASM)

Rooney Ranch was excavated by PCC intermittently from October of 1981 until fieldwork was completed in February of 1994. Recent ceramic analyses indicate the site spans the Early Rincon to the Late Rincon/Tanque Verde phase transition (ca. A.D. 950-1150) (Lea Mason-Kohlmeyer, personal communication, May 2013). The site is located on a high terrace overlooking the Cañada del Oro, a little more than 5 km southeast of Honey Bee Village, near Oro Valley, Arizona (Figure 4.2).

Twenty-Nine Wash AZ BB:5:47(ASM)

Period	Lot	Feature	Type	Artifact	Source
Late Rincon	8636-0	8	Midden	Flake	Unknown
Late to Middle Rincon	8611-1	8	Midden	Flake	Sauceda
	8611-2	8	Midden	Flake	Sauceda
Rincon	8976-0	35	Pithouse	Flake	Sauceda
	8613-1		Surface	Biface	Sauceda
	8623-1		Surface	Projectile Pt.	Antelope Creek/Mule Creek
	8794-0		Surface	Biface	Mule Mountains/Mule Creek
	8801-1		Surface	Projectile Pt.	Tank Mountains
	9007-0		Surface	Projectile Pt.	Superior
Early Rincon to Colonial	8619-0	8	Midden	Flake	Sauceda
Rillito	8617-0	8	Midden	Flake	Sauceda
	8622-0	8	Midden	Flake	Sauceda
	8887-0	34	Pithouse	Flake	Superior
	8894-0	34	Pithouse	Flake	Sauceda
	9013-1	35	Pithouse	Flake	Superior
	9013-2	35	Pithouse	Flake	Superior
	9013-3	35	Pithouse	Flake	Unknown
Canada del Oro	8656-1	20	Pithouse	Flake	Superior
	8656-2	20	Pithouse	Flake	Sauceda
Colonial	8613-1	8	Midden	Flake	Sauceda
	8613-2	8	Midden	Flake	Sauceda
	8621-0	8	Midden	Flake	Sauceda
	8657-0	20	Pithouse	Flake	Sauceda
	8711-0	22	Pithouse	Flake	Sauceda
	8801-0	31	Midden	Flake	Government Mtn.
	8899-0	32	Pithouse	Flake	Sauceda
	8928-0	34	Pithouse	Flake	Sauceda
	8938-0	34	Pithouse	Flake	Sauceda
	9016-0	35	Pithouse	Flake	Sauceda

Rooney Ranch AZ BB:9:3(ASM)

Period	Lot	Feature	Type	Artifact	Source
Middle Rincon	640	1	Pithouse	Projectile Pt.	Superior
	845	3	Pithouse	Projectile Pt.	Superior
Early Rincon	710	2	Pithouse	Projectile Pt.	Superior
	796-47	2	Pithouse	Projectile Pt.	Antelope Creek/Mule Creek

Sedentary	667	Surface	Surface	Projectile Pt.	Antelope Creek/Mule Creek
	6395	8	Pithouse	Flake	Los Vidrios
	6600	Surface	Surface	Projectile Pt.	Antelope Creek/Mule Creek
	6802	14	Pithouse	Flake	Sauceda
	6817	11	Pithouse	Projectile Pt.	Superior
GV AZ **BB:9:169(ASM)**					
Period	**Lot**	**Feature**	**Type**	**Artifact**	**Source**
Middle Rincon	7831	N/A	N/A	Flake	Sauceda
	7886	N/A	N/A	Flake	Sauceda
	8110	23	Roasting Pit	Flake	Sauceda
	8117	9	Pithouse	Flake	Sauceda
	8121	22	Pit	Flake	Sauceda
	8123	9	Pithouse	Biface	Sauceda
	8127	22	Pit	Flake	Sauceda
	8132	22	Pit	Flake	Sauceda
	8157	9	Pithouse	Flake	Sauceda
	8159	9	Pithouse	Flake	Sauceda
	8162	9	Pithouse	Flake	Sauceda

Table 4.1. Obsidian Results by Time Period.

Obsidian from six house structures and surface finds, in the case of three of the projectile points, comprise the sourced material. Unlike the other sourced sites, the obsidian samples selected from Rooney Ranch are primarily in the form of projectile points. A single projectile point from the Superior source was identified from floor context dating to the Middle Rincon phase (ca. A.D. 1000-1100). Another projectile point from the Mule Creek/Antelope Creek source was identified from floor context dating to the Early Rincon phase (ca. A.D. 950-1000).

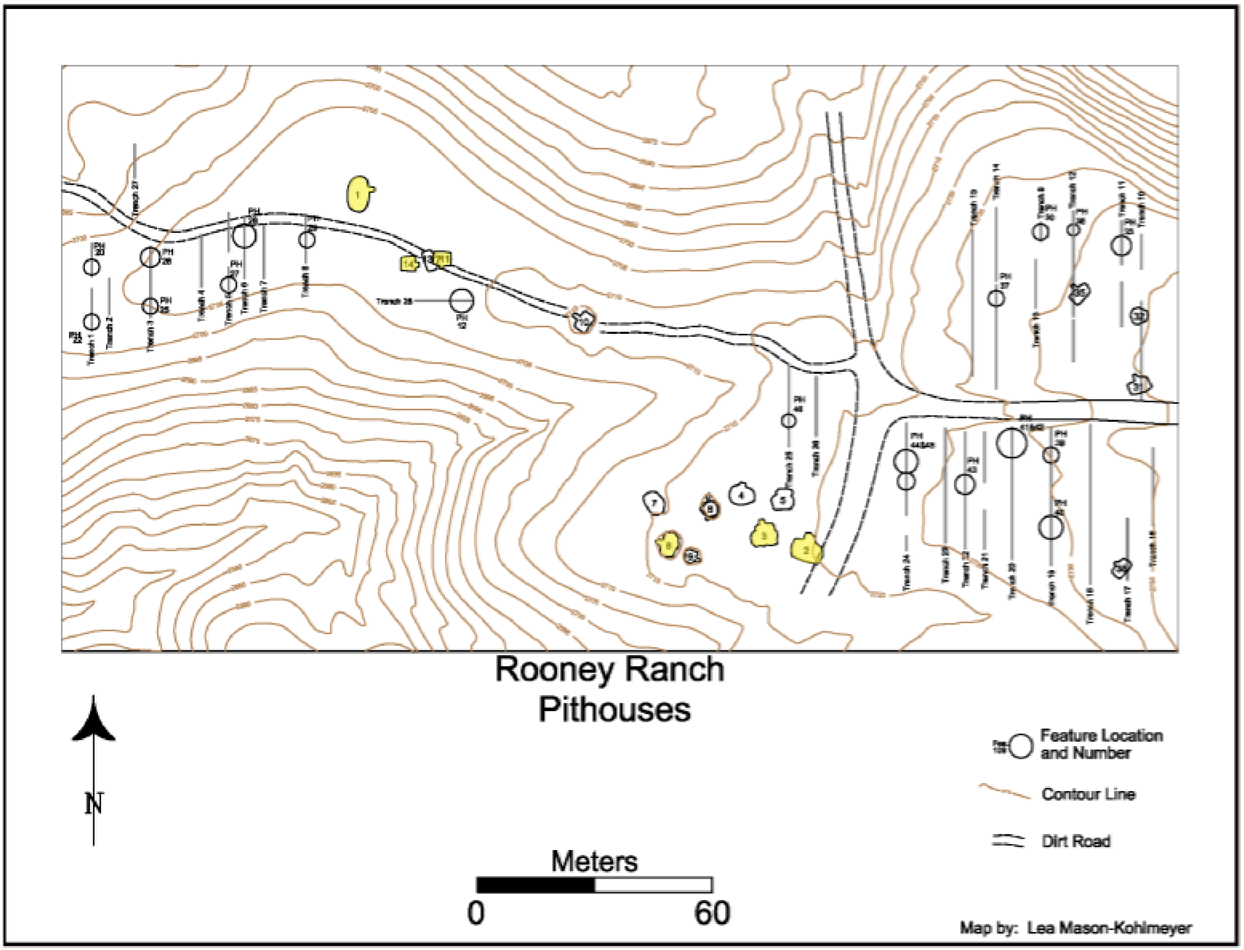

Figure 4.2. Map of Rooney Ranch after Mason-Kohlmeyer (REFERENCE). Modified to show features with obsidian sourced in this study in yellow.

Source analysis of nine obsidian samples, seven projectile points, and two pieces of debitage, identified four distinct source areas. Four projectile points were sourced to Superior, while three others were sourced to Mule Creek/Antelope Creek. The Superior points are Hoffman's (1997) Snaketown Serrated type and the three Mule Creek points do not appear to be common point types to the Tucson Basin (Figure 4.3). Hoffman's Snaketown Serrated type has been previously identified as often being associated with the Superior obsidian source (Shackley 2005). The Mule Creek points resemble those identified north of the Salt-Gila drainage and near the Gila Bend

Figure 4.3. Projectile points from Rooney Ranch. Top row shows Snaketown Serrated points made of Superior obsidian. Bottom shows points made of Mule Creek obsidian.

Area, but the match is not perfect (Sliva 2006: Figure 2.3a) The remaining two pieces were a cortical flake from the Sauceda Mountains and a noncortical flake from the Los Vidrios source in Mexico.

4.3 Other Pre-Classic Sites with Obsidian Data

Other Pre-Classic sites with obsidian discussed in this thesis are briefly described in the following paragraphs (Figure 4.4). These sites represent a best attempt to compile all known obsidian analyzed by XRF for the Colonial and Sedentary period (Table 4.2). As previously mentioned, this data was generated from cultural resource management projects across Tucson.

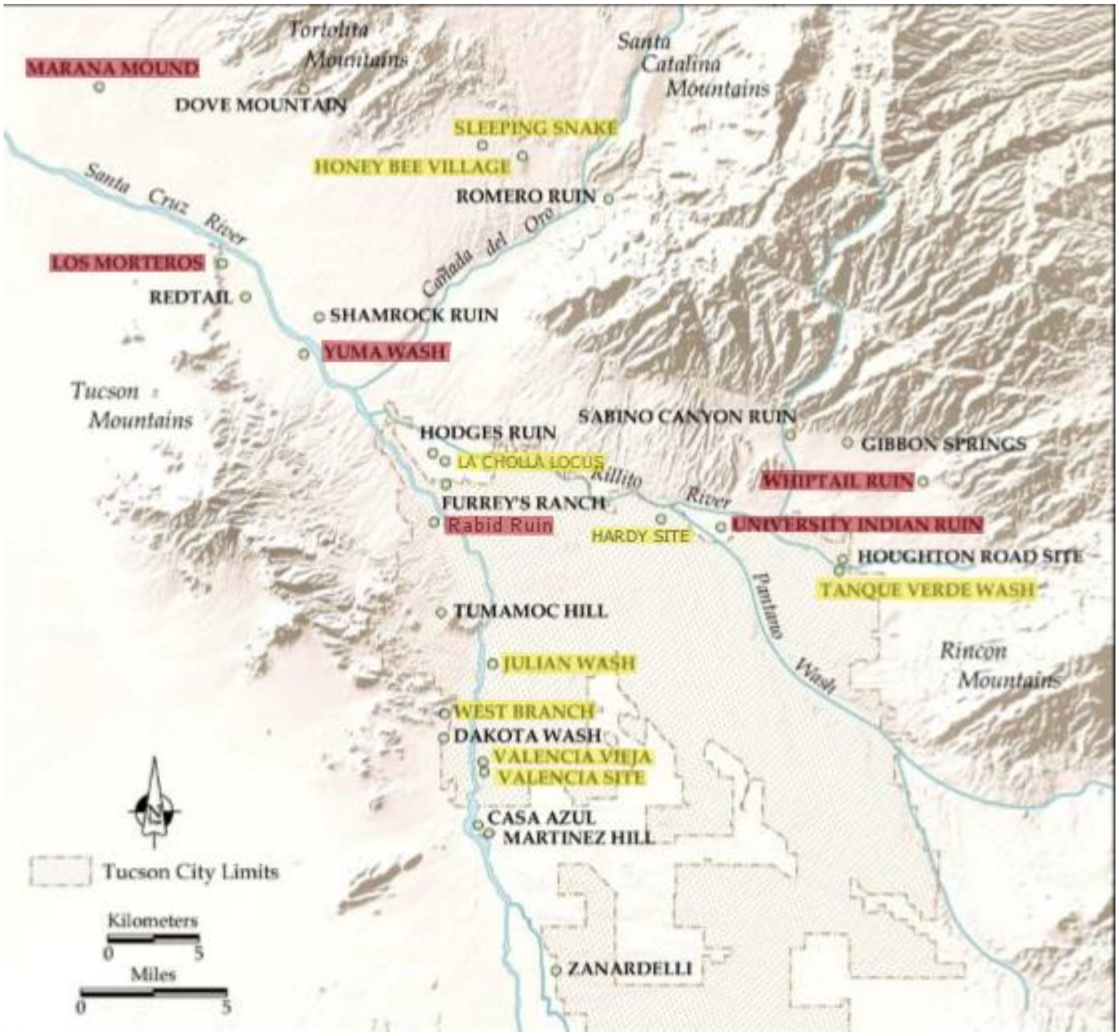

Figure 4.4. Map of Pre-Classic and Classic sites with obsidian discussed in this thesis. Yellow indicates Pre-Classic sites with sourced obsidian. Red indicates Classic sites with sourced obsidian. Map modified from Doelle 2007.

Honey Bee Village was excavated by Desert Archaeology, Inc., and its XRF analyzed obsidian sample was the largest available sample of Tucson Basin Pre-Classic obsidian prior to this thesis (Wallace 2012). The obsidian from this site primarily came from Early and Middle Rincon contexts, but the entire Sedentary period is represented. There is no discernable pattern through time in this analyzed sample, but there did appear to differential access to obsidian based on location within the site (Sliva and Ryan 2012).

The analyzed sample from Sunset Mesa is highly diverse in its obsidian source distribution, but there appears to be at least some preference for eastern sources, such as the Mule Creek area and Cow

Canyon. The obsidian all comes from the Rincon period with the majority being from the Middle Rincon phase. The obsidian from Sunset Mesa came from excavations performed by both Statistical Research, Inc. and Desert Archaeology, Inc. (Shackley 1999a, 2000).

West Branch was excavated by Statistical Research, Inc. Its analyzed obsidian sample is fairly diverse, but shows a clear preference for eastern obsidian sources with over 50 percent coming from either Cow Canyon or the Mule Creek area (Shackley 2004). Dating of contexts with obsidian was limited to the Sedentary period and phase identification could not be achieved.

Valencia Vieja was excavated by Desert Archaeology. This site's entire analyzed obsidian sample is attributed to the Cow Canyon source and comes from contexts dating from the Early Rincon to Middle Rincon 1. In his analysis, Shackley (2008) notes that it is possible that all the obsidian from this analyzed sample originates from a single nodule, though this is not conclusive.

The Valencia site was excavated by Desert Archaeology. All of the analyzed obsidian in this sample comes from Middle Rincon contexts (Shackley 2007). The Valencia site obsidian assemblage is overall diverse with a preference for eastern sources. It is also the only site to have obsidian from the Antelope Wells source.

Tanque Verde Wash was excavated by Desert Archaeology and its analyzed obsidian sample is attributed exclusively to eastern sources (Shackley 2006). This sample is smaller than many of the other sites represented, consisting of only two sourced pieces. Both pieces are from Early to Middle Rincon contexts.

The analyzed obsidian sample from Sleeping Snake was selected as a supplement to the Honey Bee Village sample and consists exclusively of projectile points (Sliva and Ryan 2012). All projectile points are either of the Snaketown Serrated type or the Sedentary Barbed type and are described by Sliva and Ryan (2012:Figure 9.24). These points are primarily attributed to the Superior source, but Sauceda and Mule Creek are also represented. The points are all Sedentary types.

Site Name	Period/Phases represented	Total Sample Size
Honey Bee Village	Sedentary Period	24
Sunset Mesa	Middle Rincon/Rincon	11
West Branch	Sedentary Period	5
Valencia Vieja	Early Rincon/Middle Rincon 1	6
Valencia	Middle Rincon	5
Tanque Verde Wash	Early/Middle Rincon	2
Sleeping Snake	Sedentary Period	5
Hardy Site	Sedentary Period	1
La Cholla Locus	Sedentary Period	1
Julian Wash	Rillito/Middle Rincon	5
TOTAL		65

Table 4.2. Other Pre-Classic sites with XRF obsidian data in the Tucson Basin by period/phase

The analyzed sample from the Hardy site consisted of a single Snaketown Serrated point attributed to the Superior source (Ryan 2013). This projectile point came from an excavated pithouse dated to the Sedentary period. This locus of the Hardy site was excavated by Desert Archaeology, Inc.

The La Cholla Locus was excavated by Tierra Right of Way Services, Ltd. The analyzed obsidian sample from this site is larger than what is utilized in this thesis. This is a multi-component site that includes the Pioneer period, Sedentary Period, and Classic period and obsidian from all periods are represented (O'Brien et al. 2013). The single Sedentary period piece is included in this analysis and is attributed to the Sauceda source. Unlike many of the other sites sampled in this study, Sauceda appears to be well represented throughout all periods at this site and is not limited to just the Sedentary period.

The analyzed obsidian from Julian Wash comes from excavations done by Statistical Research, Inc. Obsidian from this site primarily comes from Middle Rincon contexts, but a projectile point from the Rillito phase made of obsidian attributed to the Sauceda source is also represented (Shackley 1999b). The Sedentary period pieces of obsidian consist of a primarily eastern sources, but the overall analyzed sample size is small.

Overall there are 13 sites in the Tucson Basin with 112 pieces of available XRF analyzed obsidian from Pre-Classic contexts. These sites comprise both newly analyzed samples and existing analyzed samples known to date. The analysis of these are discussed in more depth in the next chapter.

CHAPTER 5 – DISCUSSION AND CONCLUSIONS

Obsidian from the Pre-Classic contexts in the Tucson Basin has been grossly understudied to date. This could be explained away as the result of the paucity of currently available data, however, the lack of a current synthesis of information is remedied here. The Pre-Classic Tucson Basin obsidian available to date appears to show more continuity with the Classic period than previously realized and social exchange networks may have been in place much longer than considered in the past. In this chapter I address the questions posed in Chapter 1 as well as provide additional avenues for future research. Each question is given an enumerated heading to facilitate ease of discussion.

5.1 What are the primary sources of obsidian being utilized by the Hohokam in the Tucson Basin ca. A.D. 750-1150?

The Tucson Basin has a differentiated spatial distribution of obsidian usage in the Pre-Classic period, ca A.D. 750-1150. Discussion of the Tucson Basin as a single entity during this period is largely due to the low number of sourced samples available for the earlier portion of this period. This reflects the low quantities of obsidian in the Pre-Classic as a whole. This lack of available data is discussed later on, but overall these patterns may be better descriptors of the entire Sedentary period rather than individual phases. There appears to be a distinction in obsidian use between sites in the northern fringes of the Tucson Basin and southern sites (Figure 5.1).

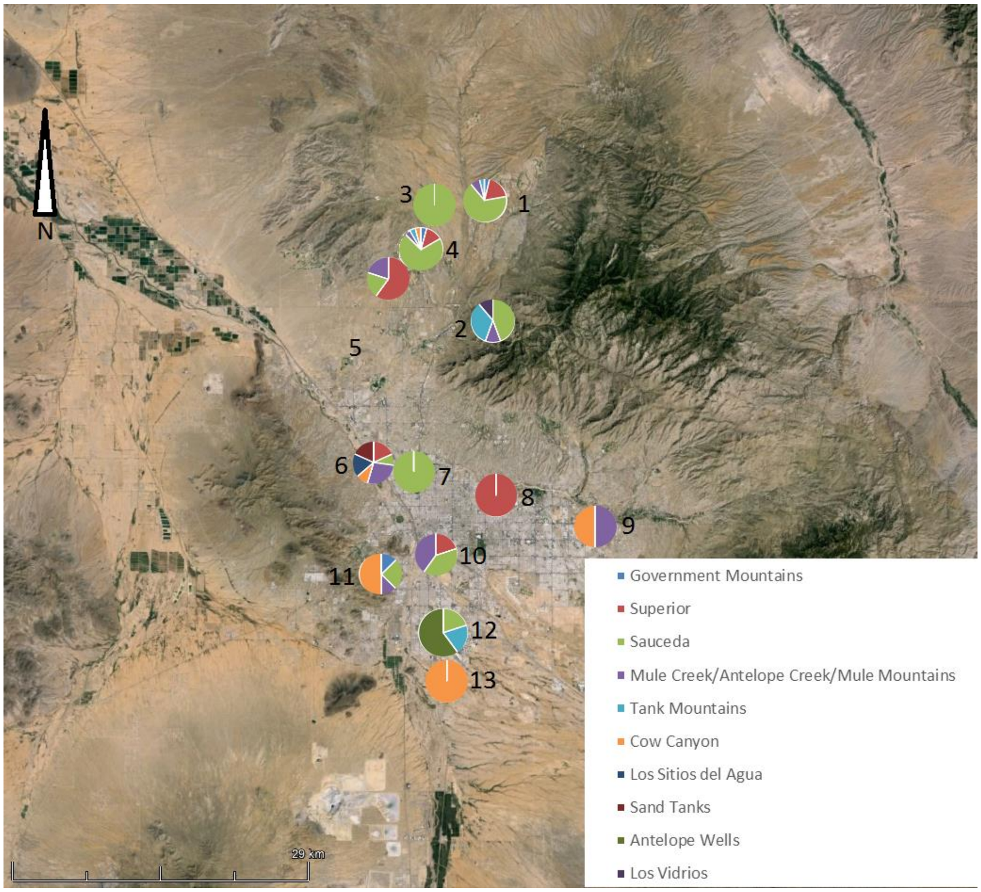

Figure 5.1. Pie charts representing obsidian distributions in the approximate locations of sites within the sample. 1=Twenty-Nine Wash, 2=Rooney Ranch, 3=GV, 4=Honey Bee Village, 5=Sleeping Snake, 6=Sunset Mesa, 7=La Cholla Locus, 8=Hardy Site, 9=Tanque Verde Wash, 10=Julien Wash, 11=West Branch, 12=Valencia, 13=Valencia Vieja.

Although some of these distinctions may be obscured by limited sample size, the northern sites are dominated by western sources, primarily Sauceda. There appears to be a continuation of this pattern between the Colonial and Sedentary periods with the obsidian distributions from the Colonial period site of Twenty-Nine Wash being nearly identical to the Sedentary period site of Honey Bee Village. Although many of the sites tested do have Late Rincon components, finding obsidian that could be tied to this particular phase proved elusive and may indicate an initial dip in obsidian before the Early Classic rise.

Sites outside of the northern portion of the basin show a much higher use of obsidian from the Mule Creek/Antelope Creek/Mule Mountains and the Cow Canyon source areas. Sauceda obsidian is still found in these assemblages, but at a much lower rate. Comparatively, XRF analyzed sample sizes from this area are much smaller, however, there is a larger site representation.

Compiled source data show that Sauceda obsidian is present in all the newly sampled sites. The northern Tucson Basin relied heavily on the Sauceda Mountain area as a source of obsidian, consisting of 62.3 percent (n=48) of the currently sourced material, although source attributed samples consisting primarily of projectile points do not as strongly show this pattern. Both Superior and Mule Creek sources are present consistently in sites in the northern Tucson Basin, albeit in smaller quantities, with the exception of the GV site, AZ BB:9:169 (ASM). The site's small size and lack of a diverse obsidian assemblage may indicate that Sauceda was the most easily obtained type of obsidian in the northern Tucson Basin. Prior to the work on Honey Bee Village, obsidian from Sauceda occurred at a rate of less than 13 percent in the Tucson Basin (Sliva and Ryan 2012). Although Honey Bee Village revealed Sauceda obsidian's dominance in the area, the results of this analysis were somewhat unexpected. The patterns observed at Honey Bee Village appear to be mirrored in other sites in the northern valley.

Overall, there is a large diversity of obsidian sources represented in the Tucson Basin, at least 10 in total. However, four sources—Sauceda, Superior, the Mule Creek/Antelope Creek/ Mule Mountains grouping, and Cow Canyon—represent the majority of the sourced material. Interestingly, this means that communities are going further away to procure their obsidian than what Distance-Decay would suggest should be occurring (Table 5.3). In some instances, obsidian sources are being entirely skipped in preference for another source. As obsidian quality generally does not vary greatly from source to source (Shackley 2005), this then suggests that some other factor is controlling the decisions being made. In this regard, the obsidian better reflects the relationships of communities than it does the need for a certain type of tool stone.

Superior	90
Los Sitios del Agua	120
Sand Tanks	160
Sauceda	170
Cow Canyon	190
Los Vidrios	200
Antelope Wells	210
Mule Creek	220
Tank Mountains	330
Government Mtns	355

Table 5.3 Average distances in kilometers of sources from Tucson.

The use of these sources appears to be consistent over time, but as suggested earlier the limited quantity of XRF sourced Colonial period obsidian leaves room for future work. The lack of sourced Colonial period data can then suggest two possible things, either obsidian is so underutilized in the Colonial period that it is archaeological invisible in most cases and Twenty-Nine Wash, the major component of the XRF sourced Colonial period sample in this dataset, is an anomaly, or sampling strategies of the past missed the obsidian, which seems to be likely. Twenty-Nine Wash as an anomaly is not unlikely, if entirely possible, the site has an unusually high amount of lithic materials and obsidian is in much higher quantities throughout time than might be expected.

Future work with added emphasis on the Colonial period will hopefully clarify this relationship, because a lack of obsidian in Colonial contexts will have interesting implications for the interpretation of data. If obsidian was not used in the Colonial period, this may imply a relation to the emerging late Colonial to Sedentary period ballcourt marketplaces in the Phoenix Basin. This is also strengthened by an apparent decrease of obsidian in Late Rincon/Late Sedentary contexts around the cessation of ballcourt usage. The lack of obsidian data, in the regard, is just as valuable as the data itself and conclusions can be drawn from it.

5.2 How does the exploitation of different obsidian sources during the Pre-Classic period contrast with the Classic Period? Which sources are more consistent over the pivotal Sedentary period?

An examination and comparison of obsidian usage between the Pre-Classic and Classic Periods in the Tucson Basin has led to an unexpected similarity in obsidian distributions. As previously mentioned, the primary sources of obsidian in the Pre-Classic periods consist of Sauceda, Superior, the Mule Creek/Antelope Creek/ Mule Mountains grouping, and Cow Canyon. When looking at data from Classic period sites, these same sources stand out as the primary sources being utilized (Table 5.4). Cow Canyon is slightly under represented overall, but is still the fourth highest source used in the Classic period.

What this suggests is that the Classic period in the Tucson Basin may be better described as a considerable expansion of obsidian usage and not necessarily a shift in the relationships from the previous periods (Table 5.5). Classic period obsidian usage, when compared to this newly analyzed Pre-Classic obsidian data, appears to be a continuation of previously established relationships to the west and east of the Tucson Basin. The similarities between the Marana Community and Yuma Wash obsidian results are strikingly similar to those seen in the northern Tucson Basin starting as early as the Colonial Period. Questions arise about how obsidian may be traveling through these existing relations, is this continuity be controlled by elites? Are the migrant streams moving obsidian following existing streams from the past?

Source Location/ Site	Sauceda	Superior	Mule Creek	Cow Canyon	Los Vidrios	Los Sitios	Antelope Wells	San Fran Volc	Sand Tanks	Jemez	Unk
UIR	10	-	27	-	6	1	1	8	3	-	-
Whiptail Ruin	-	-	3	-	-	-	-	-	-	-	-
Marana Mound	146	15	17	6	2	-	-	-	-	-	2
Los Morteros	2	43	4	-	-	1	-	-	-	-	-
Rabid Ruin	16	-	6	-	1	-	-	4	-	-	-
Yuma Wash	26	9	6	10	2	-	-	3	-	1	-
Column Total	200	67	63	16	11	2	1	15	3	1	2
Column Percent	52.5	17.6	16.5	4.2	2.9	0.5	0.3	3.9	0.8	0.3	0.5

Table 5.4. Obsidian Source Data from Classic Period Contexts in and Around the Tucson Basin (from Mills et al. 2012)

Source	Pre-Classic	Classic
Sauceda	48.2	52.5
Superior	17	17.6
Mule Creek	12.5	16.5
Cow Canyon	9.8	4.2
Government Mtns	2.6	3.9
Tank Mountains	2.6	-
Los Sitios del Agua	1.7	0.5
Sand Tanks	1.7	0.8
Antelope Wells	2.6	0.3
Los Vidrios	0.9	2.9

Table 5.5 Percentages of obsidian in relation to source area in the Pre-Classic period compared to percentages at the same sources in the Classic period.

5.3 How do finished artifacts, like projectile points, compare to raw materials in source distributions for the Pre-Classic in the Tucson Basin. That is, was it direct procurement of the raw material or were the items coming in as finished products?

Given the inherently small sample sizes available for the Pre-Classic Tucson Basin, identifying procurement patterns has proven somewhat difficult, however, two patterns appear to be present.

The western obsidian sources utilized by the Hohokam all fall within the corridor traveled from southern Arizona to the northern Gulf of California as part of shell exchange (Mitchell and Foster 2012). Whether or not people from the Papaguería were bringing shell and obsidian into central and southern Arizona or if people from central and southern Arizona were taking expeditions through this corridor themselves is difficult to discern using obsidian source data alone. It is likely that both scenarios occurred at various times in prehistory. Current models suggest that during the Colonial and Sedentary periods, ca. A.D. 750-1150, the groups who occupied the Papaguería utilized the exchange of shell and salt with neighboring Hohokam groups as a means to alleviate the need for food, cotton, and other materials that were scarce in their local environments (Mitchell and Foster 2012:180). Interestingly, Mitchell and Foster (2012) suggest that obsidian in the Pre-Classic periods was not an important resource for exchange between the western Papaguería and south central Arizona Hohokam populations. Although obsidian in Pre-Classic contexts is low, usually less than one percent from an entire flaked stone assemblage (Sliva and Ryan 2012:475), this recent work seems to suggest that it was still a resource of interest as early as the Colonial Period. Although direct procurement or direct relationships with western Papaguería groups cannot be ruled out, others have suggested that the Sauceda obsidian source was regulated and controlled by people in the Gila Bend area (see Doyel 1996). The lack of Hoffman's (1997) Gatlin-Citrus Tradition projectile point types at these sites is curious if this control is present because Shackley (2005) demonstrated that there is strong correlation between this projectile point group and the Sauceda source in the Phoenix Basin. Shackley also found that when obsidian left any of the established exchange spheres, it usually did so as a finished projectile point. This does not appear to be the case in this study area as only a single projectile point from the 48 sourced Sauceda pieces appeared to resemble Hoffman's type (1997); furthermore, this point was the only projectile point made from Sauceda obsidian in this study. It seems clear that a substantial portion of Sauceda obsidian was entering the Tucson Basin in the form of unreduced nodules or as large flakes as 39 percent of the examined pieces from this source retain cortical surfaces. If interactions with Hohokam groups from the Gila Bend area occurred, and they likely did, they were operating in a different manner from how Gila Bend groups interacted with neighboring areas in the Phoenix Basin. Furthermore, if Sauceda obsidian is being distributed through ballcourt marketplaces, the range of this exchange is limited in comparison to other obsidian sources observed in the Tucson Basin.

It has been previously suggested that the Superior source occurs most frequently as finished projectile points when found in the Tucson Basin (Sliva and Ryan 2012). This was previously suggested based on only ten samples. This analysis identified nine additional instances of Superior obsidian from two different sites. Of these nine sourced samples, five were finished projectile points of the Sedentary Serrated variety. Although the sample is still small by comparison to the Classic period, it seems highly likely that the Sedentary Serrated type, when made of obsidian, is originating from the Middle Gila locations described by Shackley (2005) elsewhere.

5.4 Are there observable differences between the Pre-Classic Tucson Basin and Phoenix Basin?

Analysis of Tucson Basin obsidian assemblages indicated a striking difference to patterns observed in the Phoenix Basin. The distribution of Pre-Classic obsidian in the Tucson Basin more closely resembles obsidian distributions from the Classic Period Tucson Basin than it does contemporary distributions in the Phoenix core area. As previously discussed in this chapter, the similarities that do exist between the two basins are between the Middle Gila, Gila Bend, and the Tucson Basin (Doyel 1996). However, even these similarities are not strong enough to suggest the same factors were controlling obsidian distribution between Phoenix and Tucson. In fact, if the same factors were at play, the Sauceda obsidian present in the Tucson Basin would be entering as finished projectile points. The exact opposite appears to be the case, meaning there may not be as much control of the Sauceda source as previously suggested.

The Tucson Basin, despite the limitations of a small sourced obsidian sample size, appears to be operating in a distinct fashion of its own in regard to obsidian distribution. As the available data expands more solid conclusions can be discerned, but tentatively it appears that the Tucson Basin has at least two distinct spheres of obsidian usage. The north relies heavily on western sources and the south shows a slight preference for sources to the east. Both of these spheres of usage suggest long distance relationships outside of the Tucson Basin itself. Perhaps of most interest, the closest obsidian source to the Tucson Basin, Superior, is under represented in sites thus far. When Superior is present, however, it provides the strongest evidence of a Phoenix Basin connection. Apart from these rare instances, there appears to be at least some avoidance of the Phoenix Basin when looking at the distributions of obsidian in the Tucson Basin.

These trends appear to be a real phenomenon that may provide insight into identity within the basin itself, future studies using materials other than obsidian may clarify if there is a distinction in relationships held between the north and south. If ceramics are moving east from southern sites in the Tucson Basin is this in some way linked to the higher quantities eastern sources of obsidian at these sites? As more data becomes available the Tucson Basin's place within the greater Hohokam area can be clarified, the relationships within the Basin can facilitate discussion of relationships and interaction outside the Basin. How Salado is affecting the obsidian distributions in the Classic period may be in some way linked to the relationships established in the Pre-Classic and this warrants further research.

Obsidian provides an excellent conduit to look at the social relations occurring across many scales. The symbolic aspects of obsidian usage, procurement, and ultimate distribution, such as identity and membership, are strong avenues of future research. Additionally, it is hoped that this analysis leads to future studies examining how the Tucson Basin interacted within and outside of its boundaries. The obsidian suggests that relationships existed across the southern deserts and how these relationships developed over time can be integral to our understanding. The Tucson Basin appears to be dynamic internally yet expresses great continuity over time. Previous ideas that obsidian distributions between the Pre-Classic and Classic periods were radically different are false when examining the Tucson Basin. The continuity of use in the Tucson Basin seems to make it unique in the Hohokam world.

APPENDIX A, OBSIDIAN XRF RESULTS

GEOARCHAEOLOGICAL XRF LAB

ARCHAEOLOGICAL X-RAY FLUORESCENCE SPECTROMETRY LABORATORY

8100 WYOMING BLVD., SUITE M4-158 ALBUQUERQUE, NM 87113 USA

LETTER REPORT

AN ENERGY-DISPERSIVE X-RAY FLUORESCENCE ANALYSIS OF OBSIDIAN ARTIFACTS FROM A SITE NEAR ORACLE, ARIZONA

25 November 2012

Richard Higgins

8409 E Nicaragua Dr

Tucson, AZ 85730

Dear Richard,

The assemblage is quite diverse from sources in western New Mexico/eastern Arizona (Cow Canyon and the Mule Creek sources) and the Sonoran Desert (Sauceda Mountains, Superior, and Tank Mountains (Shackley 2005; Table 1 and Figure 1 here). The one Tank Mountains sample is slightly outside the source standard data for Rb, but could be from that source.

The samples were analyzed using a Thermo Scientific *Quant'X* EDXRF spectrometer in the Archaeological XRF Laboratory, Albuquerque, New Mexico. Source assignments were made by comparison to published source standard data and the source standard collection at this laboratory (Shackley 1995, 2005). Instrumental methods can be found at http://www.swxrflab.net/anlysis.htm. Analysis of the USGS RGM-1 standard indicates high machine precision for the elements of interest (Govindaraju 1994; Table 1 here).

Sincerely,

M. Steven Shackley, Ph.D.

Director

VOICE: (510) 393-3931

E-mail: shackley@berkeley.edu

http://www.swxrflab.net/

REFERENCES CITED

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Shackley, M.S., 1995, Sources of archaeological obsidian in the Greater American Southwest: an update and quantitative analysis. *American Antiquity* 60(3):531-551.

Shackley, M.S., 2005, *Obsidian: Geology and Archaeology in the North American Southwest*. University of Arizona Press, Tucson.

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

Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Pb	Th	Source
8613-1	1680	333	11349	163	109	27	175	20	22	21	Sauceda Mtns
8623-1	1049	388	10445	239	24	42	109	26	32	36	Antelope Cr/Mule Cr
8794-0	1023	458	8788	180	15	23	112	34	25	26	Mule Mtns/Mule Cr
8801-1	1278	409	9482	141	138	14	118	16	18	20	Tank Mountains?
9007-0	1031	477	8212	117	19	25	94	28	25	8	Superior (Picketpost Mtn)
RGM1-S4	1567	282	13400	151	110	24	219	11	23	19	standard

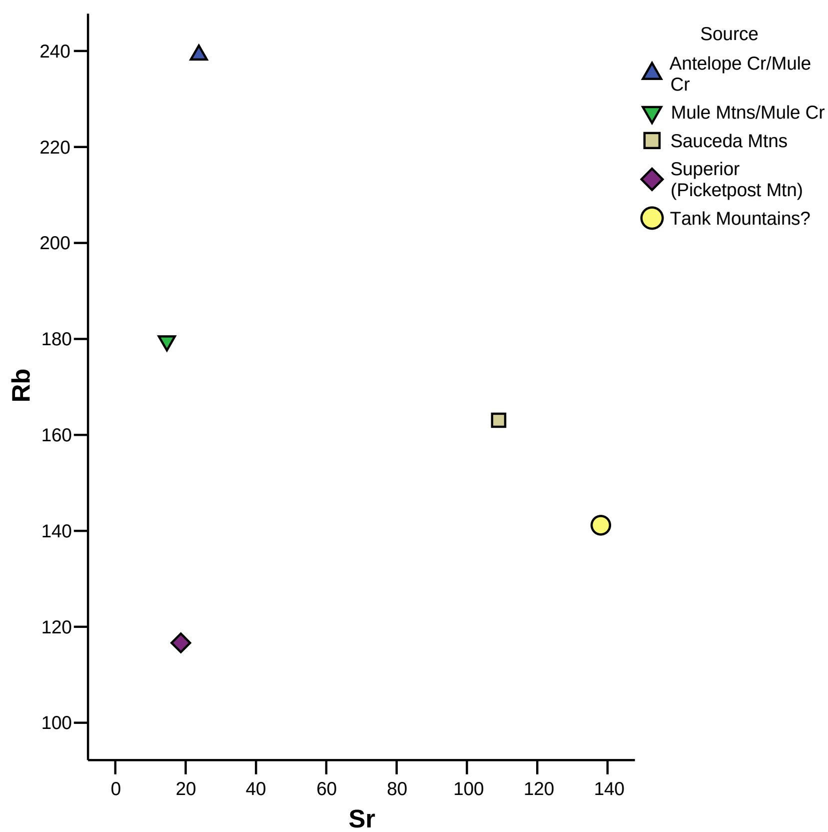


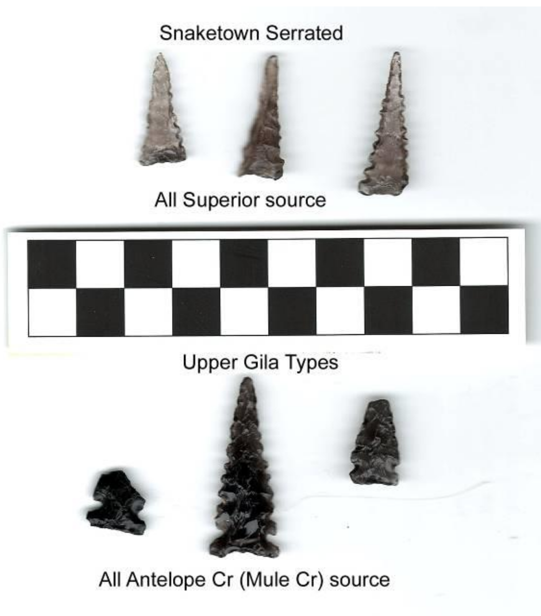
Figure 1. Sr versus Rb bivariate plot of artifacts.

GEOARCHAEOLOGICAL XRF LAB

GEOARCHAEOLOGICAL X-RAY FLUORESCENCE SPECTROMETRY LABORATORY

8100 Wyoming Blvd., Ste M4-158 Albuquerque, NM 87113 USA

SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM THREE SITES NORTH OF ORO VALLEY, ARIZONA



by

M. Steven Shackley, Ph.D., Director

Geoarchaeological XRF Laboratory

Albuquerque, New Mexico

Report Prepared for

Richard Higgins

School of Anthropology

University of Arizona, Tucson

1 May 2013

INTRODUCTION

The analysis here of 43 obsidian artifacts from Sedentary Hohokam contexts in three sites east of the Tortolita Mountains and west of the Catalina Mountains in southern Arizona indicates a very diverse assemblage dominated by Sonoran Desert sources (Sauceda Mountains, Los Vidrios, and Superior) mainly Sauceda, one sample from Government Mountain on the Coconino Plateau, Cow Canyon from eastern Arizona, and a three projectile points produced from the Antelope Creek locality at Mule Creek in the Upper Gila River region.

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 2011).

All analyses for this study were conducted on a ThermoScientific *Quant'X* EDXRF spectrometer, located at the University of California, Berkeley. 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 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.

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 200 seconds livetime to generate x-ray intensity Ka-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 least-squares 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 but Fe where a derivative fitting is used to improve the fit for iron and thus for all the other 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 2010; 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, 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 software 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. RGM-1 a USGS obsidian 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 Shackley 1995, 2005). 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 Figures 1 and 2).

DISCUSSION

These Sedentary Hohokam sites exhibit an obsidian source provenance similar to other Sedentary (Sacaton) contexts in this part of the Hohokam core area (see Shackley 2005: 147-171). Unusual is the dominance of Sauceda Mountains in these sites which is more common in Classic contexts, although this pattern is less distinct in the Tucson versus Phoenix Basins (Shackley 2005). The Rooney Ranch projectile points are most interesting from social boundary defense/social identity perspective (see Table 2 and Figure 3). The Snaketown Serrated points are all produced from Superior (Picketpost Mountain) typical of sites along the Middle Gila (i.e. Snaketown, Grewe; AZ U:11:252 ASM) while the three points produced from the Antelope Creek locality at Mule Creek are similar to styles in the Upper Gila River region (see Hoffman 1997; Jones 2013; Shackley 2005; c.f. Loendorf and Rice 2004). Robert Jones in your department, who is working at Mule Creek could shed more light on this, although he has worked mostly in Late Classic contexts. Admitting that the sample size is small, these three points could have been exchanged as finished artifacts or produced on-site by knappers from the Upper Gila. Perhaps other data sets from this site my be helpful in this regard.

However, unlike sites along the Middle Gila mentioned above, the assemblage is dominated by Sauceda Mountains raw material rather than Superior (Shackley 2005). As mentioned, this is more typical of Classic period obsidian procurement, and if these sites are truly Sedentary could indicate a long period of procurement to the west.

The one sample with it's distinctive mildly peralkaline composition that could not be assigned to source does not resemble any known sources in the greater North American Southwest, including the Los Sitios de Agua source in northern Sonora in the same volcanic field as Los Vidrios (see Martynec et al. 2011), or the peralkaline sources in Sonora or Chihuahua (Shackley 2005).

Overall, the obsidian assemblage from these sites indicates some diversity in procurement, while dominated by Sonoran Desert sources. This pattern seems typical of the later Classic sites in the region like Marana, and my indicate some long term relationships to the west.

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Table 1. Elemental concentrations and source assignments for the archaeological specimens and USGS RGM-1 obsidian standard. All measurements in parts per million (ppm).

Site/Sample	Ti	Mn	Fe	Rb	Sr	Y	Zr	Nb	Pb	Th	Source
Twenty-Nine Wash											
8611-1	1546	281	12167	157	102	24	168	21	18	25	Sauceda Mtns
8611-2	1585	327	12782	168	110	29	178	22	21	25	Sauceda Mtns
8613-0-1	1474	291	12340	158	104	24	178	14	23	21	Sauceda Mtns
8613-0-2	1692	313	12880	161	109	23	177	17	18	24	Sauceda Mtns
8617-0	1540	289	12218	158	101	26	170	23	20	25	Sauceda Mtns
8619-0	1627	274	12059	150	96	25	160	18	18	25	Sauceda Mtns*
8621-0	1478	271	11981	147	101	22	164	20	21	26	Sauceda Mtns
8622-0	1458	270	12116	155	100	23	170	17	21	30	Sauceda Mtns
8656-1	616	478	10274	120	23	24	94	28	24	11	Superior
8656-2	1522	273	11778	137	93	24	148	13	16	23	Sauceda Mtns*
8928	1549	287	11920	139	95	23	164	18	17	20	Sauceda Mtns*
8657	1666	298	12553	158	102	24	175	17	20	29	Sauceda Mtns
8711	1420	302	12098	155	101	26	170	18	18	22	Sauceda Mtns
8899	1557	279	12104	151	99	27	185	17	15	27	Sauceda Mtns
8601	414	490	11349	108	76	19	73	53	32	12	Government Mtn
8887	658	468	10318	123	22	26	93	33	22	13	Superior
8894	1582	300	12595	166	106	23	183	18	24	29	Sauceda Mtns
9016	1542	312	12395	157	104	27	179	22	24	29	Sauceda Mtns
8976	1643	318	13114	176	113	31	184	17	22	24	Sauceda Mtns
8938	1495	273	12282	156	105	27	178	19	16	20	Sauceda Mtns
9013-1	737	461	10350	117	23	25	93	32	22	16	Superior
9013-2	910	542	10727	126	20	23	91	31	22	16	Superior
9013-3	894	391	15718	164	12	53	440	36	24	16	unknown
GV											
7831-0	155	36	1245	17	81	3	20	21	19	20	Sauceda Mtns

	7	5	2	1		2	2				
7886	1655	387	12657	155	74	32	190	23	15	18	Sauceda Mtns
8110-0	1566	323	12777	168	109	29	182	20	23	27	Sauceda Mtns
8123-0	1675	315	12839	170	115	29	190	20	24	28	Sauceda Mtns
8117	1521	295	12471	171	111	24	190	21	21	27	Sauceda Mtns
8121	1574	305	12377	163	104	24	185	17	21	30	Sauceda Mtns
8127	1709	381	12483	164	80	30	195	19	24	25	Sauceda Mtns
8132	1473	353	12194	163	75	32	193	19	20	24	Sauceda Mtns
8157	1461	383	12344	162	75	31	196	22	19	27	Sauceda Mtns
8159	1432	384	12218	163	75	30	198	21	21	26	Sauceda Mtns
8162	1401	263	12184	160	105	26	180	16	22	22	Sauceda Mtns
Rooney Ranch											
640	794	474	10464	121	23	28	92	31	24	16	Superior
667	647	409	11992	258	18	47	109	24	35	29	Antelope Cr (Mule Cr)
710	697	464	10271	122	21	24	89	30	24	12	Superior
796-47	613	388	11799	247	21	42	111	24	29	26	Antelope Cr (Mule Cr)
845	1060	370	10091	98	19	21	83	25	18	15	Superior
6395	593	235	12921	240	14	68	220	31	25	29	Los Vidrios
6600	563	360	11425	245	20	43	113	29	27	30	Antelope Cr (Mule Cr)
6802	1373	301	12167	161	102	24	180	20	19	27	Sauceda Mtns
6817	998	487	10572	123	22	22	95	28	21	16	Superior
RGM1-S4	1572	277	13743	152	108	22	222	13	22	19	standard
RGM1-S4	1605	281	13718	153	106	25	214	7	22	17	standard

Table 2. Crosstabulation of site by obsidian source.

			Site			
			GV	Rooney Ranch	Twenty-Nine Wash	Total
Source	Antelope Cr (Mule Cr)	Count	0	3	0	3
		% within Source	.0%	100.0%	.0%	100.0%
		% within Sample	.0%	33.3%	.0%	7.0%
		% of Total	.0%	7.0%	.0%	7.0%
	Cow Canyon	Count	0	0	1	1
		% within Source	.0%	.0%	100.0%	100.0%
		% within Sample	.0%	.0%	4.3%	2.3%
		% of Total	.0%	.0%	2.3%	2.3%
	Government Mtn	Count	0	0	1	1
		% within Source	.0%	.0%	100.0%	100.0%
		% within Sample	.0%	.0%	4.3%	2.3%
		% of Total	.0%	.0%	2.3%	2.3%
	Los Vidrios	Count	0	1	0	1
		% within Source	.0%	100.0%	.0%	100.0%
		% within Sample	.0%	11.1%	.0%	2.3%
		% of Total	.0%	2.3%	.0%	2.3%
	Sauceda Mtns	Count	11	1	16	28
		% within Source	39.3%	3.6%	57.1%	100.0%
		% within Sample	100.0%	11.1%	69.6%	65.1%
		% of Total	25.6%	2.3%	37.2%	65.1%
	Superior	Count	0	4	4	8
		% within Source	.0%	50.0%	50.0%	100.0%
		% within Sample	.0%	44.4%	17.4%	18.6%
		% of Total	.0%	9.3%	9.3%	18.6%
	unknown	Count	0	0	1	1
		% within Source	.0%	.0%	100.0%	100.0%
		% within Sample	.0%	.0%	4.3%	2.3%
		% of Total	.0%	.0%	2.3%	2.3%
Total		Count	11	9	23	43
		% within Source	25.6%	20.9%	53.5%	100.0%
		% within Sample	100.0%	100.0%	100.0%	100.0%
		% of Total	25.6%	20.9%	53.5%	100.0%

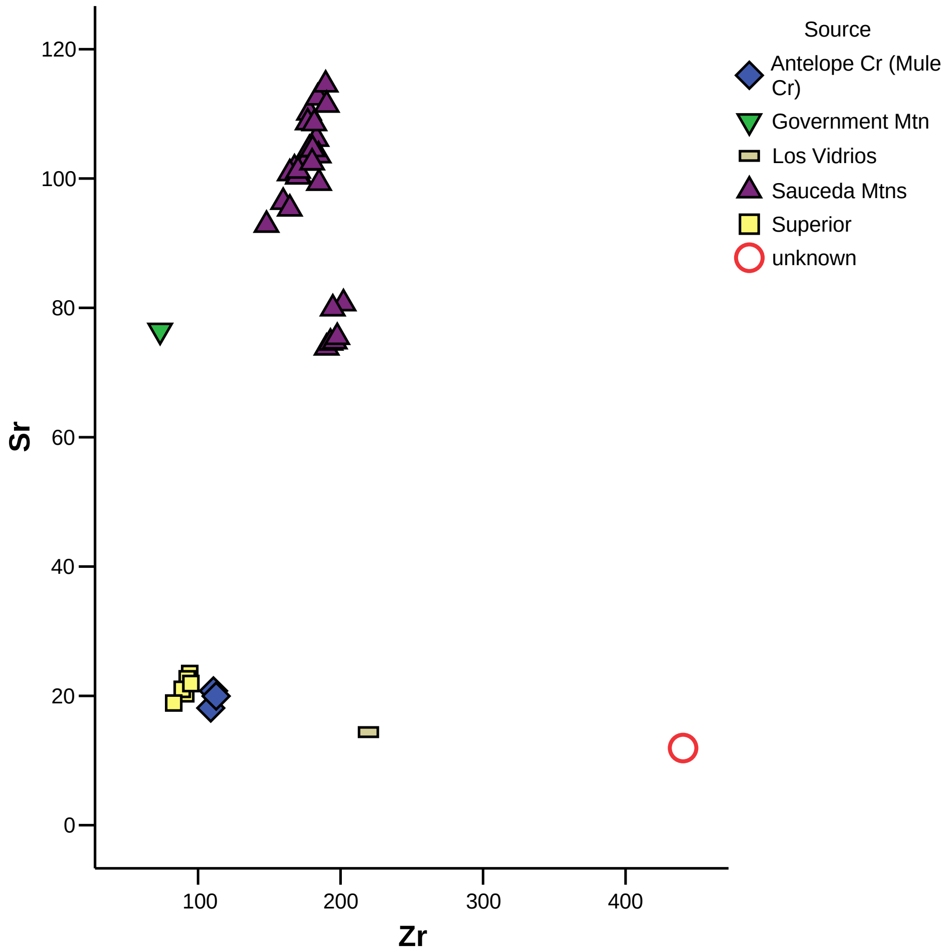

Figure 1. Zr versus Sr bivariate plot of the elemental concentrations for all archaeological specimens. Note the bimodal elemental distribution typical of Sauceda Mountains sources (see Shackley 1995, 2005).

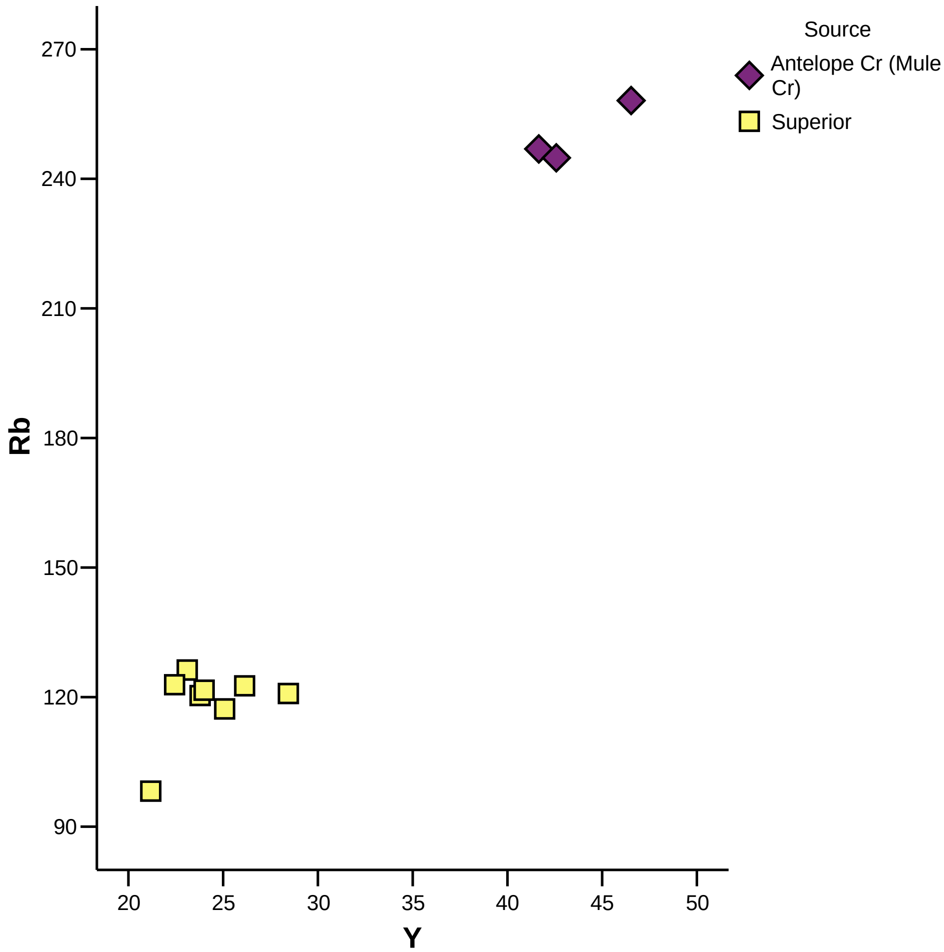

Figure 2. Y versus Rb bivariate plot of Superior and Antelope Creek (Mule Cr) samples providing discrimination.

Figure 3. Obsidian projectile point sample from the Rooney Ranch Site, Arizona.

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