THE ORGANIZATION OF AGRICULTURAL LABOR AMONG SMALLHOLDER IRRIGATION AGRICULTURALISTS: IMPLICATIONS FOR THE PHOENIX BASIN HOHOKAM

Christopher N. Watkins

ABSTRACT

Recent research has highlighted the ways in which Hohokam households organized labor. In this study I consider the possibility that the Hohokam may have drawn on agricultural labor from beyond the immediate household. Using a sample of 10 ethnographically known smallholder irrigation agriculturalists, I examine the nature and occurrence of supra-household agricultural labor. Sharecropping, or working the land of another in exchange for a share of the crop, is present universally in the ethnographic cases examined. Other forms of supra-household labor such as slavery, servitude, wage labor, and fixed rent arrangements are present, but are much less common. I propose that sharecropping arrangements did exist between patron-households and client laborers in prehistoric Hohokam communities of the Phoenix Basin. Furthermore, I argue that field houses are a likely context to observe such behavior. To support this hypothesis, I describe the excavation of a Hohokam field house site on the Arizona State University Campus that may have been used by sharecroppers.

As the "most common social component of subsistence, [and] the smallest and most abundant activity group within a community" (Wilk and Rathje 1982:618), the household is a key concept in any anthropological investigation. The household has been a critical unit of analysis in Hohokam archaeology since Pre-Classic period courtyards were correlated with these social units nearly 30 years ago (Wilcox et al. 1981). The subsequent decades have yielded a wealth of Hohokam household research, from Pre-Classic courtyards (Craig 2000, 2001, 2007; Henderson 2001; Huntington 1986; Rice 1987) to Classic period compounds (Jacobs 1994:301–322; Sires 1987) on subjects as diverse as craft production (Abbott 2000; Howard 1993; Seymour and Schiffer 1987) and ritual organization (Rice 1987, 2000).

Research on Hohokam households, however, has not fully addressed if Hohokam households provided all the labor necessary to maintain agricultural lands and irrigation features. Canal agriculture is a labor-intensive activity that requires people to perform a series of different tasks at coordinated times. This form of agriculture encourages large households and necessitates cooperation between households (see Wilk and Netting 1984; Wilk and Rathje 1982). While it is clear the Hohokam households combined labor to construct, maintain, and operate their canal systems, there has been little research on the source of this labor and the labor required to manage fields and crops. Should we expect that Hohokam households provided all or most of their own labor? If not, where might patron households have turned for client labor?

In this study, I examine the ways in which Hohokam households utilized the agricultural labor of people who were not household members. I test a hypothesis that Hohokam villagers who maintained landholdings and/or water rights used agricultural labor from outside their water-users group, which is defined as an irrigation cooperative without centralized leadership (Hunt et al. 2005). This kind of cooperative may be congruent with the archaeologically defined Hohokam canal systems. Non-household members that contributed to household production are defined as sharecroppers. In order to generate expectations for the presence of sharecroppers in the Hohokam economy, I gathered data pertaining to the organization of extra-household labor in an ethnographic sample of 10 small-holder irrigation agriculturalists. This sample is identical to that used by Clark (2004) in her study of Hohokam land use and canal management.

I begin this study by describing the ethnographic data that form the basis for test expectations. I then outline an archaeological test of the expectations that uses ceramic data collected from Hohokam field

Christopher N. Watkins / Logan Simpson Design, Inc. / cwatkins@logansimpson.com

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 105-119

houses and irrigation villages. Finally, I discuss the recent excavations at a field house site on the campus of Arizona State University as a case study which supports the proposed hypothesis of sharecropping.

ETHNOGRAPHIC CASES

In her research on Hohokam canal irrigation, Clark (2004:143) compiled a sample of 10 ethnographic cases that represented "a diverse array of ethnographic and ethnohistoric irrigation-based agricultural groups… covering a wide variety of environments, cultural traditions, and historic contexts" (Table 1). The inclusion of the Pima in this sample is of particular relevance to prehistoric Hohokam communities, because the Pima are considered to be among the populations that are likely Hohokam descendants. Thus, a direct-historical approach between Pima and Hohokam communities may be appropriate (Bahr et al. 1994; Teague 1993).

I reanalyzed this set of ethnographic cases in order to identify the presence and form of agricultural labor organized beyond the level of the household unit. Netting (1993:72–80) distinguishes three types of extra-household agricultural labor: wage labor, fixed rent relationships, and sharecropping. Wage labor, in which an individual exchanges their labor for money, livestock, or some other medium of exchange, provides the least motivation for the laborer and requires the most supervision from the employer. Fixed rent relationships, in which the tenant pays the landlord a fixed amount (typically in cash or crop) per year, requires the least amount of supervision from the landlord and the most motivation for the tenant. In this kind of relationship the landlord is compensated regardless of the harvest and any deficit falls upon the tenant. Sharecroppers, who work the land and split the harvest with the landlord, have supervision requirements and motivation levels that lie between those of wage laborers and fixed renters.

I classified extra-household agricultural labor observed in the ethnographic sample into Netting's three types of extra-household labor. I also noted cases where slaves or servants assisted in household production. When compensated, extra-household labor was institutionalized as a class or caste, or when labor was classified as such by the ethnographer, I categorized the labor as servitude, as opposed to wage labor. When slavery was clearly identified by the ethnographer, I coded slave labor as present. I also attempted to determine whether Netting's extra-household labor types were drawn from within the water-users group or from beyond this group. Unfortunately, the presence or absence of well-defined water-user groups was not always noted in the ethnographic literature.

Amhara

Most people in this Ethiopian feudal kingdom were peasants who were divided into three social classes. These classes, which roughly corresponded to internal ethnic definitions, include 1) *rist* (those that owned some land), 2) *gebbar* sharecroppers, and 3) people who were categorized by their occupations, including smiths, tanners, etc. (Messing 1985:191–192). These social classes are related to Amhara concepts of land tenure (Shack 1974:23–24). The *rist* class, or freeholders, passed the rights to land along geneaological lines; the term *rest* refers to these land rights. Sharecropping *gebbar* typically worked the rest of freeholdings and/

Table 1. Summary of ethnographic sample.

Group	Country	Traditional Social Organization (Precolonial)	References
Asia			
Sinhalese	Sri Lanka	Kingdom	Leach 1961
Ifugao	Philippines	Tribe	Barton 1919, 1922; Lambrecht 1929
Korea	South Korea	Kingdom	Brandt 1971
Ghilzai Pashtun	Afghanistan	Tribe	Ahmed 1980
Africa			
Sonjo	Tanzania	Tribe	Adams et al. 1994; Gray 1958, 1963
Amhara	Ethiopia	Feudal State	Messing 1985; Shack 1974
Idaw Tanan	Morocco	Tribe	Hatt 1974
Europe			
Törbel	Switzerland	Confederation/State	Netting 1974; 1981
North America			
Pima	U.S.A.	Tribe	Castetter and Bell 1942; Hill 1936
Tehuacan Valley	Mexico	City-State	Enge and Whiteford 1989

or other land called *gult*, hereditary fief-like grants controlled by a feudal lord. Rights to land were unstable for the *gebbar* sharecroppers, because their use rights were controlled by absentee feudal landlords. *Gebbar* rarely worked the same piece of land each year, and the land that they used varied in quality (Messing 1985:42).

Some *gebbar* in the service of feudal lords were wage laborers, and provided additional non-agricultural as well as agricultural labor as part of their contract. They usually hired on in March when light rains sparked the plowing season. The *gebbar* were required to furnish a *was*, a person who was responsible for the employee's conduct. Time, energy to be expended, and wages to be received were all arranged prior to employment. A large portion of these laborers were former slaves and their descendants, who had been recently freed by the state (Messing 1985:97–98).

Slaves and servants provided additional labor for working agricultural lands. Slaves were from an ethnic minority group and composed an available pool of unskilled labor. Nearly every household that could afford to own slaves used them as agricultural labor (Shack 1974:23–24). The servant class (*askr*) was employed by households in rural (agricultural) and town (domestic) contexts. Agricultural servants assisted in plowing and harvesting for land-owning peasants (*rist*). Servants were often permanently employed and would not leave their duties, even if their employer was behind on wages.

Day labor among ethnic Amhara was rare, but present, and was traditionally found in rural areas (Messing 1985:101). The availability of ex-slaves made hiring temporary agricultural laborers nearly unnecessary; it was considered too expensive and difficult to hire Amhara labor. There was, however, a type of day laborer, *mwayata* or simply *rata* (worker), who in 1955 was paid $1.00 a day, and who could be hired for some temporary job without the benefits of leave for church holidays or visiting kin. A poor Amhara would sometimes take a job for some ready cash, and temporarily forego his usual demands for time-off. During the caravan season, some Amhara would work as mule drivers.

Tehuacan Valley

In pre-Hispanic communities in the Tehuacan Valley of central Mexico, nobility owned nearly all of the land. Noble families appointed a *cacique* to oversee the land holdings and associated resources. The *cacique* assigned parcels to the commoners each year in a communal tenure arrangement. The commoners would also work the *cacique's* parcel. Land was not rented to outsiders. Communities did hold slaves, but they likely used slaves as sacrificial victims, not as agricultural laborers (Enge and Whiteford 1989:71–73).

After the conquest, indigenous populations, or *indios*, were pressed into Hacienda serfdom under the *encomienda* and *repartimiento* systems. Indigenous communities initially held some communal land and water rights, but these were eventually co-opted by the haciendas. Sharecropping relationships were arranged among haciendas and *indios*, as well as among native peoples themselves. By about A.D. 1900, all of the *indios* were either sharecroppers or rural wage laborers (Enge and Whiteford 1989:84, 117).

Land reforms followed the Mexican Revolution, and much native land was returned to indigenous communities. In 1982 in the Tehuacan Valley, there were 20,000 agriculturalists, 10,219 of whom were landless laborers and 7,425 of whom owned at least some irrigation water.

Extra-household laborers performed a substantial portion of both agricultural and water-use labor; in fact, these work arrangements often engendered long-term relationships. The wealthiest person in a community regularly hired the same 12 agricultural laborers each agricultural season. Long-standing sharecropping arrangements were also not uncommon. These arrangements were often underlain by robust social (non-kin) ties. Because land and water-use rights could be held separately, many members of water-user groups did not directly contribute labor to irrigation features. Instead, the irrigation canals were regularly cleaned by hired crews (Enge and Whiteford 1989:148). In some cases, laborers worked to pay debts accrued at stores that were owned by the wealthier members in a water users group.

Törbel

Netting (1981:76) characterized the Swiss Alpine village of Törbel as a "closed corporate community." Although the introduction of mechanized equipment has greatly reduced labor demands (Netting 1981:49), this settlement provides an interesting case for household self-sufficiency in agricultural labor.

Households often maintained rights to widespread land holdings, a circumstance that resulted from unusual inheritance, marriage, and exchange systems. Typically, these households managed holdings that were diverse in elevation. The different elevations of the land holdings allowed households to meet labor demands more efficiently, because they could plant, harvest, etc. fields at different times of the year (Netting 1981:18–21). Thus, the land tenure and agricultural systems selected for labor conditions that could be met by a single household.

Even in this case, extra-household labor was still occasionally employed. Land was very expensive and was nearly impossible to obtain except by inheritance (Netting 1981:76). Distant kin working within a household were sometimes called servants, who tended to be young and single. Netting (1981:212–214) suggested that these relationships were mechanisms to care for orphaned or dependent relatives. Hired labor was rare in this cash poor society, but did occur; hired laborers were usually drawn from people within the local village. However, very wealthy families occasionally hired people from outside of the community (Netting 1981:212–214). Some households rented or sharecropped certain plots; however, there was no class of landless laborers, and few extremely poor people.

Land-holding households in communities did participate in water-user groups that helped to manage irrigation features. Members of the group provided nearly all of the labor. Canal maintenance was minimal; six men working one day each spring on the lower two canal systems was sufficient maintenance for the entire year (Netting 1974:70). Each water-user group often employed a guard to check for obstruction and gullying (Netting 1981:18). However, on a day-to-day basis, women from the water-users group did a great deal of the irrigating (Netting 1974:70).

It is important to note, though, that people did participate in some wage labor outside of their own water-user group. Often, a person who performed wage labor did so in order to purchase more land to expand their land holdings (Netting 1981:54–55).

Pima and Papago

In general, Piman agricultural labor, which was focused on canal-irrigated fields, was organized through the household that held primary use rights to a piece of land. Planting, cultivation, and irrigation management among the Pima was categorized as male work, whereas gathering the harvest was categorized as female work. Typically, both men and women would work in the field together to care for plants. Communal labor was often employed in the clearing of land and in harvesting (Castetter and Bell 1942:132–134:180). Canal upkeep was undertaken by male members of the water-users group (Castetter and Bell 1942:160). Each water-user was required to contribute labor to the maintenance and construction of the irrigation infrastructure (Hill 1936:587). Each household cleared the land and built/maintained canal laterals, although neighbors would sometimes provide assistance with these tasks (Castetter and Bell 1942:160; Hill 1936:587).

If a person moved, the person's land was turned over to a relative, who generally gave some of the crop to the owner. When the owner returned, the land was also returned. Land could also be sold between close relatives. Other Pima who were not related to the land holder could sharecrop on the land, during which time they would also help with canal maintenance. In addition, people who were not of Piman descent were sometimes allowed to use some land rent-free for a short period of time (Hill 1936:588).

To supplement household labor, the canal-irrigation-based Pima routinely hired Papago workers, who came to work for the agricultural season and then returned home. This business arrangement was particularly common during times of hardship for the Papago, who were reliant on rainfall in their immediate area for *ak-chin* and ditch agriculture and for the growth of wild food sources. This productive relationship intensified after the introduction of winter wheat, which was harvested during a time that often corresponded to subsistence stress in the Papago seasonal calendar. In exchange for their labor, the Papago were given daily food and a share of the crop. In especially lean years, Papago laborers harvested almost all of the crops (Castetter and Bell 1942:47).

Sonjo

The majority of agricultural labor in Sonjo communities was organized through households who held rights to land and, more importantly, who had preferential rights to water. Gray (1963:36–39) identified three types of agricultural fields that Sonjo households managed in Tanzania, east Africa. *Hura* were lowland fields irrigated during the dry season. Each man and his sons flooded the fields to soften the ground and pulled lingering stalks and weeds. After the fields were softened, women loosened the soil with digging sticks. This arduous work was done in groups of 6 to 20 women who often aided one another. After the initial effort, each woman, her daughters, and daughters-in-law planted, weeded, and harvested alone.

Magare fields were located in the upland zone, and were only cultivated every other year during the rainy season. Men flooded and cleared the fields in cooperative groups similar to the women in the *hura* fields. This land was much more difficult to irrigate. Women then cultivated the loose-sandy soil alone or with daughters and daughters-in-law. *Isrreni* were relatively minor secondary irrigated fields irrigated via an aqueduct (Gray 1963:55).

Not every member of a Sonjo community had regular rights to water. Water rights consisted of a six-hour water share that was available every 14 days (Gray 1963:58–61). The distribution of water followed a hierarchical order of preference. The Wenamiji was a council of 17 elders, each a head of household, who together governed village affairs and the water-users group. The office was hereditary, and could only be inherited by the son or brother of the recently deceased. The Wenamiji officers have water allocation priority in dry years.

The minor Wenamiji was another council that consisted of 18 elders, each of whom was also a head of household. Officers in this council had next priority to water. This office was also hereditary, and could only be inherited by the son or brother of the recently deceased. The Wakiama were a group of 20 to 25 households that had no permanent rights to water. Instead, these village families obtained temporary month-to-month water rights by paying tribute to the Wenamiji in the form of goats. In times of shortage, the number of Wakiama was decreased to ensure that the Wenamiji and minor Wenamiji received a full water share.

Less than half of village households held rights to water. The remaining households were clients who applied to the guaranteed water holders for secondary water rights. Most households with water rights only required one-third of their six-hour water share to water their own fields; thus, they almost always had water to sell. Payment for water was usually made in honey, grain, or cash. If possible, clients obtained water from close patrilineal kin. Stealing water in times of scarcity was common, and the fine was minimal (one goat to the Wenamiji).

Men who drew water on a given day were expected to inspect and repair the ditches as needed (Gray 1963:55–56). Moreover, all able-bodied men were called upon to repair the canals annually. An exception to this required task was made for the Wateri class of male smiths and female potters, who were not permitted to participate in agricultural labor (Gray 1963:77–79).

In some cases, sharecroppers contributed extra-household labor to agricultural work on cultivated lands (Gray 1963:77–79). Sharecropping relations were arranged when a household had more cultivated lands than it could manage, or when extenuating circumstances prevented management of a given piece of land.

Korea

Prior to land reforms imposed by the state, absentee landlords in one Korean coastal village took advantage of sharecroppers, and ultimately dispossessed 45 families, who were forced to move (Brandt 1971). Following reforms, usufruct rights were guaranteed, and landlord compensation was standardized to one-third of the crop. Landowners responded by attempting to hire wage laborers whenever possible. Sharecropping was equated with people of lower status; thus, any tenant relationships that existed among kin were often concealed. Brandt (1971: 53–56) documented that, in fact, 30 families (28.5% of the total village) were involved in tenant relationships.

Overall, 12 households (11.5% of the total village) possessed less than 0.1 ha of arable land. These households supplemented their subsistence activities by working as agricultural labor for clan relatives, making wine, performing specialized ritual actions, collecting and selling firewood, begging, and fishing (Brandt 1971:56–8). Many land-poor households were forced to fish for food, a subsistence activity associated with low-status (Brandt 1971:53–56, 65). Households that provided agricultural labor to relatives often participated in cooperative labor arrangements. These contributing households were often compensated with reciprocated labor and/or a feast.

In addition to cooperative arrangements with kin, patron-client relations between rich households and poor, unrelated neighbors provided some extra-household labor. These arrangements did not offer cash payment, but instead exchanged food, tools, or access to resources for labor. A cash transaction between villagers was not common, and was considered in bad taste except in the context of the local store (Brandt 1971:72–73).

Pashtun

The Pashtun of Afghanistan define themselves as people who work the land that they own. Among the Pashtun, all land owners were members of the same water-users group. Canals were communally cleaned and maintained by members of this group (Ahmed 1980:263). However, certain elders occasionally hired a seasonal laborer from within the group to help with the harvest or with other agricultural tasks (Ahmed 1980:269).

Relations between members of the water-users group and outsiders were regulated by a caste system. A patron-client relationship formed between Pashtun and members of other castes. The non-Pashtun castes that contributed agricultural labor included *qusabgar* agricultural laborers and *ijargar* sharecroppers (Ahmed 1980:172). The extent to which outside labor and plot renting were utilized is not well-described in ethnographic reports. However, given the Pashtun emphasis on working their own land, extra-household labor was probably not widespread.

Sinhalese

Traditional land holdings among the Sinhalese of Sri Lanka included a house, an associated garden, and irrigated fields (Leach 1961:64). In the post-colonial period, land was divided into freeholdings, which were owned outright (Leach 1961:49–50), and *badu idan*, or permanent crown leases (Leach 1961:50–52).

There were three acceptable ways to transfer land holdings. It could be sold, preferably to a close kinsman (Leach 1961:136–8), mortgaged long-term (*ukas*) (Leach 1961:242–253), or put into a short-term sharecropping lease (*andē*). If the land was placed in a sharecropping lease, one-half of the crops went to the landlord, who was also responsible for providing some agricultural labor (Leach 1961:242, 266). Everyone owned some land, but those in need of additional land would often sharecrop via *andē* leases (Leach

1961:230). Most landlords and tenants were close kin (Leach 1961:243).

Labor among the Sinhalese was organized at the household level. However, outside agricultural labor could also be hired to work land. Laborers were either paid through a wage system, or by reciprocal work (Leach 1961:242). Cash, however, was not exchanged among friends or kin (Leach 1961:251). In addition, there were other forms of extra-household agricultural labor. Laborers were hired from outside of caste groups, reapers were sometimes employed and paid a percentage of what they harvested, and reciprocal labor gangs (*kayiya*), primarily composed of affinal kin, were occasionally mobilized. The general laborers and the reapers were often drawn from groups of people who were outside of the employer's water-user group. Labor gangs, however, consisted of people who were generally within a land owner's water-use group (Leach 1961:264). Labor devoted to canal/irrigation management was also organized through individual land holding households. Each plot holder tended to his own canal maintenance. A plot holder was individually responsible for maintaining the ditch adjacent to his land (Leach 1961:64).

Ifuago

The literature pertaining to the Ifuago from the Philippines is limited. As a result, I was unable to determine if any extra-household labor included wage labor, sharecropping, or fixed rental occurred. However, the literature does document that both servitude and slavery existed within Ifuago communities. Servants were attached to specific households and worked for room and board. The relationship could be terminated by either party at any time. Servants could also inherit property. In some instances, children were sold into slavery by poor parents. Slaves were often set free and given a rice field when the master died. It is unknown whether slaves and servants came from within the water- users group (Barton 1922:34).

Idaw Tanan

Traditional subsistence practices among the Idaw Tanan of Morocco included a mixture of dry farming, irrigation agriculture, and herding. Households usually owned both irrigated and dry fields, sometimes in different localities. Fields were not always irrigated during the first crop, especially in wet years. However, irrigation was critical to the success of the second and third crops. On average, there was enough water for a third crop in two out of three years (Hatt 1974:77). Each irrigated field was named and had a specified water share (Hatt 1974:78). Households tried to negotiate their water turns so as not to overreach their labor force (Hatt 1974:260).

Self-sufficiency is an important cultural ideal in Idaw Tanan society (Hatt 1974:92). Thus, self-sufficient households were considered to be well-off. In contrast, unfortunate households used the market, and poor households sold labor (Hatt 1974:115). Approximately 20 percent of the population subsisted primarily on dry farming supplemented by herding (Hatt 1974:80). Slaves formerly did the herding, but, after slavery was outlawed, low-status young people assumed this task (Hatt 1974:86).

The village congregation (*jema't*) was composed of males from all households with tenure to irrigated or non-irrigated land (Hatt 1974:94). Community consensus was the most important factor that determined land ownership (Hatt 1974:394–395). The *jema't* made decisions on all matters of common interest to the village, including hiring water guards, closing agricultural land until harvest time to prevent theft and/or spoilage (Hatt 1974:221), building and maintaining canals via corvee labor (Hatt 1974:222–224, 258), scheduling water turns (Hatt 1974:258), and settling major disputes. Five percent of the population was non-landowning specialists, who included hereditary religious specialists and mediators, slaves or former slaves, blacksmiths, and Jews specializing in liquor manufacture (Hatt 1974:292).

Land was transferred in one of four ways. Fathers and grandfathers were the holders of *ayda*, or full rights to land. Sons maintained milk rights to land until their father died, at which time their milk was converted to *ayda*. Women were prohibited from inheriting land, but some land was passed though women to their husbands in the form of *ti-yisti* matrilineal inheritance. Patrilocal residence patterns created logistical obstacles for households wishing to continue to work *ti-yisti* land, and these parcels were often sharecropped by local male relatives who split the crop with the landowner. *Ti-yisti* claims often lapsed and were reincorporated into the holdings of the local patrilineage (Hatt 1974:366–374, 378). *Sdaqt* land was donated, and primarily existed as a legal means of distributing property in the absence of a legal heir (Hatt 1974:382). A son could be adopted via *sdaqt* (Hatt 1974:384). In rare transactions, marginal or token *ti-yisti* land could be sold as *bi'ya*, often to finance some small enterprise.

One alternative to transferring land was the maintenance of a second home with affinal kin in places where a given household owns land but does not live. In other cases, households maintained two houses, leaving some household members in each house during various times of the year. These disparate land holdings were often obtained via *ti-yisti* inheritance (Hatt 1974:80).

Although the immediate household and relatives provided a substantial portion of agricultural labor

Table 2. Collective extra-household agricultural labor.

Group	Extra-household Agricultural Labor	Servants	Slaves	Wage	Sharecrop	Fixed Rent
Asia						
Sinhalese	X			X	X	X
Ifugao	X	X	X	---------------No Data-----------------		
Korea	X			X	X	X
Ghilzai Pashtun	X			X	X	?
Africa						
Sonjo	X				X	
Amhara	X	X	X	X	X	
Idaw Tanan	X	X	X	X	X	
Europe						
Törbel	X	X		X	X	
North America						
Pima	X				X	
Tehuacan Valley	X			X	X	

within Idaw Tanan communities, unrelated individuals also performed some labor. *Jaraka* partnerships were formed when unrelated persons farmed the other's *tiyisti* land (both keeping the entire crop), or when persons sharecropped parcels. If both partners were landowners, the relationship was peer-to-peer (*imaziyen*) (Hatt 1974:427). Poor tribesmen were often forced to exchange household labor for food (usually via sharecropping). A poor person might also send a son away to work temporarily in a wealthier household. However, hired hands were thought to shirk work and "eat" their employer by draining resources (Hatt 1974:383). The host provided for the subsistence of the hired male and paid cash to the family annually (Hatt 1974:428–429). Short-term refugees occasionally entered into patron-client relationships with a powerful land-owning member of their blood group. These refugees sometimes married a family member of their patron, were granted land, and became a full member of the tribe (Hatt 1974:278–280). Both types of client laborers were classified as "rented sons," and were usually fully integrated into the patron's household during the period of the contract (Hatt 1974:430).

Discussion

In every ethnographic case examined, at least some agricultural labor was contributed from beyond the household (Tables 2 and 3). Extra-household labor was a rare occurrence in Törbel. It occurred only when distant, unmarried kin joined the household as a type of servant, when households hired wage laborers, or when households entered into periodic sharecropping agreements. As indicated above, the inheritance, marriage, and exchange systems in Törbel generally selected for land holdings that could be worked by a single household, and thus minimized the need for extra-household labor. A need for extra labor was also rare among the Pashtun, who have a cultural ideal encouraging group members to work only the land that they own.

Sharecropping was the most common form of extra-household labor. It occurred in all nine cases for which data were available; it even occurred in the Pashtun and Törbel cases, where extra-household labor was rare. Wage labor was the next most common form of labor. It occurred in seven of the nine cases for which data were available. Fixed renters were only observed in two cases (Table 2).

Slavery and servitude occurred in 30 percent and 40 percent of the respective cases (Table 3). However, it is likely that slavery was under-represented in the ethnographic sample, because colonial powers had begun to take root in many areas during the time that the data were collected. Slavery was common in Pre-Columbian North America (Meltzer 1993:61–74). Historic period witnesses observed the Pima and Papago enslaving Apaches and Yumans and selling them to the Spanish in 1863 (Meltzer 1993:69). Servitude was most prevalent in more industrialized economies or in societies with institutionalized social classes, and as such, probably did not occur among the Hohokam. Because it is difficult to identify slavery and servitude in the archaeological record, I do not consider these forms of extra-household labor in the rest of this paper. Nevertheless, I suggest that both forms of labor, particularly slavery, may have existed within Hohokam communities.

The mutual pooling of labor among households was an additional form of extra-household labor identified in the ethnographic survey. This practice was mentioned in six of the ethnographies and was currently in practice in four of these cases. Although such

Table 3. Extra-household agricultural labor divided by water user group and co-resident community.

				Within Water Users Group			Outside Water Users Group but within Co-resident Community			Outside Water Users Group and Co-resident Community		
Group	Extra-household Agricultural Labor	Servants	Slaves	Wage	Sharecrop	Fixed Rent	Wage	Sharecrop	Fixed Rent	Wage	Sharecrop	Fixed Rent
Asia												
Sinhalese	X			X	X	X	X	X				
Ifugao	X	X	X	-----No Data-----								
Korea	X						X	X	X			
Ghilzai Pashtun	X			X			X	X	?	X	X	?
Africa												
Sonjo	X				X			X				
Amhara	X	X	X				X	X		X	X	
Idaw Tanan	X	X	X	X	X		X	X		X	X	
Europe												
Törbel	X	X		X	X		----------All Members---------					
North America												
Pima	X				X		----------All Members---------				X	
Tehuacan Valley	X						X	X		X	X	

mutual aid was probably common among Hohokam communities, it is extremely difficult to identify archaeologically.

The ubiquity of sharecropping among ethnographically documented smallholder irrigation agriculturalists suggests that sharecropping was practiced within Hohokam society. Wage labor was less prevalent than sharecropping in the ethnographic data, but was still common among the ethnographic cases reviewed in this paper. The Hohokam economy, however, was not monetary. Therefore, I do not expect that wage labor was present among the Hohokam. Fixed rent was the least common form of extra-household labor in the ethnographic sample. This type of labor arrangement occurred within the water-users group among the Sinhalese and outside the water-users group in the Korean fishing village. It is also possible that fixed rent arrangements were present in Hohokam communities, but the scarcity of fixed rent arrangements in the ethnographic sample implies that it is less likely to have occurred in the Hohokam world.

I then categorized the sources of extra-household labor according to their positions in the water-users group and in the co-resident community (Table 3). I performed this classification in order to construct a set of test expectations that could be evaluated in the archaeological record. More specifically, I generated a set of expectations for the potential sources of extra-household labor in prehistoric Hohokam communities.

The only clear pattern that emerged from the ethnographic data was a tendency for wage laborers to be drawn from the patron's co-resident community, who were not members of the water-users group (Table 3). This lack of patterning may be due to the diverse nature of the irrigation systems in the sample. For example, some ethnographic cases included a single co-resident community and irrigation system (such as the Törbel and the Korean fishing village), while others spanned many co-resident communities and water-user groups (such as the Amhara and the Idaw Tanan). A fine-grained analysis of these data, one that focuses on the ethnographies covering many settlements and irrigation systems, might yield information which can be used to facilitate the creation of more detailed inferences for the Hohokam.

ARCHAEOLOGICAL IMPLICATIONS FOR HOHOKAM SHARECROPPING

As the loci for mobilizing agricultural labor within Hohokam social groups (Cable and Doyel 1985; Cable and Mitchell 1988:400; Crown 1983; Henderson 1989:334–357; 2004; Henderson and Clark 2004; Kwiatkowski 1988; Rice 2001), field houses are the most likely archaeological feature to yield evidence relevant to sharecropping. Two hypotheses have been proposed to explain field house residency: 1) field houses were the first settlements in an area and were occupied by a small set of colonizers living in and around newly improved agricultural land (e.g., Cable and Doyel 1985; Howard and Wilcox 1988:933–936), and/or 2) field houses were occupied by members of neighboring communities and represented markers of land ownership (e.g., Henderson and Clark 2004).

I propose two additional hypotheses to test the possibility that some field house residency represents certain forms of sharecropping within Hohokam agricultural labor arrangements. These additional hypotheses state that 3) field houses were occupied temporarily by sharecroppers who had no claims to irrigated land, and/or that 4) field houses were utilized logistically by members of a land-tenured household who had either entered into a sharecropping agreement with the owners or who had inherited some land from principal owners. It is important to note that I do NOT consider these four hypotheses to be mutually exclusive. At different places and at different times, field houses may have been used for all of the hypothesized reasons or any combination of these reasons.

Hypotheses for Field House Residency

One often-repeated hypothesis that may explain field residency asserts that field houses were temporary dwellings constructed by the first residents, or colonizers, of an area. These colonizers would have lived in field houses among newly improved agricultural lands during the growing season and then returned to their original village after the fall harvest (Cable and Doyel 1985; Howard and Wilcox 1988:933–936; Rice 2001:6–7; Woodson and Randolph 2000:264–267). As fields and canals became established in the colonized area, sturdy, relatively large residential structures, likely classified as farmsteads, may have succeeded the field houses. Eventually, some of the farmsteads may have grown into full-fledged villages with ballcourts and mounds (Howard and Wilcox 1988:934; Rice 2001:6–7). If the colonization hypothesis accurately explains field house residency in a given archaeological case, then the field houses should predate any surrounding villages.

A second hypothesis that addresses field house use states that these structures were occupied by the residents of the nearest irrigation village as markers of land ownership. Attempting to explain why field houses are often located very close to irrigation villages, Henderson and Clark (2004) proposed that people from the nearest irrigation village occasionally lived in their fields to claim ownership of the land, the crops, and water rights. Although people likely used logistical camps to tend to agricultural lands, it is likely that complete households used field house sites to serve an institutional function, a claim for ownership of the land and its associated resources. If this hypothesis accurately explains the residency of particular field houses in an archaeological case, then those houses should be contemporary with, and contain ceramic assemblages that are consistent with assemblages from the nearest agricultural village.

Although the previously discussed hypotheses have aided researchers to understand field house residency in a number of archaeological contexts, I suggest that it is important also to consider that field house use may be associated with sharecropping arrangements. Thus, I propose two additional hypotheses that test field house connections to sharecroppers and/or sharecropping labor relationships. A third hypothesis that may explain field house residency asserts that sharecroppers without tenure to any irrigated land may have temporarily resided in field houses for the duration of their agreement with the patron household. In addition, some sharecroppers may have been from households that lived in the same resident community as patron households. However, this kind of relationship, between households in the same coresident community, would be very difficult to detect archaeologically.

Rather than a landless class of peasants, I envision some sharecroppers in the Hohokam world as members of households that had no tenure to irrigated land and who hired on with a tenured household that could not meet its own labor obligations. Thus, sharecroppers were likely to establish labor arrangements in wet years when the amount of irrigated land exceeded the supply of labor, or when circumstances such as unexpected death or illness prohibited a tenured household from being able to muster enough labor to farm their land independently. Note that sharecropping arrangements would have been particularly beneficial to land-tenured Hohokam households when water availability was unpredictable from year to year, because sharecroppers would have been much easier to cut loose than permanent household members in a time of scarcity.

Ceramic assemblages in field houses utilized by households that did not have tenure to irrigated land should be similar to assemblages recovered from areas where *ak-chin* agriculture was practiced, including the Northern Periphery of the Phoenix Basin. I provide an example below that identifies a potential sharecropping arrangement at a field house site on the Arizona State University campus.

A fourth hypothesis that addresses field house residency considers logistical uses. This hypothesis suggests that field houses may have been utilized logistically by members of a tenure-holding household head-quartered in a distant co-resident community and who inherited/acquired the land from a principal household. Alternatively, the house may have been used by members of a household who had entered into share-cropping agreements with residents of a more distant community. If a sharecropping arrangement did exist among members of tenure-holding households who lived in different co-resident communities (and possibly in different water-use groups), then the ceramic assemblages from given field houses should more closely resemble assemblages in the home village.

Unfortunately, archaeological research has not been able to elucidate any details about Hohokam land inheritance rules and the relationship of these rules to sharecropping arrangements. I suggest that it is reasonable to infer some understanding of inheritance rules among Hohokam households through ethnographic analogs. I consider several of the ethnographic descriptions discussed above to identify some useful ethnographic analogies. Among the Pima, households that moved did not retain immediate rights to their land and its resources. Rather, close relatives who belonged to other households that remained near the fields managed the land and associated resources. It was customary for those managing the land to share a portion of any crop, if possible, with the household that moved. Finally, relatives were often socially obligated to return the land and resources to the original owner if and when that household returned. Relatives often bought land from households that were permanently relocating. In the Tehuacan Valley, families often moved their primary residence to a new co-resident community but retained their land holdings in the place of their original dwelling. Several wealthy families often maintained land and water in multiple user groups, because participation in water-user groups was not dictated by the location of residence. The Idaw Tanan also held spatially diverse land holdings. Idaw Tanan token matrilineal inheritance, via *ti-yisti*, was generally responsible for a household's wide spatial distribution of holdings. Typically, either sharecroppers (usually members of the wife's extended family who remained in the immediate area) or logistical parties from the tenure holding household managed the land holdings and resources. These logistical parties often stayed with affines or maintained a second residence near their land. Sinhalese and Törbel households also maintained widespread land and resource holdings.

I suggest that the discussed ethnographic case studies provide three important general inferences about land inheritance that may apply to inheritance among Hohokam households. Foremost, in the ethnographic cases, households frequently belonged to more than one water-users group. A household's participation in a water-users group appears to have been based largely on the ability to meet the labor and capital requirements necessary to maintain a canal system. Households able to meet these obligations could, in principle, maintain membership in more than one group. Therefore, it is possible that some wealthy households in Hohokam villages participated in many water-users groups. Second, in most of the ethnographic cases, households that emigrated from one location did not necessarily abandon their claims to land tenure. Hohokam archaeologists cannot assume that households that moved away from a Hohokam village or local area lost their tenure claims or use rights. Third, in some of the cases, households who did not live in the nearest or even neighboring co-resident community still worked the land to which they had a claim. Logistical parties continued to work land in an area far from their household's primary residence. Thus, if some Hohokam households were able to maintain tenure on land holdings some distance from their residence, these households may have sent logistical parties to continue to work those lands.

This discussion of Hohokam land inheritance suggests that the proposed methodology cannot distinguish between households who maintain diverse land holdings and sharecroppers. Recall that the fourth hypothesis focuses on the logistical use of field houses. The strategic, intermittent use of these structures could be related to labor parties from households who inherited land in different places or who maintained rights to land in spatially disparate places. Some use of field houses could also be associated with sharecroppers hired by distant households to manage their land.

If the logistical-use hypothesis accurately explains field house residency in an archaeological case, then the ceramic assemblage of a given field house should resemble the assemblage from a distant irrigation village more closely than a ceramic assemblage from a spatially proximate village. In other words, the assemblage should be more similar to assemblages from other spatially separate villages than it is to assemblages from the nearest irrigation village.

An Archaeological Test of the Hypotheses on Field House Residency

An archaeological test of the four hypothesized explanations for field house residency is dependent on a concept that Rice and Ravesloot (2001:10–12; see also Rice 2001:7) originally proposed in their research on the middle Gila River. They suggested that a detailed analysis of the small, logistical sites between irrigation villages can be associated with settlements

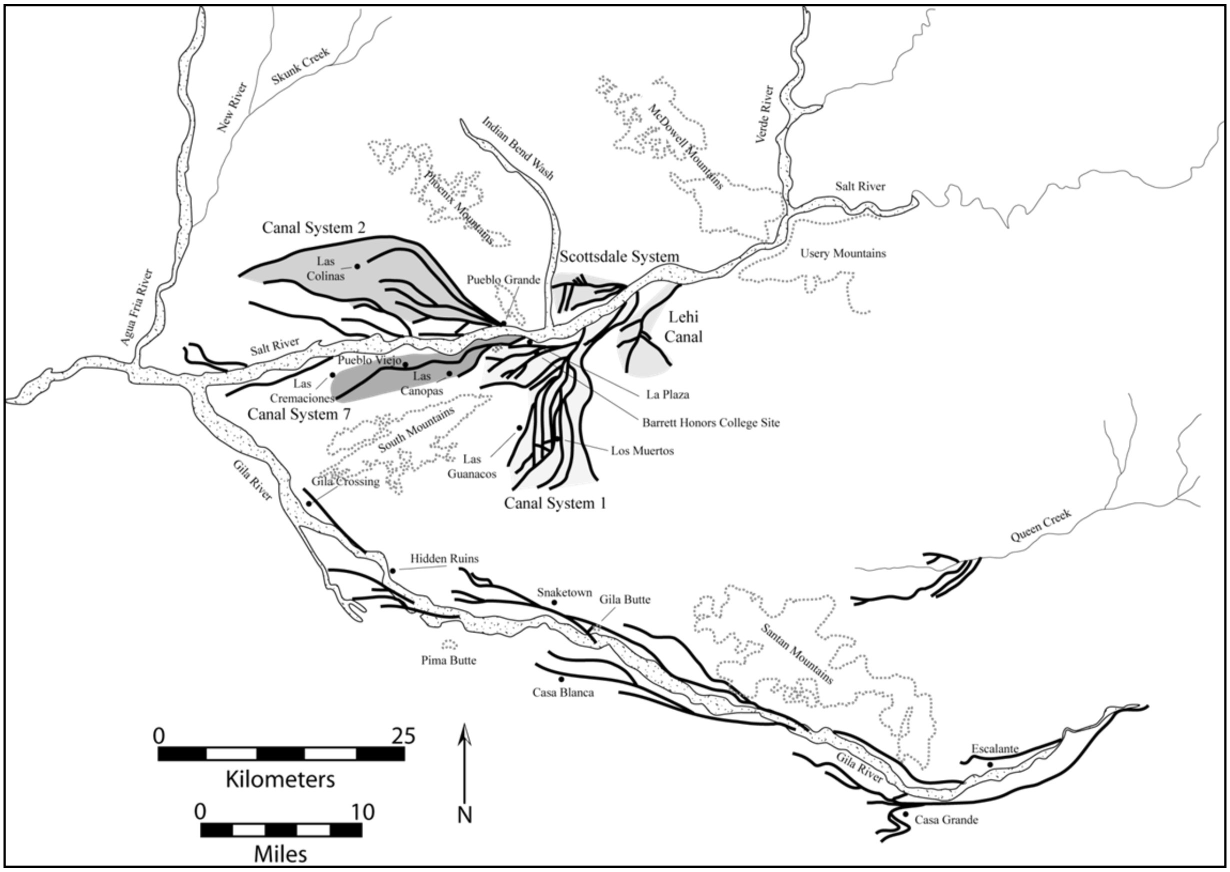


Figure 1. Setting of the Barrett Honors College site, AZ U:9:281 (ASM), in the Phoenix Basin (lower Salt River Valley from Turney 1929; Queen Creek from Dart 1983; middle Gila River Valley from Woodson 2007).

within or beyond the middle Gila area through a detailed analysis of ceramics. For each field house site, a given ceramic assemblage can be compared to assemblages at the surrounding villages to determine the point of origin for the logistical activity.

However, there are two important requirements that the feature and ceramic data must meet in order for the comparative analysis of ceramic assemblages to produce a useful result. First, each field house must be well-dated (to rule out colonization). Second, and most importantly, the plain ware and red ware sherds in each field house assemblage must be classified according to the Abbott-Schaller temper typology (Abbott 1994, 2000; Schaller 1994) and reported by feature. The classification of ceramics by this typology creates a powerful tool for measuring the movement of people across a local landscape in the Phoenix Basin.

If the people who occupied a given field house were primary residents of a local village, then the ceramic assemblage of that field house should mirror assemblages found at a local village. In contrast, if the people who occupied a given field house came from a more distant location or at least from a non-neighboring village, then the ceramic assemblage from that field house should not be a subset of the larger assemblages found at local villages.

BARRETT HONORS COLLEGE PROJECT

A field house that was likely occupied by sharecroppers without land tenure was recently identified during excavations at the Barrett Honors College on the campus of Arizona State University (Steinbach et al. 2008; Watkins and Rice 2008) (Figure 1). A total of 24 cultural features associated with the Hohokam occupation of the area were documented during the investigation: canals, human burials, extramural pits and hearths, and two field houses (Figure 2). A study that includes a large sample of Hohokam field houses is currently in press (Watkins et al. 2011). The present discussion focuses only on the features excavated at the Barrett Honors College.

The first field house, which dates to the middle Sacaton phase (ca. A.D. 1000 to 1070), was dominated by ceramics with phyllite and Squaw Peak Schist temper types. These temper varieties are commonly found at contemporary sites in the Northern Periphery, an area without irrigation agriculture. The phyllite-tempered sherds may also have been manufactured in the area of Las Colinas, but no rim sherds were present

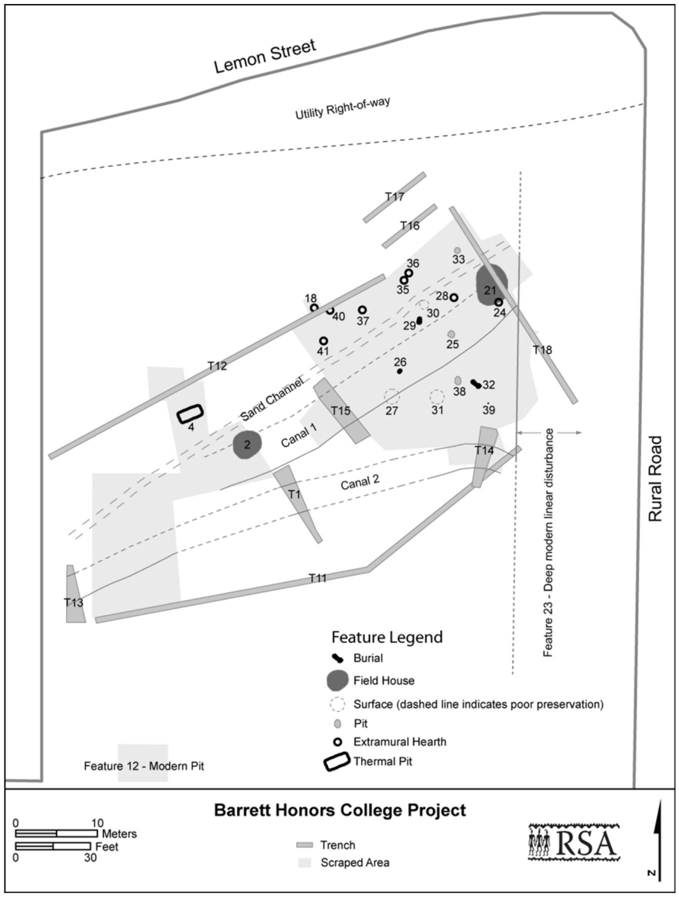


Figure 2. The Barrett Honors College site, AZ U:9:281(ASM), on the Arizona State University Tempe campus.

in the phyllite-tempered assemblage. Rim sherds could have assisted in differentiating a Las Colinas production locale from a Northern Periphery locale, because only large to medium-sized water jars were manufactured at Las Colinas during this time period. The phyllite-tempered vessels were likely transported by the residents of the field house to the site, as vessels with this type of temper are not found south of the Salt River in any significant quantity during this time period. The specific point of origin of these sharecroppers could be better determined if the phyllite-tempered pottery was subjected to chemical analysis with the electron microprobe. However, the presence of Squaw Peak Schist with the phyllite-tempered ceramics implies that the Northern Periphery is a more likely point of origin for the occupants of this field house.

The second field house, an early Classic period feature, was associated with a ceramic assemblage consistent with the nearest agricultural village, La Plaza. Unfortunately, comparative data from other contemporary villages on Canal System 1 were not available at the time of our analysis. I am therefore unable to exclude the possibility that the users of this feature were sharecroppers or members of a distant household with tenure to this land from elsewhere on Canal System 1. These two hypotheses can be differentiated when early Classic ceramic data from other irrigation village sites on Canal System 1 become available. Regardless, the ceramics associated with this field house were likely produced along Canal System 1, whereas those from the other field house were produced on the north side of the Salt River.

SUMMARY AND DIRECTIONS FOR FURTHER RESEARCH

Sharecropping, in which a household exchanges labor on a piece for land for a portion of the crop produced, is ubiquitous within the ethnographic sample of smallholder intensive irrigation agriculturalists. Based on these results, it seems likely that the Hohokam practiced sharecropping. In this paper, I have introduced a methodology that uses ceramic sourcing data to identify some forms of sharecropping at Hohokam field houses.

I have presented an archaeological case study in which two field houses were identified as potential residences of sharecroppers. One field house was likely used by sharecroppers from a non-tenured household from the Northern Periphery, or perhaps sharecroppers from a Canal System 2 settlement. The second field house was likely used by a household from the immediately adjacent village. However, it also possible that the second house was the logistical base for a household whose primary residence was elsewhere on Canal System 1. Clearly, a sample size of two field houses is not substantial enough to identify a pattern in field house residency and/or use. I hope that other researchers will begin to date field houses and to conduct sourcing analyses using the Abbott-Schaller temper classification. It may also be possible to extract a larger sample from the excavation notes of projects such as the excavations at the Sky Harbor Airport North Runway.

Acknowledgements. A version of this paper was originally written for Michelle Hegmon's Archaeology of Small-Scale Society seminar at Arizona State University, and I am grateful for her useful critique of the research. My Ph.D. advisor, David Abbott, also provided helpful comments on a draft of this manuscript. Finally, Glen Rice of Rio Salado Archaeology made numerous suggestions on the research design presented in this paper and provided me with funding to revise the article for publication.

REFERENCES CITED

Abbott, David R
2000 *Ceramics and Community Organization among the*

Hohokam. University of Arizona Press, Tucson.
Abbott, David R. (editor)
1994 *The Pueblo Grande Project, Volume 3: Ceramics and the Production and Exchange of Pottery in the Central Phoenix Basin*. Publications in Archaeology No. 20. Soil Systems, Inc., Phoenix.
Adams, William M., Tomasz Potkanski, and John E. G. Sutton
1994 Indigenous Farmer-Managed Irrigation in Sonjo, Tanzania. *The Geographical Journal* 160(1):17-32.
Ahmed, Akbar S.
1980 *Pukhtun Economy and Society: Traditional Structure and Economic Development in a Tribal Society*. Routledge and Kegan Paul, Boston.
Bahr, Donald, Juan Smith, William Smith Allison, and Julian Hayden
1994 *The Short, Swift Time of Gods on Earth: The Hohokam Chronicles*. University of California Press, Berkeley.
Barton, Roy F.
1910 *Ifugao Law.* University of California Press, Berkeley.
1922 *Ifugao Economics.* University of California Press, Berkeley.
Brandt, Vincent S. R.
1971 *The Korean Village: Between Farm and Sea*. Harvard University Press, Cambridge, MA.
Cable, John and David E. Doyel
1985 Hohokam Land-use Patterns along the Terraces of the Lower Salt River Valley: The Central Phoenix Project. In *Proceedings of the 1983 Hohokam Symposium, Part I*, edited by Alfred E. Dittert and Donald E. Dove, pp. 263–310. Arizona Archaeological Society Occasional Paper No. 2. Arizona Archaeological Society, Phoenix.
Cable, John and Douglas Mitchell
1988 La Lomita Pequena in Regional Perspective. In *Excavations at La Lomita Pequena: A Santa Cruz/Sacaton Phase Hamlet in the Salt River Valley*, edited by Douglas R. Mitchell, pp. 395–446. Soil Systems Publications in Archaeology Number 10. Soil Systems Inc., Phoenix.
Castetter, Edward F. and Willis H. Bell
1942 *Pima and Papago Indian Agriculture*. University of New Mexico Press, Albuquerque.
Clark, Tiffany C.
2004 A Study of Small-Scale Irrigation Agriculturalists. In *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*, edited by T. Kathleen Henderson, pp. 153–165. Anthropological Papers No. 10. Pueblo Grande Museum, Phoenix.
Craig, Douglas B.
2000 The Demographic Implications of Architectural Change at the Grewe Site. In *The Hohokam Village Revisited*, edited by David E. Doyel, Suzanne K. Fish and Paul R. Fish, pp. 139–166. Southwest and Rocky Mountain Division of the American Association for the Advancement of Science, Glenwood Springs, CO.
2001 Domestic Architecture and Household Wealth at Grewe. In *The Grewe Archaeological Research Project Volume 3: Synthesis*, edited by D. B. Craig, pp 115–130. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff.
2007 Courtyard Groups and the Emergence of House Estates in Early Hohokam Society. In *The Durable House: House Models in Archaeology*, edited by Robin A. Beck, Jr., pp. 446–463. Center for Archaeological Investigations Occasional Paper No. 35. Southern Illinois University, Carbondale, IL.
Crown, Patricia L.
1983 Introduction: Field Houses and Farmsteads in South-Central Arizona. In *Hohokam Archaeology along the Salt-Gila Aqueduct, Central Arizona Project, Vol. 5: Small Habitation Sites on Queen Creek*, edited by Lynn S. Teague and Patricia L. Crown, pp. 3–22. Arizona State Museum Archaeological Series No. 150. Arizona State Museum, University of Arizona, Tucson.
Dart, Alan
1983 Agricultural Features. In *Hohokam Archaeology along the Salt-Gila Aqueduct, Central Arizona Project, Vol.3; Specialized Activity Sites*, edited by Lynn S. Teague and Patricia L. Crown, pp 345–573. Archaeological Series No. 150. Arizona State Museum, University of Arizona, Tucson.
Enge, Kjell I. and Scott Whiteford
1989 *The Keepers of Water and Earth, Mexican Rural Social Organization and Irrigation.* University of Texas Press, Austin.
Gray, Robert F.
1958 The Sonjo: An Irrigation-based Society of East Africa. Unpublished PhD dissertation, Department of Anthropology, University of Chicago, Chicago.
1963 *The Sonjo of Tanganyika: An Anthropological Study of an Irrigation-based Society*. Oxford University Press, published for the African Institute, London.
Hatt, Doyle Gordon
1974 Skullcaps and Turbans: Domestic Authority and Public Leadership among the Idaw Tanan of the Western High Atlas, Morocco. PhD Dissertation, University of California-Los Angeles. University Microfilms, Ann Arbor.
Henderson, T. Kathleen
2001 Household Organization and Activity at Grewe. In *The Grewe Archaeological Research Project, Volume 3: Synthesis*, edited by Douglas B. Craig, pp. 93–114. Anthropological Papers No. 99-1. Northland Research, Inc, Tempe.
Henderson, T. Kathleen (editor)
1989 *Prehistoric Agricultural Activities on the Lehi-Mesa Terrace: Excavations at La Cuenca del Sedimento*. Northland Research, Inc., Flagstaff.
2004 *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*. Anthropological Papers No. 10. Pueblo Grande Museum, Phoenix.
Henderson, T. Kathleen and Tiffany C. Clark
2004 Changing Perspectives: Considerations of Past Agricultural Use of the Salt River Floodplain. In *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*, edited by T. Kathleen Henderson, pp. 167–186. Anthropological Papers No. 10. Pueblo Grande Museum, Phoenix.
Hill, W. W.
1936 Notes on Pima Land Law and Tenure. *American Anthropologist* 38:586–589.
Howard, Anne V.
1993 Marine Shell Artifacts and Production Processes at

Shelltown and the Hind Site. In *Shelltown and the Hind Site, A Study of Two Hohokam Craftsman Communities in Southwestern Arizona, Vol. 1*, edited by William S. Marmaduke and Richard J. Martynec, pp. 321–423. Northland Research, Inc. Flagstaff.

Howard, Jerry B. and David R. Wilcox

1988 The Place of Casa Buena and Locus 2 in the Evolution of Canal System 2. In *Excavations at Casa Buena: Changing Hohokam Land Use along the Squaw Peak Parkway, Vol. 2*, edited by Jerry B. Howard, pp. 903–939. Publications in Archaeology No. 11. Soil Systems, Inc., Phoenix.

Hunt, Robert C., David Guillet, David R. Abbott, James Bayman, Paul Fish, Suzanne Fish, Keith Kintigh, and James A. Neely

2005 Plausible Ethnographic Analogies for the Social Organization of Hohokam Canal Irrigation. *American Antiquity* 70: 433–456.

Huntington, Frederick W.

1986 *Archaeological Investigations at the West Branch Site: Early and Middle Rincon Occupation in the Southern Tucson Basin.* Anthropological Papers No. 5. Institute for American Research, Tucson.

Jacobs, David (editor)

1994 *Archaeology of the Salado in the Livingston Area of Tonto Basin, Roosevelt Platform Mound Study: Report on the Livingston Management Group, Pinto Creek Complex, Parts 1 and 2*. Roosevelt Monograph Series 3, Anthropological Field Studies 32. Office of Cultural Resource Management, Department of Anthropology, Arizona State University, Tempe.

Kwiatkowski, Scott

1988 The Macrobotanical and Flotation Analyses of Small Sites in the East Papago Freeway Corridor, Including an Archaeobotanical Study of Hohokam Fieldhouses. In *Arizona Department of Transportation Archaeological Testing Program: Part 2, East Papago Freeway*, edited by Daniel G. Landis, pp. 207–231. Publications in Archaeology No. 13. Soil Systems, Inc., Phoenix.

Lambrecht, Francis

1929. Ifugaw Villages and Houses. *Publications of the Catholic Anthropological Conference* 1(3):117-141.

Leach, Edmund R.

1961 *Pul Eliya: A Village in Ceylon: A Study of Land Tenure and Kinship.* Cambridge University Press, Cambridge, UK.

Meltzer, Milton

1993 *Slavery: A World History*. Da Capo Press, New York.

Messing, Simon D.

1985 *Highland Plateau Amhara of Ethiopia, Vol. 1*. Human Relations Area Files, Inc., New Haven, CT.

Netting, Robert McC.

1974 The System Nobody Knows: Village Irrigation in the Swiss Alps. In *Irrigation's Impact on Society*, edited by Theodore E. Downing and McGuire Gibson, pp. 67–75. Anthropological Papers No. 25. University of Arizona Press, Tucson.

1981 *Balancing on an Alp: Ecological Change and Continuity in a Swiss Mountain Community.* Cambridge University Press, Cambridge, UK.

1993 *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*. Stanford University Press, Palo Alto, CA.

Rice, Glen E.

1987 *The Hohokam Community of La Ciudad*. Office of Cultural Resource Management Report No. 69. Office of Cultural Resource Management, Department of Anthropology, Arizona State University, Tempe.

2000 Hohokam and Salado Segmentary Organization: The Evidence from the Roosevelt Platform Mound Study. In *Salado*, edited by J. S. Dean, pp. 143–169. University of Utah Press, Albuquerque.

2001 *The Role of Field Houses and Farmsteads in Hohokam Settlement Systems*. P-MIP Technical Report No. 2001-10. Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

Rice, Glen E. and John Ravesloot

2001 *Who Used the Areas between Villages? The Role of Camps, Activity Areas and Fields in the Study of Prehistoric Landscapes*. P-MIP Technical Report No. 2001-09. Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

Schaller, David M.

1994 Geographic Sources of Phoenix Basin Hohokam Plainware Based on Petrographic Analysis. In *The Pueblo Grande Project, Volume 3*: *Ceramics and the Production and Exchange of Pottery in the Central Phoenix Basin*, edited by D. R. Abbott, pp. 17–90. Publications in Archaeology No. 20. Soil Systems, Inc., Phoenix.

Seymour, Deni and Michael Schiffer

1987 A Preliminary Analysis of Pithouse Assemblages from Snaketown, Arizona. In *Method and Theory for Activity Area Research: An Ethnoarchaeological Approach*, edited by Susan Kent, pp. 549–603. Columbia University Press, New York.

Shack, William A.

1974 *Ethnographic Survey of Africa: North-eastern Africa, Part IV. The Central Ethiopians Amhara, Tigrina, and Related Peoples.* Ethnographic Survey of Africa's North-eastern Africa Series, Part IV. International African Institute, London.

Sires, Earl W., Jr.

1987 Hohokam Architectural Variability and Site Structure during the Sedentary- Classic Transition. In *The Hohokam Village: Site Structure and Organization*, edited by D. E. Doyel, pp. 171–182. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Glenwood Springs, CO.

Steinbach, Erik, Christopher N. Watkins, and Glen E. Rice

2008 *Hohokam Canals and Field Houses on the ASU Campus: Excavations at the Barrett Honors College Site, Arizona State University*. Technical Report No. 07-16. Rio Salado Archaeology, LLC., Tempe.

Teague, Lynn S.

1993 Prehistory and the Traditions of the O'odham and Hopi. *Kiva* 58(4): 435–454.

Turney, Omar

1929 Prehistoric Irrigation. *Arizona Historical Review* 2 (5).

Watkins, Christopher N. and Glen E. Rice

2008 Ceramics from AZ U:9:281 (ASM). In *Hohokam Canals and Field Houses on the ASU Campus: The Barrett*

Honors College Site, Arizona State University, edited by Erik Steinbach, Christopher N. Watkins, and Glen E. Rice, pp. 105–110. Technical Report No. 07-16. Rio Salado Archaeology, LLC., Tempe.

Watkins, Christopher N., Glen E. Rice, and James M. Bayman
2011 The Organization of Agricultural Labor on the Hohokam Irrigation Canals (A.D. 300-1100) of the Lower Salt Valley, Arizona. *Journal of Field Archaeology.*

Wilcox, David R., and Thomas R. McGuire, and Charles Sternberg
1981 *Snaketown Revisited: A Partial Cultural Resource Survey, Analysis of Site Structure and an Ethnohistoric Study of the Proposed Hohokam-Pima National Monument.* Archaeological Series No. 155. Arizona State Museum, University of Arizona, Tucson.

Wilk, Richard R., and Robert M. Netting
1984 Households: Changing Forms and Functions. In *Households: Comparative and Historical Studies of the Domestic Group*, edited by R. M. Netting, R. R. Wilk, and E. J. Arnould, pp. 1–28. University of California Press, Berkeley and Los Angeles.

Wilk, Richard, and William L. Rathje
1982 Household Archaeology. *American Behavioral Scientist* 25:617–639.

Woodson, M. Kyle
2007 Map of Prehistoric Canal Systems in the Middle Gila Valley. 2nd ed. On file at Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

Woodson, M. Kyle and Brenda G. Randolph
2000 *National Register of Historic Places Eligibility Assessment of 67 Sites in and Adjacent to the Blackwater Management Area, Pima-Maricopa Irrigation Project, Gila River Indian Community, Pinal County, Arizona*. P-MIP Technical Report No. 00-03. Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

COMMUNITY DISINTEGRATION: THE VALENCIA COMMUNITY DURING THE ELEVENTH CENTURY

Michael W. Lindeman
James M. Heidke

ABSTRACT

This paper explores the settlement history of the Valencia Community, one of the preeminent Hohokam farming communities in the southern Tucson Basin in the Pre-Classic period. Special attention is paid to a shift in settlement that occurred during the eleventh century, a relocation which is interpreted as a fracturing of the community. The settlement shift involved the apparent movement of an entire residential group from the southern plaza to the northern margins of the Valencia site, and then to an entirely new site less than 500 m to the north. This residential move is viewed as evidence of social tensions between two constituent factions of the community. The social dynamics evident at the Valencia Community provide an opportunity to explore aspects of Hohokam social, political, and economic organization.

In this paper, we examine the settlement history of the Valencia Community, a large Hohokam farming community in the southern Tucson Basin (Figure 1). The community was a center of population along the eastern banks of the Santa Cruz River for much of the Pre-Classic period, with an occupation beginning in the late Agua Caliente phase (ca. A.D. 350–500) and continuing through the end of the Middle Rincon phase (ca. A.D. 1000–1100) (Doelle 1985; Elson and Doelle 1986; Wallace 2003). At the heart of the community were two plazas and a ballcourt—central facilities for gatherings, feasts, and celebrations (Figure 2). The people living at Valencia would have been enmeshed in social interactions on a variety of levels: households, social factions, and communities. Ritual, social, political, and economic activities would have bound people together in relationships based on kinship, friendship, and necessity. These interactions would have fostered a sense of community among the inhabitants. However, such connectivity has a flip-side, and viewing such associations as purely beneficial or simply promoting social solidarity would be naïve (Brumfiel 1992). Envisioning prehistoric societies as homogenous entities with common social and economic situations obscures a great deal of variability, and masks inherent tensions, conflicts, and resolutions that shaped prehistoric society. Tensions based on differences in social standing, access to agricultural land, kin group membership, and productive pursuits could

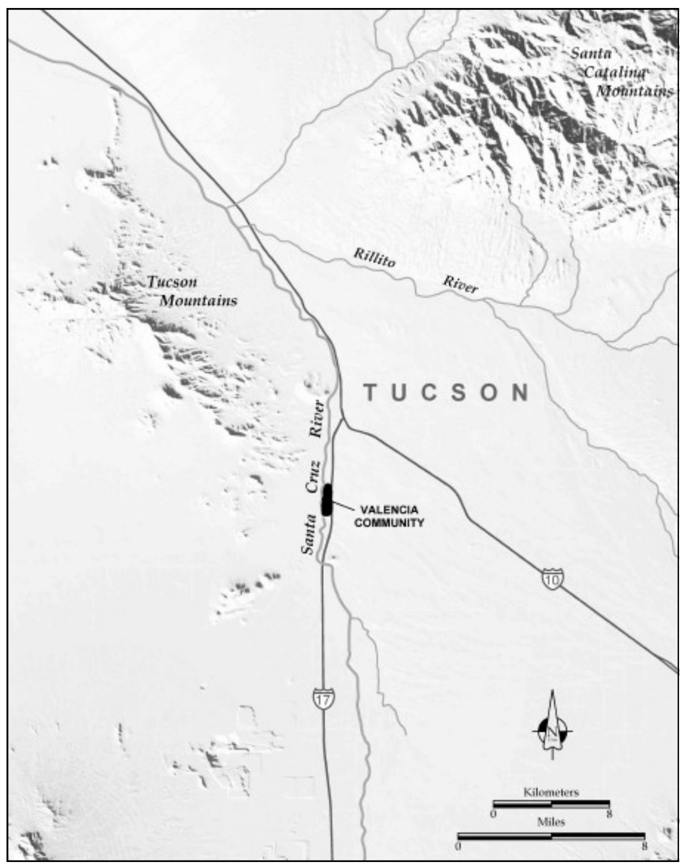


Figure 1. Location of the Valencia Community.

Michael W. Lindeman / Desert Archaeology, Inc. / mike@desert.com
James M. Heidke / Desert Archaeology, Inc. / jim@desert.com

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 120-127

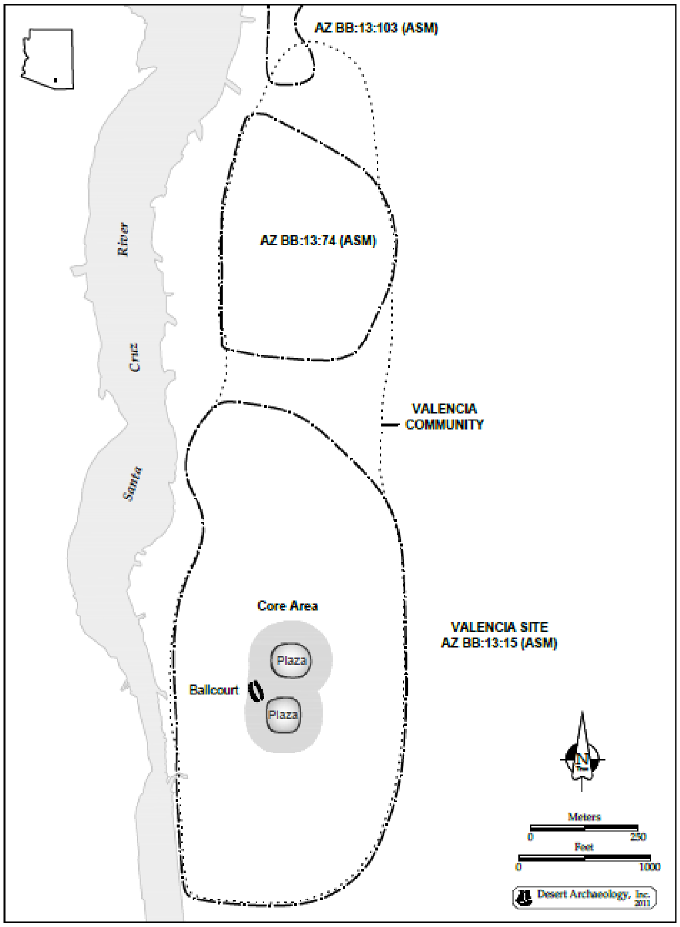


Figure 2. Sites in the Valencia Community.

have led to conflict within the community. The following discussion reviews the settlement history of the Valencia Community with a particular emphasis on the settlement shifts that occurred in the eleventh century. The settlement shifts are interpreted as a fracturing of the community.

THE VALENCIA COMMUNITY

We follow Doelle (1985; see also Doelle and Wallace 1991) in using the term Valencia Community to describe a group of affiliated sites that extend along the Santa Cruz River between Valencia and Irvington roads. This usage is consistent with Nelson's (1994:3) view that "[t]he focus on community points to a human group, not just to a place or a site. Sites sometimes constitute communities and sometimes are subsumed by them." It is also consistent with Wills and Leonards' (1994:xiii) broad definition of community which states that a community is a "a residential group whose members interact with one another on some regular basis." The discussion of the Valencia Community that follows focuses on the three major sites that made up the community: Valencia proper, AZ BB:13:15 (ASM), and two sites located to the north of the main complex, AZ BB:13:74(ASM) and AZ BB:13:103(ASM).

The heart of the Valencia Community sits on a roughly 27 ha parcel that Pima County recently purchased to preserve the archaeological site. The Pima County parcel encompasses the core of the Valencia site; it includes the area immediately adjacent to the plazas and ballcourt as well as areas slightly removed from the core. Archaeological work on the county parcel has been limited and our best information comes from a detailed surface collection conducted by Elson and Doelle (1986). The collection was largely conducted in 25-m-square grids, which provided good spatial resolution for core and near-core areas of the site. Heidke recently re-analyzed the ceramic assemblage collected during this work. In addition, archaeological excavations have been conducted along the margins of the Pima County preserve at Valencia. Of particular note for this study are Wallace's (2003) excavations at Valencia Vieja, Doelle's (1985) excavations in Calle Santa Cruz along the western margin of the site, and Lindeman's (2006) work at Valencia Northeast. Archaeological data from subsurface contexts have been recovered from the two sites north of Valencia proper, BB:13:74 and BB:13:103 (Bradley 1980; Lindeman 2003; Lindeman and Wörcherl 2009; Schott 1978; Sense 1980; Whitney and Lindeman 2003).

To understand the settlement and organizational changes that occurred during the Middle Rincon subphase, we rely heavily on the seriation of Middle Rincon Red-on-brown collections into three parts, known as MR1, 2, and 3 (Heidke 1995; Wallace 1986). Unfortunately, these data are only available for the more recent excavations. During his reanalysis of the Valencia surface data, Heidke found few sherds large enough to assign to specific portions of the Middle Rincon sequence. In this analysis, surface collections from the Valencia core and near-core areas can only be attributed to the phase level, while excavated materials from the Valencia peripheries and sites north of Valencia proper can be assigned to finer level subdivisions.

Pioneer and Colonial Periods

The first well-documented occupation of the Valencia Community began with the founding of Valencia Vieja during the late Agua Caliente phase (ca. A.D. 350–500) (Figure 3) (Lindeman and Wallace 2004; Wallace 2003). The settlement, which began with a handful of structures, grew into a relatively large plaza-centric village during the early portions of the Tortolita phase (ca. A.D. 500–700). Over 300 pithouses are estimated to have once been present at the site, with an estimated population of approximately 100 people at any given time (Wallace 2003). The founding of the plaza may have represented the creation of an integrative facility that linked the people of the Valencia area

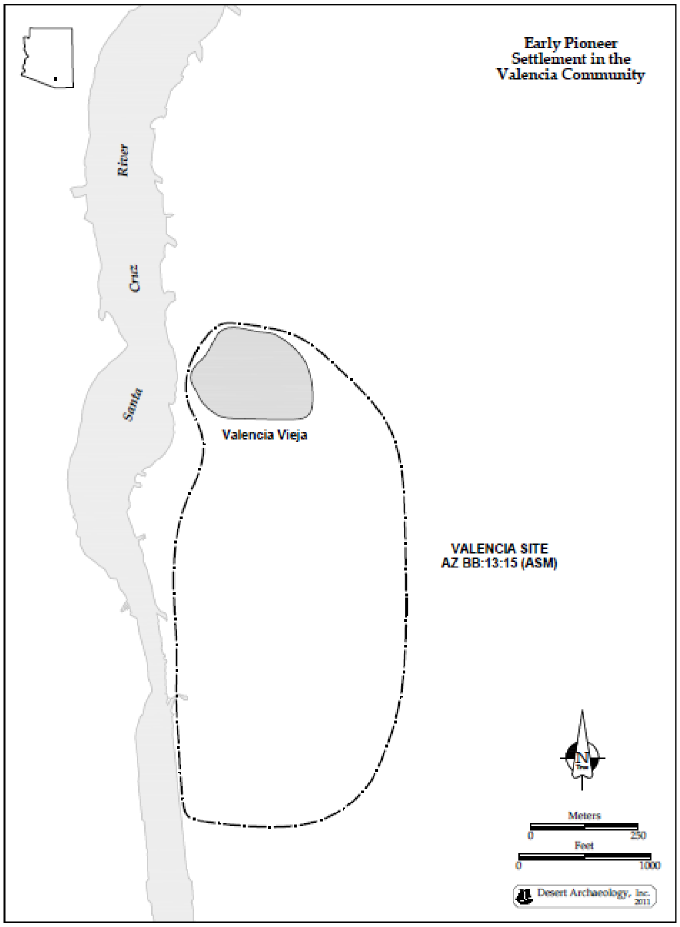


Figure 3. Early Pioneer period settlement in the Valencia Community.

(Wallace and Lindeman 2008). At A.D. 700, this portion of the site was apparently abandoned quite rapidly.

By the Snaketown phase (ca. A.D. 700–750), the Valencia Vieja residents likely moved south some 500 m to the core of the Valencia site (Figure 4). At the center of the site were two plazas that served as focal points for the settlement. Feast days, religious ceremonies, and political events would likely have been marked by gatherings on the plazas. An earthen-bermed ballcourt sits between the two plazas at Valencia. The location of these features—almost all are located adjacent to plazas—speaks to the centrality of events at ballcourts to the social life at Valencia. The position of the ballcourt, between the two plazas, may point to a symbolic joining of the village inhabitants, who had divided themselves into two social groups, each with their own plaza.

Surface collections conducted at Valencia by Elson and Doelle (1986) provide the majority of dating information from the central site precincts. Heidke has recently reexamined the collections. While the low number of Snaketown phase (ca A.D. 700–750) diagnostics (n=15) precludes any firm conclusions about their distribution, the concentration of Cañada del Oro phase (CDO) (ca. A.D. 750–850) and Rillito phase (ca. A.D. 850–950) diagnostic ceramics is informative. The reanalysis of CDO and Rillito diagnostics demonstrates that nearly 60 percent of these ceramics were recovered from the core area, around the plazas and ballcourt, and that the remainder of the diagnostic sherds were found in adjacent areas (Figure 5). In contrast, relatively little Colonial period material has been identified in excavations along the Valencia periphery, with the exception of a few structures southeast of the core (Ruble 2004). This speaks to both the concentration of population around the plaza-ballcourt complex and the centrality of these communal features.

Sedentary Period

In analyzing surface data from the Valencia core, Doelle and Wallace (1991:319) note that "[f]or the Middle Rincon subphase, the southern cluster of population almost disappears," while the northern cluster is reduced but persists. The ceramic reanalysis does not contradict this conclusion, but adds details that can help flush out the intensity and timing of the population shift.

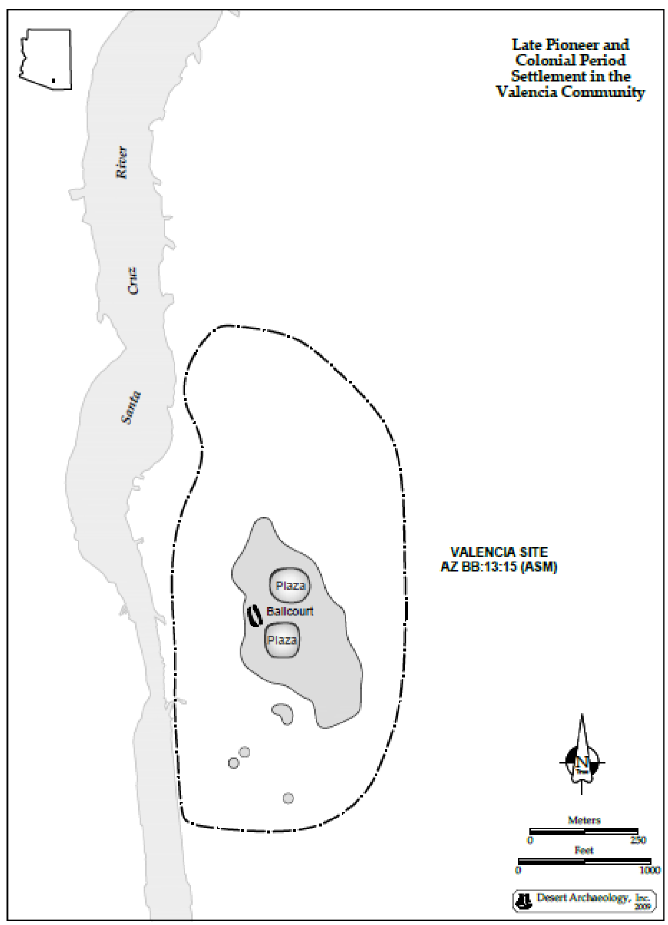


Figure 4. Late Pioneer and Colonial period settlement in the Valencia Community.

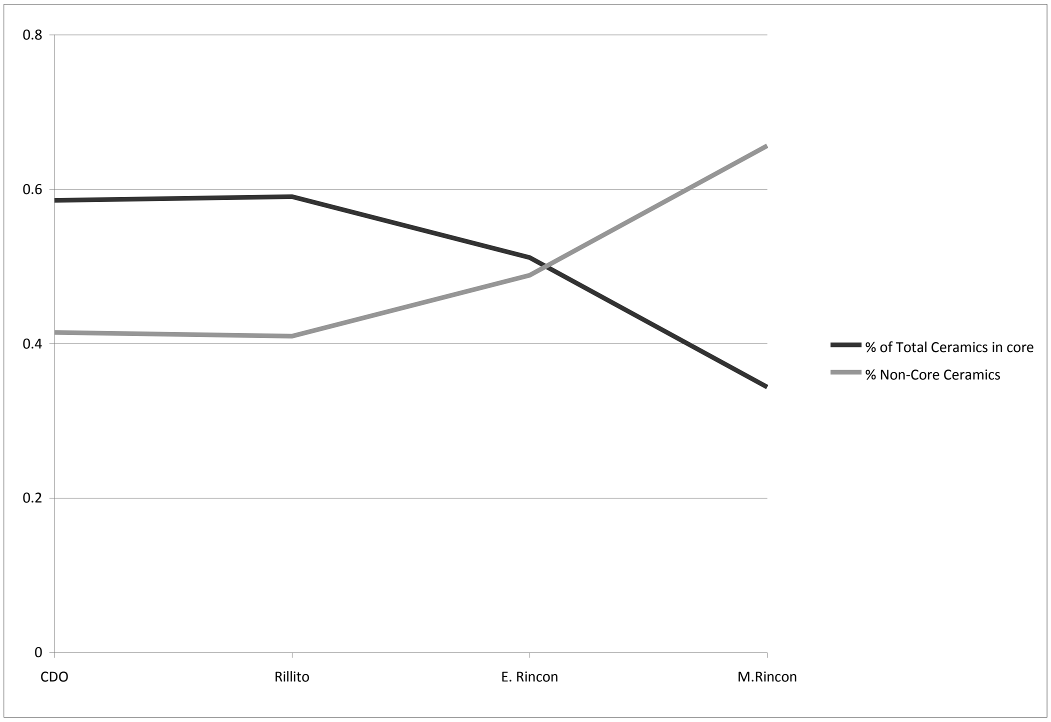


Figure 5. Percent of ceramics in core and non-core contexts by phase at the Valencia site, AZ BB:13:15(ASM).

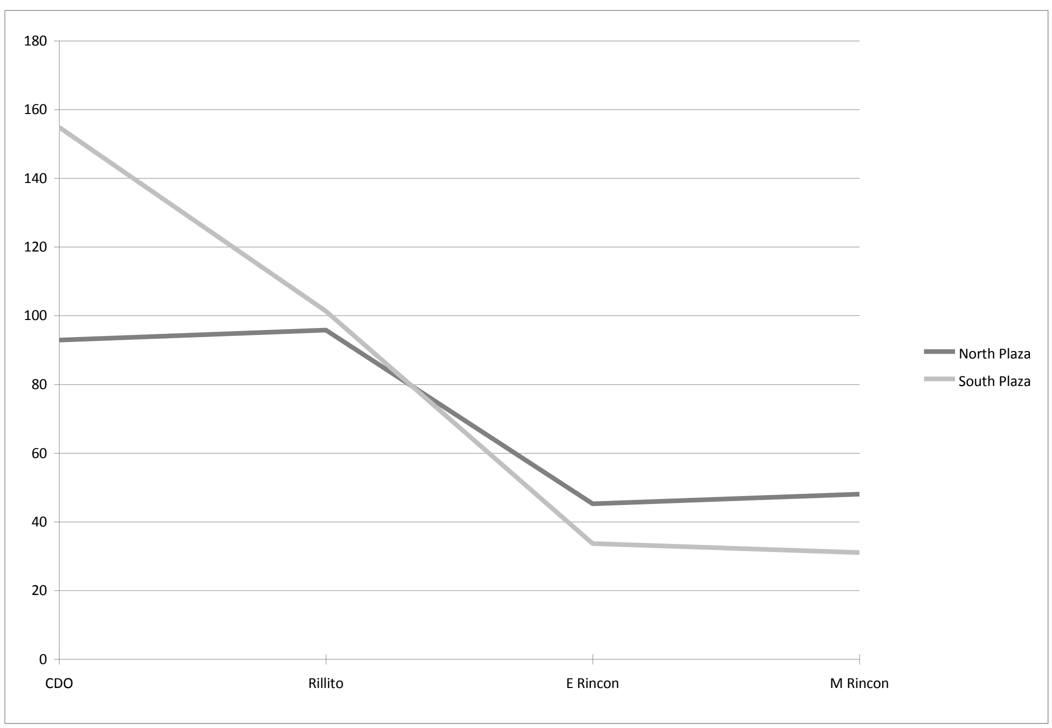


Figure 6. Standardized frequencies of phase diagnostics around the northern and southern plazas at the Valencia site, AZ BB:13:15(ASM).

At the beginning of the Early Rincon phase (ca. A.D. 950–1000), people began to move away from the Valencia core. If we assume that the relative percentage of diagnostic ceramics reflects occupation intensity, then we can demonstrate graphically that the core area decreased in importance from the end of the Colonial period through the Middle Rincon (Figure 5). The relatively stable state of core occupation during the Colonial period began to decline during Early Rincon, from almost 60 percent to 51 percent. This process accelerated by Middle Rincon, with only 34 percent of Middle Rincon diagnostics found in the core area.

The data presented in Figure 5 do not necessarily indicate a depopulation of the core. Rather, these data may be indicative of a population explosion during Middle Rincon. To address this question, diagnostic counts from the Cañada del Oro, Rillito, Early Rincon, and Middle Rincon phases were standardized based on average decorated percentages found on sites of each phase (Heidke 2004). Figure 6 shows the standardized frequencies of phase diagnostics from the Valencia core. A dramatic dip is evident around both the north and south plazas from Rillito to Early Rincon, with

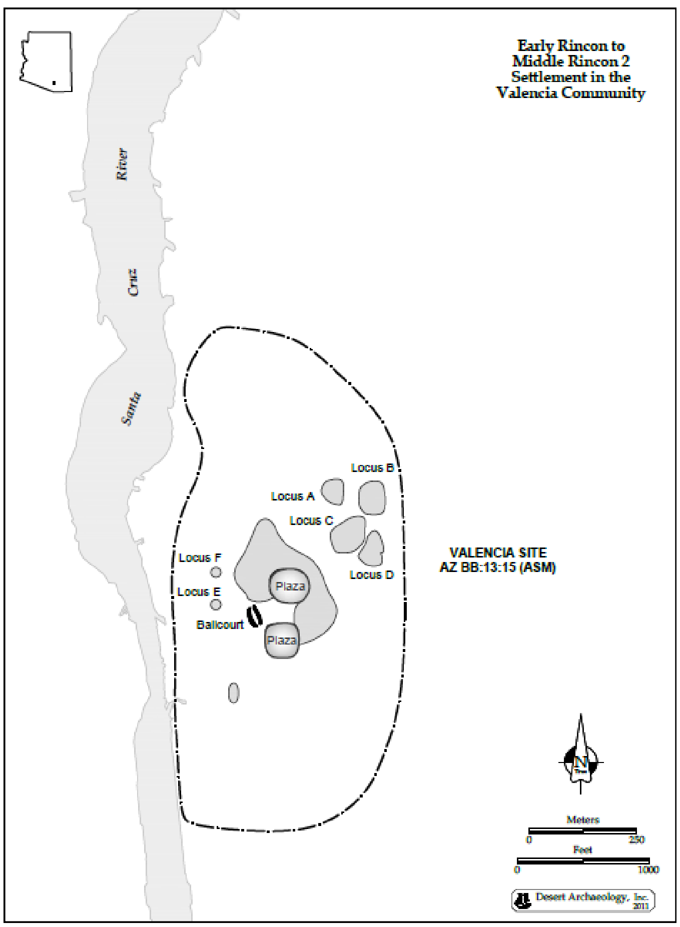


Figure 7. Early Rincon to Middle Rincon 2 settlement in the Valencia Community.

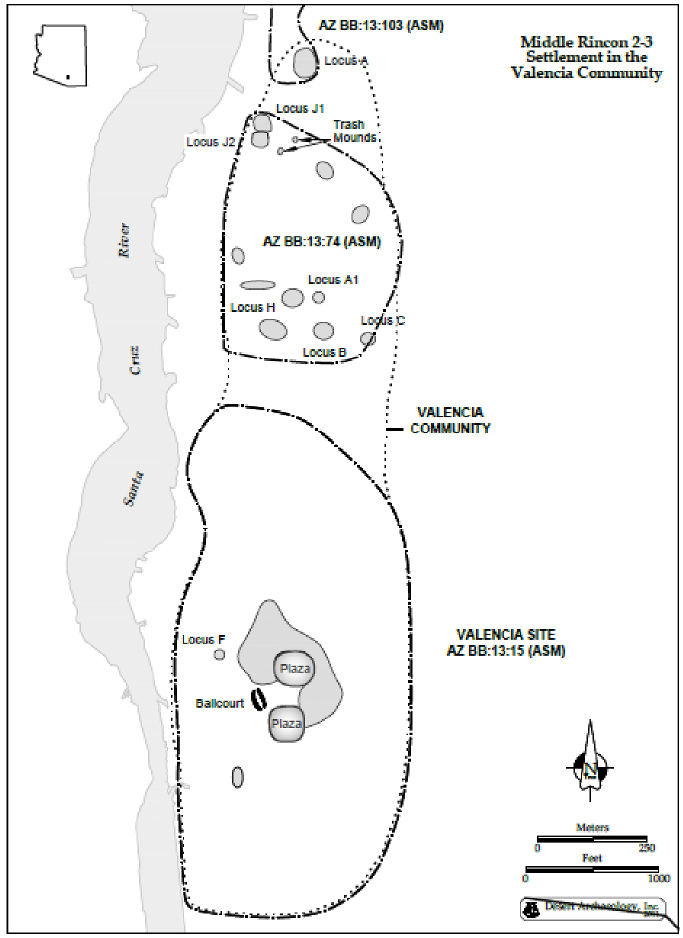


Figure 8. Middle Rincon 2 and 3 settlement in the Valencia Community.

fewer Early and Middle Rincon diagnostics found around the south plaza than around the north plaza (for Middle Rincon, south plaza n=31 and north plaza n=48). In tandem, the analyses summarized in Figures 5 and 6 show a decreasing intensity of settlement in the Valencia core during Middle Rincon times and a concomitant movement to the periphery.

Initially, settlement did not range far from the plazas with people settling along the margins of the core (Doelle 1985; Elson and Doelle 1986; Lindeman 2006). Excavations just outside of the core at Valencia Northeast revealed four loci that were settled during the Early Rincon subphase and early in the Middle Rincon subphase (MR1 subdivision) (Lindeman 2006) (Figure 7). Doelle's (1985) work within Calle Santa Cruz suggests a similar pattern for settlement on the northwestern margins of the Valencia core, with one house cluster established by the Early Rincon phase (see Figure 7).

The movement to the margins of the core appears to have been short-lived (Figure 8). At Valencia Northeast, the four loci appear to have been abandoned by the end of the MR2 portion of Middle Rincon (Lindeman 2006). West of the core, the data is more

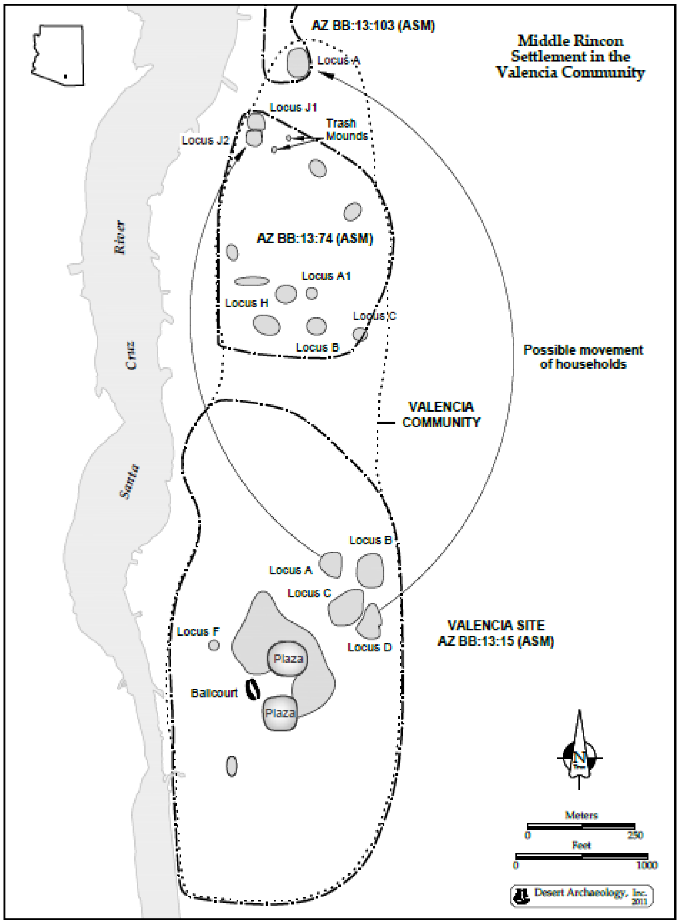


Figure 9. Possible settlement shifts from Middle Rincon 1-2 to Middle Rincon 2-3 in the Valencia Community. Settlement shifts are identified using ceramic small element, obsidian, and agave data.

ambiguous because Wallace's (1986) preliminary ceramic seriation did not identify trends within Middle Rincon (Doelle 1985). However, given the lack of pure Middle Rincon contexts at Locus E, this house cluster appears to have been abandoned relatively early in the Middle Rincon subphase (Doelle 1985).

Coincident with the abandonment of courtyards near the site center, a new settlement was established at BB:13:74 and BB:13:103, roughly 700 m north of the plazas and ballcourt. Excavations at BB:13:74 and BB:13:103 have produced sufficiently large samples of decorated ceramics to place their founding during the second half of Middle Rincon, either MR2 or MR3—exactly when loci to the south were being abandoned (Lindeman 2006; Lindeman and Wöcherl 2009). It thus appears that people left the core of the Valencia site, particularly the southern plaza, and settled in a new location.

Some evidence connects people living at Valencia Northeast to the settlers of BB:13:74 and BB:13:103 (Figure 9). Looking at small geometric elements painted on the ceramics, Heidke and his colleagues (2009) found that certain elements were unique to specific loci at Valencia Northeast. Comparing this information to similar stylistic data from BB:13:74 and BB:13:103, he found that small geometric elements specific to loci at Valencia Northeast were limited to certain loci at BB:13:74 and BB:13:103. Thus, particular loci from Valencia Northeast shared the same suite of unique small elements in painted pottery designs with their northern counterparts (Table 1). Given the evidence for ceramic production at Valencia Northeast and at BB:13:74, Heidke and his colleagues (2009) raise the possibility that potters, using unique sets of small elements, moved from Valencia (BB:13:15) to BB:13:74 and BB:13:103.

The distribution of obsidian parallels the pattern found in the ceramic small element data (Ryan 2009). Of the 11 Middle Rincon loci that have been sampled at Valencia, BB:13:74, and BB:13:103, obsidian was recovered from only one locus at Valencia Northeast and from two loci at BB:13:74. The loci that contained obsidian also shared unique small geometric elements in their painted pottery designs. Macrobotanical data further support movement from Valencia Northeast to BB:13:103 (Diehl 2009). In the sample of eleven Middle Rincon loci, agave was recovered from only a single locus at Valencia Northeast and from the one Middle Rincon locus at BB:13:103. This spatial pattern mirrors the distribution of exclusive small elements that Heidke and his colleagues (2009) identified in pottery designs.

If the occupants of a locus established contacts for acquiring obsidian or preferences for working with obsidian, these contacts and/or preferences likely remained even after relocation to a new area. The same can be suggested for the presence of agave in house-

Table 1. Small element data from Middle Rincon loci in the Valencia Community. Shared elements suggesting possible movement are shaded in gray.

Element Category	VALENCIA SITE RESIDENTIAL LOCI				
	A.D. 990 - 1040s	A.D. 1040 - 1100		A.D. 990 - 1040s	A.D. 1040 - 1100
	BB:13:15 Locus A	BB:13:74 Locus J1	BB:13:74 Locus J2	BB:13:15 Locus C	BB:13:103 Locus A
55.1	P	P	—	P	P
9	P	P	P	—	—
104.2	P	P	P	—	—
96	—	P	—	—	—
205	—	—	P	—	—
1	—	—	—	P	P
2	—	—	—	P	P
19	—	—	—	P	—
32	—	—	—	P	—
47	—	—	—	P	—
51	—	—	—	P	—

hold assemblages. Given the overall rarity of agave in the assemblages, the presence of agave at only two loci may indicate that the inhabitants had established privileged access to it or a had preference for agave, as a fiber, food or both. If this is the case, these preferences would likely have been retained by people even after they moved.

The data linking the residents of specific loci at Valencia Northeast with those at BB:13:74 and BB:13:103 are intriguing but require further testing to establish with confidence. What can be stated unequivocally, however, is that peripheral areas around Valencia were abandoned during MR2 and new settlements were established at BB:13:74 and BB:13:103. Furthermore, it appears that this movement was substantial and involved a large number of people. Previous investigations at BB:13:74 and BB:13:103 exposed 11 house clusters at the two sites (Bradley 1980; Lindeman 2003; Lindeman and Wörcherl 2009; Schott 1978; Sense 1980; Whitney and Lindeman 2003).

Inspection of unexcavated portions of BB:13:74 has identified additional trash mounds that indicate the presence of other house clusters. Pooling the surface and excavation information leads to a conservative estimate of 13 to 15 house clusters at the two sites. If each of the house clusters represents a household, then the movement of such a large number of households away from the core of Valencia would have been a major event, representing a move of potentially half of the population.

Classic Period

During the Late Rincon phase (ca. A.D. 1100-1150), population in the Valencia Community was dramatically reduced. There are some indications of a remnant population north of the northern plaza at the Valencia site (Doelle 1985; Elson and Doelle 1986). The splinter group that settled at BB:13:74 and BB:13:103 appears to have largely abandoned the community (Only a single field house remained at BB:13:103.) (Lindeman and Wöcherl 2009). Tanque Verde phase (ca. A.D. 1150–1300) occupation of the Irvington to Valencia Road area consists primarily of scattered pithouses, with examples at BB:13:74 and at Valencia Vieja (BB:13:15) (Bradley 1980; Lindeman and Wöcherl 2009; Wallace 2003; Whitney and Lindeman 2003).

DISCUSSION

After roughly 250 years of relatively stable occupation centered on the plazas and ballcourt in the Valencia site core, the following 150 years appear to have been tumultuous times in the Valencia Community. The changes in settlement began relatively slowly, gained steam through the eleventh century, lead to the splintering of the community, and ultimately resulted in its abandonment. Many of the changes in settlement seem focused on the southern plaza, which appears to have been nearly depopulated during the Middle Rincon subphase (ca. A.D. 1000–1100).

The movement of an entire residential group from the Valencia core to new settlements less than 700 m to the north points to a fissure within the community. Unfortunately, the causes underlying the rift between community factions are unclear. The relatively slow movement away from the site core suggests that it was a social issue that developed gradually and that became more divisive over time. The choice of settlement location, far enough to create physical space but still adjacent to agricultural land and canals used by the larger community, suggests that the initial splintering was not caused by degradation of the floodplain from channel entrenchment (Waters 1988; Waters and Ravesloot 2001). Nevertheless, it is evident that the residential split in the Valencia Community foreshadows the virtual abandonment of the area less than half a century later.

REFERENCES CITED

Bradley, Bruce A.
1980 *Excavations at Arizona BB:13:74, Santa Cruz Industrial Park, Tucson, Arizona*. CASA Papers No. 1. Complete Archaeological Service Associates, Oracle, AZ.

Brumfiel, Elizabeth
1992 Distinguished Lecture in Archaeology: Breaking and Entering the Ecosystem-Gender, Class, and Faction Steal the Show. *American Anthropologist* 94:551–567.

Diehl, Michael W.
2009 Macrobotanical Remains from the Valencia Community. In *The Parque de Santa Cruz Project: Life on the Northern Margin of the Valencia Community*, edited by M. W. Lindeman and H. Wöcherl, pp. 227–238. Desert Archaeology, Inc., Tucson.

Doelle, William H.
1985 *Excavations at the Valencia Site, a Pre-Classic Hohokam Village in the Southern Tucson Basin*. Anthropological Papers No. 3. Institute for American Research, Tucson.

Doelle, William H., and Henry D. Wallace
1991 The Changing Role of the Tucson Basin in the Hohokam Regional System. In *Exploring the Hohokam: Prehistoric Desert Peoples of the American Southwest*, edited by G. J. Gumerman, pp. 279–345. University of New Mexico Press, Albuquerque.

Elson, Mark D., and William H. Doelle
1986 The Valencia Site Testing Project: Mapping, Intensive Surface Collecting, and Limited Trenching of a Hohokam Ballcourt Village in the Southern Tucson Basin. Technical Report No. 86-6. Institute for American Research, Tucson.

Heidke, James M.
1995 Ceramic Analysis. In *Archaeological Investigations at Los Morteros, a Prehistoric Community in the Northern Tucson Basin*, edited by H. D. Wallace, pp. 263–442.

Anthropological Papers No. 17. Center for Desert Archaeology, Tucson.
2004 Colonial and Sedentary Period Pottery. In *Archaeological Investigations at the Southern Margin of the Valencia Site, AZ BB:13:15 (ASM), Pima County, Arizona*, edited by E. C. Ruble, pp. 31–46. Technical Report No. 2001-02. Desert Archaeology, Inc., Tucson.

Heidke, James M., Melissa K. Markel, and Carlos P. Lavayen
2009 Native American Ceramics from the Parque de Santa Cruz Project. In *The Parque de Santa Cruz Project: Life on the Northern Margin of the Valencia Community*, edited by M. W. Lindeman and H. Wöcherl, pp. 123–176. Technical Report No. 2008-02. Desert Archaeology, Inc., Tucson.

Lindeman, Michael W.
2003 Excavations at AZ BB:13:74 (ASM): An Examination of Three Middle Rincon Phase Loci. Technical Report No. 2000-01. Center for Desert Archaeology, Tucson.
2006 Results of Limited Excavation and In-situ Site Preservation at the Pima Community College Desert Vista Campus. Technical Report No. 2005-12. Desert Archaeology, Inc., Tucson.

Lindeman, Michael W., and Henry D. Wallace
2004 A Revised Chronology of the Plain Ware and Red Ware Horizons in South and Central Arizona. *Kiva* 70:97–120.

Lindeman, Michael W., and Helga Wöcherl (editors)
2009 The Parque de Santa Cruz Project: Life on the Northern Margin of the Valencia Community. Technical Report No. 2008-02. Desert Archaeology, Inc., Tucson.

Nelson, Ben A.
1994 Introduction: Approaches to Analyzing Prehistoric Community Dynamics. In *The Ancient Southwestern Community*, edited by W.H. Wills and R. D. Leonard, pp 3–7. University of New Mexico Press, Albuquerque.

Ruble, Ellen C.
2004 Archaeological Investigations at the Southeastern Margin of the Valencia Site, AZ BB:13:15 (ASM), Pima County, Arizona. Technical Report No. 2001-02. Desert Archaeology, Inc., Tucson.

Ryan, Stacy
2009 Flaked Stone Artifacts from the Parque de Santa Cruz Project Area. In *The Parque de Santa Cruz Project: Life on the Northern Margin of the Valencia Community*, edited by M. W. Lindeman and H. Wöcherl, pp. 211–225. Technical Report No. 2008-02. Desert Archaeology, Inc., Tucson.

Schott, George C.
1978 Letter regarding Preliminary Archaeological Investigation of BB:13:74 (North Portion), 15 October. Private letter to Peter Hills, Engineer Division, City of Tucson.

Sense, Richard
1980 Archaeological Investigations: Santa Cruz Riverpark, Drexel to Irvington Roads. Archaeological Resources, Tucson.

Wallace, Henry D.
1986 *Rincon Phase Decorated Ceramics in the Tucson Basin: A Focus on the West Branch Site. Anthropological Papers No. 1*. Institute for American Research, Tucson.

Wallace, Henry D. (editor)
2003 *Roots of Sedentism: Archaeological Excavations at Valencia Vieja, a Founding Village in the Tucson Basin of Southern Arizona*. Anthropological Papers No. 29. Center for Desert Archaeology, Tucson.

Wallace, Henry D., and Michael W. Lindeman
2008 The Florescence of a Regional Center: Hohokam Cultural Development in the Tucson Basin, A.D. 700 to 1150. In *Hohokam Trajectories in World Perspective*, edited by P. R. Fish and S. K. Fish. University of Arizona Press, Tucson, in press.

Waters, Michael R.
1988 The Impact of Fluvial Processes and Landscape Evolution on the Archaeological Sites and Settlement Patterns along the San Xavier Reach of the Santa Cruz River, Arizona. *Geoarchaeology* 3:205–219.

Waters, Michael R., and John C. Ravesloot
2001 Landscape Change and the Cultural Evolution of the Hohokam Along the Middle Gila River and Other River Valleys in South-Central Arizona. *American Antiquity* 66:285–299.

Whitney, Gregory J., and Michael W. Lindeman
2003 Monitoring and Limited Data Recovery Results for the Construction of a Cellular Monopole Within the Boundaries of AZ BB:13:74 (ASM), Tucson, Pima County, Arizona. Technical Report No. 2004-03. Desert Archaeology, Inc., Tucson.

Wills, W.H. and Robert D. Leonard
1994 Preface. In *The Ancient Southwestern Community*, edited by W.H. Wills and R. D. Leonard, pp xii–xvi. University of New Mexico Press, Albuquerque.

HOHOKAM POTTERY PRODUCTION AREAS AND THE ORGANIZATION OF CERAMIC PRODUCTION AND EXCHANGE IN THE PHOENIX BASIN

M. Kyle Woodson

ABSTRACT

Understanding the distribution and consumption of goods can only be achieved through the delineation of the organization of production. The prevailing model of the organization of Hohokam ceramic production and exchange in the Phoenix Basin is based largely on indirect evidence. Direct evidence for production is scant but is necessary to evaluate this model. This paper reviews the known Hohokam pottery production areas in the Phoenix Basin and describes a recently discovered locus at the Sweetwater site in the middle Gila River Valley. The implications of the direct evidence for our understanding of the organization of Hohokam ceramic production and exchange in the Phoenix Basin are discussed. Overall, the evidence indicates that Hohokam pottery production encompassed greater than expected organizational variability.

Archaeologists have long assumed that ceramic containers were produced and consumed at the household level in autonomous, egalitarian villages across the prehistoric Southwest (e.g., Judd 1954:235; Schroeder 1982; also see discussions in Cordell 1991 and in Plog 1995). This assumption was based on the belief that pottery production in historic Southwestern Native American communities was an appropriate analog for prehistoric ceramic production (Mills and Crown 1995:6). Although Anna Shepard (1942; Kidder and Shepard 1936) first questioned this reliance on analogy, research over the past two decades has revealed a sophisticated structure for ceramic production and exchange systems among prehistoric Southwestern groups (e.g., Abbott 2000, 2003a; Abbott, ed. 1994; Abbott et al. 2007; Crown 1994; Harry 2000; Heidke 1996; Mills and Crown 1995; Wallace and Heidke 1986). In the Hohokam region of south-central Arizona, analyses of the production technology of pottery—especially temper composition—and geological studies of temper sources (e.g., Abbott, ed. 1994; Heidke 1996; Lombard 1987; Miksa 2001; Schaller 1994) have led to significant insights regarding the organization of production and exchange. For instance, Hohokam archaeologists now contend that a relatively small number of settlements produced the majority of the utilitarian pottery used in the Phoenix Basin (e.g., Abbott 2003b; Abbott and Walsh-Anduze 1995:106). Certain villages or locales specialized in the production of plain, red, and buff ware pottery vessels that were distributed across varying distances in different spheres of exchange (Abbott et al. 2001; Heidke 1996; Van Keuren et al. 1997; Wallace and Heidke 1986).

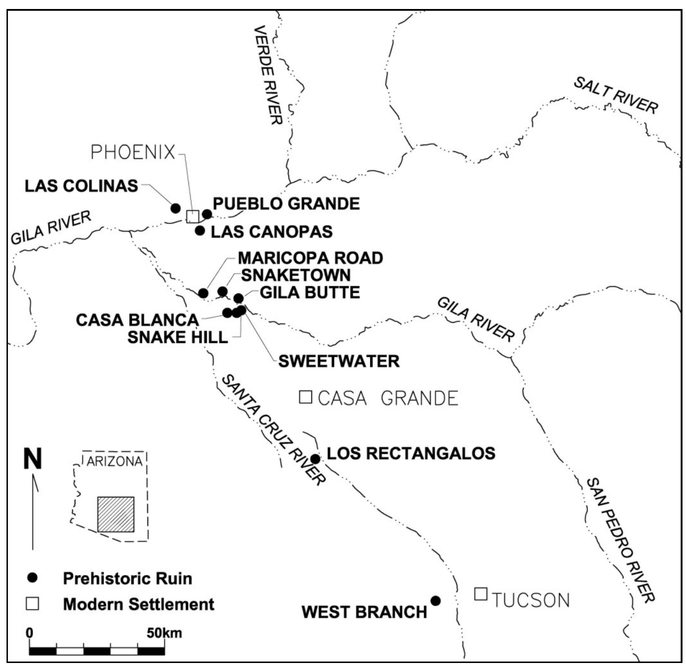


Figure 1. Map of south-central Arizona showing the location of the Sweetwater site and other sites mentioned in the text.

M. Kyle Woodson / Cultural Resource Management Program, Gila River Indian Community / Kyle.Woodson@gric.nsn.us

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 128-147

Clear temporal changes also are evident in the production loci of these pottery types as well as in the structure of their exchange systems.

Despite these advances in knowledge, very little evidence for the actual locations where pottery was made and fired has been found in the Hohokam region or in the Southwest as a whole (Mills and Crown 1995:7; Sullivan 1988:23; also see Bernardini 2000). Although a number of Hohokam sites contain indirect evidence for pottery production, only seven sites in the Phoenix Basin contain unambiguous, direct evidence for on-site pottery production out of thousands of known sites (Figure 1). As used here, direct evidence means the site contains raw materials, tools, debris, and facilities (e.g., mixing basins, firing pits) associated with pottery production in primary-use contexts (Costin 1991:18–19; Mills and Crown 1995:7). The discovery of a pottery production area at the Sweetwater site in the middle Gila River Valley constitutes a significant addition to this limited database (Woodson 2002).

This paper reviews the current evidence for Hohokam pottery production areas in the Phoenix Basin. To provide a framework for evaluating these production areas, the parameters of the organization of ceramic production are briefly reviewed, and the prevailing model of Hohokam ceramic production and exchange during the Sedentary and Classic periods in the Phoenix Basin is outlined. The final section discusses the implications of the direct evidence for understanding the organization of ceramic production and exchange in the Phoenix Basin.

ORGANIZATION OF CERAMIC PRODUCTION

The organization of ceramic production encompasses the ideas of "where, when, [and] how ceramics were made," as well as "who is producing for whom and why" (Mills and Crown 1995:2). It characterizes the "social, economic, and political contexts of production and how these contexts change through time" (Mills and Crown 1995:2; also see Arnold 1985; Bey and Pool 1992; Costin 1991). The self-sufficient farming household represents the fundamental production unit for pottery manufacture in the late pre-

Table 1. Costin's (1991) four parameters of specialized ceramic production and their identified archaeological measures (adapted from Mills and Crown 1995:5).

Parameters	Values	Archaeological Measures
Context (Degree of vertical control over production)	Independent, Attached	▪ Location of production tools, debris, or facilities vis-à-vis high-status residences or administrative structures
Concentration (Relative spatial organization of production)	Dispersed, Nucleated	▪ Relative spatial distribution of production tools, debris, or facilities ▪ Homogeneity or heterogeneity in assemblage composition (evenness)
Scale (Size of producing unit and principles of recruitment)	Individual, Household, Community	▪ Size of production facilities ▪ Degree of standardization in raw-material preparation and finished products[A]
Intensity (Amount produced per unit of time)	Part-Time, Full-Time	▪ Number of vessels produced (controlling for population size and duration of occupation) ▪ Range of economic activities represented ▪ Number of production steps used[B] ▪ Standardization in raw-material preparation and finished products ▪ Degree of skill

[A] Standardization may be a measurement of both the size of the producing unit (scale) and the amount produced by that unit during a given period of time (intensity).
[B] This measure probably has a more curvilinear relationship with intensity. Low intensity of production will result in few production steps, as well as many cases in which items are mass produced.

historic Southwest (Hagstrum 1995:284). According to Hegmon and others (1995:33), the household craft production strategy is characterized by three basic modes of production: “(1) unspecialized household production, in which each household makes pottery for its own use; (2) dispersed individual specialization, in which a few individuals or households make pottery for an entire community; and (3) community specialization, in which individual specialists, aggregated in a limited number of communities, produce pottery for regional distribution” (also see Hagstrum 1995:286). Specialization is defined here as “production above the needs of the household for purposes of exchange…The term implies a relatively small number of producers in relation to the number of consumers” (Hegmon et al. 1995:33, citing Spielmann 1988:1).

Costin’s (1991) typology identifies four general parameters that can be used to characterize the organization of specialized production: the context, concentration, scale, and intensity of production (Table 1). Her formulation can also be used to describe unspecialized household production (Hegmon et al. 1995:31). This approach emphasizes organizational variability by focusing on the multidimensional parameters of production, and stresses the economic principle that production is interrelated with distribution and consumption (Mills and Crown 1995:4).

Technological analyses, such as studies of vessel attributes and standardization, and distributional analyses of pottery and pottery production tools can provide information on Costin’s four parameters of production (Stark 1985). Compositional analyses, incorporating geological studies of temper and clay sources, are pivotal in identifying the general production sources of pottery. Such methods have been used extensively in Hohokam ceramic studies, and they form the primary basis for models of Hohokam ceramic production and exchange. Data from actual pottery production areas, however, are needed to provide a more complete interpretation of the organization of Hohokam ceramic production.

HOHOKAM CERAMIC PRODUCTION AND EXCHANGE IN THE PHOENIX BASIN DURING THE SEDENTARY AND CLASSIC PERIODS

The prevailing model of the organization of Hohokam ceramic production and exchange during the Sedentary and Classic periods in the Phoenix Basin, elaborated most recently by Abbott (e.g., 2000, 2001a, 2001b, 2003a; Abbott, ed. 1994) and his colleagues, is based largely on statistical and compositional analyses of ceramic assemblages from various Hohokam sites and on geological studies of temper sources (Table 2). In general, the Sedentary period is viewed as a time of sophisticated pottery economics and is characterized by remarkable rates of pottery production and exchange over large territories (Abbott 2001b:269, 2003b; Abbott et al. 2001). This mode of production was likely facilitated by periodic marketplaces associated with the ritual ballcourt network (Abbott et al. 2007; Doyel 1981; Haury 1976:78). Abbott (2003b:205) contends that households in the lower Salt River Valley and probably in the middle Gila River Valley “were each dependent on multiple and often distant producers for the full complement of their domestic pottery inventories.”

During the Sedentary period (ca. A.D. 950–1150), red-on-buff pottery was likely produced by specialists in villages in the middle Gila Valley and was widely distributed in large quantities throughout the Phoenix Basin (Abbott 1985, 2000; Abbott, ed. 1994). The concentration of buff ware production appears to have been highly nucleated, but it is unclear whether pottery was produced by a few specialists in highly centralized pottery workshops (Doyel 1980) or in several locations, including the Gila Butte site (Rafferty 1982; Walsh-Anduze 1993) and Maricopa Road site (Lascaux and Ravesloot 1993) (see Figure 1). The stylistic and technological uniformity of Sacaton Red-on-buff ceramics has led some researchers to suggest that it was standardized and produced at only one or very few production loci (Abbott 1983; Crown 1984; Doyel 1980).

Plain ware production appears to have been highly specialized and concentrated at a few villages during the Sedentary period (Abbott 2000, 2001b, 2003b; Abbott and Love 2001:153; Van Keuren et al. 1997). Plain ware pottery found at sites on the north side of the Salt River in Canal System 2 and on the Scottsdale Canal System was made at Las Colinas and at sites in the South Mountain area. Plain wares used in settlements on the south side of the Salt River in Canal System 1 were produced at places in the middle Gila River Valley, where an unknown number of villages was crafting these vessels. Unfortunately, the degree of concentration and specialization of plain ware pottery production in the middle Gila River Valley is still unclear.

Red ware pottery (e.g., Sacaton Red and Gila-Salt Red) occurs in small proportions during the Sedentary period (Abbott 1988:188–189, 2001a:98). Red ware pots probably were made in small quantities in both the lower Salt and middle Gila valleys (Abbott 2000, 2003a). The production organization of these wares is not well understood, though.

Significant changes occurred in the organization of ceramic production and exchange in the Classic period (ca. A.D. 1150–1450). Abbott (2000, 2001b) hypothesizes that, after the collapse of the ballcourt system near the end of the Sedentary period, the reliable sys-

Table 2. Location and organizational parameters of Hohokam ceramic production in the Phoenix Basin.

Pottery Ware	Parameter	Sedentary Period	Classic Period
Buff Ware	Location	Middle Gila Valley (Snaketown, Gila Butte?, Maricopa Road?)	Middle Gila Valley
	Context	Independent	Independent
	Concentration	Highly Nucleated	Less Nucleated or Dispersed
	Scale	Community	Community
	Intensity	Part-Time	Part-Time
Plain Ware	Locations	Las Colinas, South Mountain (Las Canopas), Middle Gila Valley, Others?	Multiple locations in Canal Systems 1 and 2, Scottsdale, Middle Gila Valley (Sweetwater)
	Context	Independent	Independent
	Concentration	Nucleated	Dispersed
	Scale	Community	Community, Household
	Intensity	Part-Time	Part-Time
Red Ware	Locations	Lower Salt and Middle Gila valleys	South Mountain, Scottsdale, Middle Gila Valley (Casa Blanca, Sweetwater), Others?
	Context	Independent	Independent
	Concentration	Dispersed?	Nucleated
	Scale	Household	Community, Household
	Intensity	Part-Time	Part-Time

tem for pottery production and exchange dissipated and pottery manufacturing was reorganized into a less specialized and more localized, self-sufficient mode. Production appears to have taken place at a smaller scale in multiple locales, and villages obtained their pottery from multiple sources (Abbott 2000; Abbott, ed. 1994; Abbott and Love 2001; Eiselt and Woodson 2002). Red-on-buff production declined abruptly, probably as a result of the collapse of the exchange system centered on ballcourts (Abbott 2000). Buff ware production may have been decentralized and the number of buff ware (i.e., Casa Grande Red-on-buff) production loci may have expanded during the early Classic period (Abbott 2001a:99).

A full range of plain ware pottery vessel forms was produced in most villages for local consumption during the Classic period (Abbott 2000:131; Haury 1976:191–192). Exchange patterns are variable, however. In Canal System 2, for example, plain wares were traded primarily within the system during the early Classic period but were traded more widely by the late Classic. Available provenance data for sites in Canal System 2 indicate an increase in pots imported from Canal System 1 through the Classic period (Abbott 2003a:156–157). A very different pattern is evident in the Scottsdale Canal System. Settlements in this canal system obtained some plain ware pots from the middle Gila River Valley and Queen Creek during the early Classic period, but primarily traded plain wares within the system in the late Classic period (Abbott 2003a:157).

Red ware pottery was also made locally at a number of production areas, but it was more widely exchanged than plain ware pots (Abbott 2003a:156). Community-based specialized production of red wares appears to have occurred in the South Mountain area and in the middle Gila River Valley (Abbott 2000:132; Abbott and Walsh-Anduze 1995). In general, most of the red ware pots found in the lower Salt Valley during the early Classic period were imported from production areas in the middle Gila Valley (Abbott 2000:123–129; Abbott and Walsh-Anduze 1995). Recent studies (e.g., Eiselt and Woodson 2002) suggest the Casa Blanca village was a primary producer of red ware pottery in the middle Gila Valley. The middle Gila–lower Salt exchange network, however, is not well documented. In contrast, most of the red ware in the Phoenix area in the late Classic period was derived from production areas on the eastern flanks of South Mountain (Abbott 2000; Abbott and Walsh-Anduze 1995). Residents in the Scottsdale System, as well as in the middle Gila Valley, manufactured their own red ware pottery during the late Classic period (Abbott 2003a:157–158).

DIRECT EVIDENCE OF HOHOKAM POTTERY PRODUCTION IN THE PHOENIX BASIN

Only seven sites in the Phoenix Basin have clear, direct evidence of pottery manufacturing: Snaketown, Maricopa Road, Gila Butte, Rattlesnake Hill, Sweetwater, Las Colinas, and Las Canopas (see Figure 1). The first five sites are located in the middle Gila River Valley; the last two are in the lower Salt River Valley.

Snaketown is a unique site that presents multiple and unambiguous lines of evidence for both pottery-making and pottery-firing facilities (Figure 2) (Haury 1976:194–197; Sullivan 1988). This Sedentary period workshop is situated in a space between five pit houses adjacent to Mound 40 on the south side of the plaza. The pottery production area encompasses five clay-mixing basins, seven firing pits or kilns, a pit with a puki, raw materials (including a lump of processed clay), and a few possible pottery tools. The firing pits ranged from 1 m to 3 m in diameter and from 15 cm to 30 cm deep. It is unlikely that any of these pits were used simultaneously. The pits were filled with ash, and six of them contained a high density of waster sherds (Wasters are fragments of misfired pots, which can be used to cover and protect unfinished pots during firing.). The waster sherds included both Gila Plain and Sacaton Red-on-buff.

Haury (1976:194–197) suggested the five houses could have been the residences of the potters, but no evidence from the houses supported this idea other than their proximity to the work area. Seymour and Schiffer (1987:588–590) found that other contemporary houses within 45 m of the production area contained relatively high frequencies of pottery-making tools and materials. The discovery of these tools indicates that numerous households were involved in pottery manufacture. Abbott and Love (2001:144) showed that a sample of the potter's clay from this workshop was buff-firing clay. The evidence provides strong support for the large-scale, specialized production of Sacaton Red-on-buff pots at Snaketown.

The Maricopa Road site, which is contemporaneous with Snaketown, contains a small locus with three clay-lined mixing basins (similar to those at Snaketown), raw materials (including clay lumps, mica schist and hematite), and a presumed potter's toolkit[1] (Figure 3) (Lascaux and Ravesloot 1993:43–45). The toolkit included an anvil, a mortar (with hematite), a polishing stone, two chipped-stone "scoops" (one with hematite on worked edge), three flake choppers, and other ground-stone artifacts that could have been used in pottery manufacture. An adjacent area with a possible thermal pit and dark ashy fill with numerous sherds may have been a pottery firing area. Project right-of-way restrictions prevented the full excavation of this area, but available evidence suggests that red-on-buff pottery was made at this locus in the Sedentary period. The apparently small size of the facility is indicative of a household level of production. However, based on the abundance of decorated pottery at the site (over 40 percent) and its proximity to Snaketown and Gila Butte, the site may have been involved in the large-scale, specialized production of buff wares.

The Gila Butte site is adjacent to Gila Butte, where 61 mica schist quarries, possible schist-crushing mortars, and associated firepits have been documented on the northeastern part of the butte (Rafferty 1982; Walsh-Anduze 1993). Gila Butte was a primary source for mica schist temper in buff ware pottery and probably for plain and red wares made in the middle Gila River Valley. The Gila Butte site likely controlled access to the quarries during the Colonial and Sedentary periods. Furthermore, Rafferty (1982) suggests that residents of the site produced buff ware pottery. He supports this proposition with several lines of evidence, including a high decorated ware percentage (60 percent); concentrations of mica schist (possible temper stockpiles) with ash, charcoal, and sherds; and three cremation burials that included "pottery-making tools" and chunks of mica schist. Although these data represent indirect evidence, the proximity of the schist temper quarries at Gila Butte lends support to the contention of on-site pottery manufacture.

Rattlesnake Hill, a small bedrock outcrop south of Gila Butte, is another mica schist source with eight possible prehistoric quarries at the base of the hill (Burton and Simon 2002; Eiselt and Woodson 2002; Walsh-Anduze 1993). Prehistoric ceramics around the hill primarily date to the Colonial and Sedentary periods (Eiselt et al. 2002). Also, thermal pits containing crushed and burned mica schist were reported at a site on the east side of the hill (Walsh-Anduze 1993, citing personal communication from Owen Lindauer). The mica schist present on Rattlesnake Hill is similar to the schist from Gila Butte in its suitability for use as ceramic temper (Burton and Simon 2002).[2]

Las Colinas, located in the lower Salt Valley, contains two large settling basins fed by canals situated near the western side of the site (Figure 4) (Abbott 1988; Nials and Fish 1988). The basins are separated from the main concentration of houses by a canal. During the Sedentary period, these basins appear to have been used specifically for supplying potters with high-quality, levigated clay. In conjunction with sherd

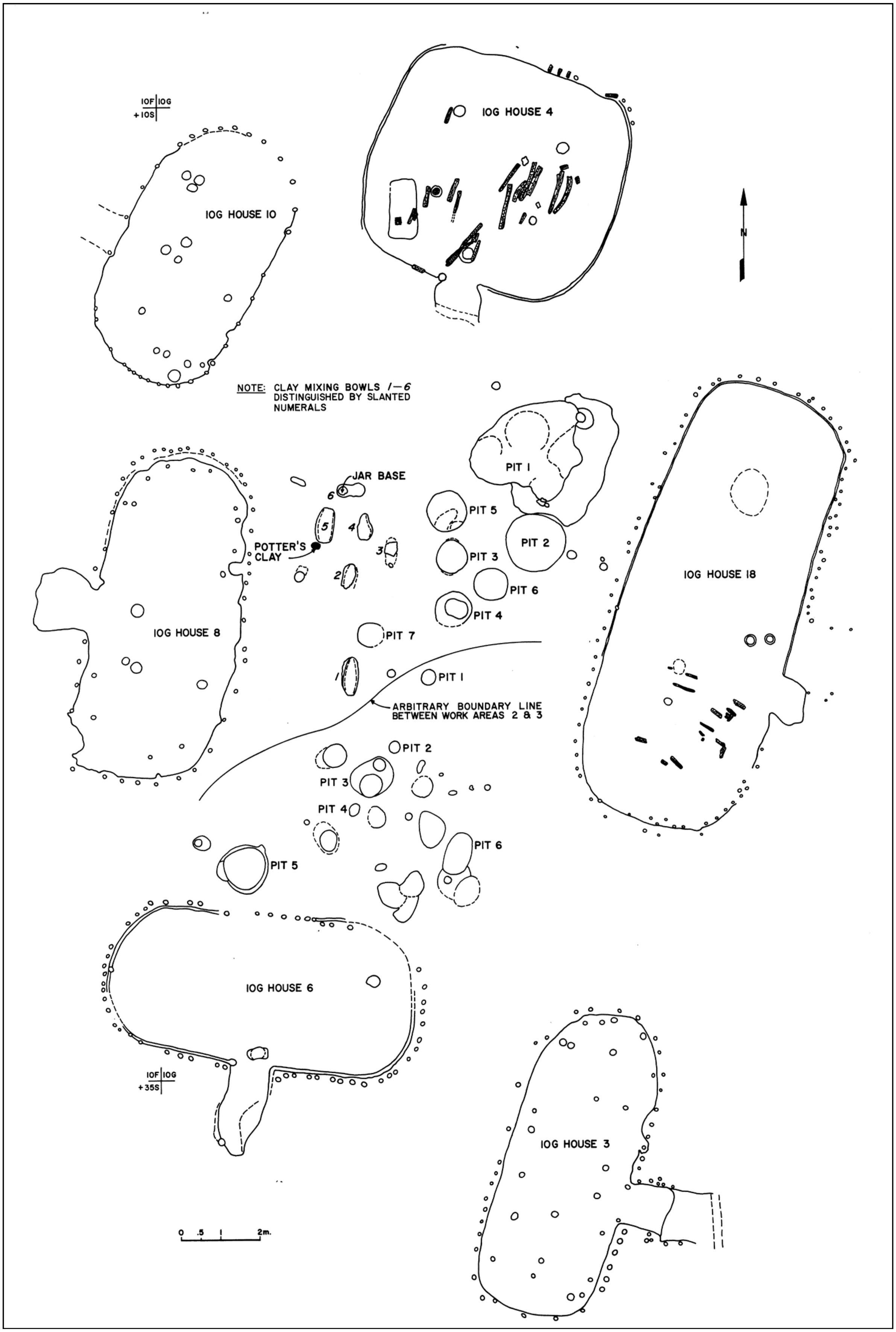


Figure 2. Map of the Snaketown pottery production area (adapted from Haury 1976:195).

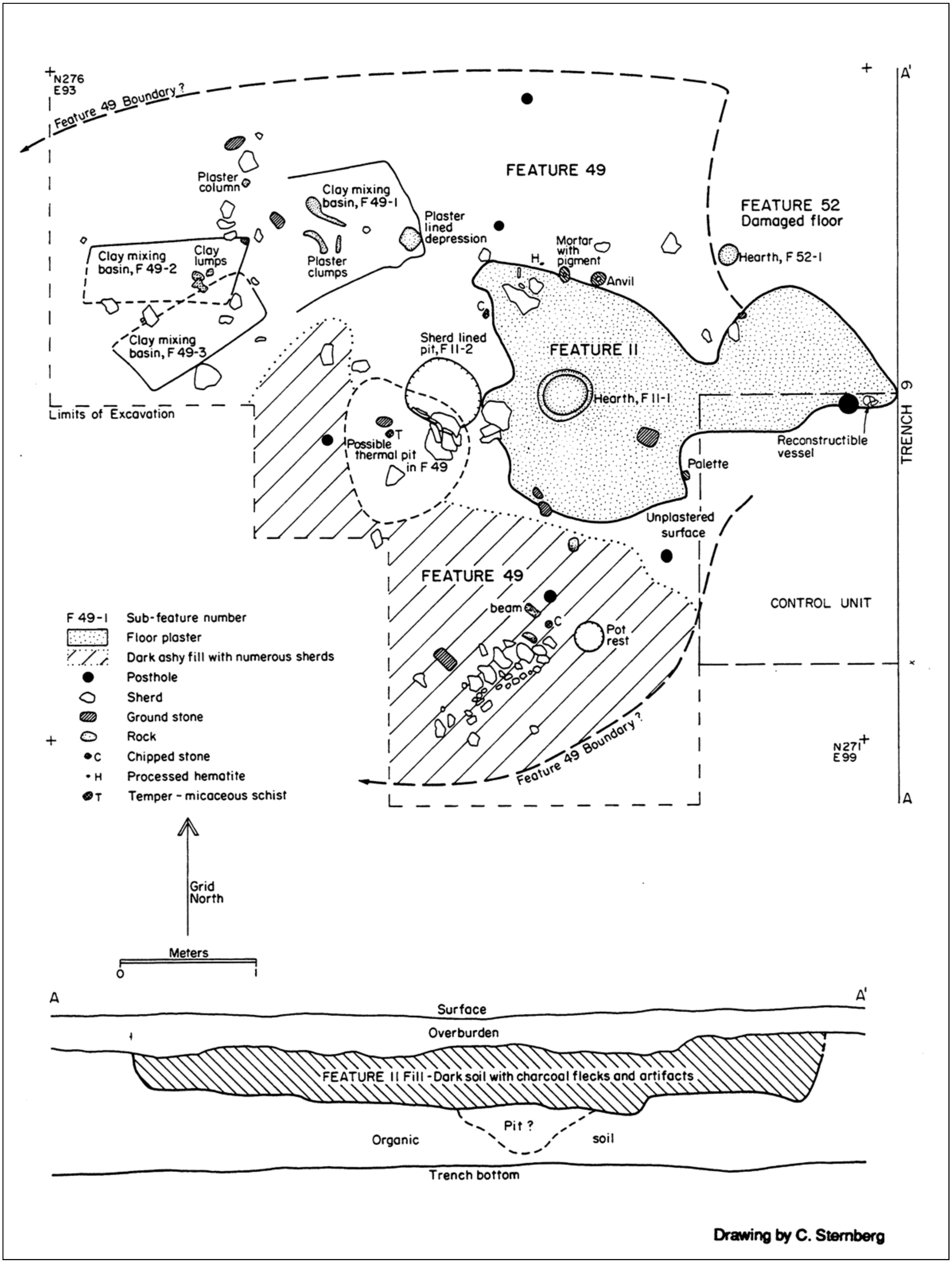


Figure 3. Map of the pottery production area (Feature 49) at the Maricopa Road site (adapted from Lascaux 1993:61).

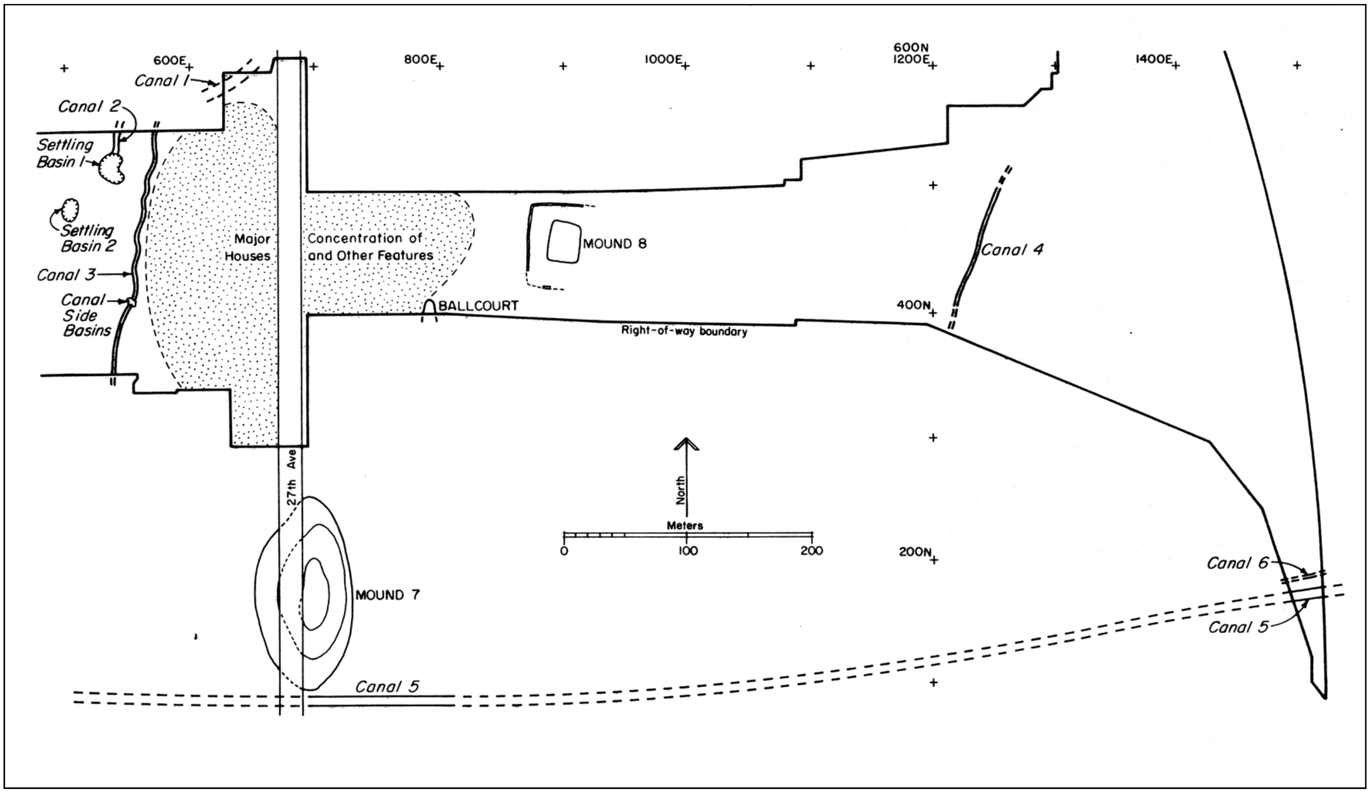


Figure 4. Map of the excavated portion of Las Colinas, with the settling basins in the western portion of the site area (adapted from Nials and Fish 1988:276).

temper provenance data, other evidence indicates that large-scale plain ware manufacture took place at the site (Van Keuren et al. 1997).

Most recently, a pottery kiln has been documented at Las Canopas along Canal System 7 in the lower Salt Valley (Rice et al. 2009; Figure 5). This unusual feature (Feature 1045) is a circular, 1.6 m deep straight-walled pit with an upper diameter of 4 m. It was filled with ash, but it contained no charcoal and only a few small sherds. In addition, the pit was surrounded by an oxidation ring up to 80 cm wide. The kiln was built at the edge of a borrow pit, and a horizontal shaft like "tunnel" linking the two pits served as a vent that allowed a natural updraft. An horno (Feature 687) was later excavated into the fill of this feature.

Rice et al. (2009) interpret Feature 1045 as a shaft furnace kiln used to produce large plain ware ollas (jars) during the Pre-Classic period. The large size of the kiln pit was likely designed to accommodate the big ollas. There is additional evidence that residents of Las Canopas produced pottery at the site in the vicinity of the kiln. Foremost, 92 percent of the ceramic manufacturing tools that were recovered from the site were found in the vicinity of the kiln. Moreover, the only three burials (out of 622 total burials) that contained pottery production tools and raw materials were clustered near the kiln. Las Canopas thus represents one of several settlements that produced these ollas near the eastern end of the South Mountains and distributed them to many other consumers across the valley (Van Keuren et al. 1997).

POTTERY PRODUCTION AT THE SWEETWATER SITE

The Sweetwater site in the middle Gila Valley contains the only known production facility for either plain or red ware pottery during the Classic period in the Phoenix Basin (Woodson 2002). The Sweetwater site is situated on the south side of the Gila River near its confluence with the Little Gila River, directly opposite Gila Butte. The pottery production area (designated Feature 50) occurs in a prehistoric agricultural field setting along the Casa Blanca canal system. Feature 50 consists of a hard-packed extramural activity surface with pottery-making and pottery-firing facilities, tools, and materials (Figure 6). The activity surface encompasses five secondary pit features, including two fire pits, two bell-shaped pits, and a clay-lined pit. Three rectangular to subrectangular thermal pits and a prehistoric canal adjacent to the feature are likely associated with the production area.

Numerous artifacts are clustered on the activity surface and in the feature fill between these eight pits. The ceramic assemblage includes 482 sherds and is

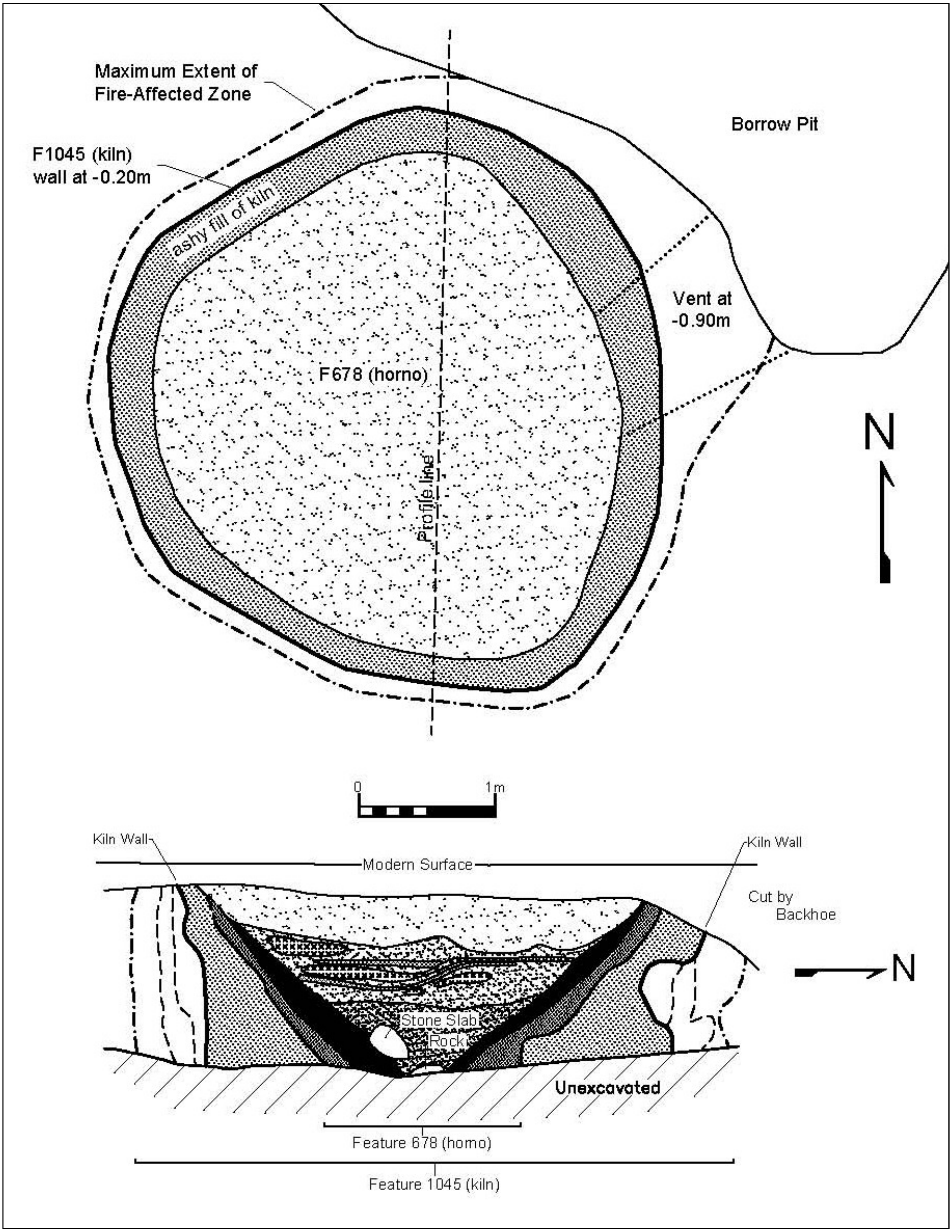


Figure 5. Plan and profile of shaft furnace kiln (Feature 1045) at Las Canopas (adapted from Rice et al. 2009:86, 88).

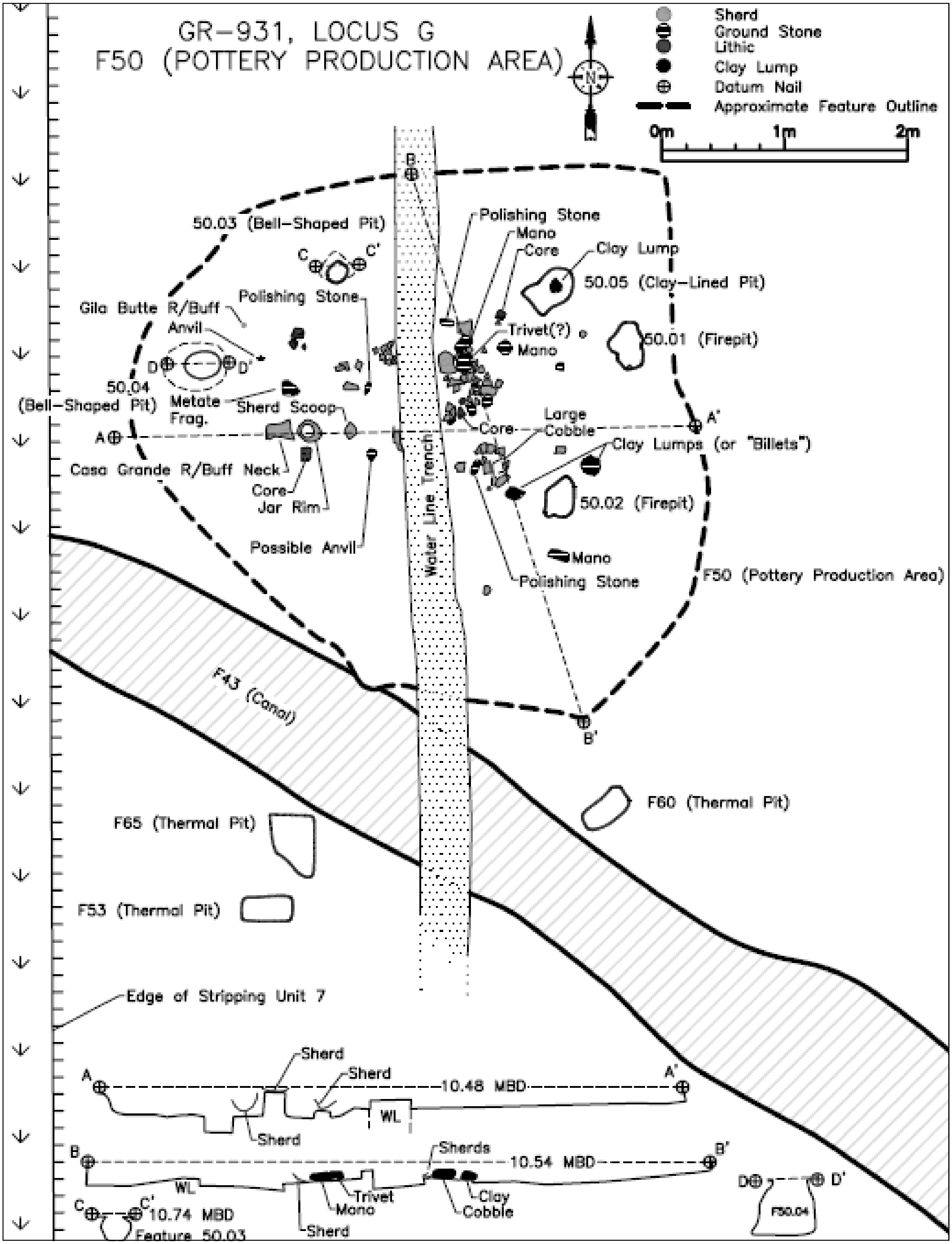


Figure 6. Map of the Sweetwater pottery production area (Feature 50) and adjacent features (adapted from Woodson 2002:84).

dominated by red wares (50.5 percent; n=244), followed by plain wares (36.5 percent; n=176), buff wares (12.4 percent; n=59), and other ceramic types (0.6 percent; n=3). Jars account for 50.8 percent (n=245) and bowls account for 15.6 percent (n=75) of the vessel forms in the assemblage; 33.6 percent (n=162) of the sherds could not be classified to a form. There are three large sherds within the sherd assemblage: a red ware jar body (shoulder) sherd, a Casa Grande Red-on-buff jar neck sherd, and the complete rim and neck of a red ware jar.

Binocular microscope analysis of temper indicates that sand (including coarse sand, fine sand, and sand of mixed grain sizes) accounts for 74 percent of the temper types in the assemblage, with mixed sand and coarse sand as the predominant types, respectively. These sand tempers are granitic with free pieces dominated by feldspar and quartz. Sherd/sand temper characterizes another 19 percent of the sherds, whereas crushed mica schist temper occurs in 7 percent of the assemblage (plain and buff wares only).

These temper descriptions were compared with the most recent middle Gila River Valley petrofacies model (Miksa 2001; Miksa and Castro-Reino 2001) and with a study of potential ceramic temper sources on the Gila River Indian Community (Burton and Simon 2002) to establish temper provenance. The Sweetwater site is located within the Gila River petrofacies, which is characterized by fluvial sands with "an abundance of well-rounded fine-sand particles comprising a highly diverse assemblage of rock and mineral types" (Burton and Simon 2002:4–5). This lithic-rich petrofacies has "a mixed composition with quartz, feldspars, and a wide variety of metamorphic and volcanic lithic grains" (Miksa and Castro-Reino 2001:16). The Sacaton Mountains petrofacies encompasses the pediments around the mountains and extends to a point roughly 3 km south of the Sweetwater site. This mineral-rich petrofacies is "characterized by abundant white granite along with quartz, plagioclase, and potassium feldspar derived from the granite," with biotite in the 2 to 10 percent range and minerals such as hornblende, magnetite, muscovite, epidote, chlorite, and sphene in less than 2 percent abundance (Miksa 2001:16). The sand temper in the sherds is consistent with the Sacaton Mountains petrofacies. The mica schist temper source is indeterminate, but the closest sources are Gila Butte, Rattlesnake Hill, and Sacaton Butte.

Eight clay samples were recovered. The samples include two partially fired lumps of clay with quartz and feldspar inclusions that likely represent temper. These lumps occurred on the activity surface near fire pit Feature 50.02 and appear to have been partially fired during the use of the fire pit. The other six clay samples comprise two clay deposits from the bell-shaped pits (Features 50.03 and 50.04), a clay lump from the clay-lined pit (Feature 50.05), and three unfired clay fragments.

Ground-stone artifacts found in Feature 50 include one mushroom-shaped anvil (vesicular basalt), one possible anvil (vesicular basalt), three polishing stones (two basalt, one quartzite), two manos (vesicular basalt), one pestle fragment (granite), one trough metate fragment (vesicular basalt), a bead fragment (argillite), and a pendant fragment (schist). The anvil is extensively shaped, and measures roughly 7 cm by 6 cm on its flat, oval face and 4 cm high along the perpendicular face. The possible anvil is less formally shaped, is partially burned, has a flat, squarish face measuring about 5.5 cm in diameter, and has an appendage roughly 7 cm long. Flaked-stone artifacts include 49 flakes, six shatter pieces, eight core/hammerstones, one hammerstone, and a retouched flake. Six unworked rocks were also collected. These pieces of raw material include two pieces of mica schist, a chrysocolla piece, and three quartzite rocks (roughly 15 cm to 20 cm in diameter).

Relative and chronometric dates provide information on the age of Feature 50. The 4:1 ratio (244/59) of red wares to buff wares indicates a Classic period age. This relative date is based on the recognition that red ware production increased and buff ware production decreased during the late Sedentary and Classic periods; hence, higher percentages of red wares should indicate a later age (Abbott 1985, 2000:56; Crown 1981). Fifteen decorated sherds were typed. They include Sacaton Red-on-buff (n=5), Casa Grande Red-on-buff (n=5), and single specimens of Gila Butte Red-on-buff, Santa Cruz Red-on-buff, Mimbres Black-on-white (Style II or III), Gila Polychrome, and historic red-on-brown. The historic red-on-brown sherd is an outlier and probably was introduced into the fill at a later date. The low frequencies of prehistoric painted ceramic types, in tandem with the wide temporal range (A.D. 750–1450), suggests that these sherds were in secondary contexts and were either purposefully brought from other locations or inadvertently mixed into the feature assemblage. As such, the latest pottery types—Casa Grande Red-on-buff and Gila Polychrome—probably are the best indicators for a relative feature age. The presence of these sherds places the date of the feature in the Classic period (ca. 1150–1450).

In addition, three chronometric dates were obtained. Two dates were attained from two charred mesquite seeds found in Feature 50.02 (firepit) and in Feature 50.03 (bell-shaped pit) (Table 3). The 2-sigma range for the chronometric sample taken from the fire pit is A.D. 1210–1390, with the highest probability interval at A.D. 1210–1320. The 2-sigma range for sample taken from the bell-shaped pit is A.D. 1480–1960, with the highest probability interval at A.D. 1480–1690. A third chronometric date was attained from a plain ware sherd recovered from the central artifact cluster in Feature 50. This potential "waster" sherd (see below) was submitted for thermoluminescence (TL) dating. The TL sample (UW734) produced a calendar age of A.D. 1563 ± 34, which was corrected (due to anomalous fading) to A.D. 1456 ± 53 (A.D. 1403–1509). The TL sample had high radioactivity and lacked a good plateau, two pieces of data that suggest the sherd could be older than the TL date that was returned. The chronometric dates from Feature 50 correspond well with the relative age as estimated above, and they bolster the claim that the feature was used in the Classic period. However, the AMS age range for the bell-shaped pit and the TL sample suggest the feature use-life possibly extended into the sixteenth and seventeenth centuries. Although this is tentative evidence for use of the feature, it accords with findings of other researchers who suggest the Hohokam Classic period may endure into the mid-1500s in parts of southern Arizona (e.g., Dean 1991; Marmaduke and Henderson 1995).

Interpretation

The evidence gathered from Feature 50 and from adjacent features indicates that all stages of pottery manufacture and firing occurred in this discrete, open-aired activity area. Foremost, the caching of raw materials is represented by the clay deposits in the two bell-shaped pits. This clay had been minimally processed after being dug out of the ground and placed in the pits for future use. Such practice of storing clay to age or sour, sometimes in pits, has been documented in the ethnographic literature (Fontana et al. 1962:57; Rice 1987:115, 119).

Pottery clay preparation is represented by a clay-lined pit (Feature 50.05) with a clay lump that was used to mix clay, and also by the three pits (Features 53, 60, and 65) that may have been used as clay-mixing basins. The latter three pits resemble the clay-mixing basins in the pottery production area at Snaketown (Haury 1976:194–197). However, they also resemble rectangular thermal pits used for cooking or baking mesquite beans at sites such as Los Rectángulos (Hackbarth 1993:180–183) and Pueblo Grande (Mitchell 1994). The two partially fired lumps of clay with coarse sand inclusions (possibly temper) were prepared and shaped into loafs, or "billets," and were likely intended for use as pottery clay. However, they appear to have been partially fired during the use of the firepit; they may have been used as trivets during a firing episode. The canal (Feature 43) could have provided the potters with a source of water and possibly clay.

To test whether the clays from these various caching and preparation contexts were used for manufacturing pottery, seven clay samples and 35 sherds from Feature 50 were subjected to instrumental neutron activation analysis (INAA).[3] Unfortunately, the results were inconclusive. It remains uncertain if the clays were used to produce the vessels represented by these sherds.

Many of the artifacts in Feature 50 are consistent with an assemblage associated with pottery-making activities. For example, several ground- and flaked-stone artifacts closely resemble the items in a hypothetical potter's tool kit that was identified in the pottery manufacturing facility at the Maricopa Road site (Lascaux and Ravesloot 1993:44). In particular, the anvils and polishing stones are artifact types that are directly related to pottery manufacture. The shape and the smoothness of the pestle fragment and one unworked rock are such that they could have been used as anvils. Three large ceramic vessel pieces, although unworked, could have been used as scoops, containers, or vessel supports. Finally, the ash in firepit Feature 50.01 may have been used to prevent clay from sticking to pottery-making tools and surfaces and to the potter's hands. This use of ash is a production technique that has been documented in ethnographic contexts (e.g., Fontana et al. 1962; Rice 1987:141–142).

Pottery firing is indicated by the presence of two firepits (Features 50.01 and 50.02) exhibiting heavy oxidation. In addition, Feature 50.02 preserved charcoal from probable fuelwoods (mesquite and cottonwood/willow). Possible trivets or supports for pots during firing are represented by several large, unmodified rocks and by the two partially fired lumps of clay near Feature 50.02. Most of the sherds in the central cluster of artifacts (65 red ware sherds, 39 plain ware sherds, and one Gila Polychrome sherd) have characteristics that are consistent with misfired or underfired ceramics (see Rice 1987:334). These 105 sherds, which represent 22 percent of the Feature 50 ceramic assemblage, are extremely friable and contain a gray core that extends partially or completely through the ceramic paste. The large sherd sizes, the sherd conditions that are typical of misfired or underfired clays, and the proximity of the sherd cluster to the two firepits suggest that they are the remains of vessels that were broken during the firing process. These "waster" sherds also may have been used to support or control the firing of other vessels. The Gila Polychrome sherd, however, may have been trash, because most Salado Polychromes are thought to have been produced outside the Phoenix Basin (Abbott 2000:131; Abbott and Schaller 1992).

If these misfired or underfired sherds represent waster sherds, then the dominant pottery types and

Table 3. Sweetwater site AMS radiocarbon dates.

Sample No. (AA)	Feature No.	Material	$^{13}C/^{12}C$	Radiocarbon Age (B.P.)	cal A.D. (1s) [probability]	cal A.D. (2s) [probability]
47236	50.02 (Firepit)	*Prosopis* seed	-20.6	713 ± 45	1250–1300 [57.7%] 1360-1390 [10.5%]	1210–1320 [76.7%] 1350–1390 [18.7%]
47237	50.03 (bell-shaped pit)	*Prosopis* seed	-23.6	255 ± 47	1520–1590 [22.2%] 1620–1680 [30.2%] 1770–1800 [11.9%] 1940–1960 [3.9%]	1480–1690 [69.2%] 1730–1810 [20.2%] 1920–1960 [6.0%]

Note: Calibrations made with OxCal v3.10 (2005)

vessel forms in this group may represent the pottery that was made in Feature 50. Excluding the Gila Polychrome sherd, the cluster includes 65 red ware sherds and 39 plain ware sherds (Table 4). The plain ware sherds are predominantly from jars but do not include rim sherds. The five incurved rims are from plain ware bowls. The plain ware sherds were finished predominantly by polishing and hand wiping, although eight sherds (seven from jars) are smudged. The red ware sherds are evenly distributed between bowls and jars. The six incurved rims and 11 outcurved rims are from red ware bowls. Most of the red ware sherds are smudged (23 jar shrerds and 17 bowl sherds) or polished. The sand temper in the 104 plain and red ware waster sherds is consistent with the Sacaton Mountains petrofacies (Miksa 2001; Miksa and Castro-Reino 2001; cf. Burton and Simon 2002). Thus, it may be inferred that both red and plain ware jars and bowls were manufactured in the Sweetwater pottery production area using locally available temper. The term "local" is used in a behavioral sense, following Arnold's (1985) ethnographic model that suggests that potters will use local resources for temper. That is, potters typically will travel less than 1 km and up to a maximum of 3 km to collect materials (Miksa and Heidke 1995:133–134).

Organization of Production

The organization of production in the Sweetwater pottery production area can be evaluated with the collected data. The production area is situated outside a village or permanent habitation area in an agricultural field setting. This setting may have been chosen for several reasons: to have readily available fuel (either from a nearby agricultural field or stand of trees) and water (in the canal), to conduct firing safely in an area that would not endanger houses, and/or to conduct multiple tasks (e.g., pottery production, tending crops and canals, processing plants) in one locale. Additional activities beyond clay mixing, such as baking or open-fire cooking, could have created Features 53, 60, and 65.

The scale and intensity of production are difficult to measure for this facility (see Costin 1991:30–32; Rice 1987:180–181). The small size of the facility, the few production features, its location away from a habitation area, and the low density of debris suggest it was used by a single household on a part-time (and probably short-term) basis. The number of pots made was likely small. Unfortunately, it is difficult to estimate output (see Wallace and Heidke 1986) due to unknown factors such as the number of potters using the facility, the frequency of pottery manufacture, as well as what percentage of the plain and red ware assemblages at the site were produced in the facility. Also, there is no simple correlation between density of debris and intensity and scale (Costin 1991:31). The output probably was sufficient to supply one and possibly a few families. Note that the latter case would constitute specialization. Thus, the organization of production can be characterized as either unspecialized household production or dispersed individual specialization. That is, utilitarian red and plain ware ceramics were produced independently on a part-time basis at the household level for consumption by the potter household and perhaps other households in the community.

EVALUATION OF THE MODEL OF CERAMIC PRODUCTION AND EXCHANGE

Adding the Sweetwater pottery production area to the list of six other pottery production locales provides an opportunity to evaluate the model of Hohokam ceramic production and exchange outlined above. Available evidence from several sites matches the expectations of the model, while evidence from other sites does not match the expectations well. Overall, the collective discrepancies between the observed data and the predicted expectations indicate that Hohokam pottery production encompassed greater than expected organizational variability.

Direct evidence for pottery production fits the model's expectations in three cases (Snaketown, Las Colinas, and Las Canopas) and partially fits in a third case (Sweetwater). The evidence from Snaketown (buff wares), Las Colinas, and Las Canopas (plain wares) accords well with expectations for specialized production at the community level during the Sedentary period. The Sweetwater production area, where red and plain ware pottery was made in a mode of either unspecialized household production or dispersed household specialization during the Classic period, contrasts with the Sedentary period cases. For plain wares, though, the Sweetwater setting and its mode of production accord well with expectations for localized, small-scale production during the Classic period.

The direct evidence departs from the model in two cases (Gila Butte, Maricopa Road) and partially differs in one case (Sweetwater). Although some evidence from the Gila Butte site suggests that potters produced buff wares on a large scale at the site (Rafferty 1982), direct evidence supports an inference of specialization only in one stage of pottery production—the procurement (and probable processing) of mica schist temper. Similarly, indirect evidence suggests the Maricopa Road site may have been involved in the large-scale, specialized production of buff wares (Lascaux and Ravesloot 1993:44–45). Yet the exposed portion of this production area is small and appears to represent specialized production at the household level. Further excavation in the vicinity (which was restricted by the project right-of-way) may have revealed other production facilities that would indicate a large production scale. For the Classic period, the household level of red ware production at Sweetwater departs from the prediction of a nucleated concentration of specialists at a few villages.

As a final observation, the number of sites with direct evidence of pottery manufacture is extremely low despite the impressive number of excavations and surveys that have been conducted in the Hohokam region. Two explanations that could account for this paucity are the low visibility of production features and inadequate site sampling (see Rice et al. 2009; Wallace and Heidke 1986:234–235). Several factors complicate the identification of facilities like mixing basins and firing pits: 1) many features are small, informal, and have a limited distribution within a producer site; 2) different stages of production may have occurred in separate locales so facilities will not necessarily be found together; and 3) different pottery wares may have been made in the same production locus at some sites, such that the total number of loci are low. On the other hand, given the numerous excavations that have been conducted at habitation sites, the dearth of discoveries lends support to the idea that few ceramic production centers existed in the Phoenix Basin. Hence, although most field studies are conducted where production features tend to occur (within or near Hohokam habitation sites), the people who lived at sites that have been sampled may not have produced ceramics. This is supported by indirect evidence for ceramic production and exchange (reviewed above), most of which suggests that pottery was made at a limited number of sites in the Phoenix Basin.

DISCUSSION

This examination of pottery production facilities and features in the Phoenix Basin has significant implications for concepts of Hohokam economy and social organization. First, certain inferences about the organization of ceramic production (i.e., context, concentration, scale, and intensity) are strengthened by

Table 4. Characteristics of probable waster sherds in the Sweetwater pottery production area.

Ware	Vessel Form			Vessel Part		Rim Style[A]		Surface Treatment				Temper Type		
	Bowl	Jar	Indet	Body	Rim	In-curved	Out-curved	Buff Slip	Hand Wiped	Polished	Smudged	Coarse Sand	Sand	Sherd/ Sand
Plain (n=39)	7	18	14	33	6	5	0	4	14	13	8	5	21	13
Red (n=65)	28	27	10	46	19	6	11	0	0	18	47	1	20	44
Total (n=104)	35	45	24	79	25	11	11	4	14	31	55	6	41	57

[A] All 22 rim sherds are from bowls.

the data. For example, the production context of Hohokam pottery may be characterized as independent, because the manufactured items are utilitarian, their distribution is not restricted to an elite sphere, and the production facilities generally are associated with domestic rather than elite architecture (Costin 1991:11, 25). Additionally, access to production facilities is not restricted. Access restriction is expected in cases where attached specialists are producing most of the crafts (Costin 1991:25). Open access is congruent with the lack of evidence for elite control of craft specialists in the prehistoric Southwest, where economic specialization tends to be limited in comparison to more sociopolitically complex societies (Hagstrum 1995:283; Hegmon et al. 1995:31–32).

The primary scale of ceramic production appears to be the household, the key production unit for most craft manufacture across the prehistoric Southwest (Hagstrum 1995:284; also see other chapters in Mills and Crown 1995). A household scale is indicated by the relatively small size of the production facilities, their location within or adjacent to domestic space, and the generally loose structure of the work areas (Costin 1991:29–30). The Gila Butte and Sweetwater cases depart slightly from these specifications because they are not situated adjacent to domestic space. The Sweetwater production area represents household production, but the size of the unit which procured and processed the temper at Gila Butte is difficult to discern. Also, multiple households clearly utilized the Snaketown work area, which may be characterized as a workshop (Seymour and Schiffer 1987). Many households also likely used the Las Canopas kiln. In the latter two cases, the firing stage was organized at a larger scale than the vessel forming stage (see Bernardini 2000). However, the autonomous work groups were households whose collective craft activities functioned as community specialization.

For comparative purposes, a similar scale of production has been inferred for the West Branch site in the Tucson Basin, one of the only other sites in the Hohokam region with direct evidence for pottery production (Dart and Swartz 1996; Harry 2000; Huntington 1986; Swartz 2005). This site contains abundant pottery production tools (e.g., polishing stones, anvils) and raw materials (e.g., processed clays, hematite for pigment, raw temper) in most of the excavated households with preserved floor assemblages. The distributions of these tools and materials suggest that production took place in distinct stages and that it was a seasonal activity probably conducted in the summer growing season. Data from petrographic research and the chemical analysis of ceramic pastes from sites in the Tucson Basin indicate that a large percentage of red, red-on-brown, and polychrome ware ceramics were made with sands obtained near the West Branch site (Harry 2000; Heidke 1996; Heidke et al. 2002; Lombard 1987). In conjunction, these data lend strong support to the argument for community-based, specialized ceramic production at the West Branch site.

Hohokam artisans probably manufactured pottery on a part-time (i.e., low intensity), seasonal basis. The evidence suggests that potters employed a generalized economic strategy in which they minimized risk by also conducting subsistence activities, employed few technological innovations to maximize efficiency (although see below), and scheduled production during periods of low agricultural demands (see Costin 1991:16–17, 32). Based on archaeobotanical evidence, production activities at the Sweetwater site appear to have occurred during the late spring or summer (Woodson 2002), and they seem to have occurred at Las Colinas in the summer as well (Nials and Fish 1988:302–303). Pottery production at the West Branch probably also occurred in the summer. As further support that pottery production occurred in the summer season, Huntington (1986) cites Fontana et al. (1962:20) who report that the Papago preferred the warm weather of southern Arizona for pottery production activities. A seasonal production schedule is possible for most Hohokam pottery manufacture. Given the large amount of pottery needed year-round by numerous and widespread consumers, however, it cannot be assumed that all Hohokam ceramic production was confined to the late spring or summer.

A few cases suggest that Hohokam potters, especially buff ware potters, may have intensified production by improving efficiency. This was achieved by dividing distinct stages of specialized production into tasks that may have been carried out by different individuals or groups. Some of these stages were conducted in spatially discrete areas. At Snaketown, separate production stages may have been accomplished by different households cooperating in the overall manufacturing process (Seymour and Schiffer 1987). In addition, the clay preparation and pottery firing facilities were centralized in the workshop area. A possible trail between Gila Butte and Snaketown may have been used partly to transport schist from the quarries to Snaketown for use as temper (Motsinger 1998). This suggests that the Gila Butte site may have specialized in the procurement and transport of schist temper. The distribution of pottery tools at the West Branch site also suggests that production took place in stages, although these tasks may have been conducted by the same household. Such routinization of tasks, along with the concentration of specialists in a few sites near preferred raw material sources, enabled the mass production of pottery in these areas (Costin 1991:16). In each of these cases, any gains in efficiency do not appear to have resulted in an increase in the overall intensity of production (i.e., to full-time) or in the size of the production unit (i.e., to a supra-household or community level).

Second, the data on production facilities and the organization of production have important implications for the distribution system. For instance, the assertion that pottery was distributed on a massive scale in the Sedentary period (e.g., Abbott 2001b) is supported by the evidence of community specialization in the mass production of plain wares (Las Colinas, Las Canopas) and buff wares (Snaketown, Gila Butte, and possibly Maricopa Road) in the Phoenix Basin. In addition, data from Snaketown, Gila Butte, and Maricopa Road support the contention that buff ware specialists were concentrated in a small part of the middle Gila River Valley (Abbott 2000, 2001b:266; Abbott, ed. 1994; Doyel 1980). The proximity of all suspected buff ware producers on the north side of the middle Gila River may be analogous to the situation in the Tucson Basin, where most of the Middle Rincon Red-on-brown pottery was made in neighboring villages (West Branch, Julian Wash, and Valencia) associated with the Beehive Petrofacies (Heidke 1996; Heidke et al. 2002; Wallace 2006). The evidence for community specialists suggests that the pattern of specialized production and long-distance exchange was widespread during the Sedentary period. By extension, the data also indicate that there was a large demand for mass-produced pottery and that an effective exchange system existed to distribute the goods (Costin 1991:13–14). Exchange could have been facilitated by periodic marketplaces associated with the ritual ballcourt network (Abbott 2001b:269, 2003b; Abbott et al. 2001, 2007; Doyel 1981; Haury 1976:78). This inference also is supported by the co-occurrence of the collapse of the ballcourt network at the end of the Sedentary period with the reorganization of ceramic production into a less specialized and more localized, self-sufficient mode (Abbott 2000, 2001b:270).

Finally, in four cases (Snaketown, Maricopa Road, Las Colinas, and Las Canopas), pottery production areas and features (including firing facilities) are located within or adjacent to residential areas in villages. The Gila Butte temper procurement and processing areas are situated within 0.5 km of a village. Each of these sites appears to have been involved in specialized production at the community level. The overriding concern for mass production may have dictated that production stages, and probably raw materials, should occur as close as possible to the specialists. This conforms to the contention that potters will use local resources (Miksa and Heidke 1995:133-134; also see Arnold 1985). In behavioral terms, this idea posits that potters typically will travel less than 1 km and as far as a maximum of 3 km to collect materials. In contrast, the Sweetwater production area, representing dispersed production at the household level, occurs in an agricultural field away from a habitation area. This suggests that small-scale household production was expedient and that the decision about when and where to make pottery was based on whether other tasks (especially subsistence) could be conducted at the same time and whether fuel and water (and possibly raw materials) were readily available.

CONCLUSIONS

This paper has argued that only seven Hohokam sites in the Phoenix Basin, including a recently documented locus at the Sweetwater site, exhibit direct evidence of pottery production. Data from these production areas represent an important, separate line of evidence for evaluating models of production that are based on indirect evidence. The small-scale, expedient production inferred for the Sweetwater production area in the Classic period contrasts significantly with the large-scale production indicated at other sites for the Sedentary period. Overall, the direct evidence indicates that Hohokam pottery production encompassed greater than expected organizational variability. Yet the continuing dearth of evidence for production areas and features suggests that relatively few ceramic production centers existed in the Phoenix Basin. Our understanding of the sophisticated structure of Hohokam economy will certainly be improved with the discovery of more production areas and features.

Notes

1. David Abbott (personal communication, 2002) analyzed some clay samples from the Maricopa Road site; however he found that the samples did not contain enough clay to form into tiles for chemical assay. Consequently, he doubts that they were examples of potter's clay.

2. Pima Butte represents another mica schist source in the middle Gila River Valley that has been identified as a probable source of temper for some sherds from the Grewe site (Miksa 2001). However, the butte lacks strong evidence of quarries (Walsh-Anduze 1993) and is not included here as a site with clear, direct evidence of pottery-making activities.

3. The clay samples submitted for INAA include the three specimens from the pits, the two billets, and two samples from prehistoric canals in the vicinity of Feature 50. The 35 sherds comprise two groups, including a set of 25 sherds that appear to have been made with similar clay and temper as the clay billets, and 10 sherds that seem to have been made from different materials. Statistical analyses of the compositional data suggest that some sherds may have been produced in Feature 50, but the analyses do not completely support the inferred division of sherds into locally and non-locally made groups in relation to the

clay samples (Fertelmes 2011). Cluster and discriminant analyses identified about a dozen sherds with compositions that are similar to the billets. However, these sherds include specimens from both macroscopically defined groups (i.e., some thought to be made with the same materials as the billets and some that were thought to be different). Statistical analyses grouped the raw clays from the production area pits and the canals into one group and the clay billets into another group. This indicates that statistically significant differences may be attributed to compositional differences between samples with only clay and those with clay and temper. This patterning helps to explain the incompatibility between the macroscopic and chemical classification of the ceramic sherds. Thus, those samples with an increased proportion of clay in the assayed part of the sherd would be grouped with the raw clay samples, while those samples with a hearty mix of clay and temper would be classified with the billet samples. Both explanations are likely correct. A handful of the sherds probably have the same composition as the clay billets and represent locally produced ceramics. Conversely, some of the analyzed sherds were possibly produced at the site but cannot be matched to the clay samples due to an abundance of clay or temper in the assayed sample. Therefore, determination of sherd provenance for the analyzed samples is presently imprudent.

Acknowledgements. An early version of this paper was presented at the Statewide Historic Preservation Conference "A Sense of Place," held in Chandler, Arizona on June 2003. Work at the Sweetwater site was conducted by the Gila River Indian Community Cultural Resource Management Program under contract to the Arizona Department of Transportation in advance of a road improvement project along State Route 587 on the Gila River Indian Community. I extend thanks to the analysts and consultants who provided their expertise to the project: Linda Newman (ceramics), Chris Loendorf (lithics, ground stone), Karen Adams (archaeobotanical remains), Tiffany Clark (faunal), James Feathers (thermoluminescence dating), and Susan Smith (pollen). The AMS samples were processed by the NSF Arizona AMS Facility at the University of Arizona, Department of Physics. The INAA data was collected by Ronald Bishop at the National Institute of Standards and Technology (NIST) Center for Neutron Research laboratory, Washington, D.C. Craig Fertelmes (GRIC-CRMP) analyzed the INAA data and provided the interpretation summarized herein. John Ravesloot, Owen Lindauer, Mary-Ellen Walsh, Doug Mitchell, Kathy Henderson, and David Abbott provided useful comments on a version of the pottery production area report. I also thank David Abbott and an anonymous reviewer for their comments on a earlier manuscript. Thanks to Lynn Simon for drafting the figures. The author assumes responsibility for any omissions or misuse of ideas.

REFERENCES CITED

Abbott, David R.

1983 A Technological Assessment of Ceramic Variation in the Salt-Gila Aqueduct Area: Toward a Comprehensive Documentation of Hohokam Ceramics. In *Hohokam Archaeology Along the Salt-Gila Aqueduct, Central Arizona Project, Volume VIII: Material Culture*, edited by L. S. Teague and P. L. Crown, pp. 3–118 Archaeological Series No. 150. Arizona State Museum, University of Arizona, Tucson.

1985 Spheres of Intra-Cultural Exchange and the Ceramics of the Salt-Gila Aqueduct Project. In *Proceedings of the 1983 Hohokam Symposium, Part II,* edited by A. E. Dittert and D. E. Dove, pp. 419–438. Occasional Paper No. 2. Arizona Archaeological Society, Phoenix.

1988 Form, Function, Technology, and Style in Hohokam Ceramics. In *The 1982–1984 Excavations at Las Colinas: Material Culture*, edited by D. R. Abbott, K. E. Beckwith, P. L. Crown, T. R. Euler, D. A. Gregory, J. R. London, M. B. Saul, L. A. Schwalbe, and M. Bernard-Shaw, pp. 73–198. Archaeological Series No. 162(4). Arizona State Museum, University of Arizona, Tucson.

2000 *Ceramics and Community Organization Among the Hohokam*. The University of Arizona Press, Tucson.

2001a Detailed Sherd Analysis. In *The Grewe Archaeological Research Project, Volume 2: Material Culture, Part 1: Ceramic Studies*, edited by D. R. Abbott, pp. 67–106. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff and Tempe.

2001b Conclusions for the GARP Ceramic Analyses. In *The Grewe Archaeological Research Project, Volume 2: Material Culture, Part 1: Ceramic Studies*, edited by D. R. Abbott, pp. 263–272. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff and Tempe.

2003a Ceramics, Communities, and Irrigation Management. In *Centuries of Decline During the Hohokam Classic Period at Pueblo Grande*, edited by D. R. Abbott, pp. 148–165. The University of Arizona Press, Tucson.

2003b The Politics of Decline in Canal System 2. In *Centuries of Decline During the Hohokam Classic Period at Pueblo Grande*, edited by D. R. Abbott, pp. 201–227. The University of Arizona Press, Tucson.

Abbott, David R. (editor)

1994 *The Pueblo Grande Project, Vol. 3: Ceramics and the Production and Exchange of Pottery in the Central Phoenix Basin, Part I*. Publications in Archaeology No. 20. Soil Systems, Inc., Phoenix.

Abbott, David R., and Tina K. Love

2001 Specialized Studies and Observations on Pottery Production. In *The Grewe Archaeological Research Project, Volume 2: Material Culture, Part 1: Ceramic Studies*, edited by D. R. Abbott, pp. 141–153. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff and Tempe.

Abbott, David R., and David M. Schaller

1992 Exploring the Production and Social Significance of

Salado Polychrome at Central Phoenix Basin Hohokam Sites. In *Proceedings of the Second Salado Conference, Globe, Arizona*, edited by R. C. Lange and S. Germick, pp. 248–258. Occasional Paper. Arizona Archaeological Society, Phoenix.

Abbott, David R., and Mary-Ellen Walsh-Anduze
1995 Temporal Patterns Without Temporal Variation: The Paradox of Hohokam Red Ware Ceramics. In *Ceramic Production in the American Southwest*, edited by B. J. Mills and P. L. Crown, pp. 88–114. University of Arizona Press, Tucson.

Abbott, David R., Alexa M. Smith, and Emiliano Gallaga
2007 Ballcourts and Ceramics: The Case for Hohokam Marketplaces in the Arizona Desert. *American Antiquity* 72:461–484.

Abbott, David R., Susan L. Stinson, and Scott Van Keuren
2001 The Economic Implications of Hohokam Buff Ware Exchange During the Early Sedentary Period. *Kiva* 67:7–29.

Arnold, Dean E.
1985 *Ceramic Theory and Cultural Process*. Cambridge University Press, Cambridge.

Bernardini, Wesley
2000 Kiln Firing Groups: Inter-Household Economic Collaboration and Social Organization in the Northern American Southwest. *American Antiquity* 65(2):365–377.

Bey, George J., III, and Christine A. Pool (editors)
1994 *Ceramic Production and Distribution, An Integrated Approach*. Westview Press, Boulder, CO.

Burton, James H., and Arleyn W. Simon
2002 Geologic Reconnaissance of Potential Ceramic Temper Sources on Lands of the Gila River Indian Community. Ms. on file, Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

Cordell, Linda S.
1991 Anna O. Shepard and Southwestern Archaeology: Ignoring a Cautious Heretic. In *The Ceramic Legacy of Anna O. Shepard*, edited by R. L. Bishop and F. W. Lange, pp. 132–153. University Press of Colorado, Niwot, CO.

Costin, Cathy L.
1991 Craft Specialization: Issues in Defining, Documenting, and Explaining the Organization of Production. In *Archaeological Method and Theory, Volume 3*, edited by M. B. Schiffer, pp. 1–56. University of Arizona Press, Tucson.

Crown, Patricia L.
1981 Analysis of Las Colinas Ceramics. In *The 1968 Excavations at Mound 8, Las Colinas Ruins Group, Phoenix, Arizona*, edited by L. S. Hammack and A. P. Sullivan, pp. 87–169. Archaeological Series No. 154. Arizona State Museum, University of Arizona, Tucson.

1984 Design Variation in Salt-Gila Aqueduct Red-on-Buff Ceramics. In *Hohokam Archaeology Along the Salt-Gila Aqueduct, Central Arizona Project, Volume VIII: Material Culture*, edited by L. S. Teague and P. L. Crown, pp. 205–247 Archaeological Series No. 150. Arizona State Museum, University of Arizona, Tucson.

1994 *Ceramics and Ideology: Salado Polychrome Pottery*. University of New Mexico Press, Albuquerque.

Dart, Allen, and Deborah L. Swartz
1996 *Archaeological Data Recovery Project at the Cook Avenue Locus of the West Branch Site, AZ AA:16:3 (ASM).* Technical Report No. 96-8. Center for Desert Archaeology, Tucson, AZ.

Dean, Jeffrey S.
1991 Thoughts on Hohokam Chronology. In *Exploring the Hohokam: Prehistoric Desert Peoples of the American Southwest*, edited by G. J. Gumerman, pp. 61–149. Amerind Foundation New World Studies Series No. 1. Amerind Foundation, Dragoon, Arizona, and University of New Mexico Press, Albuquerque.

Doyel, David E.
1980 Hohokam Social Organization and the Sedentary to Classic Transition. In *Current Issues in Hohokam Prehistory: Proceedings of a Symposium*, edited by D. E. Doyel and F. Plog, pp. 23–40. Anthropological Research Papers No. 23. Arizona State University, Tempe.

1981 *Late Hohokam Prehistory in Southern Arizona*. Contributions to Archaeology No. 2. Gila Press, Scottsdale, AZ.

Eiselt, B. Sunday, and M. Kyle Woodson
2002 Changing Patterns of Pottery Production in the Casa Blanca Area of the Middle Gila River Valley. Paper presented in the symposium entitled Visible Archaeology on the Gila River Indian Reservation, at the 67th Annual Meeting of the Society for American Archaeology, Denver CO.

Eiselt, B. Sunday, M. Kyle Woodson, Jewel Touchin and Erin Davis
2002 *A Cultural Resources Assessment of the Casa Blanca Management Area, Pima Maricopa Irrigation Project (P-MIP), Gila River Indian Community, Arizona*. P-MIP Report No. 8. Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

Fertelmes, Craig M.
2011 Results of instrumental neutron activation analysis for clay and ceramic samples from the Sweetwater site, Gila River Indian Community, Arizona. Ms on file, Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

Fontana, Bernard L, Edmond J. D. Faubert, and Barney T. Burns
1962 *Papago Indian Pottery*. Monographs of the American Ethnological Society No. 37. University of Washington Press, Seattle.

Hackbarth, Mark R.
1993 Archaeological Investigations at Los Rectángulos. In *Classic Period Occupation on the Santa Cruz Flats: The Santa Cruz Flats Archaeological Project*, edited by T. K. Henderson and R. J. Martynec, pp. 145–222. Northland Research, Inc., Flagstaff, AZ.

Hagstrum, Melissa B.
1995 Creativity and Craft: Household Pottery Traditions in the Southwest. In *Ceramic Production in the American Southwest,* edited by B. J. Mills and P. L. Crown, pp. 281–299. University of Arizona Press, Tucson.

Harry, Karen G.
2000 Community-Based Craft Specialization: The West Branch Site. In *The Hohokam Village Revisited*, edited by D. E. Doyel, S. K. Fish, and P. R. Fish, pp. 197–220.

Southwest and Rocky Mountain Division of the American Association for the Advancement of Science, Fort Collins, CO.

Haury, Emil W.
1976 *The Hohokam: Desert Farmers and Craftsmen, Excavations at Snaketown, 1964–1965*. University of Arizona Press, Tucson.

Hegmon, Michelle, W. Hurst, and James R. Allison
1995 Production for Local Consumption and Exchange: Comparisons of Early Red and White Ware Ceramics in the San Juan Region. In *Ceramic Production in the American Southwest*, edited by B. J. Mills and P. L. Crown, pp. 281–299. University of Arizona Press, Tucson.

Heidke, James M.
1996 Production and Distribution of Rincon Phase Pottery: Evidence from the Julian Wash Site. In *Late Sedentary Occupation at Julian Wash, AZ BB:13:17 (ASM),* edited by J. B. Mabry, pp. 47–70. Technical Report No. 96-7. Center for Desert Archaeology, Tucson, AZ.

Heidke, James M., Elizabeth J. Miksa, and Henry D. Wallace
2002 A Petrographic Approach to Sand-Tempered Pottery Provenance Studies: Examples from Two Hohokam Local Systems. In *Ceramic Production and Circulation in the Greater Southwest: Source Determination by INAA and Complementary Mineralogical Investigations*, edited by D. M. Glowacki and H. Neff, pp. 152–178. Monograph No. 44. Cotsen Institute of Archaeology, University of California, Los Angeles.

Huntington, Frederick W.
1986 *Archaeological Investigations at the West Branch Site: Early and Middle Rincon Occupation in the Southern Tucson Basin*. Anthropological Papers No. 5. Institute for American Research, Tucson, AZ.

Judd, Neil
1954 *The Material Culture of Pueblo Bonito*. Smithsonian Miscellaneous Collections No. 24. Smithsonian Institution, Washington, D.C.

Kidder, A. V., and Anna O. Shepard
1936 *The Pottery of Pecos, Vols. 1 and 2*. Papers of the South West Expedition No. 7. Phillips Academy, Andover, and Yale University Press, New Haven.

Lascaux, Annick
1993 Excavation Results and Feature Descriptions. In *The Maricopa Road Site: A Pre-Classic Hohokam Village, AZ T:16:13 ASU, Pinal County, Arizona*, edited by J. C. Ravesloot and A. Lascaux, pp. 49–118. Anthropological Field Studies No. 28. Office of Cultural Resource Management, Department of Anthropology, Arizona State University, Tempe.

Lascaux, Annick, and John C. Ravesloot
1993 The Maricopa Road Site Viewed in its Local and Regional Context. In *The Maricopa Road Site: A Pre-Classic Hohokam Village, AZ T:16:13 ASU, Pinal County, Arizona*, edited by J. C. Ravesloot and A. Lascaux, pp. 39–48. Anthropological Field Studies No. 28. Office of Cultural Resource Management, Department of Anthropology, Arizona State University, Tempe.

Lombard, James P.
1987 Ceramic Petrography. In *The Archaeology of the San Xavier Bridge Site (AZ BB:13:14)*, edited by J. C. Ravesloot, pp. 335–368. Archaeological Series No. 171. Arizona State Museum, University of Arizona, Tucson.

Marmaduke, William S., and T. Kathleen Henderson
1995 *Archaeology in the Distribution Division of the Central Arizona Project.* Northland Research, Inc., Flagstaff.

Miksa, Elizabeth J.
2001 Temper Provenance Studies. In *The Grewe Archaeological Research Project, Volume 2: Material Culture, Part 1: Ceramic Studies*, edited by D. R. Abbott, pp. 7–45. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff and Tempe.

Miksa, Elizabeth J., and Sergio Castro-Reino
2001 *An Updated Sand Petrofacies Model for the Middle Gila River Basin*. Petrographic Report No. 2001-02. Desert Archaeology, Inc., Tucson.

Miksa, Elizabeth J., and James M. Heidke
1995 Drawing a Line in the Sands: Models of Ceramic Temper Provenance. In *The Roosevelt Community Development Study, Volume 2: Ceramic Chronology, Technology, and Economics*, edited by J. M. Heidke and M. T. Stark, pp. 133–206. Anthropological Papers No. 14. Center for Desert Archaeology, Tucson.

Mills, Barbara J., and Patricia L. Crown (editors)
1995 *Ceramic Production in the American Southwest*. University of Arizona Press, Tucson.

Mitchell, Doug R. (editor)
1994 *The Pueblo Grande Project, Volume 2: Feature Descriptions, Chronology, and Site Structure.* Publications in Archaeology No. 20. Soil Systems, Inc., Phoenix.

Motsinger, Thomas N.
1998 Hohokam Roads at Snaketown, Arizona. *Journal of Field Archaeology* 25:89–96.

Nials, Fred L., and Suzanne K. Fish
1988 Canals and Related Features. In *The 1982–1984 Excavations at Las Colinas: The Site and Its Features,* edited by D. A. Gregory, W. L. Deaver, S. K. Fish, R. Gardiner, R. W. Layhe, F. L. Nials, and L. S. Teague, pp. 275–305. Archaeological Series No. 162(2). Arizona State Museum, University of Arizona, Tucson.

Plog, Stephen
1995 Paradigms and Pottery: The Analysis of Production and Exchange in the American Southwest. In *Ceramic Production in the American Southwest*, edited by B. J. Mills and P. L. Crown, pp. 268–280. University of Arizona Press, Tucson.

Rafferty, Kevin
1982 Hohokam Micaceous Schist Mining and Ceramic Craft Specialization: An Example from Gila Butte, Arizona. *Anthropology* 6:199–222.

Rice, Glen E., T. Cureton, Eric Steinbach, and Christopher N. Watkins
2009 A Ceramic Kiln at Las Canopas. In *Excavations at Las Canopas: A Hohokam Village in the Phoenix Basin, Part 2: The Feature Descriptions*, edited by J. L. Czarzasty and G. E. Rice, pp. 84–92. Pueblo Grande Museum Anthropological Papers No. 17. Rio Salado Archaeology, Phoenix, AZ.

Rice, Prudence M.
1987 *Pottery Analysis: A Sourcebook*. University of Chicago Press, Chicago.

Schaller, David M.

1994 Geographic Sources of Temper In Central Phoenix Basin Ceramics Based on Petrographic Analysis. In *The Pueblo Grande Project, Vol. 3: Ceramics and the Production and Exchange of Pottery in the Central Phoenix Basin, Part I,* edited by D. R. Abbott, pp. 17–90. Publications in Archaeology No. 20. Soil Systems, Inc., Phoenix, AZ.

Schroeder, Albert H. (editor)
1982 Southwestern Ceramics: A Comparative Perspective. *The Arizona Archaeologist* No. 15. Arizona Archaeological Society, Phoenix.

Seymour, Deni J., and Michael B. Schiffer
1987 A Preliminary Analysis of Pithouse Assemblages from Snaketown, Arizona. In *Method and Theory for Activity Area Research: An Ethnoarchaeological Approach*, edited by S. Kent, pp. 549–603. Columbia University Press, New York.

Shepard, Anna O.
1942 *Rio Grande Glaze Paint Ware: A Study Illustrating the Place of Ceramic Technological Analysis in Archaeological Research*. Contributions to American Anthropology and History No. 39. Publication No. 528. Carnegie Institute of Washington, Washington, D.C.

Spielmann, Katherine A.
1988 Craft Specialization and Exchange in Tribal Societies. Proposal submitted to the National Science Foundation, Washington, D.C.

Stark, Barbara L.
1985 Archaeological Identification of Pottery Production Locations: Ethnoarchaeological and Archaeological Data in Mesoamerica. In *Decoding Prehistoric Ceramics*, edited by Ben A. Nelson, pp. 158–194. Southern Illinois University Press, Carbondale, IL.

Sullivan, Alan P., III
1988 Prehistoric Southwestern Ceramic Manufacture: The Limitations of Current Evidence. *American Antiquity* 53:23–35.

Swartz, D. L. (editor)
2005 *Results of Phase 2 Data Recovery at the Southern Margin of the West Branch Site, AZ AA:16:3 (ASM), Pima County, Arizona*. Technical Report No. 2005-01. Desert Archaeology, Inc., Tucson.

Van Keuren, Scott, Susan L. Stinson, and David R. Abbott
1997 Specialized Production of Hohokam Plain Ware Ceramics in the Lower Salt River Valley. *Kiva* 63:155–175.

Wallace, Henry D. (editor)
2006 *Craft Specialization in the Southern Tucson Basin: Archaeological Excavations at the Julian Wash Site, AZ BB:13:17 (ASM), Part 2, Synthetic Studies*. Anthropological Papers No. 40. Center for Desert Archaeology, Tucson.

Wallace, Henry D., and James M. Heidke
1986 Ceramic Production and Exchange. In *Archaeological Investigations at the Tanque Verde Wash Site, a Middle Rincon Settlement in the Eastern Tucson Basin*, edited by M. D. Elson, pp. 233–270. Anthropological Papers No. 7. Institute for American Research, Tucson.

Walsh-Anduze, Mary-Ellen
1993 The Gila Butte Site: Inference and Evidence for Hohokam Ceramic Production. Paper presented at the 66th Pecos Conference, Springerville, Arizona.

Woodson, M. Kyle (editor)
2002 *Archaeological Investigations at the Sweetwater Site on the Gila River Indian Community*. CRMP Technical Report No. 2002-14. Cultural Resource Management Program, Gila River Indian Community, Sacaton, AZ.

SETTLEMENT AND PRODUCTION AT THE CASHION SITE COMPLEX: THE EARLY ARCHAIC AND HOHOKAM PERIODS AT AZ T:11:94(ASM)

William M. Graves
Robert M. Wegener
Richard Ciolek-Torrello
Gary Huckleberry

ABSTRACT

Recent work at AZ T:11:94(ASM) (Site 94), located just south of the Cashion site complex, near the confluence of the Salt and Gila rivers, provides a wealth of information concerning the human use of the Salt River floodplain in the western Phoenix Basin from the Early Archaic and Hohokam Pre-Classic periods. A possible Early Archaic period structure and pits provide information concerning settlement and the subsistence activities in which people were engaged during this early period of time. Later, Pre-Classic period field houses, pits, and a possible canal document how pre-Hispanic residents of the Cashion site complex used the floodplain. We examine the data gathered at Site 94 to discuss more general patterns in the ways that both Archaic period hunter-gathers and Hohokam agriculturalists utilized floodplain lands and resources. In addition, we discuss the kinds of social relations and cultural connections in which residents of the western Phoenix Basin were engaged.

The Salt River and its surrounding floodplain environment have been central to social and economic life in the Phoenix Basin throughout its human history. In this paper, we discuss our ideas concerning the pre-Hispanic use of the Salt River floodplain in the western Phoenix Basin. Our information comes from excavations Statistical Research, Inc. (SRI) conducted at the site of AZ T:11:94 (ASM), otherwise known as Site 94 (Graves et al. 2009). Our work at Site 94 was part of a series of projects that SRI conducted for the Los Angeles District of the U.S. Army Corps of Engineers in support of the Tres Rios Ecosystem Restoration and Flood Control Project in western Phoenix (Figure 1). Site 94 is located on a portion of the Lehi Terrace (Péwé 1978) in the northern floodplain of the lower Salt River and is part of the Cashion site complex (Figure 2).

Our research agenda in this paper has two primary components. First, our excavations resulted in the identification of pit structures and a pit feature dating to the Early Archaic period, ca. 6500–6000 B.C. to ca. 3500 B.C. (after Huckell 1996). These features provided the oldest radiometrically dated evidence of human occupation in the Phoenix Basin. Although sparse, these results have significant implications concerning the archaeological record of the lowermost Salt River floodplain and the Phoenix Basin. Second, our work contributes to research on floodplain settlement and agricultural production during the Hohokam Pre-Classic and Classic periods, ca. A.D. 500 to 1450 (after Bostwick 2008; Henderson and Clark 2004). Agricultural production on the floodplain has figured prominently in archaeological interpretations of canal system growth, population aggregation, changes in the organization of production, and sociopolitical relations among Phoenix Basin Hohokam communities (e.g., Bostwick 2008; Cable and Doyel 1987; Henderson and Clark 2004). Consequently, Site 94 provides an important view of the floodplain from a perspective downstream of the major canal systems of the basin.

The apparent simplicity of Site 94 belies the rich history contained within its boundaries. The evidence of Early Archaic period features is obviously far removed in time from the Pre-Classic and Classic period Hohokam use of and settlement along the Salt River. However, these seemingly disparate periods are linked together by place. This particular location reveals glimpses of social and economic life at different times during the long history of human use of the lower Salt River floodplain.

William M. Graves / Statistical Research, Inc., Tucson, Arizona / bgraves@sricrm.com
Robert M. Wegener / Statistical Research, Inc., Tucson, Arizona / rwegener@sricrm.com
Richard Ciolek-Torrello / Statistical Research, Inc., Redlands, California / rct@sricrm.com
Gary Huckleberry / Geoarchaeological Consultant, Tucson, Arizona / ghuck10@comcast.net

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 148-161

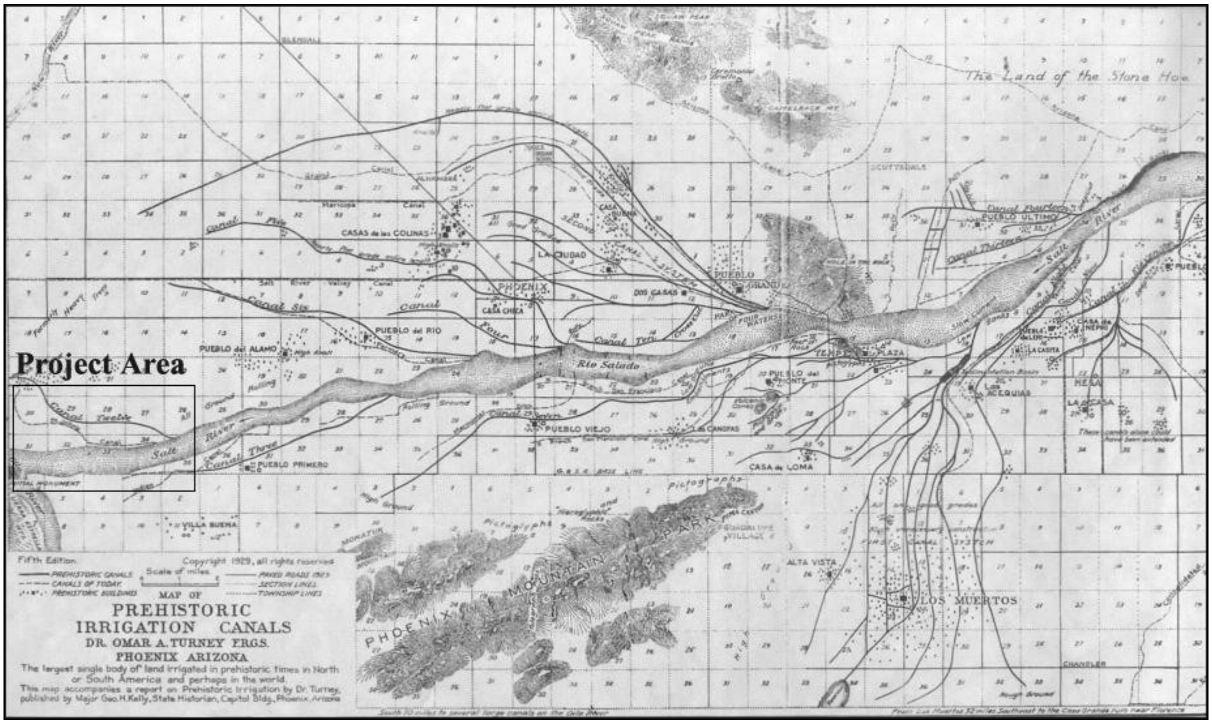


Figure 1. Omar Turney's (1929) irrigation canal map of the Phoenix area with the sites discussed in the text circled.

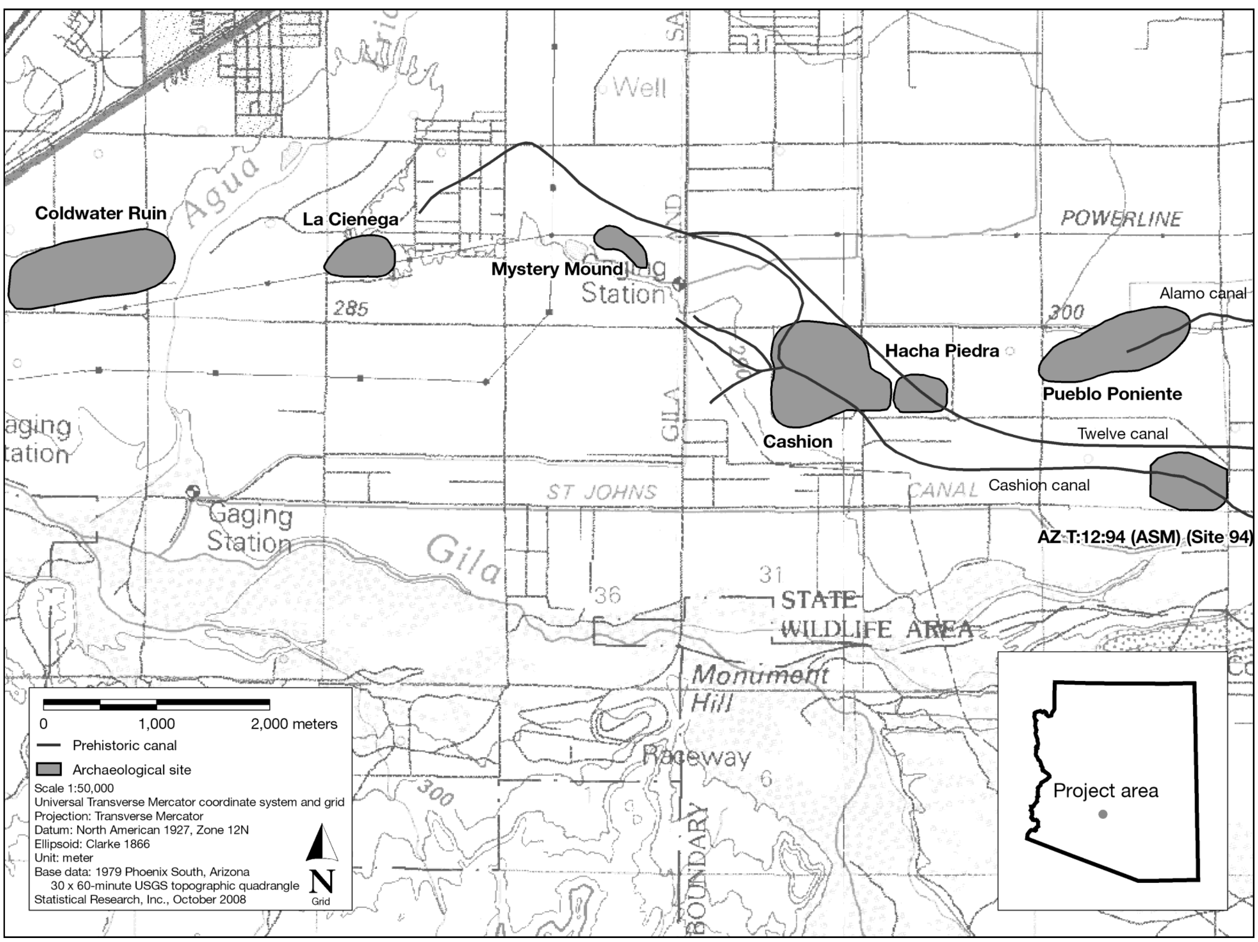


Figure 2. The Cashion site complex.

SITE 94 AND THE CASHION SITE COMPLEX

Site 94 is located within the lower Salt River floodplain, an area that was cultivated by occupants of the Cashion site complex. The Cashion site complex is a group of sites located mostly along the Pleistocene terrace edge overlooking the floodplain near the confluence of the Salt, Agua Fria, and Gila rivers (see Figure 1). The complex consists of the Cashion Ruin, one of the largest Pre-Classic period villages along the Salt River; Hacha Piedra and Pueblo Poniente to the east; and Mystery Mound, La Cienega, Coldwater Ruins, and other sites to the west (Antieau 1981; Loendorf and Rice 2002; Wright 2007:16). The Cashion Ruin was occupied from the Pioneer to the Sedentary periods, whereas Pueblo Poniente was established during the Pre-Classic and occupied intensively during the Classic period (Antieau 1981; Wright 2007). Other large habitation sites located to the west along the Agua Fria and Gila rivers have a similar settlement history, with apparent Pre-Classic to Classic period shifts in population. Coldwater Ruin and the Van Liere, Alkali, and Brewster sites, located to the west of the confluence of the Aqua Fria and Gila rivers, were occupied during the Pre-Classic period. The La Cienega, Lakin, Mystery Mound, and Cashion sites, to the east of the rivers' confluence, were also occupied during the Pre-Classic (Antieau 1981:361). By the early Classic period, though, only the Brewster site, the Coldwater site, and the newly established Morocco site were occupied on the west side of the confluence. Pueblo Poniente and Hacha Piedra were established a short distance to the east of the Cashion Ruin (Antieau 1981).

The Cashion site complex also includes several canal alignments, most prominently Canal 12 or the Cashion Canal (Wright 2007:16). The exact alignment of Canal 12 is not known, but it appears to have brought water out of the Salt River near Site 94 and onto the Pleistocene terrace above it (Antieau 1981; Wright 2007:Figure 9). In addition, Canal 6 may have been extended westward from Pueblo del Alamo to supply water to Pueblo Poniente in the Classic period (Ciolek-Torrello et al. 2007).

SRI's work at Site 94 began in 2002 with a geoarchaeological assessment of the Tres Rios Project area, which stretches westward from the wastewater treatment plant on South 91st Avenue to the Aqua Fria-Gila confluence (Onken et al. 2004). This work detailed the alluvial stratigraphy of the Salt-Gila confluence, and focused on identifying areas with potential for preserved archaeological deposits. Site 94 was discovered in an earlier survey by U.S. Army Corps of Engineers archaeologists (McLean and Perry 2002); however, the first buried features at the site were found during SRI's geoarchaeological work. This work was followed by a testing program at Site 94 in 2003 (Onken and Ciolek-Torrello 2005), data recovery excavations in early 2008 (Graves et al. 2009), and construction monitoring activities in early 2009 (Graves et al. 2009).

Sixty-five features were identified at Site 94. The features include nine pit structures, 51 extramural pits, three cremations, and two canals. In this paper, we focus on those features for which we have the most complete information: the six pit structures, 10 extramural pits, and the canal excavated during our data recovery efforts. Data recovery focused on three areas, Loci A, B, and C, and consisted of a combination of mechanical trenching and stripping and hand excavation (Figure 3). A modern plow zone truncated most Pre-Classic and Classic period features, and we suspect that modern plowing destroyed many features. We believe, however, that our excavations provide adequate information to characterize many aspects of past site activities.

Most of the features appear to date to the Pre-Classic period, ca. A.D. 500 to 1150. Low artifact density, coupled with the presence of ephemeral structures, canals, and a virtual absence of food processing tools, suggests that Hohokam-period residents used Site 94 primarily for cultivation. In contrast, archaeological data from earlier contexts indicates that Early Archaic period task groups or family units used the area as a seasonal habitation. We discuss the Early Archaic period component first.

EARLY ARCHAIC PERIOD

Prior to SRI's discovery, the oldest known Archaic period remains in the Phoenix Basin were at the Last Ditch Site, located in Paradise Valley on a low bajada slope west of the McDowell Mountains (Hackbarth 1998; Rogge 2009). Forty of approximately 200 excavated pit features at this site date to the Middle Archaic period, ca. 3500 B.C. to ca. 1500 B.C. (after Huckell 1996). Broadly, these features indicate that the site functioned as a seasonal plant food collection and processing locale. Two-sigma calibrated radiocarbon dates from 17 of the pit features (Rogge and Phillips 2009:50) indicate the site was occupied between 2930 and 2140 B.C. If only dates obtained from annual plant remains are considered, then the occupational range narrows to between 2570 and 2140 B.C. (Rogge and Phillips 2009:54).

SRI's work at Site 94 identified Early Archaic period components in Loci A and B in discontinuously preserved terrace remnants within the geological floodplain of the lower Salt River. Loci A and B are located ca. 0.5 km north of the modern Salt River channel on the Lehi Terrace, an extensive landform composed of Holocene channel (cobbles, gravel, and sand) and fine-

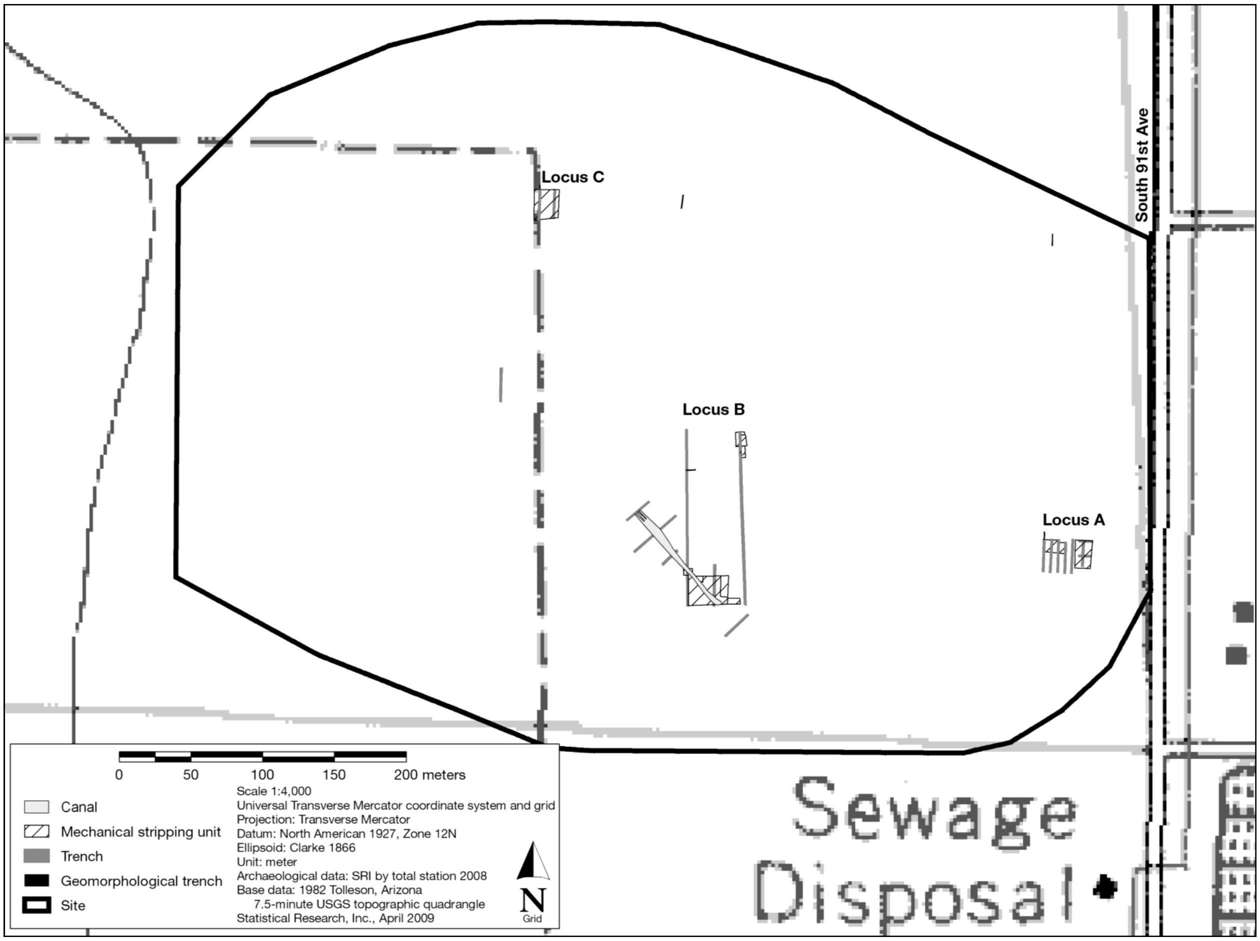


Figure 3. Site 94 (AZ T:11:94 [ASM]) showing SRI data recovery loci.

textured overbank (sand, silt, and clay) deposits. Radiocarbon dates from overbank deposits within the terrace have been reported as being less than 2000 years old (see Huckleberry 1999; Onken and Ciolek-Torrello 2005:20). These more recent dates suggest that lateral channel erosion removed earlier overbank sediments. The supposed erosion has led to the hypothesis that the absence of Archaic period sites in the lower Salt River floodplain is due to geological processes rather than a lack of Archaic occupation (Waters and Keuhn 1996).

In general, the Lehi Terrace contains weakly developed alluvial soils with A/C or A/Bw horizonation typical of late Holocene pedogenesis. Loci A and B, however, contain buried paleosols with more mature horizonation at ca. 5 m to 1.5 m below the modern surface. The upper paleosol contains a moderately developed Bt horizon with clay skins and Stage I $CaCO_3$ morphology suggestive of landforms that date between the latest Pleistocene (100,000–10,000 cal yr BP) and late Holocene (< 4000 cal yr BP) (Huckleberry 1997). The lower paleosol contains a well-developed Bk horizon with Stage I+ to III $CaCO_3$ typical of soils in the latest Pleistocene Blue Point Terrace (Péwé 1978). Thus, pedogenic evidence at Site 94 indicates that early Holocene patches of fine-textured alluvium overlying a Pleistocene surface are preserved in places within the Lehi Terrace on the lower Salt River. These early Holocene patches represent islands within a braided stream system that survived erosion due to channel avulsion and were later buried through overbank sedimentation.

Two shallow pit structures—Feature 80, found in the south-central portion of the site in Locus B, and Feature 42, found in Locus A—are of particular archaeological interest (Figures 4a, 4b, and 5). Mesquite charcoal gathered from the floor fill of the Feature 80 house produced two radiocarbon dates: one with a two-sigma calibrated date range of 5210–4940 cal B.C. and another with a two-sigma calibrated date range of 4540–4400 cal B.C. (Table 1; see also Miljour et al. 2009:Table 6). Feature 80 originated within a moderately formed Bk horizon, which in turn had also formed through the house fill. The house was circular to oval, measured 3.10 m by 2.80 m, was preserved to a depth of 10–20 cm, and exhibited an ash and charcoal stained earthen floor (see Figure 4b).Three samples of charred mesquite structural debris in direct contact with the earthen floor of Feature 42 produced two-sigma calibrated date ranges of 5040–4800 cal

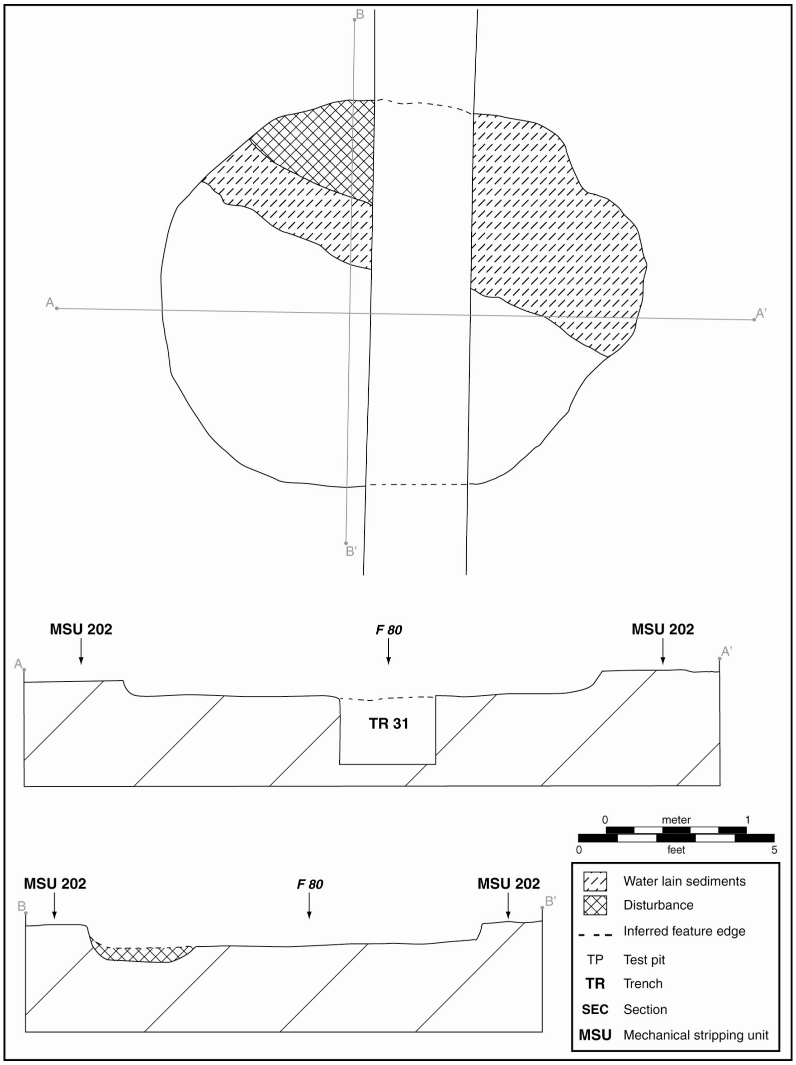


Figure 4a: Plan and profile drawings of Feature 80, an Early Archaic period pit structure, Site 94.

Figure 4b: Photograph of Feature 80.

Table 1: Dated features from testing and data recovery excavations at Site 94 (AZ T:11:94 [ASM]) (from Miljour et al. 2009: Tables 6 and 8).

Locus	Feature Type	Feature #	Dating Technique	Dates	Period
A	pit structure	223	ceramics	A.D. 950–1150	Sedentary
A	pit structure	224	^{14}C	cal A.D. 720–890	Colonial
A	extramural non-thermal pit	301	stratigraphy	postdates F 223	Sedentary to Protohistoric
A	extramural thermal pit	450	^{14}C	3970–3790 cal B.C.	Early Archaic
A	pit structure	42	^{14}C	cal A.D. 640–770, 770– 410 cal B.C., 4960–4720 cal B.C., 5000–4840 cal B.C., and 5040–4800 cal B.C. [A]	Early Archaic
B	extramural thermal pit	40	^{14}C	cal A.D. 1010–1190	Sedentary
B	pit structure	80	^{14}C	5210–4940 cal B.C. and 4540–4400 cal B.C.	Early Archaic
B	canal	39	ceramics and ^{14}C	A.D. 700–1300 and 6360–5750 cal B.C.[B]	Pre-Classic[C]
B	extramural thermal pit	66	^{14}C	cal A.D. 1450–1640	Protohistoric
B	thermal pit (possible hearth)	233	archaeomagnetic	A.D. 935–1040, 1085–1265, 1435–1640, and 1660–1690	Sedentary to early Classic or Protohistoric
C	pit structure	1	ceramics and ^{14}C	A.D. 950–1150 and cal A.D. 690–970	Colonial
C	thermal pit (possible hearth)	160	archaeomagnetic	A.D. 910–1040, 1160–1190, and 1435–1690	Sedentary to early Classic or Protohistoric

Table Notes:

[A] See endnote 1

[B] The radiocarbon date from the canal may be from older plant material introduced into the canal fill from the surrounding sediments.

[C] Although the ceramics recovered from the canal fill (Lower Colorado Buff ware) date to both the Pre-Classic and the Classic periods, we assume the canal dates to the Pre-Classic given the lack of clearly identifiable Classic period materials.

B.C., 5000–4840 cal B.C., and 4960–4720 cal B.C. (see Table 1) (see also Miljour et al. 2009:Table 6).[1] Mesquite charcoal gathered from Feature 450, a small thermal pit originating at the same stratigraphic position but located approximately 5 m south of Feature 42, produced a two-sigma calibrated date range of 3970–3800 cal B.C. This radiocarbon result identifies a later Early Archaic component (see Table 1 and Figure 5) (see also Miljour et al. 2009:Table 6).

Together, the radiocarbon results from Features 80 and 42 suggest that they are among the oldest pit structures documented in the Southwest. The only older structures that are reported in widely available, published literature are four shallow, circular pit structures recorded in Unit III of Cowboy Cave in southeastern Utah by Schroedl and Coulam (1994). The reported radiocarbon dates from Cowboy Cave's Unit III range from "6675 ± 75 B.P." to "7215 ± 75 B.P." (Jennings 1980:Table 3; see also Huckell 1996:334–335). Note that these reported dates are uncalibrated (Jennings 1980:28).

Overall, we believe the implications of these results are significant for several reasons. First, we have demonstrated that early and mid-Holocene alluvial landforms are preserved in the lowermost portions of the Salt River floodplain, and that Early Archaic period peoples established habitation loci on these landforms. As such, the lower Salt River floodplain, at least in the vicinity of Site 94, has the potential to contain highly significant information concerning Early Archaic land-use practices in the Phoenix Basin. Second, archaeological sites immediately predating the introduction of Mesoamerican domesticates may also be preserved. Discovery and excavation of any such sites would allow future researchers to examine more closely the physical and social setting immediately preceding Early Agricultural period lifeways. Consequently, we feel strongly that future investigations

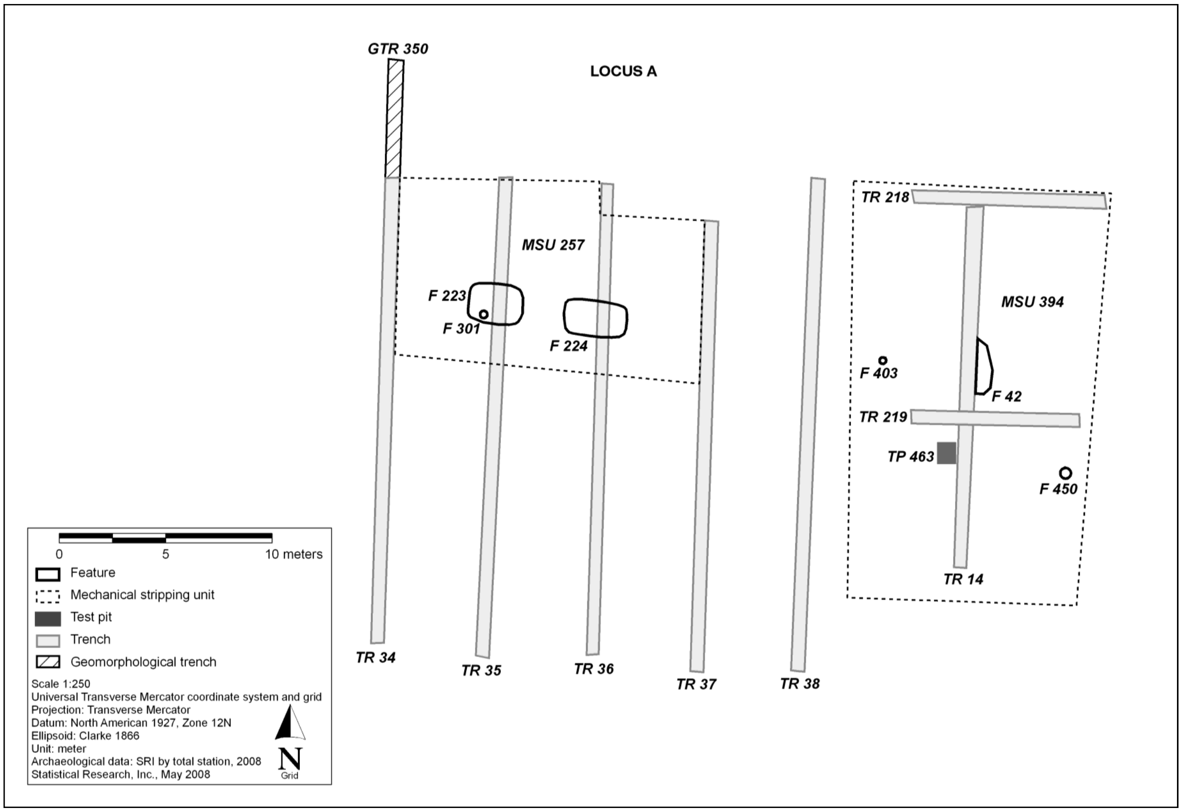


Figure 5. Excavations and features at Locus A, Site 94.

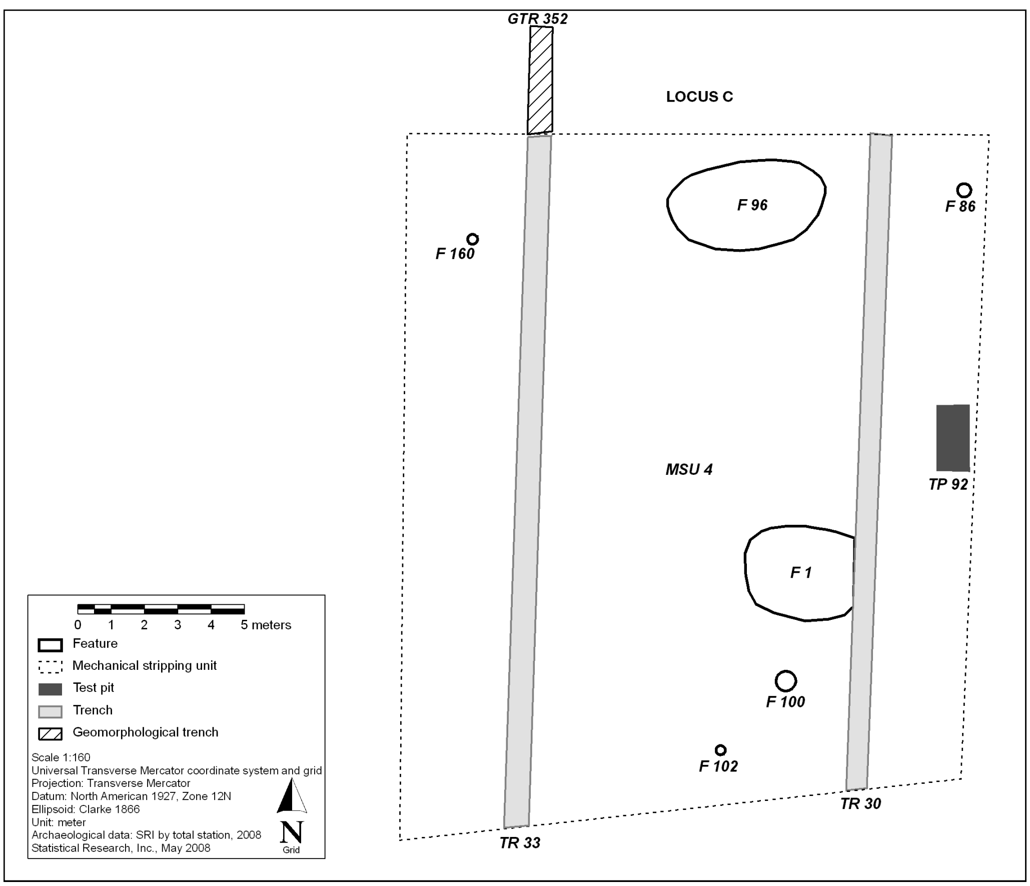


Figure 6. Excavations and features at Locus C, Site 94.

within the lower Salt River floodplain have the potential to expand upon our understanding of Early Archaic lifeways, along with the forager-farmer transition in the Phoenix Basin and the greater Southwest.

PRE-CLASSIC PERIOD

SRI's work at Site 94 also allowed an examination of floodplain use during the Hohokam Pre-Classic and Classic periods, ca. A.D. 500 to 1450 (Figure 6 and see Figure 5). Alluvial reconstructions of the Tres Rios Project area suggest a relatively stable floodplain regime between ca. A.D. 1 and 1000 (Onken et al. 2004). Available geological evidence indicates that this time may have been a period with a relatively low frequency of large floods. Sometime around A.D. 1000, the frequency of large floods increased on the middle Gila and lower Salt rivers and resulted in greater floodplain dynamics (Huckleberry 1995, 1999; Waters and Ravesloot 2001). A late Pre-Classic enhanced flood regime would have increased channel shifting and avulsion, and perhaps caused farmers to rebuild headgates and diversion dams more frequently in order to irrigate their fields, which may have suffered from erosion as well.

Absolute dating and ceramic cross-dating suggest primarily Colonial and Sedentary period use of the floodplain at Site 94 (see Table 1). One pit that was dated to the Protohistoric period was also present. SRI's excavations resulted in the collection of 11 radiocarbon dates, two archaeomagnetic dates, and decorated ceramics. The chronometric samples and diagnostic ceramics allowed us to date eight Pre-Classic period features that were encountered during testing and data recovery (see Table 1). With the exception of an extramural thermal pit (Feature 66), no dated feature postdates A.D. 1150, or the start of the Classic period. In fact, two smudged red ware sherds on the surface of the site were the only potentially Classic period remains found at Site 94. Features 1 and 224, both Pre-Classic pit structures, and Feature 42, a possible Early Archaic pit structure (see above), yielded materials with calibrated radiocarbon date ranges beginning in the early Colonial period. The date from Feature 42 is from a charred corn cupule in the feature's upper fill, and appears to have been intrusive. In addition, artifacts on Site 94's surface suggest that the site may have been occupied in the late Pioneer period as well. One Estrella Red-on-gray sherd and one Snaketown Red-on-gray sherd found on the site surface suggest a limited late Pioneer period use.

SRI's work documented a low frequency of pit structures and agricultural features widely dispersed across Site 94. Interestingly, pit structures that date to the Sedentary period appear to be paired or clustered. At Locus A, Feature 223 was located just a few meters from the slightly earlier Feature 224, and both houses shared the same orientation (see Table 1 and Figure 5). In Locus C, Features 1 and 96 occurred about 10 m apart (see Figure 6). Feature 160 was a shallow thermal pit in Locus C that may have been the remains of an intramural hearth that marked the location of another house destroyed by modern plowing (see Figure 6). At Locus B, no Hohokam structures were encountered. Nonetheless, Feature 233, another small pit feature that likely dates to the late Colonial or early Sedentary period (see Table 1), may represent the remains of another intramural hearth from a house destroyed by modern plowing. Feature 40, a middle Sedentary–Classic period extramural thermal pit, was discovered just 7 m away (see Table 1).

All of the Hohokam houses at Site 94 were ephemeral and poorly preserved. No plastered hearths or prepared floors were encountered, and only two of the four Pre-Classic period houses contained evidence of postholes or intramural storage pits (Features 1 and 96). In addition, only eight distinctly extramural pit features that date to the Pre-Classic period were found. These features were small pits likely used for a variety of processing and storage purposes. Only one Pre-Classic period thermal pit was found (Feature 40). Overall, the ratio of Pre-Classic period extramural pits to houses is 2:1. However, if Features 160 and 233 represent two additional houses (see above), this ratio decreases to 1:1.

The low density of residential structures, the dispersed distribution of these houses and extramural pits, and the informal architectural characteristics of the structures suggest that the Pre-Classic period features at the site represent the remains of field houses, similar to those found at the Dutch Canal Ruin in Canal System 2 (see Bostwick 2008; Greenwald 1994; Greenwald and Ballagh 1996; Greenwald and Ciolek-Torrello 1988; Greenwald et al., eds. 1994; Greenwald et al., eds. 1995; Henderson 2003, 2004). The houses were small, informally built, and did not exhibit the same level of labor invested as contemporary houses at nearby village sites (e.g., Antieau 1981). A low density of artifacts and a low ratio of extramural pits to houses also identifies Site 94 as a limited-activity locale in comparison to contemporary and nearby villages.

SRI investigators also encountered two Pre-Classic canal segments: Feature 39, found in Locus B during data recovery excavations (see Figure 3), and Feature 541, located approximately 80 m to the southeast during monitoring. These canal segments indicate that the Lehi Terrace was cultivated during the Pre-Classic period at Site 94. An SRI excavation team followed the Feature 39 canal for about 100 m with a combination of mechanical stripping and trenching. At its northwest terminus, the canal diverged into three smaller channels. Its orientation and gradient suggest a southeast to northwest flow. During monitoring, construction exposed approximately 60 m of Feature 541. An SRI crew hand-excavated a trench through the exposed segment of the canal. The orientation of this feature indicates that it flowed from the northeast to the southwest. The canal's cross-section is wider and deeper than Feature 39; this relatively large cross-section suggests that this canal had a greater capacity than Feature 39. Both canals were filled with fine-grained silts and clays and had relatively low-velocity flows, which contrasts markedly with the steep gradients and high-velocity flows exhibited by Pre-Classic period floodplain canals near Canal System 2 (e.g., Greenwald and Ciolek-Torrello 1988; Nials and Henderson 2004). Given each canal's location, size, and orientation, we believe that the Feature 39 canal may have been a lateral that branched off from Feature 541 to irrigate fields at the site.

Pre-Classic Agricultural Production at the Cashion Site Complex

These data produce an intriguing, although partial, picture of floodplain use by the inhabitants of the Cashion site complex. The inhabitants of Site 94 irrigated, cultivated, and constructed field houses at Site 94 during the Colonial and Sedentary periods. Feature and artifact density is low, but not significantly lower than other floodplain sites in the Phoenix Basin (see Bostwick 2008).

We suspect that households predominantly managed agricultural control of the floodplain. Similar to Henderson and Clark's (2004) argument for the use of contemporary farm lands along Canal System 2, we propose that individual households from nearby villages built and maintained field houses, in part, to mark their control over particular plots of agricultural lands. Like pit structures at Canal System 2 floodplain sites, pairs of houses at Site 94 may represent the persistence of land claims and use rights by Pre-Classic households (see Kohler 1992 for a discussion of the relationship of field houses and land tenure). At Site 94, the house pairs appear to represent sequential occupations, although no superpositioning of house outlines, as documented by Henderson and Clark (2004), have been documented at the site. SRI's data also demonstrate that pre-Hispanic residents were irrigating the lower Lehi Terrace; however, Site 94 occupants may have also practiced floodwater farming. It is important to note that these activities on the Lehi Terrace would have supplemented the irrigation of fields elsewhere on the Pleistocene terrace. The projected location of Canal 12, or the Cashion Canal (see Figures 1 and 2), indicates that additional pre-Hispanic irrigated fields were present in the immediate area.

Sometime during the late Sedentary period, people stopped building field houses and irrigation canals in the floodplain at Site 94. Although dendrohydrological reconstructions for the Salt River indicate relatively low flow variability during this time (Graybill et al. 2006), the cessation of construction may have coincided with a possible increased flood regime of the Salt River (Huckleberry 1999; Onken et al. 2004). In the Canal System 2 area, field houses and many canals in the floodplain also appear to have been abandoned during the Sedentary period, as irrigation canals were diverted onto the higher Pleistocene terraces.

We do not yet entirely understand the relationship between the social changes occurring in the Phoenix Basin at the end of the Pre-Classic period and what appear to be contemporary changes in the flow of the Salt River and in the floodplain environment. As discussed earlier, the Pre-Classic-to-Classic transition was a time of great transformation in settlement and agricultural practices in the Cashion site complex. Antieau (1981) has argued that apparent population increases throughout the Phoenix Basin during the late Sedentary and early Classic periods, along with the great expansion of canal systems upstream of Cashion, may have led to the abandonment of the Cashion Canal and much of the Cashion site complex. He argued that this abandonment was related to low-magnitude flow regimes in the lower end of the Salt River Valley that resulted from the expanding upstream settlements diverting increasing amounts of water for their own use (Antieau 1981; Ciolek-Torrello et al. 2007; Onken et al. 2004).

Alternatively, a possible increased flood regime of the Salt River (Huckleberry 1999; Onken et al. 2004) may have created so many problems with canal construction and repair, and perhaps even with field erosion, that people decided to move away from the Cashion Ruin and Site 94. Regardless of the exact causes, Onken and Ciolek-Torrello (2005; Ciolek-Torrello et al. 2007) have suggested that, in response to the changing environmental and social situation, much of the Cashion population relocated to take advantage of the flow of the Agua Fria. Other residents moved east to Pueblo Poniente, which may have received irrigation waters from Canal 6.

Political-Economic Implications of Field Houses and Their Disappearance

How was the presence and subsequent disappearance of field houses in the floodplain at Site 94 related to these large-scale changes in settlement and agricultural production? The timing of events seems to suggest that residents of the Cashion site complex stopped farming the floodplain at a time when environmental conditions made such practices difficult. In this section, we shift our focus to highlight some of the possible political-economic implications of this apparent shift in settlement and production.

The Site 94 data may reflect rather significant changes in the organization of agricultural production—how the means of production were controlled, and by whom. Residents of the Cashion site complex ceased to irrigate the floodplain at Site 94 at the same time that they shifted much of their agricultural efforts and settlement to the confluence of the Agua Fria and Gila rivers. Nevertheless, people likely continued to farm at Site 94 during the Classic period. As discussed earlier, the nearby Pueblo Poniente was occupied primarily in the Classic period, (Wright 2007) and surface collections from Site 94 contained a few blackened red ware sherds that suggest a Classic period use of the site.

It is possible that modern plowing and differential preservation of the archaeological record may have eradicated Classic period features at Site 94. Sediments dating to the past 800 years are shallow and differentially disturbed on the site. Thus, Classic period features are less likely to be preserved than earlier features. In addition, the sheer lack of Classic period materials within the disturbed plow zone suggests that the absence of preserved Classic period features may reflect a real absence of such features during this period of time.

The lack of Classic period features may not necessarily mean that people ceased to use the floodplain. Classic period use of the floodplain at Site 94 may have been of a much different and perhaps more limited nature than in earlier periods. Henderson and Clark (2004) suggested that a similar disappearance of field houses in Canal System 2 during the late Sedentary period reflects a transition in production from the household level to some supra-household level of organization. They argue that the floodplain was not abandoned and that floodwater farming replaced irrigation as a low-risk, high-yield practice. Such practices could also have been low risk and potentially high yield in the Cashion site complex, especially given the possible enhanced flood regime at the end of the Pre-Classic period (see Onken et al. 2004).

We propose that the cessation of field house use at Site 94 may also indicate a demise of household production and land tenure in the Cashion site complex, similar to the situation that Henderson and Clark (2004) described for Canal System 2. We interpret field houses as markers that Pre-Classic households from nearby villages used, in part, to control or restrict access to their irrigated lands. By controlling or limiting access to land, households exerted at least partial control over the means of production. Subsequently, they also exerted some control or power over food production and the surplus labor process (sensu Saitta 1994, 1997).

We subscribe to Saitta's (1994:206–209, 1997) use of the concept of surplus labor process to capture how social surplus labor is produced, appropriated, and distributed. Following Saitta (1994, 1997) and others (e.g., Cobb 1993; McGuire 2002), we believe that understanding how surplus production and labor are created and used are fundamental to understanding how production is organized socially and politically in all societies, including the Hohokam. Saitta's (1994:226) notion of surplus labor refers to "the time and energy expended beyond the amount required (termed 'necessary labor') to meet the subsistence needs of individuals." All societies produce surplus labor and surplus product (the fruits of surplus labor), because surplus is necessary for a whole range of social needs and purposes, such as the replacement of tools and implements or the care of the sick and other non-producers, in order to satisfy common social or economic needs and to fund administrative or religious-ritual activities (Saitta 1994:226). Thus, the control and appropriation of surplus labor and production inevitably create power and prestige differences among people or groups (Saitta 1994:206).

By controlling their own labor, as well as a significant portion of the means of production (land), individual households that farmed at Site 94 were likely both (1) the producers of surplus production and the providers of surplus labor, as well as (2) the consumers and appropriators of such labor and production (McGuire 2002; McGuire and Saitta 1996; Saitta 1994, 1997). Controlling surplus production and labor while simultaneously acting as the consumers and appropriators of that surplus may have underwritten the political autonomy, control, and power thought to have been exerted by households in Pre-Classic Hohokam society (e.g., Bayman 1996; Craig 2001; McGuire 2002).

Whatever level of control over agricultural production and surplus labor was exerted by households in the Pre-Classic, it seems that this control weakened substantially during the Classic period. The absence of Classic period field houses at Site 94 may mark a shift in the control of the means of agricultural production away from household social units. Henderson and Clark (2004) surmise that this control was taken over by some "corporate" organizational group. Regardless of who controlled the floodplain, it does appear that individual households may have lost control of floodplain fields—a primary means of production—at the end of the Pre-Classic and consequently no longer had as much control over the agricultural production process and the material products of surplus labor (Saitta 1994:217–219). As a further consequence, the structure of the surplus labor process may have changed in some significant way, with households no longer acting as the appropriators of surplus to the same degree or in the same manner as they once had. This shift in the appropriation and consumption of surplus from households to some other social unit(s) may have provided the political-economic underpinnings of the power or control exerted by elites, religious leaders, or secular leaders during the Classic period (e.g., Abbott 2003; Harry and Bayman 2000; Gregory 1991; McGuire 2002; Wilcox 1991).

Alternatively, it is possible that the absence of field houses in the Classic period may reflect a change in the perception of floodplain fields from lands owned by individual households to communal lands available to all members of the community. In pre-industrial agricultural economies, land tenure and ownership of the means of production become increasingly important issues as farmers intensify production and increase labor efforts to construct canals and perform other improvements to their fields (Flannery 1972; Ciolek-Torrello et al. 2007). With the abandonment of canals in the floodplain and a return to less intensive floodwater farming practices, land tenure may have become less important, and households may not have felt it necessary to maintain field houses near their fields. If Antieau (1981) is correct, there would have been very little water available for downstream canals in the Classic period, except perhaps during major flooding events or periods of high precipitation. Field locations may have largely shifted to upstream canal systems and to locations along the Agua Fria River, though people may have continued to use floodplain fields to supplement their production on a periodic basis when conditions were optimal for floodwater farming.

SUMMARY AND CONCLUSIONS

SRI's work at Site 94, a floodplain agricultural site, provides an intriguing look at agriculture and the organization of production, as well as the larger social and settlement history of the Cashion site complex, perhaps the largest Pre-Classic and Classic period Hohokam settlement in the west valley. In addition, SRI's testing and excavations at the site revealed a rather surprising discovery—the remnants of early and/or mid-Holocene terraces or bars that were occupied as early as 5210 B.C., and thereafter again around 3970–3790 B.C.

The discovery of Early Archaic period features increases the antiquity of human use of the floodplain and the Phoenix Basin. We have just begun our work compiling information on the Archaic periods, although we have yet to find Early Archaic remains or any evidence of habitations features or sites older than 5200 B.C.

During the Hohokam Pre-Classic and Classic periods, we see some interesting patterns in how residents of the Cashion site complex organized agriculture, production, and labor. During the Colonial and Sedentary periods, two canal segments and field houses indicate that pre-Hispanic people were irrigating the floodplain and that households may have controlled irrigable land, a primary means of agricultural production. In contrast, the absence of canal irrigation or field houses in the lowermost Salt River floodplain during the Classic period may be due, at least in part, to significant changes in the flow regime of the Salt River that would have made irrigation farming on the floodplain difficult or impossible. Dendrohydrological reconstructions suggest the latter half of the Sedentary period was a time of low flow variability on the Salt (Graybill et al. 2006), while alluvial stratigraphy in the vicinity of Site 94 (Onken et al. 2004) and elsewhere (Huckleberry 1999) suggest this would have been a time of an increased flood regime along the river. The disappearance of field houses also suggests a shift in the social groups who controlled agricultural production and, by extension, surplus production and labor (sensu Saitta 1994, 1997). This apparent change in how production and labor were organized may provide the basis for additional insight into potential political-economic underpinnings of the fundamental transformations in settlement and agriculture within the Cashion site complex at the Pre-Classic-to-Classic-period transition.

Note

1. Five radiocarbon dates were obtained from the Feature 42 structure (see Table 1). These include one date from a maize cupule that produced a two-sigma calibrated age range of cal A.D. 640–770 (Miljour et al. 2009:Table 6); this date is considered intrusive to the general structure fill. A second date from charred mesquite in the upper structure fill produced a two-sigma calibrated date range of cal 770–410 cal B.C. (Miljour et al. 2009:Table 6). Three additional dates from charred mesquite, interpreted as the remains of structural wood in direct contact with the floor, produced two-sigma calibrated date ranges of cal 5040–4800 cal B.C., 5000–4840 cal B.C., and 4960–4720 cal B.C. (Miljour et al. 2009:Table 6). We have assigned an Early Archaic ca. 5000 B.C. age to Feature 42 based on the structural wood dates, and we interpret the younger dates as materials incorporated into the structure fill from the overlying strata.

Acknowledgments. This paper was first presented at the 2008 Arizona Archaeological Council Advances in Hohokam Research Conference. We would like to thank Doug Craig and Todd Bostwick for inviting us to participate in such an interesting and stimulating conference. We would also like to thank Amy Holmes and Steve Dibble of the Los Angeles District of the U.S.

Army Corps of Engineers for their continuing support of our work for the Tres Rios Project.

REFERENCES CITED

Abbott, David R.
2003 The Politics of Decline in Canal System 2. In *Centuries of Decline during the Hohokam Classic Period at Pueblo Grande,* edited by David R. Abbott, pp. 201–227. University of Arizona Press, Tucson.

Antieau, John M.
1981 *The Palo Verde Archaeological Investigations: Hohokam Settlement at the Confluence: Excavations along the Palo Verde Pipeline.* Research Paper No. 20. Museum of Northern Arizona, Flagstaff.

Bayman, James N.
1996 Shell Ornament Consumption in a Classic Hohokam Platform Mound Community Center. *Journal of Field Archaeology* 23:403–418.

Bostwick, Todd W.
2008 *Beneath the Runways: Archaeology of Sky Harbor International Airport*. Pueblo Grande Museum, Parks and Recreation Department and Aviation Department, City of Phoenix.

Cable, John S., and David E. Doyel
1987 Pioneer Period Village Structure and Settlement Pattern in the Phoenix Basin. In *The Hohokam Village: Site Structure and Organization*, edited by David E. Doyel, pp. 21–70. Southwestern and Rocky Mountain Division, American Association for the Advancement of Science Publication No. 87-15. Glenwood Springs, Colorado.

Ciolek-Torrello, Richard, Jill Onken, and Amelia Natoli
2007 *Historic Properties Treatment Plan for AZ T:12:93 (ASM) and AZ T:11:94 (ASM), Tres Rios Project, Maricopa County, Arizona.* Technical Report 05-65. Statistical Research, Inc., Tucson, Arizona, and Redlands, California.

Cobb, Charles R.
1993 Archaeological Approaches to the Political Economy of Nonstratified Societies. In *Archaeological Method and Theory*, Volume 5, edited by M. B. Schiffer, pp. 43–100. University of Arizona Press, Tucson.

Craig, Douglas B.
2001 Domestic Architecture and Household Wealth at Grewe. In *The Grewe Archaeological Research Project, Vol. 3: Synthesis*, edited by D. B. Craig, pp. 115–130. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff and Tempe, Arizona.

Flannery, Kent V.
1972 The Origins of the Village as a Settlement Type in Mesoamerican and the Near East: A Comparative Study. In *Man, Settlement and Urbanism*, edited by P. Ucko, R. Tringham, and G. W. Dimbleby, pp 321–336. Gerald Duckworth and Co., London.

Graves, William M., Robert M. Wegener, and Richard Ciolek-Torrello (editors)
2009 *Settlement, Production, and the Floodplain Environment along the Lowermost Salt River: Early Archaic, Hohokam, and Protohistoric Life at AZ T:11:94 (ASM), Phoenix, Arizona*. Technical Report 09-32. Statistical Research, Inc., Tucson.

Graybill, D. A., D. A. Gregory, G. S. Funkhouser, and F. L. Nials.
2006 Long-Term Streamflow Reconstructions, River Channel Morphology, and Aboriginal Irrigation Systems along the Salt and Gila Rivers. In *Environmental Change and Human Adaptation in the Ancient American Southwest,* edited by J. Dean, and D. Doyel, pp. 69–123. University of Utah Press, Salt Lake City.

Greenwald, David H. (editor)
1994 *Early Desert Farming and Irrigation Settlements: Archaeological Investigations in the Phoenix Sky Harbor Center, Vol. 1: Testing Results and Data Recovery Plan*. SWCA Anthropological Research Paper No. 4, Flagstaff, Arizona.

Greenwald, David H., and Jean H. Ballagh (editors)
1996 *Early Desert Farming and Irrigation Settlements: Archaeological Investigations in the Phoenix Sky Harbor Center, Vol. 4: Special Studies, Synthesis, and Conclusions*. SWCA Anthropological Research Paper No. 4, Flagstaff, Arizona.

Greenwald, David H., and Richard S. Ciolek-Torrello (editors)
1988 *Archaeological Investigations at the Dutch Canal Ruin, Phoenix, Arizona: Archaeology and History along the Papago Freeway Corridor.* Research Paper No. 38. Museum of Northern Arizona, Flagstaff.

Greenwald, David H., M. Zyniecki, and Dawn M. Greenwald (editors)
1994 *Early Desert Farming and Irrigation Settlements: Archaeological Investigations in the Phoenix Sky Harbor Center, Vol. 2: Dutch Canal Ruin*. SWCA Anthropological Research Paper No. 4, Flagstaff, Arizona.

Greenwald, David H., Mark L. Chenault, and Dawn M. Greenwald (editors)
1995 *Early Desert Farming and Irrigation Settlements: Archaeological Investigations in the Phoenix Sky Harbor Center, Vol. 3: Pueblo Salado*. SWCA Anthropological Research Paper No. 4, Flagstaff, Arizona.

Gregory, David A.
1991 Form and Variation in Hohokam Settlement Patterns. In *Chaco and Hohokam: Prehistoric Regional Systems in the American Southwest,* edited by P. L. Crown and W. J. Judge, pp. 159–194. School of American Research Press, Santa Fe.

Hackbarth, Mark R.
1998 *Archaic and Hohokam Occupation of the Mayo Boulevard Project Area in Northeast Phoenix, Arizona*. Anthropological Papers No. 8. Pueblo Grande Museum, Phoenix.

Harry, Karen G., and James M. Bayman
2000 Leadership Strategies among the Classic Period Hohokam: A Case Study. In *Alternative Leadership Strategies in the Prehispanic Southwest*, edited by Barbara A. Mills, pp. 136–153. University of Arizona Press, Tucson.

Henderson, T. Kathleen (editor)
2003 *Hohokam Farming on the Salt River Floodplain: Excavations at the Sky Harbor Airport North Runway.* Anthropological Papers No. 42, Center for Desert Archaeology. Tucson. Anthropological Papers No. 9. Pueblo Grande Museum, Phoenix.

2004 *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*. Anthropological Papers No. 43, Center for Desert Archaeology, Tucson. Anthropological Papers No. 10, Pueblo Grande Museum, Phoenix.

Henderson, T. Kathleen, and Tiffany C. Clark

2004 Changing Perspectives: Considerations of Past Agricultural Use of the Salt River Floodplain. In *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*, edited by T. Kathleen Henderson, pp. 167–186. Anthropological Papers No. 43, Center for Desert Archaeology, Tucson. Anthropological Papers No. 10, Pueblo Grande Museum, Phoenix.

Huckell, Bruce B.

1996 The Archaic Prehistory of the North American Southwest. *Journal of World Prehistory* 10(3):305–373.

Huckleberry, Gary. A.

1995 Archaeological Implications of Late Holocene Channel Changes on the Middle Gila River, Arizona. *Geoarchaeology* 10:159–182.

1997 Rates of Holocene Soil Formation in South-Central Arizona. Arizona Geological Survey Open-File Report 97-7, Tucson, Arizona.

1999 Prehistoric Flooding and Its Effect on Indigenous Agriculture in the Northern Sonoran Desert, U.S.A. *Journal of Arid Land Studies* 9(4):277–284.

Jennings, J. D.

1980 *Cowboy Cave.* University of Utah Anthropological Papers 104. University of Utah Press, Salt Lake City.

Kohler, Timothy A.

1992 Field Houses, Villages, and the Tragedy of the Commons in the Early Northern Anasazi Southwest. *American Antiquity* 57:617–634.

Loendorf, Christopher, and Glen E. Rice

2002 An Archaeological Assessment of a Portion of the Cashion Ruin (Draft.) Report No. 99. Office of Cultural Resource Management, Department of Anthropology, Arizona State University, Tempe.

McGuire, Randall H.

2002 *A Marxist Archaeology*. Percheron Press, Clinton Corners, New York.

McGuire, Randall H., and Dean J. Saitta

1996 "Although They Have Petty Captains, They Obey Them Badly": The Dialectics of Prehispanic Western Pueblo Social Organization. *American Antiquity* 61:197–216.

McLean, Roderic, and Richard Perry

2002 The Tres Rios Survey: An Archaeological Survey of 700 Acres for the Proposed Tres Rios, Arizona Feasibility Study, Maricopa County. Prepared by and submitted to U.S. Army Corps of Engineers, Los Angeles District, Los Angeles.

Miljour, Heather J., William M. Graves, Stacey N. Lengyel, Kerry L. Sagebiel, Karry L. Blake, Amelia Natoli, Cannon S. Daughtrey, and Robert M. Wegener

2009 Excavation and Feature Descriptions, Construction Monitoring, and Site Chronology. In *Settlement, Production, and the Floodplain Environment along the Lowermost Salt River: Early Archaic, Hohokam, and Protohistoric Life at AZ T:11:94 (ASM), Phoenix, Arizona*, edited by W.M. Graves, R.M. Wegener and R. Ciolek-Torrello, pp. 45–126. Technical Report 09-32. Statistical Research, Inc., Tucson.

Nials, Fred L., and T. Kathleen Henderson

2004 The Sky Harbor Project Canals. In *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*, edited by T. Kathleen Henderson, pp. 125–152. Anthropological Papers No. 43, Center for Desert Archaeology, Tucson. Anthropological Papers No. 10, Pueblo Grande Museum, Phoenix.

Onken, Jill, and Richard Ciolek-Torrello

2005 *Archaeological Testing at AZ T:11:94 (ASM), Tres Rios Project, Maricopa County, Arizona*. Technical Report 04-39. Statistical Research, Redlands, California.

Onken, Jill, Michael R. Waters, and Jeffrey A. Homburg

2004 *Geoarchaeological Assessment for the Tres Rios Project, Maricopa County, Arizona.* Technical Report 03-68. Statistical Research, Redlands, California.

Péwé, T.L.

1978 Terraces of the Lower Salt River Valley in Relation to the Late Cenozoic History of the Phoenix Basin, Arizona. In *Guidebook to the Geology of Central Arizona,* edited by D.M. Burt, and T.L. Péwé, pp. 1–46. Bureau of Geology and Mineral Technology Special Paper 2, Tucson, Arizona.

Rogge, A. E. (Gene) (editor)

2009 *Excavations within the State Route 101L/64th Street Locus of the Last Ditch Site, AZ U:5:33 (ASM), Phoenix, Arizona*. URS Corporation Cultural Resources Report 2008-18(AZ). URS Corporation, Phoenix.

Rogge, A. E. (Gene) and Bruce G. Phillips

2009 Chronology and Geomorphology. In *Excavations within the State Route 101L/64th Street Locus of the Last Ditch Site, AZ U:5:33 (ASM), Phoenix, Arizona*, edited by A.E. Rogge, pp. 47–59. URS Corporation Cultural Resources Report 2008-18(AZ). URS Corporation, Phoenix.

Saitta, Dean J.

1994 Agency, Class, and Archaeological Interpretation. *Journal of Anthropological Archaeology* 13:201–227.

1997 Power, Labor, and the Dynamics of Change in Chacoan Political Economy. *American Antiquity* 62(1):7–26.

Schroedl, Alan R., and Nancy J. Coulam

1994 Cowboy Cave Revisited. *Utah Archaeology* 7:1–34.

Turney , Omar

1929 Prehistoric Irrigation. *Arizona Historical Review* 2 (5).

Waters, Michael R. and David D. Keuhn

1996 The Geoarchaeology of Place: The Effect of Geological Processes on the Preservation and Interpretation of the Archaeological Record. *American Antiquity* 61:483–497.

Waters, Michael R. and John C. Ravesloot

2001 Landscape Change and the Cultural Evolution of the Hohokam Along the Middle Gila River and Other River Valleys in South-Central Arizona. *American Antiquity* 66:285–299.

Wilcox, David R.

1991 Hohokam Social Complexity. In *Chaco and Hohokam: Prehistoric Regional Systems in the American Southwest*, edited by Patricia L. Crown and W. James

Judge, pp. 253–276. School of American Research Press, Santa Fe.

Wright, Thomas E.
2007 *The Terrazona Archaeological Project: Investigations in a Portion of Pueblo Poniente, AZ T:11:164 (ASM), A Hohokam Site in Southwestern Phoenix, Maricopa County, Arizona*. Pueblo Grande Museum Occasional Papers No. 8. Pueblo Grande Museum, Phoenix, and Archaeological Research Services, Inc., Tempe, Arizona.

DATING HOHOKAM CANALS: A METHODOLOGICAL CASE STUDY

Christopher N. Watkins
Glen E. Rice
Erik Steinbach

ABSTRACT

In this case study, we compare the utility of four different methods for dating Hohokam canals: ceramic cross-dating, AMS radiocarbon dating of annuals, thermoluminescence (TL) dating of sherds, and optically stimulated luminescence (OSL) dating of canal sediments. Rio Salado Archaeology, LLC researchers used each method to date a single canal excavated on the campus of Arizona State University. The ceramic, ASM, and TL dates were comparable; the OSL date was not. We suggest that TL dating of ceramics is a viable method to date Hohokam canals accurately. In addition, we discuss the apparent unreliability of the single-aliquot fine-silt-polymineral OSL dating technique for dating prehistoric canal sediments.

In his pioneering study of Hohokam irrigation at Snaketown, Emil Haury (1976) expended great effort to obtain a chronological sequence of canals and other excavated water control features. He applied various innovative techniques toward chronology building in his broader investigation, but was ultimately forced to rely on ceramic cross-dating and stratigraphy to date the Snaketown canals, although he did obtain one radiocarbon date from material in a "canal lining" (Haury 1976:334). Haury was successful with the methods he employed. However screening canal fill to recover sherds is time-consuming and can fail to generate a representative sample of temporally sensitive sherds.

In 2007, Rio Salado Archaeology, LLC conducted an archaeological investigation on the central campus of Arizona State University in advance of a redevelopment project (Steinbach et al. 2007). Excavation crews identified nearly 30 archaeological features at the Barrett Honors College site, AZ U:9:281(ASM): two prehistoric canals, two field houses, three burials, and several other hearths and pits (Figure 1). Research efforts focused on dating the canals. We dated the first canal (Canal 1) through Haury's traditional methods, which involved screening fill for diagnostic ceramics and stratigraphy. We then dated the other canal (Canal 2) with a variety of methods, including ceramic cross-dating, radiocarbon dating of annuals, thermoluminescence (TL) dating of ceramics, and optically stimulated luminescence (OSL) dating of canal sediments.

In this case study, we compare the utility of the various techniques available for dating Hohokam canals, and prioritize them according to presumed accuracy. Three of the dating techniques— ceramic cross-dating, radiocarbon dating, and TL dating of ceramics— yielded consistent and seemingly accurate results. The OSL dating technique used here produced a result that was not consistent with, and presumably less accurate than the results from the other dating techniques. However, recent innovations in OSL dating suggest that this dating method has the potential to produce extremely accurate dates for Hohokam canals. Following our assessment of each method, we

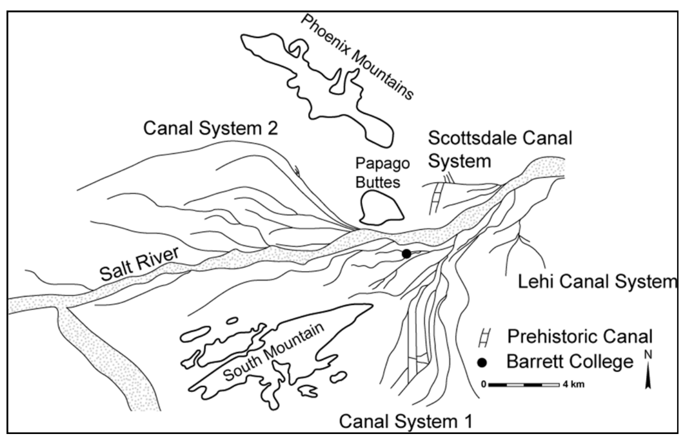


Figure 1. Location of the Barrett Honors College site in the Phoenix Basin.

Christopher N. Watkins / Logan Simpson Design, Inc. / cwatkins@logansimpson.com
Glen E. Rice / Rio Salado Archaeology, LLC / glenrice@riosaladoarchaeology.com
Erik Steinbach / Rio Salado Archaeology, LLC / erik@riosaladoarchaeology.com

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 162-168

conclude with a description of single-grain OSL dating and recommend future utilization of the technique.

BARRETT HONORS COLLEGE SITE

The Barrett Honors College site, AZ U:9:281(ASM), is located in the southeast portion of the Arizona State University campus and on the northwest corner of Apache Boulevard and Rural Road on the second terrace of the Salt River, roughly 2 km south of the current river channel. At approximately 356.6 m (1,170 ft) above sea level, the native vegetation in this area, prior to development, would have been assigned to the Lower Colorado River Valley Subdivision of the Sonoran Desert Scrub Biotic Community. The dominant plants would have been creosotebush, saltbush and bursage, with occasional occurrences of paloverde, mesquite, prickly pear, saguaro, barrel cacti, cholla, and a variety of grasses (Turner and Brown 1982). At the time of the excavation, the area was landscaped, paved, or covered by gravel parking lots.

A total of 29 features were encountered during the course of testing and data recovery at the site (Figure 2). Two prehistoric canals and a natural historic period drainage extended from the northeast corner across the project area to the southwest boundary. An inhumation and two cremations were excavated from a small cemetery area in the northeast corner of the excavated area. Architectural features included two field houses and three poorly preserved surfaces. Pit features included eight isolated hearths, one roasting pit, four indeterminate pits, and one pit that contained an isolated vessel. Modern features were also present at the site; they included utility trenches, a concrete foundation, and two modern pits containing construction material.

Four different methods for dating canals were applied to Canal 2: 1) ceramic cross-dating, 2) radiocarbon dating (AMS) of annuals, 3) TL dating of pottery sherds, and 4) OSL dating of canal sediments. This case study tests the comparability of different measures of canal chronology. We begin, however, with a discussion of the dating of Canal 1, which illustrates the limitations associated with the traditional method of dating Hohokam canals with time-sensitive ceramics.

Canal 1 Chronology

Following the discovery and documentation of Canal 1 in plan view and in profile (Steinbach et al. 2007:32–33), we began screening canal fill in an attempt to recover a sample of sherds that could be used to date the feature. Four crew members excavated and screened fill for more than two days. Their efforts resulted in the recovery of only one sherd that was temporally diagnostic, and no samples suitable for radiocarbon dating. The sherd dated to the early Snaketown phase, ca. A.D. 700–750. In addition, a pithouse (Feature 2) that was superimposed on the canal dated to the middle Sacaton phase, ca. A.D. 1000–1070 (Watkins 2007). The age during which Canal 1 was used is thus bracketed by the sherd and the overlying field house; it ranges from the early Snaketown to the middle Sacaton phases, a broad temporal span of more than 300 years.

Canal 2 Chronology

Rio Salado Archaeology researchers performed six independent chronological analyses using four different methods on samples from Channels II and III of Canal 2. The methods included ceramic cross-dating using decorated sherds (Gila and Tonto Polychrome), AMS radiocarbon analysis, blue light (quartz) and infrared light (feldspar) TL on a plain ware sherd, and two OSL dates of canal sediments. Stratigraphy was not effective in dating this feature, because no independently dated features were positioned above or below Canal 2 in a stratigraphic profile. The collective results of these different dating techniques are displayed in Table 1. The dates obtained from ceramic cross-dating, radiocarbon analysis, and TL overlap between A.D. 1320 and 1388 and fall in the Civano phase. However, the two OSL dates of sediment samples are much earlier.

The availability of additional dating techniques does not diminish the utility of ceramic cross-dating. Just as in Haury's era, it is analytically inexpensive to obtain dates through ceramic association; the technique is also quite accurate, particularly in light of the recent refinements to the Hohokam ceramic sequence (Wallace 2001, 2004a, 2004b). Gila and Tonto Polychrome sherds from multiple vessels were found in the base of Channel III in the excavated Canal 2 sample. Drawing on dendrochronological dates of small, briefly occupied sites, McCartney et al. (1994) showed that the production of Gila Polychrome began around A.D. 1320 and ceased by the end of the Hohokam tradition, ca. A.D. 1450. The presence of these sherds provided a relatively accurate date for the feature, even in the absence of other temporal indices. However, it is difficult to rely on ceramic cross-dating alone as a dating technique, because excavation does not always recover decorated sherds. Moreover, the use of multiple techniques often increases the precision of dating results.

The second method used to date the canal was TL analysis of a plain ware sherd, a pottery style that was used over a long period of time and that is not temporally diagnostic. Thermoluminescence (TL) analysis permits dating of any sherd recovered from a canal. This analytic tool lends itself particularly well to canals in which plain ware sherds are far more likely to occur than decorated sherds or charred organic material.

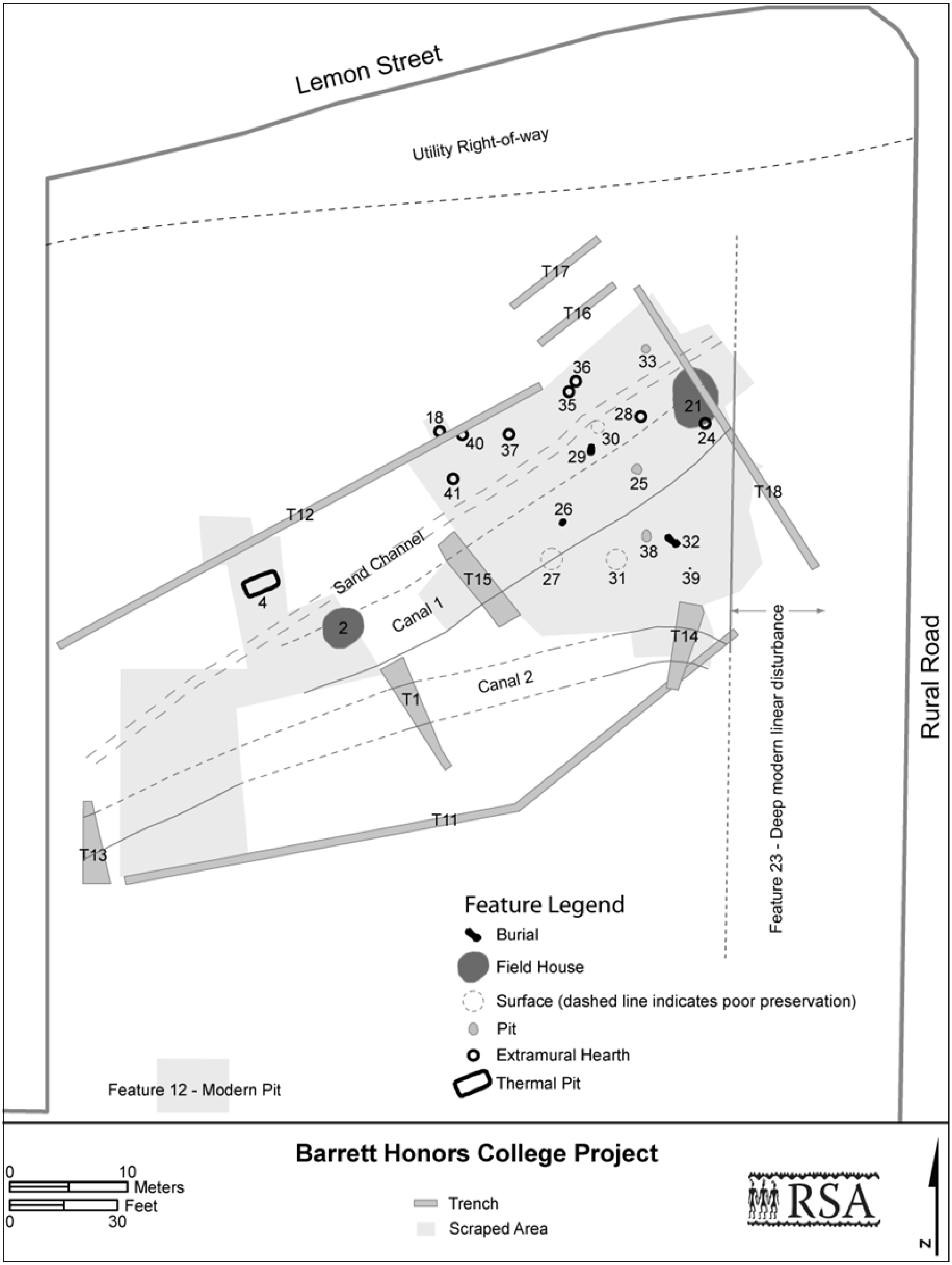


Figure 2. Features encountered at the Barrett Honors College site.

Table 1. Chronological indicators of Channels II and III, Canal 2.

Context	Sample Type	Date (A.D.)	Method
Channel III, Canal 2, T. 14	Sherds	1320-1450	Gila and Tonto Polychrome sherds
Channel III, Canal 2, T. 14	Charcoal	1290-1390	AMS assay (dendro-calibrated one-sigma range)
Channel II, Canal 2, T. 1	Sherd	1284-1388	TL (BOSL) analysis (95% confidence interval)
(second assay, same sherd)	(same)	1197-1437	TL (IROSL) analysis (95% confidence interval)
Channel III, Canal 2, T. 1	Sediment	1027-1111	OSL fine-silt SAR (95% confidence interval)
Channel II, Canal 2, T. 1	Sediment	216-700	OSL fine-silt SAR (95% confidence interval)

The plain ware sherd was recovered from near the middle of the fill deposits in Channel II of Canal 2. Dr. Carl Lipo of the University of California, Long Beach analyzed the sherd in two ways to obtain a date of the last time that the sherd was exposed to heat (Table 1) (Lipo et al. 2007). The use of blue light stimulation (BOSL) obtained a signal from quartz grains in the sand; this technique returned a date range of A.D. 1284–1388. The use of infrared light (IROSL) obtained a less-precise signal from feldspar grains; this approach returned a date range of A.D. 1197–1437.

The third method that we used to date Canal 2 was an AMS assisted radiocarbon analysis of burned annuals collected from the base of the canal's Channel III. The excavation crew observed concentrations of charcoal of a small, "brushy" plant during hand-excavation of the Salado Polychrome sherds exposed at the bottom of the canal feature. The crew collected these twigs that were later identified as *Pluchea* (arrowweed), an annual moisture-loving plant that commonly grew along the edges of Hohokam canals. *Pluchea* and other annuals are excellent candidates for radiocarbon dating , and are particularly well-suited to the dating of canals, as the original plants were likely burned during periodic canal maintenance. The tree-ring calibration of the one-sigma range for the date is A.D. 1290 to 1390 (Table 1).

In summary, the results of these three methods yielded highly comparable date ranges, with an overlap from A.D. 1320 to 1388 (Figure 3). Collectively, the dates place the use of the canal in the mid-Civano Phase (ca. A.D. 1300 to 1450). In contrast, two OSL dates of sediments obtained from the base of Channel III and the mid-point of Channel II produced very different dates. The OSL method employed here used a single-aliquot (SAR) fine-silt polymineral approach (Berger et al. 2004a, 2004b; Lipo et al. 2007).

The ranges of the two OSL dates of sediments are much earlier than the others (Table 1, Figure 3), a result we attribute to the inadequate bleaching of the sediments while suspended in the canal water. The OSL dates' lack of agreement with the date ranges returned by the other three, independent dating techniques suggests that the OSL method may be less accurate than the other techniques. Refinements in methods, such as the use of single-grain analysis (see below), may enhance the reliability of OSL dating on canal sediments in the future. However, this case suggests that the application of the SAR method to fine grains lacks the accuracy needed for confident employment as an independent form of canal dating.

Evaluation of Methods for Dating Canals

This study compared four techniques for dating canals: cross-dating of ceramic styles, AMS radiocarbon dating of charcoal from burned annuals, TL dating of plain ware sherds recovered from canal fill, and direct OSL dating of canal sediments. All four techniques were applied to the dating of a single canal feature; three yielded consistent results. Here, we evaluate each of these methods on 1) the elegance of the bridging argument linking the dated event to the targeted cultural event (Dean 1978), 2) the precision of the results, and 3) the availability of usable contexts.

In this case study, the most effective analytic technique for dating prehistoric canals is the TL dating of plain ware sherds recovered from canal fill. The technique yields accurate dates, which are more precise than tree-ring corrected radiocarbon dates. In addition, the samples are more abundant than decorated sherds or charcoal fragments, but less abundant than sediment samples. However, it is necessary to construct bridging arguments in order to relate the targeted to the dated events (the disposal of the sherd in the canal vs. the manufacture of the vessel). The other

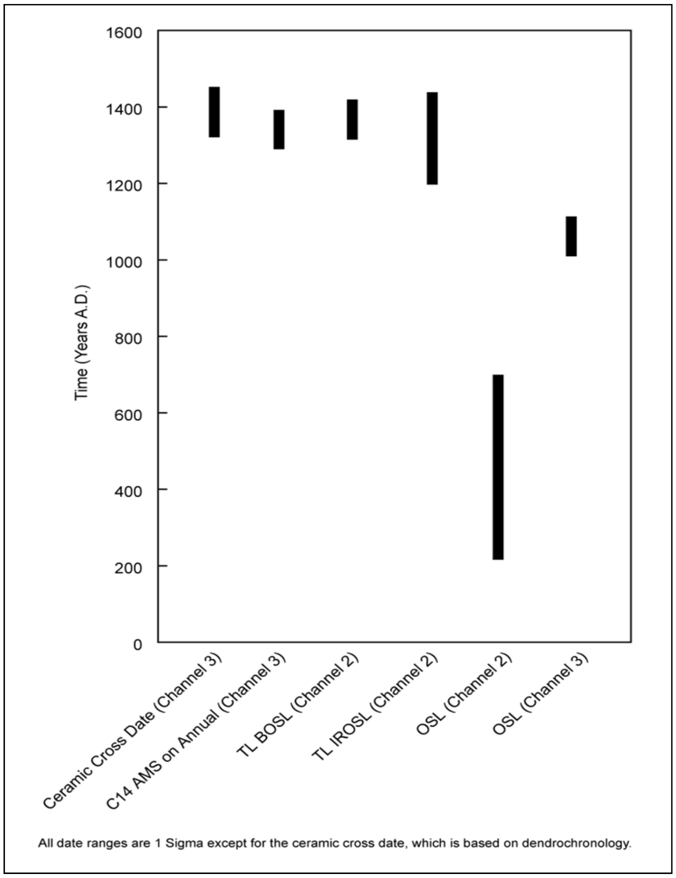


Figure 3. Dates associated with Canal 2.

available, viable methods require bridging arguments as well, though.

The second most effective method is AMS radiocarbon dating of charcoal fragments of annual plants. The technique yields accurate dates, and tree-ring corrected radiocarbon dates are more precise than phases (although they are frequently less precise than OSL dates). In addition, the target and dated events are closely associated when the samples are burned annuals. However, samples are less abundant than decorated sherds.

The third most effective technique is ceramic cross-dating that uses ceramic styles with a relatively narrow and known period of production. The technique yields dates that are equivalent to phases but that are less precise than OSL and tree-ring corrected C14 dates. The dating samples are more abundant than burned annuals but less so than sediment samples and plain ware sherds. Finally, bridging arguments are needed to link the targeted and dated events

At present, the OSL dating of canal sediments does not yield reliable results. The problem with this technique is that the effect of partial bleaching of the sediments cannot be identified and removed from the signal. Once material science has perfected a method for the luminescence dating of canal sediments (see below), such that the dated and targeted events are equivalent, it should have the highest priority in dating canals. There would be no need for a bridging argument linking the dated event to the target event, samples could be obtained from nearly every canal, and precision should approach or exceed tree-ring calibrated AMS radiocarbon dates.

CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

In the evaluation of chronological methods, it is important to distinguish between dated events and target events (Dean 1978). In the case of the OSL analysis of canal sediment, the date reflects the last exposure of the canal sediment to light, with the expectation that the dated event (the bleaching of the sediments) corresponds to the target event (the introduction of water into the canal by humans). In order for the OSL dating of canal sediments to be applied widely, researchers must demonstrate that that these two events are consistently the same. Moreover, the method can have a significant impact on the archaeological analysis of irrigation features if researchers develop a procedure for identifying when these two chronological events are not the same.

Berger et al. (2004a, 2004b) have contributed to the study of the OSL dating of Hohokam canal sediments by demonstrating that the single-aliquot regeneration (SAR) method has greater precision than a multi-aliquot (MA) approach. They also found overlap in the standard deviation of the averages of three sets of dates for a single canal: nine multi-aliquot (MA) OSL dates (819 +/-45 years bp), five single-aliquot (SAR) OSL dates (826+/-32 years bp), and two AMS radiocarbon (tree-ring calibrated) dates (761+/- years bp). Despite the general congruence between the three methods (AMS radiocarbon, MA OSL, and SAR OSL), the overlap between the AMS dates and the SAR dates is only 8 years, and the SAR dates are older than the AMS dates. Thus, the level of congruence between the more precise of the two OSL methods and the AMS dates is tenuous. In addition, the older age of the OSL dates relative to ASM dates raises the potential that partial bleaching of grains affected the OSL dates in their study.

Using independent dating procedures, our case study has demonstrated that OSL sediment dates for canals at the Barrett Honors College site were considerably older than the dates provided by three other methods. Since the three independent methods yielded three highly consistent dates from the same context, we conclude that the OSL sediment assays provided a dated event (bleaching of the silts) that was not contemporary with the target event (use of the canal). Our findings, coupled with the results of the study by Berger et al. (2004a, 2004b), suggest that current methods for the OSL dating of Hohokam canal sediments do not as yet generate reliable results, and that the results are frequently older than expected.

A potential methodological solution is the application of single-grain OSL techniques (for an overview see Duller 2004). In single-grain OSL, the unit of analysis is the individual grain, whereas other techniques analyze several grains simultaneously and calculate an average to arrive at an assay. Single-grain OSL may be particularly applicable to Hohokam canal sediments, because the pre-Hohokam dates of some individual grains would identify them as grains that were not sufficiently exposed to sunlight while they were suspended in the canal water. These grains can then be removed from the analysis, and the dating of the canal sediment can be based on particles that reflect the target dating event.

Other techniques, such as MAAD IRSL (Wright et al. 2007), may also prove to date Hohokam Canals accurately. On-going research by Dr. David K. Wright and others at the Cultural Resource Management Program of the Gila River Indian Community is investigating the applicability of this technique to Hohokam canal sediments (personal communication, 2008).

Finally, our case study demonstrates the utility of using TL dating of plain ware sherds to date canal use. The elegance of TL dating of ceramics is that the firing of the pot is commonly both the dated and the target event (Feathers 2003). An additional bridging argument is needed when the age of a sherd is used to date the canal. The researcher must be able to argue that a minimum amount of cultural time separates the manufacture of the vessel from its deposition in the canal. However, note that this argument of association also applies to ceramic cross-dating and to the AMS radiocarbon dating of charcoal inclusions. Overall, the TL dating of plain ware sherds, the AMS radiocarbon dating of burned annuals, and the ceramic cross-dating of decorated sherds in canal sediments yielded consistent results. These three independent results together increase our confidence of a late Classic period age (A.D. 1320 to 1389) for Canal 2 at the Barrett Honors College site.

REFERENCES CITED

Berger, Glenn W., T. Kathleen Henderson, D. Banerjee, and Fred L. Nials

2004a Luminescence Dating of 13 Silt Samples from the Sky Harbor Airport Canals, Phoenix, Arizona. In *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*, edited by T. Kathleen Henderson, pp. 319–328. Anthropological Papers No. 10. Pueblo Grande Museum, Phoenix, Arizona.

2004b Photonic Dating of Prehistoric Irrigation Canals at Phoenix, Arizona, U.S.A. *Geoarchaeology* 19:1–19.

Dean, Jeffrey S.

1978 Independent Dating in Archaeological Analysis. In *Advances in Archaeological Method and Theory*, Volume 1, edited by M. B. Schiffer, pp. 223–255. Academic Press, New York.

Duller, Geoff A.T.

2004 Luminescence Dating of Quaternary Sediments: Recent Advances. *Journal of Quaternary Science* 19:183–192.

Feathers, J.K.

2003 Use of Luminescence Dating in Archaeology. *Measurement Science and Technology* 14:1493–1509.

Haury, Emil W.

1976 *The Hohokam, Desert Farmers and Craftsmen: Excavations at Snaketown, 1964-1965*. University of Arizona Press, Tucson.

Lipo, Carl P., Kristin Safi, and Sachiko Sakai

2007 Appendix D – Luminescence Results. In *Hohokam Canals and Field Houses on the ASU Campus: The Barrett Honors College Site, Arizona State University*, edited by E. Steinbach, C. N. Watkins, and G. E. Rice, pp. 151–156. Technical Report No. 07-16. Rio Salado Archaeology, LLC., Tempe.

McCartney, Peter H, Owen Lindauer, Glen E. Rice, and John C. Ravesloot

1994 Chronological Methods. In *Archaeology of the Salado in the Livingston Area of Tonto Basin, Roosevelt Platform Mound Study: Report on the Livingston Management Group, Pinto Creek Complex, Part 1*, edited by David Jacobs, pp. 21–50. Roosevelt Monograph Series 3, Anthropological Field Studies 32. Office of Cultural Resource Management, Department of Anthropology, Arizona State University, Tempe.

Steinbach, Erik, Christopher N. Watkins, and Glen E. Rice (editors)

2007 *Hohokam Canals and Field Houses on the ASU Campus: The Barrett Honors College Site, Arizona State University.* Technical Report No. 07-16. Rio Salado Archaeology, LLC., Tempe.

Turner, Raymond M. and David E. Brown

1982 Lower Colorado River Valley Subdivision. In *Biotic Communities of the American Southwest–United States and Mexico*, edited by David E. Brown. Desert Plants Vol. 4 (1-4):190–200.

Wallace, Henry D.

2001 Time Seriation and Typological Refinement of the Middle Gila Buffware Sequence: Snaketown Through Soho Phases. In *Grewe Archaeological Project: Vol. 2. Material Culture, Part 1. Ceramic Studies*, edited by D. R. Abbott, pp. 177–261. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff and Tempe, Arizona.

2004a Update to the Middle Gila Buff Ware Ceramic Sequence. In *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*, edited by T.K. Henderson, pp. 45–124. Anthropological Papers No. 43. Center for Desert Archaeology, Tucson. Anthropological Papers No. 10. Pueblo Grande Museum, Phoenix, Arizona.

2004b Appendix B: Coding and Variable Definitions. In *Hohokam Farming on the Salt River Floodplain: Refining Models and Analytical Methods*, edited by T. K. Henderson, pp. 231–246. Anthropological Papers No. 43, Center for Desert Archaeology, Tucson. Anthropological Papers No. 10, Pueblo Grande Museum. Phoenix, Arizona.

Watkins, Christopher N.

2007 Ceramics from AZ U:9:281 (ASM). In *Hohokam Canals and Field Houses on the ASU Campus: The Barrett Honors College Site, Arizona State University*, edited by E. Steinbach, C. N. Watkins, and G. E. Rice, pp. 73–94. Technical Report No. 07-16. Rio Salado Archaeology, LLC., Tempe.

Wright, David K., S.L. Forman, C.M. Kusimba, J. Pierson, J. Gomez, and P. Tattersfield

2007 Stratigraphic and Geochronological Context of Human Habitation Along the Galana River, Kenya. *Geoarchaeology* 22:709–728.

FINDING THE HOHOKAM LANDSCAPE

Ronnie Dunn
David Jacobs

ABSTRACT

Archaeologists have identified Hohokam material remains on the physical landscape of south-central Arizona, and are beginning to integrate these findings into a more complete understanding of the cultural landscape that comprised the Hohokam world. One aspect of this understanding requires moving beyond individual remnants of material culture and cementing together the many pieces into a meaningful assortment. A closely related aspect is embracing a nonwestern perspective, preferably one stemming from an indigenous aboriginal perspective claiming prehistoric linkage. This paper focuses on the Hohokam cultural landscape as a space defined by both material activities (e.g., subsistence, habitation, travel) and those nonmaterial activities (e.g., rituals, songs, words) that impart meaning to the physical world. Special attention is paid to portions of the landscape away from villages that were important ritually and that likely served to promote regional integration.

The picture of the Hohokam world that has emerged in recent years is one of large irrigation-based communities centered on villages with public architecture. Typically, the focal point of research has been the individual village, or in some instances a group of villages linked by a network of canals that were first recorded by Omar Turney in 1929 (Figure 1). Many of these villages exhibit a formal structure consisting of one or more central plazas surrounded by house clusters, cemeteries, mounds, and public architecture, such as ballcourts and platform mounds (Gregory 1991; Haury 1976; Wilcox et al. 1981). Central plazas appear to have constituted part of the integrative core of Hohokam communities (Wallace 2007). They were likely an area where games, ceremonies, and other ritual activities were conducted. These shared activities are believed to have helped integrate populations residing at different settlements along the canal system. The widespread distribution of ballcourts and platform mounds further suggests the presence of a shared cultural identity and the emergence of an integrated regional system that operated above the level of the individual community (Wilcox 1991; Wilcox and Sternberg 1983).

In this paper, we argue that discussions of cultural identity and regional integration need to go beyond large villages and public architecture and to consider areas outside of the village that were also important ritually and that may have served to integrate neighboring communities. We refer to these areas as liminal spaces (after Turner 1969 and Leach 1976). In in the case of the Hohokam, these spaces likely included prominent places on the physical landscape, such as mountains, rock shelters, springs, and other bodies of water, as well as areas imbued with cultural meaning, such as travel corridors (trails) and ancestral shrines. Importantly, the attachment of the mythical and ritual to liminal spaces can provide a way of integrating communities through shared ideologies, without the need of an overarching political structure. This is especially true in instances where liminal spaces among communities may overlap.

LIMINAL SPACES: CONCEPTUAL CONSIDERATIONS

The works of Victor Turner (1969) and Edmund Leach (1976) provide theoretical explanations for ceremonial areas that are associated with contexts located away from villages and near what can be considered the outer edges of a larger community. Turner (1969:166), building on van Gennep's (1960) theory of rites of passage, proposed a theory of ritual process suggesting that ritualized performance is organized

Ronnie Dunn / Rio Salado Archaeology, LLC. / ronldunn@aol.com
David Jacobs / Arizona State Historic Preservation Office / djacobs@azstateparks.gov

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 169-175

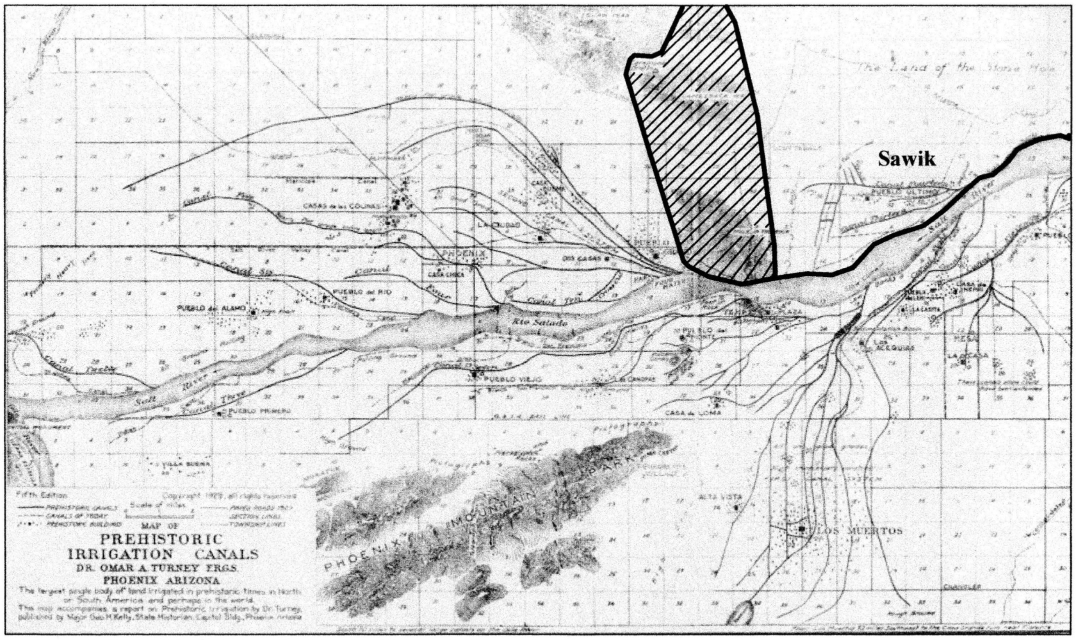


Figure 1. Prehistoric irrigation canals and shared liminal zones between Pueblo Grande (Canal System 2) and Sawik (Scottsdale) Communities (Canal Systems 13 and 14). Note: Base map by Turney (1929). Hatched area corresponds to Zone VII in Doyel and Crary 1995).

into three phases: (1) preliminal, (2) liminal, and (3) postliminal. Using rites of passage as an example, the preliminal phase refers to one's status prior to the ritual. For example, in a marriage ritual, one enters the ritual as an unmarried person. During the liminal phase, one is in an ambiguous position in that he or she is neither married nor unmarried; rather, the person is in a temporal state of no social status. After the liminal climax of a ritual, one enters the postliminal phase in which he or she is now ritually transformed and socially recognized as maintaining a status of married.

Edmund Leach extended Turner's concept of liminality to include time and space. Leach (1976) suggested that the physical and mythical worlds of tribal societies tend to maintain spatially overlapping areas that he called "liminal zones." For example, if a group of people considered their community area to be safe and the great expanse beyond the community area to be dangerous, then the combined result is an ambiguous space that cannot be defined as either safe or dangerous. This ambiguous portion of land is what Leach defines as a liminal zone; it is neither here nor there, but someplace in between. Besides a spatial model of a liminal zone, Leach also accounted for temporal liminal zones. However in this paper, we focus only on the spatial (Leach 1976) and ritual (Turner 1969) aspects of liminality.

Songscapes

Songscapes, which are landscapes remembered and discussed in songs, represent one example of the ways in which places outside villages are incorporated into O'odham historical narratives. Sections of the song trail for one of these songscapes—the Oriole song—is shown in Figure 2 (Note that song trails are often named after animal spirits.) (see Darling and Lewis 2007:133–135). The portion of the Oriole song trail that is shown in the figure extends north from O'odham farming villages along the middle Gila River

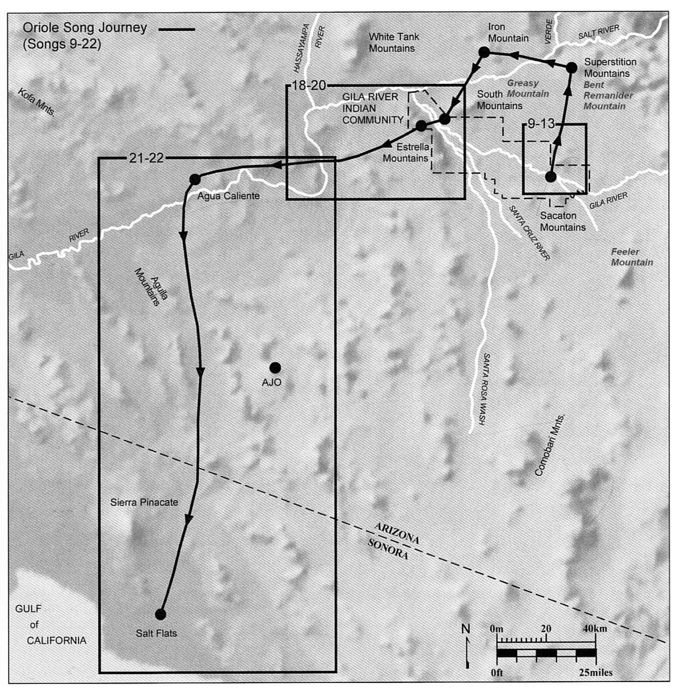


Figure 2. Oriole Song Journey (adapted from Darling and Lewis 2007: Figure 16.4).

to the Superstition Mountains, then west to Iron Mountain, south to South Mountain, and southwest to the Estrella Mountains, eventually crossing the Paguería and ending up at the salt flats on the Sonoran Gulf Coast, before returning home to the Gila River. Pilgrimages to these salt flats were considered important religious events for the O'odham. Darling and Lewis (2007:135) reported that they "offered opportunities for dreaming and acquiring spiritual power." Likewise, Bahr (personal communication, 2008) offered the following statement about O'odham songscapes: "For the ordinary reader it may be helpful to think of a Piman sing as an imagistic montage, a travelogue of the sacred geography of *jewed ka:cim*, the O'odham homeland." Songscapes illustrate how the landscape and places within it serve as a tangible reminder and validation of ideologies and oral histories maintained by the O'odham people.

Storied Mountains

Nearly every mountain or butte in the Salt and Gila River valleys holds some level of historical significance to the O'odham; however, other features such as certain ponds, caves (Russell 1975), and hot springs held similar importance (Bahr et al. 1997; Darling and Lewis 2007:134). To illuminate the storied roles that mountains play in maintaining oral traditions, we discuss the oral histories tied to three mountains in the Salt and Gila River valleys.

South Mountain is one of several mountains in Arizona with strong cultural affiliations to Yuman-speaking tribes living along the Colorado and Gila rivers, and to Uto-Aztecan-speaking O'odham tribes who historically occupied the lower Salt and middle Gila valleys. The current name for South Mountain is derived from an Anglo reference that locates the mountains with respect to the Salt River. The accepted indigenous (Pee-Posh) name for this range of mountains is Greasy Mountain (*vikwaxa's*), which refers to its association "as the scene of the incident in the Creation tale where Coyote finished eating the culture hero's heart and wiped his greasy hands" on the mountain (Spier 1978:253). There is an O'odham creation story that uses a similar motif for South Mountain and that attributes a similar cultural significance to the mountain (Bahr 2001:22-25). This story recalls that "the people overtook Coyote, and he (Coyote) ran northward across the Gila, where he ate the (Rabbit's) heart, and as he did so the grease fell upon every stone of the mountain, which accounts for its appearance and the name it bears to this day *Móhatûk*, Greasy Mountain" (Russell 1975:217). The motif for both the Yuman (Pee-Posh) and O'odham stories associated with South Mountain is concerned with each culture's reaction to death and the consumption of a deceased figure's heart.

A dominant figure associated with South Mountain is Elder Brother, the creator of the O'odham people as well as their Huhugam (Hohokam) ancestors. In one story, Elder Brother had a home in South Mountain, and it was while he was living here that the Hohokam came to kill him (Shaw 1968:15–16). South Mountain is one of several mountains where Elder Brother was supposed to have lived; other mountains where Elder Brother lived include Baboquivari Peak (Griffith 1992; Lumholtz 1990:42; Underhill 1969) and the Sierra Pinacate Mountains in northern Mexico (Lumholtz 1990:192, 208). Most O'odham currently believe that Elder Brother lives in a cave on Baboquivari Peak. Therefore, South Mountain is a place associated with stories from several cultures, and it is considered a very important place among the O'odham and several Yuman-speaking tribes.

The Superstition Mountains are another important place for the O'odham. Oral traditions state that, during ancient times, there was a flood that resulted in the destruction of many of the inhabitants of the land. The flood was caused by the tears of a crying child. During the flood, a group of people went to the Superstition Mountains in an effort to escape, but they were apparently unsuccessful and were turned into stone (see Bahr et al. 1994; Russell 1975:211–212). According to O'odham oral traditions, these petrified people still stand as sentinels on the summit of the southwest portion of Superstition Mountains and as a constant reminder of the relationship this mountain has with the O'odham people.

The Picacho Mountains are another mountain range tied to several O'odham creation stories (Bahr et al. 1994). One story tells of a human-eating witch and another tells of a figure called Corn Man, who supposedly lived somewhere in these mountains as well as several other mountains associated with the Gila River Valley (Bahr et al. 1994:99–100). The witch lived in a cave in this mountain after leaving her home at the Casa Grande Ruins (Bahr et al. 1994:146–149). Both of these figures and the Picacho Mountains play significant roles in O'odham oral traditions.

Marking the Landscape with Shrines

Just as mountains remind people of mythological events, so, too, have people created features on the landscape that remind them of events in the past. Various O'odham shrines include but are not limited to mortar shrines (Russell 1975), devil shrines (Kozak and Lopez 1999), summit shrines (Russell 1975), and geoglyphs (Russell 1975). The O'odham landscape has many features like these shrines; some are well known and others are less recognized. One of the best known and largest shrines is the Children's Shrine in the Santa Rosa Valley of southwestern Arizona.

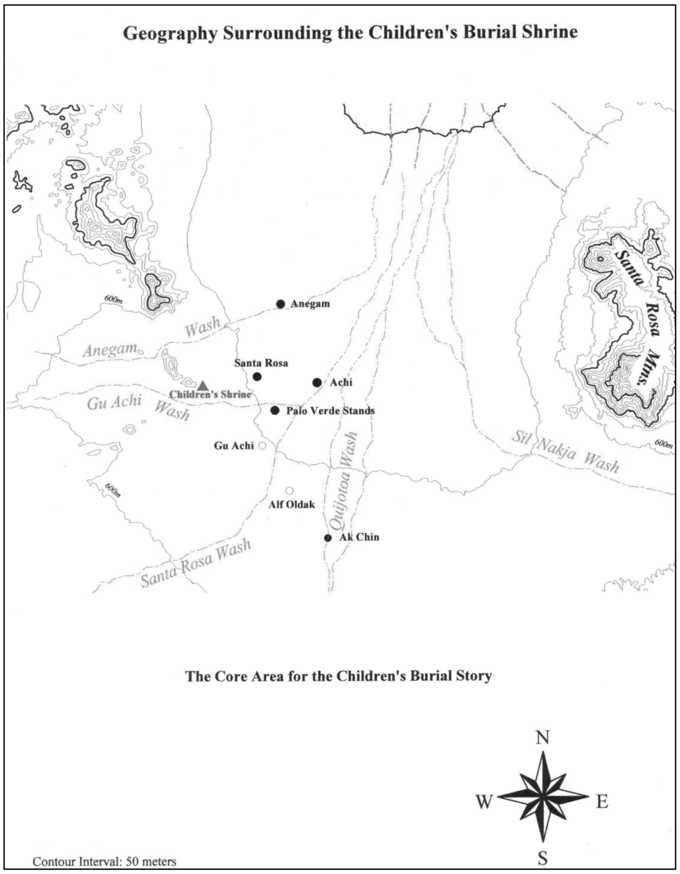


Figure 3. Santa Rosa Valley.

The Children's Shrine is a geoglyph-type shrine that is not located in any particular mountain range; rather, it is situated near a drainage between two buttes. It is an ancient shrine that, according to historical narratives, is the place where four children were sacrificed to avoid a flood (Lopez 2007:118). Figure 3 shows the location of this shrine in a liminal zone to the west of the four Tohono O'odham communities that maintain it. A ceremony known as the *Wigita* ceremony, which is based on story from oral traditions, is associated with the shrine. The context of the Children's Shrine supports the claim that stories are a requisite part of rituals, and that the sharing of liminal space is akin to sharing a common story that structures ritual performance.

The Children's Shrine is important because it not only embodies ideologies associated with the O'odham, but it also mimics attributes of a mythical landscape that recognize rain houses located in each of the four cardinal directions. That is, the Children's Shrine symbolizes a miniature mythical landscape within a larger natural landscape. The shrine is surrounded by a palisade of ocotillo wands with openings corresponding to each of the four cardinal directions. According to Underhill (1969), each opening is linked with a sacrificed child and an associated rain house.

IDENTIFYING LIMINAL SPACES IN THE ARCHAEOLOGICAL RECORD

It is clear that investment in intensive irrigation agriculture fundamentally altered the cultural landscape of the Hohokam. At the same time, many subsistence activities continued to be located away from villages and agricultural fields, even after the canal systems had been developed, reconfigured, and expanded. Maize, beans, squash and other plants (e.g., cotton) were cultivated in fields watered by irrigation canals, but other plants and animal resources composed substantial portions of the Hohokam diet, and many of these resources were located away from the canal systems.

Doyel and Crary's (1995) analysis of the Sawik (Scottsdale) irrigation community in the eastern Phoenix Basin provides an example of this resource diversity. As shown in Figure 4, Doyel and Crary (1995) postulated that the Sawik community was divided into nine resource zones related to particular uses or activities. Figure 5 provides an idealized view of these zones as they ranged from the river's edge, across the terraces of irrigable land, up the slopes through the ba-

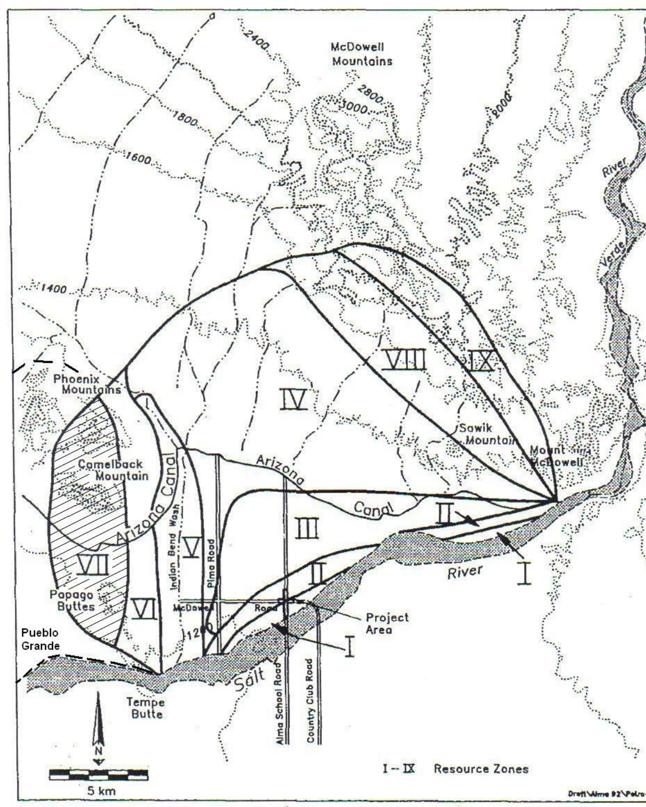


Figure 4. Suggested resource zones for the Sawik (Scottsdale) Community (adapted from Doyel and Crary 1995: Figure 21.02). Note: Hatched area represents shared liminal zone between the Pueblo Grande community (dashed lines) and the Sawik community (solid lines).

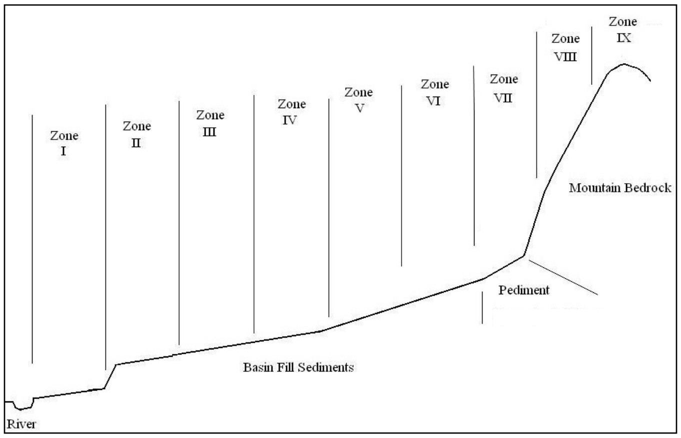


Figure 5. Idealized section view of Sawik Community Resource Zones I - IX (adapted from Doyel and Crary 1995).

jadas, and onto the upper elevations of the mountains. All of these spaces were arenas where people from Hohokam communities likely conducted activities, and thus they should be considered part of a Hohokam cultural landscape. Similarly, during analysis of the Marana Platform Mound community, Suzanne and Paul Fish (2007:39–47) incorporated the use of zonal patterning in an attempt to understand Hohokam use of the Tortolita Mountain bajadas. They were able to identify six different zones based on type of vegetation, elevation, and resource availability.

One implication of the zonal model that Doyel and Crary (1995) and Fish and Fish (2007) have advanced is that ceremonial areas are often in places away from residential sites. In the case of the Sawik community, for example, important ceremonial areas were located at Hole in the Rock on Papago Buttes and in the Ceremonial Grotto on Camelback Mountain. Both landscape features are located some distance from the nearest villages (see Figure 1). Importantly, both of these places are also close to Pueblo Grande and likely functioned as ceremonial areas for settlements along Canal System 2, in addition to those along the Sawik System. This implies that ceremonial areas in liminal spaces need not be mutually exclusive; they can overlap into areas that do not belong to any one particular community.

If we follow Doyel and Crary's (1995) lead on community zonal patterns, we are led to the conclusion that Pueblo Grande, like the Sawik community, had a ritual area at the periphery of the community. Thus, the Papago Park area would have held a shared ritual relationship among people living in the the Pueblo Grande and Scottsdale communities (Figure 6). There is archaeological evidence to support the hypothesis that prehistoric residents of Pueblo Grande did have ritual ties to Papago Park. The northeast corner of one of the rooms on top of the platform mound at Pueblo Grande has an opening that is oriented toward Hole in the Rock. At a certain time of year, a beam of light is cast across the floor of the room and terminates in the southwest corner of the room. It has been suggested that the relationship of this opening and its resulting annual play of light functioned as a type of solar marker for Summer Solstice sunrise, which would rise over a particular place in Papago Park. Therefore, the data suggests that both the Scottsdale community and the Pueblo Grande community shared the ritual liminal

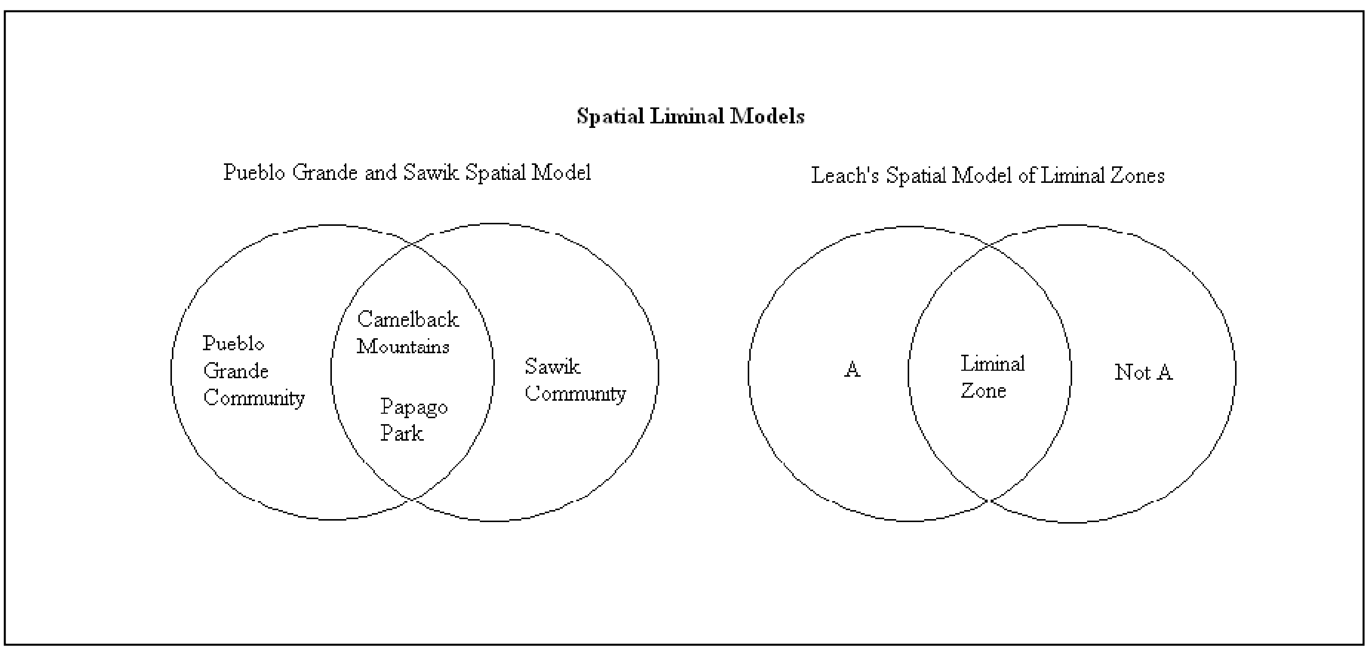


Figure 6. Spatial relationship of Pueblo Grande (Canal System 2) and Sawik (Scottsdale) Communities (Canal Systems 13 and 14) and Leach's model of liminality (1976:82).

space (Papago Park) located between the two canal systems.

Although most archaeologists correlate ritual activities to features such as plazas, ballcourts, and platform mounds, Bostwick and Krocek (2002:216) suggest that some ritual activity might have occurred on South Mountain. This idea is consistent with Leach's (1976) theory of spatial liminality and suggests that such activity areas represent outside community liminal zones. It is important to note, however, that all of the ritual activities and ritual locations discussed thus far have been directed toward activities and places not located inside any particular settlement.

Oral histories and liminal spaces tied to landscapes outside of community areas may eventually become symbolically reconstructed inside community areas in the form of ballcourts, plazas, and platform mounds (cf Donald 1991). All of these features symbolically represent an ideological position in the oral history of the people at the time of any particular construct. Although there is no present method of proving or disproving the possibility, we suspect that ballcourts, platform mounds, and plazas represent aspects of the natural environment that symbolized ideologies once attached to various features and locations outside or at the periphery of community areas.

SUMMARY AND CONCLUSIONS

In this article, we have attempted to demonstrate that, even though the majority of Hohokam material culture is associated with farming villages located along canal systems, there is a large body of evidence related to Hohokam ritual and ideology associated with places located outside of village boundaries. We have also argued for the archaeological value of oral histories. Storied mountains, orations, and songscapes are modes of discourse that involve landscapes of ritual and liminal significance to the O'odham people, and it is likely that they served a similar function among the Hohokam. Potter (2004) has recently observed that there is more to cultural landscapes than land and geography, and that landscapes are both a conceptual and behavioral process. He notes that "[l]andscapes are created by human activity, which is influenced not only by the distribution of resources on the land but also by cultural perceptions of human relationships to these resources" (Potter 2004:322). Indigenous perspectives of the landscape, as expressed in oral histories, should therefore not be dismissed. Instead, they should be viewed, like the archaeological record, as windows to the past.

Acknowledgements. The authors wish to thank Don Bahr for his intellectual insights into the Southwestern native perspective of the landscape and its characterization in their oral traditions.

REFERENCES CITED

Bahr, Donald (editor)
2001 *O'odham Creation and Related Events: As Told to Ruth Benedict in 1927*. University of Arizona Press, Tucson.

Bahr, Donald M., Lloyd Paul, and Vincent Joseph
1997 *Ants and Orioles: Showing the Art of Pima Poetry*. University of Utah Press, Salt Lake City, Utah.

Bahr, Donald M. Juan Smith, William Allison, and Julian Hayden
1994 *The Hohokam Chronicles: The Short Swift Time of Gods on Earth*. University of California Press, Berkeley.

Bostwick, Todd W., and Peter Krocek
2002 *Landscape of the Spirits*. University of Arizona Press, Tucson.

Darling, J. Andrew, and Barnaby V. Lewis
2007 Songscapes and Calendar Sticks. In *The Hohokam Millennium*, edited by S. K. Fish and P. R. Fish, pp. 131–139. School for Advanced Research Press, Santa Fe.

Donald, Merlin
1991 *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition*. Harvard University Press, Cambridge, MA and London.

Doyel, David E. and Joseph S. Crary
1995 The Sawik Community. In *Archaeological Excavations at Pueblo Blanco: The MCDOT Alma School Road Project, Volume 2*, edited by D. E. Doyel, A. T. Black, and B. S. Macnider, pp. 467–481. Cultural Resources Report No. 90. Archaeological Consulting Services, Tempe.

Fish, Suzanne K. and Paul R.
2007 Community, Territory, and Polity. In *The Hohokam Millennium*, edited by S. K. Fish and P. R. Fish, pp. 39–47. School for Advanced Research Press, Santa Fe.

Gregory, David A.
1991 Form and Variation in Hohokam Settlement Patterns. In *Chaco & Hohokam: Prehistoric Regional Systems in the American Southwest*, edited by P. L. Crown and W. J. Judge, pp. 159–193. School of American Research Press, Santa Fe.

Griffith, James S.
1992 *Beliefs and Holy Places: A Spiritual Geography of the Pimeria Alta*. University of Arizona Press, Tucson.

Haury, Emil W.
1976 *The Hohokam: Desert Farmers and Craftsmen, Excavations at Snaketown, 1964-1965*. University of Arizona Press, Tucson.

Kozak, David L. and Lopez, David I.
1999 *Devil Sickness and Devil Songs*. Smithsonian Institution Press, Washington and London.

Leach, Edmund
1976 *Culture and Communication: The Logic by Which Symbols Are Connected*. Cambridge University Press, Cambridge, UK and New York.

Lopez, Daniel
2007 Huhugam. In *The Hohokam Millennium*, edited by S. K. Fish and P. R. Fish, pp. 117–121. School for Advanced Research Press, Santa Fe.

Lumholtz, Carl M.
1990 *New Trails in Mexico*. University of Arizona Press, Tucson.
Potter, James M.
2004 The Creation of Person, The Creation of Place: Hunting Landscapes in the American Southwest. *American Antiquity* 69(2):322–338.
Russell, Frank
1975 *The Pima Indians*. The University of Arizona Press, Tucson.
Shaw, Anna Moore
1968 *Pima Indian Legends.* The University of Arizona Press, Tucson.
Spier, Leslie
1978 *Yuma Tribes of the Gila River*. Dover Publications Inc., New York.
Turner, Victor
1969 *The Ritual Process: Structure and Antistructure*. Aldine Press, Chicago.
Turney , Omar
1929 Prehistoric Irrigation. *Arizona Historical Review* 2 (5).
Underhill, Ruth M.
1969 *Papago Indian Religion*. AMS Press Inc., New York.
van Gennep, Arnold
1960 *The Rites of Passage*. University of Chicago Press, Chicago.
Wallace, Henry D.
2007 Hohokam Beginnings. In *The Hohokam Millennium*, edited by S. K. Fish and P. R. Fish, pp. 13–21. School for Advanced Research Press, Santa Fe.
Wilcox, David R.
1991 Hohokam Social Complexity. In *Chaco & Hohokam: Prehistoric Regional Systems in the American Southwest,* edited by P. L. Crown and W. J. Judge, pp. 253–276. School of American Research Press, Santa Fe.
Wilcox, David R. and Charles Sternberg
1983 *Hohokam Ballcourts and Their Interpretation. Archaeological Series No. 160*. Arizona State Museum, University of Arizona, Tucson.
Wilcox, David R., Thomas R. McGuire, and Charles Sternberg
1981 *Snaketown Revisited: A Partial Cultural Resource Survey, Analysis of Site Structure, and an Ethnohistoric Study of the Proposed Hohokam-Pima National Monument*. Archaeological Series No. 155. Arizona State Museum, University of Arizona, Tucson.

SALT, SEASHELLS, AND SHINY STONES: PREHISTORIC HOHOKAM RESOURCE EXPLOITATION IN THE PAPAGUERÍA AND NORTHERN GULF OF CALIFORNIA

Douglas R. Mitchell
Michael S. Foster

ABSTRACT

The prehistoric Hohokam made use of obsidian, marine shell, and salt for tools, ornaments, and food. Many of these materials were obtained during trips through the Papaguería in southwestern Arizona and on the coast of the Gulf of California in northern Mexico. The purpose of this paper is to describe the routes and strategies that may have been used by the Hohokam to procure and transport these valuable materials across the region. We use archaeological examples and ethnographic accounts to support our reconstructions that Hohokam travelers likely used an embedded procurement strategy that involved procurement of all three resources in a single, important expedition.

Prehistoric peoples living in Hohokam settlements of central and southern Arizona procured and used marine shell, obsidian, and salt with some regularity, along with a number of other resources located in the wider Sonoran desert region. While there is ample direct evidence in the archaeological record that prehistoric people used shell and obsidian, archaeologists can only infer from ethnographic studies of O'odham populations that Hohokam inhabitants of the Phoenix and Tucson basins used salt. Both shell and salt were available along the margins of the northern Gulf of Mexico in the area around what is now Puerto Penasco, Sonora. To access these two resources, prehistoric occupants of Hohokam villages must have traveled through the Papaguería, the arid southwestern desert of Arizona. Importantly, this area also contains several obsidian sources, including the Sauceda Mountains and Los Vidrios sources, resources that were valuable to the Hohokam, especially in late prehistory.

This paper discusses procurement strategies that Hohokam inhabitants of the Phoenix and Tucson basins may have used to acquire salt, marine shell, and obsidian. We argue that prehistoric people employed an embedded procurement strategy (Binford 1979) along with a kin-based exchange pattern (see Peterson et al. 1997). This procurement and exchange arrangement involved logistical forays into the Papaguería and to the coastal zone to acquire all three of these materials during a single expedition (also see Slaughter and Lascaux 2000:517–520; Tagg and Heilen 2008:79–84).

PROCURING SALT, SHELL, AND OBSIDIAN

Archaeologists have long recognized that Hohokam populations and other prehistoric peoples in the northern Sonoran desert obtained marine shell for making ornaments from the northern Gulf of California. Travelers, explorers, shell specialists, geologists, and university archaeologists have visited the gulf area since the early 1900s. Carl Lumholz (1990), a Norwegian explorer who traveled in northern Sonora and southern Arizona in 1909 and 1910, provided one of the earliest accounts of the gulf. His travelogue described the Tohono O'odham salt expeditions as both an economic and religious activity. It also includes discussion of shell and obsidian artifacts along the Rio Sonoita and saltpans and freshwater springs on the coast.

Salt

No archaeological evidence exists for the use of salt at Hohokam archaeological sites in southern Arizona. Nonetheless, it was undoubtedly an important supplement to the Hohokam diet. Salt was mined prehistorically in the Verde River Valley north of Phoenix (Morris 1928) and was also likely gathered from the margins of the Gulf of California.

Douglas R. Mitchell / PaleoWest Archaeology / dmitchell@paleowest.com
Michael S. Foster / Logan Simpson Design, Inc. / mfoster@logansimpson.com

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 176-184

Frank Russell, who lived with the Pima Indians in 1901 and 1902, discussed the Papago salt expeditions. He cited an 1859 report by Indian agent John Walker (1860), "These Papagos regularly visit a salt lake which lies near the coast and just across the line of Sonora, from which they pack large quantities of salt…" (Russell 1975:94). Lumholz also described large salt deposits that he visited in the Sierra Pinacates in 1909 and 1910. He described one deposit as

> A distance of only three miles inland, but necessitating laborious travel over sand dunes, brought us to the largest Salina in that part of the country. This salt deposit has sometimes been called Salina Grande. Surrounded by sand dunes of medium size, it appears to be from twenty to thirty feet above sea-level. It is two miles long at its greatest length, three-quarters wide at its broadest point, and this breadth is maintained for at least half a mile, where the most valuable part of it is. Walking across it, I found the salt hard and beautifully white, and the middle section appeared deep [1990:261].

Underhill (1938:111–114; 1946) also described the salt pilgrimage of the Papago as an arduous journey that was intricately linked with attaining "ocean power," making rain, and symbolic corn. This expedition included recognized leaders who had experience from many previous trips and knew the locations of the trails and water sources. The event was communal and "any village which had decided on a trip would send messengers to its neighbors, inviting recruits" (Underhill 1946:213). The trips appear to have been restricted to males and served as a rite of passage for younger males. In describing the return, Underhill stated,

> [W]hen they reach the home village, they make a triumphant entry. The old women help themselves to salt, and the boys swing slabs of wood on long strings to simulate the sound of rain. That night, everyone gathers in the council house. The neophytes sit to one side with the trophies they have brought from the seashore—white shells or scraps of seaweed, 'ocean clouds', which will act as magic charms for the rest of their lives. In the center is the basket of 'sea corn'. Each pilgrim has contributed to it some of his precious load…. [1938:130].

It is likely that a simple evaporation method, or a variation of it, was used along the upper Gulf of California coast by the prehistoric and historic peoples. Andrews (1983:16) described a salt making method used by the Maya. He reported, "The most widespread method used today is solar evaporation, whereby salt water from coastal estuaries is collected in shallow pans and allowed to evaporate by solar action until only salt, known as *sal solar*, remains." He concluded that solar evaporation had been a basic salt-making technique in the Yucatecan salinas for more than 2,000 years. Andrews (1983:109) also noted that such activities are not visible in the archaeological record.

While searching for shell middens during an archeological reconnaissance survey in the Puerto Peñasco area of northern Sonora between 1997 and 2007 (Foster et al. 2008; Mitchell and Foster 2000), we identified several large salt flats adjacent to estuaries, including a particularly large one adjacent to Estero las Lisas (Figure 1). These flats are probably a result of occasional tidal surges that left salt residue after evaporation.

Shell

Hohokam use of marine shell is well documented in the archaeological record (e.g., Hayden 1972; Doyel 1991; Gifford 1946; Haury 1976; Jernigan 1978; McGuire and Howard 1987; Nelson 1991). Nearly all of the shell found within Hohokam villages came from the northern Gulf of California in the vicinity of Puerto Peñasco and the nearby shores of Bahía Adair. The margins of the northern Gulf in these areas are lined with hundreds of shell midden sites that represent food remains that accumulated over a 5,000-year period (Foster et al. 2008; Foster et al. 2011; Mitchell and Foster 2000). These middens not only contain the remains of shellfish and other marine fauna, but also include a variety of artifacts, principally pottery sherds, flaked stone, and ground stone (Gifford 1946, 1948).

Archaeological evidence from Hohokam villages suggests that *Glycymeris* and *Laevicardium* were the

Figure 1. Salt flat near Estero las Lisas.

two most commonly collected genera of shell from the northern Gulf. *Glycymeris* shell was procured primarily for the manufacture of bracelets, whole shell pendants, effigies, and rings. *Laevicardium* was used for cut shell ornaments, disk beads, and pendants. A myriad of other genera were also collected for crafting tinklers, rings, whole shell pendants, and even trumpets (see Mills and Ferguson 2008; Nelson 1991). Much of the shell tends to lack the distinctive coloration that can be found on live or recently dead animals, indicating they were likely collected from shore deposits or perhaps fossil shell beds exposed in dune faces lining the shore.

Despite having visited numerous sites along the northeastern shore of the northern Gulf, we have identified only limited evidence for the manufacture of shell ornaments. To date, we have found only two *Glycymeris* shell bracelet blanks. Both blanks were produced from old, worm eaten shells and they may have been discarded because they were of insufficient quality to warrant further reduction and finishing.

We have not found any evidence of shell workshops or any shell working tools such as reamers or other implements (e.g., Copus 1993). Other researchers have found limited evidence for *Glycymeris* shell manufacturing on these coastal midden sites (see Brusca and Poulus 2000; Mabry 2008). Sites in the western Papaguería, areas such as Growler Wash, Lost City, and the Gila Bend area, exhibit evidence of various stages of shell ornament manufacture (e.g., Howard 1993, 2000; Lyon et al. 2008; Martynec and Martynec 2008; Slaughter and Lascaux 2000).These sites contain shell debitage, ornaments broken during production, ornament blanks, and shell working tools.

Obsidian

Hohokam inhabitants of the Phoenix and Tucson basin exploited four obsidian sources in the Papaguería and in the modern day state of Sonora: Sauceda, Los Vidrios, Los Sitios del Agua (formerly referred to as Unknown A), and Sand Tank obsidian (Martynec et al. 2011; Mitchell and Shackley 1995; Shackley 1988, 1995). All these sources lie within the corridor that Hohokam populations used to travel between southern Arizona and the northern Gulf of California.

The most important Papaguería obsidian source occurs in the Sauceda Mountains. The significance of this source is demonstrated in an analysis of southern Arizona artifact assemblages where nearly 50 percent of 617 obsidian artifacts sourced from eight different Classic period villages in the Phoenix Basin and Tucson Basin were traced to the Sauceda source (Table 1). The obsidian nodules that Hohokam peoples likely gathered have eroded out of primary geological contexts over the centuries and are now spread over several miles. According to Shackley (2005:42), the secondary deposition of this material follows Sauceda Wash for at least 20 km and perhaps as much as 35 km. The nodule size averages about 5 cm, with some examples

Table 1. Comparison of obsidian types from various Classic Period Hohokam sites in Southern Arizona, showing the number of artifacts by obsidian source (data from Mitchell and Shackley 1995).

Source	Phoenix Area sites (n=311)	Brady Wash Sites (n=69)	Picacho Sites (n=30)	Escalante Ruin (n=29)	Marana (n=178)	Total
Sauceda Mts.	84	53	8	18	152	315
Vulture	106	5	3	--	10	124
Flagstaff volcanics*	65	3	--	1	--	69
Superior	32	2	1	8	7	50
New Mexico volcanics**	--	2	14	1	7	24
Los Vidrios	8	2	3	1	--	14
Tank Mts.	2	--	--	--	--	2
Unknowns[t]	14	2	1	--	2	19

Note: Phoenix area sites include Pueblo Grande, Grand Canal Ruins, Casa Buena, Rolley Site

*Flagstaff Volcanics include Government Mountain, Partridge Creek, RS Hill

**New Mexico Volcanics include Cow Canyon, Mule Creek, Antelope Wells

[t] Unknowns – includes the newly discovered Los Sitios del Agua (formerly AZ Unknown A)

measuring up to 8 or 9 cm. Shackley described the material as translucent green brown, with variations of black, green and light gray bands. He noted that "this obsidian makes excellent knapping raw material, equal to any in the Southwest" (Shackley 2005:42).

The Sierra Pinacate volcanic fields in northern Sonora also yield obsidian that Hohokam people from the Phoenix and Tucson basins collected, known as Los Vidrios obsidian. The relative low importance of obsidian from this source, in comparison to material from the Saucedas, is evidenced in the same artifact analysis discussed above. Only 14 of 617 pieces were traced to the Los Vidrios source (see Table 1). Raw material from this source has probably been eroding into the Rio Sonoita over long periods of time. Los Vidrios obsidian occurs as nodules with a brown to gray cortex and black, opaque interiors. Shackley (2005:79) noted that, although the material is good, its use may have been restricted because it is quite brittle.

Shackley reported an archaeological obsidian source that was common in assemblages analyzed from Organ Pipe National Monument and also occurred in assemblages from Gila Bend and Pueblo Grande. He referred to this source as "AZ Unknown A," and speculated that it probably occurred on the western edge of the Tohono O'Odham reservation (Shackley 2005:76). Recently, members of the Ajo Chapter of the Arizona Archaeological Society discovered the geological source for this obsidian near the Los Vidrios source (Martynec et al. 2011). The source formerly referred to as "AZ Unknown A" has now been renamed Los Sitios Del Agua obsidian. The obsidian occurs as small nodules and ranges from translucent dark green to opaque light green (Martynec et al. 2011). Although analysis of its distribution at Arizona archaeological sites was not done for this study, we suspect that its distribution is quite similar to Los Vidrios since it is located only a few kilometers away from that geological source, and is also along the Rio Sonoita.

A fourth obsidian source also exists in the Papaguería. The Sand Tank obsidian is located near Gila Bend in the Sand Tank Mountains (Shackley and Tucker 2001). This obsidian is found in low proportions at sites in the Gila Bend area and at sites in the Hohokam core area in the Phoenix Basin. However, it is reportedly high quality obsidian. Small nodules (3–4 cm) of Sand Tank obsidian erode into the Sand Tank Wash.

TRAILS AND TRAVEL CORRIDORS

Trails and travel corridors were used by prehistoric peoples in this region to gather resources and move them across the landscape. Trails and corridors, some with shell petroglyph markers, have been identified in the Papaguería of southwestern Arizona (Hayden 1972). Specialized shell manufacturing sites, such as Verbena Village, Lago Seco (Huckell 1979), and Lost City (Fontana 1965; Martynec and Martynec 2008), have also been identified along these routes (McGuire 1982; Schiffer and McGuire 1982).

Access to the northern Gulf area was likely through two primary routes: one that followed the now extinct Rio Sonoita and the other around the Sierra Pinacate through the Desierto de Altar to the eastern edge of the Bahía Adair. Archaeologists have speculated that travel occurred in several areas that included the Growler Valley, the Sauceda Valley, and along the Rio Sonoita (Figure 2) (e.g., Hayden 1972; Lyon et al. 2008).

Trails, trail markers, and campsites associated with travelers making their way to the northern Gulf and its varied and abundant resources have been identified (Becker and Altschul 2008; Darling and Lewis 2007; Hayden 1972). Drawing on anthropologist Donald Bahr's work with Native American songs (Bahr et al. 1997), Darling and Lewis (2007) present a compelling case for a specific travel itinerary from the Gila River to the Salt Flats on the Sonoran coast.

DISCUSSION

Various behavioral models have been offered to address shell acquisition and the production and distribution of finished shell ornaments. These descriptive models generally fall into two categories. The first type of model suggests that Hohokam groups in central and southern Arizona directly exploited raw shell sources and that the logistical group then produced shell craft items at sites from which they originated. The second type argues that groups of people in the Papaguería acquired shell for the production of ornaments and then exchanged raw shell and finished ornaments with Hohokam groups in the Tucson and Phoenix basins. It is unlikely that either model alone accounts for Hohokam resource acquisition; rather, different strategies may have prevailed at different times.

For example, Howard (1985) has argued that, during the Pre-Classic period, Papaguerían communities were the primary procurers of raw shell and the primary producers of shell ornaments, which were then traded to Hohokam populations in the Gila Bend, Santa Cruz River Valley, and the Phoenix Basin. During the Classic period, there was an increase in the local production of shell ornaments in the Phoenix Basin. Howard (1985) has proposed that the Papaguerían provided raw shell to Phoenix Basin Hohokam populations, who then produced finished ornaments in their villages. Although Howard's production/exchange model suggest Papaguerían populations played major roles in the acquisition of raw shell during both the Pre-Classic and Classic periods, her models do not specifi-

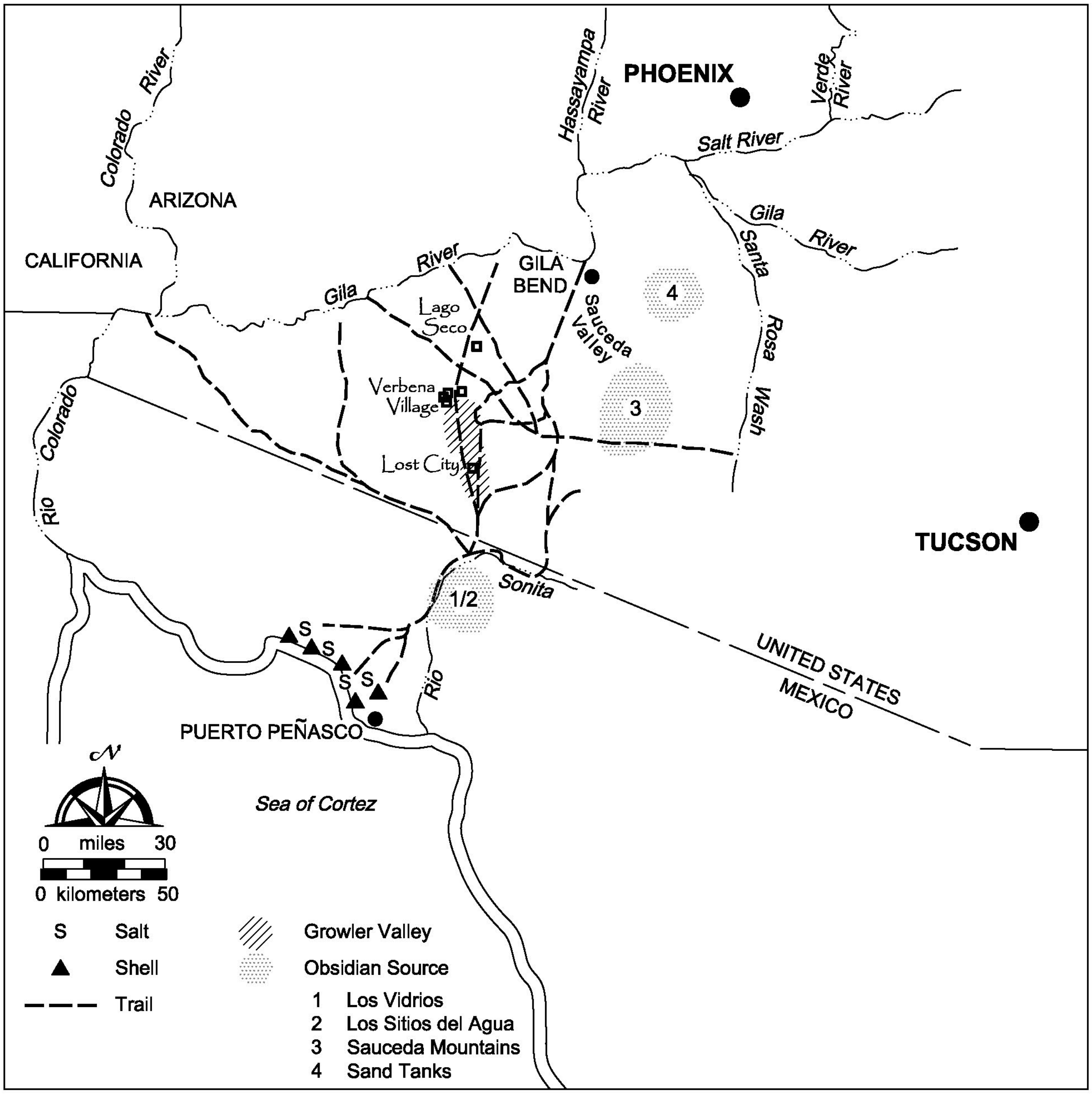


Figure 2. Salt, shell, and obsidian source locations and trails that may have been used by the Hohokam to access these resources.

cally exclude the possibility that Hohokam villagers from the Phoenix and Tucson basins trekked to the coast to collect shell and other resources (e.g., Haury 1976:306–307; Hayden 1972). As Haury (1976) noted, travel to shell sources would have allowed Hohokam collectors to be highly selective. The Papaguerians, because of their proximity to the resource and use of the general area, were probably the primary providers of raw shell to the Hohokam. However, their role as producers of finished ornaments, as Howard (1985) noted, seems to have waned over time.

Current production/exchange models and their supporting data suggest that at least two procurement and production modes existed throughout the history of Hohokam marine shell use. During the Colonial and Sedentary periods, ca. A.D. 750–1150, the groups who occupied the western Papaguería may have used the procurement and exchange of shell with groups in the Hohokam core area as a buffering mechanism. More precisely, Papaguerían populations may have procured and traded shell to riverine Hohokam groups in exchange for food, cotton, and other goods that were scarce in their local environments. Based on their research at the Barry Goldwater Range, Ahlstrom and Chenault (2000:261) have suggested that these groups "were not core-area Hohokam passing through on their way to and from the gulf, but rather were the inhabitants of the region who were participating in a system of shell procurement, production, and exchange." These people may have supplemented their subsistence by trading salt and shell to groups to the east and north for agricultural products. This hypothesis, that Papaguerían peoples were actively engaged in shell procurement, is supported by the identification of Papaguería plain ware pottery in coastal middens. Archaeological work at middens in the Puerto Peñasco area has found Sells Plain and Gila Bend varieties of Gila Plain, which were almost certainly manufactured at village sites in the Papaguería.

Interestingly, during the early part of the Pre-Classic period, obsidian appears to have been a minor component in the exchange system between Papaguería and Hohokam populations. It does not appear to have been an important resource at this time. Although Papaguerían populations probably played a significant role in acquiring shell directly from the Puerto Peñasco area during the Pre-Classic period, it is equally likely that some people from Hohokam villages ventured there directly from the Phoenix and Tucson basins. Such trips may have occurred during the late fall through early spring, when cooler weather prevailed and when winter rains provided drinking water in the scattered *tinajas* (natural rock tanks) and freshwater *pozos* that occur along the coast (Ezcurra et al. 1988; May 2007). In addition, Dettman's (2008) analyses of shell growth rings from shells found in coastal middens indicate that death occurred during the winter. Late fall and winter procurement would not have conflicted with agricultural activities of late spring through early fall. On the other hand, Underhill (1946:213) reported that the Tohono O'odham made salt gathering trips to the coast in the summer, because spring high tides left unusually large deposits of salt on the beach.

As Howard (1985) noted, procurement and exchange patterns appear to have changed during the Hohokam Classic period. At Pueblo Grande, some Classic period habitation areas and burial groups contained significantly higher quantities of shell than others did. This differential distribution led to the suggestion that certain lineages may have controlled particular economic resources such as shell (Mitchell 1994:172). Social groups within these lineages may have made treks to the coast to obtain this resource. In addition, obsidian use increased dramatically during the Classic period. Procurement and exchange patterns between the Papaguería and the Hohokam core area certainly reflect this escalation. According to Ahlstrom and Chenault (2000:261),

> It is probable that raw material obsidian from the Papaguerían sources was included with … shell and traded through the same network. In other words, the shell industry of the Pre-Classic period in the Papaguería evolved into an exchange industry of raw material shell and obsidian during the Classic period.

CONCLUSIONS

Hohokam peoples were efficient desert dwellers. They likely employed an embedded resource procurement strategy (Binford 1979) in their trips through the Papaguería. During their trips to collect shell, they undoubtedly gathered other resources from coastal environments and possibly from other environmental zones in the Papaguería. In an analysis of Hohokam obsidian procurement and distribution patterns, Peterson and colleagues (1997) evaluated three conceptual models: an opportunistic model, a centralized redistribution model, and a kin-based geographic model (also see Doyel 1991; Renfrew 1977). Peterson et al.'s opportunistic model for the procurement of obsidian describes a pattern in which distance to an obsidian source correlates highly with the quantity of material at a site (see Mitchell and Shackley 1995). The authors' centralized redistribution model envisions the flow of obsidian towards a central place, such as a platform mound village, through which the movement of obsidian is facilitated and/or controlled (see Doyel 1991). Finally, the kin-based geographic model suggests that the "distribution of obsidian at Classic period Hohokam sites is primarily a function of acquisition and exchange networks based on family or simple reciprocal ties" (Peterson et al. 1997:238).

We propose that a kin-based model, with an embedded resource procurement strategy for the collection of multiple resources, provides the best explanation for the observed archaeological patterns. This model suggests that acquisition and exchange networks are based on family connections or on simple reciprocal ties. The model accounts for the acquisition of both utilitarian and ritual items through reciprocal exchange relationships that existed among kin, neighbors, and other trading partners. Note that it does not rely on a hierarchical system of acquisition or redistribution. In our proposed model, individuals or small social groups either collected the materials themselves or participated in exchange for other materials. Once these groups returned to their villages, they could have then traded through their existing kin-based or friendly reciprocal relationships within the village and the larger community.

During the Hohokam Classic period, salt, obsidian, and shell were in frequent use and in high demand. Although beyond the scope of this paper, the movement and exchange of these resources took place within the Hohokam regional system. This distribution may have operated, in part, through a marketplace system first associated with ballcourts (e.g. Abbott et al. 2007; Doyel 1991) and later associated with platform mound villages.

Finally, knowledge about the locations of specific resources—shell, salt, obsidian, and drinking water—was undoubtedly passed from generation to generation by means of stories and songs (Darling and Lewis 2007; Rankin et al. 2008). The exact routes probably changed through time as the needs and tastes of villagers altered. As suggested by Darling and Lewis's (2007) reconstruction, trips were not straight-line, least-cost ventures. Rather, they involved stops along the way to visit with kin, allies, and potential or future trading partners. In addition, people may have taken large-village resources (e.g., agricultural produce, textiles, pottery) with them as exchange items. Further study of the sites along these Papaguerían travel corridors will help us better understand these patterns.

Acknowledgements. Partial funding for our work along the coast was provided by the Arizona Archaeological and Historical Society. Mexico's National Insituto Nacional de Antropologia e Historia (INAH) provided permits and the Center for the Study of Desert and Oceans often provided a place to stay. We would also like to thank colleagues Gary Huckleberry, Dave Dettman, and Karen Adams for various discussions and ideas. Stephanie Sherwood drew Figure 2. We would also like to thank Rick Martynec for sharing unpublished manuscripts about the discovery of the Los Sitios del Agua obsidian source.

REFERENCES CITED

Abbott, David R., Alexa M. Smith, and Emilano Gallaga
2007 Ballcourts and Ceramics: The Case for Hohokam Marketplaces in the Arizona Desert. *American Antiquity* 72(3):461–484.

Ahlstrom, Richard V.N. and Mark L. Chenault
2000 A Site-Database Approach to Themes in the Prehistory of the Western Papaguería. In *Living in the Western Papaguería: An Archaeological Overview of the Barry M. Goldwater Air Force Range in Southwestern Arizona*, edited by Richard V.N. Ahlstrom, pp. 217–263. Cultural Resource Report No. 98-186. SWCA Environmental Consultants, Tucson.

Andrews, Anthony P.
1983 *Maya Salt Production and Trade*. University of Arizona Press, Tucson.

Bahr, Donald, Lloyd Paul, and Vincent Joseph
1997 *Ants and Orioles: Showing the Art of Pima Poetry*. University of Utah Press, Salt Lake City.

Becker, Kenneth M., and Jeffrey H. Altschul
2008 Path Finding, The Archaeology of Trails and Trail Systems. In *Fragile Patterns, The Archaeology of the Western Papaguería*, pp.419–446, edited by Jeffrey H. Altschul and Adrianne G. Rankin. SRI Press, Tucson.

Binford, Lewis
1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35:255–273.

Brusca, Richard C. and Anastasia Poulus
2000 The Aboriginal Shell Middens of Estero Morua, Sonora, Mexico. Ms. on file, Arizona Sonora Desert Museum, Tucson.

Copus, James
1993 Shellworking Tools from Shelltown and the Hind Site. In *Shelltown and the Hind Site, a Study of Two Hohokam Craftsman Communities in Southwestern Arizona*, edited by W. S. Marmaduke and R. J. Martynec, pp. 424–448. Northland Research, Inc., Flagstaff.

Darling, J. Andrew and Barnaby V. Lewis
2007 Songscapes and Calendar Sticks. In *The Hohokam Millenium,* edited by Suzanne K. Fish and Paul R. Fish, pp. 131–140. School for Advanced Research Press, Santa Fe.

Dettman, David L.
2008 Seasonality of Prehistoric Fishing and Mollusk Collecting in the Puerto Penasco Area. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver, B.C.

Doyel, David E.
1991 Hohokam Exchange and Interaction. In *Chaco and Hohokam: Prehistoric Regional Systems in the American Southwest*, edited by P.L. Crown and W.J. Judge, pp. 225–252. School for American Research Press, Santa Fe.

Ezcurra, Exequiel, Richard C. Felger, Ann D. Russell, Miguel Equihua
1988 Freshwater Islands in a Desert Sand Sea: The Hydrology, Flora, and Phytogeography of the Gran Desierto Oases of Northwestern Mexico. *Desert Plants* 9:35–44.

Foster, Michael S., Douglas R. Mitchell, Gary Huckleberry, and David L. Dettman
2008 Observations on the Archaeology, Paleoenvironment, and Geomorphology of the Puerto Peñasco Area of Northern Sonora, Mexico. *Kiva* 73(3):263–290.

Foster, Michael S., Douglas R. Mitchell, Gary Huckleberry, David L. Dettman, and Karen R. Adams
2011 Archaic Period Shell Middens, Sea Level Fluctuation, and Seasonality: Archaeology Along the Northern Gulf of California Littoral, Sonora, Mexico. Accepted for publication in *American Antiquity*.

Fontana, Bernard L.
1965 An Archaeological Site Survey of the Cabeza Prieta Range, Arizona. Ms. on file, Arizona State Museum, Tucson.

Gifford, E.W.
1946 Archaeology in the Punta Peñasco Region, Sonora. *American Antiquity* 4:215–221.
1948 The Edward Winslow Gifford Papers: Archaeological Research in Puerto Penasco, Sonora, Mexico of 1948 -1949. Notes on file at the George and Ivtary Foster Anthropology Library, Kroeber Hall. University of California, Berkeley.

Hayden, Julian D.
1972 Hohokam Petroglyphs of the Sierra Pinacate, Sonora and the Hohokam Shell Expeditions. *Kiva* 37 (2): 74–83.

Haury, Emil

1976 *The Hohokam, Desert Farmers and Craftsmen. Excavations at Snaketown 1964-1965*. University of Arizona Press, Tucson.

Howard, Ann Valdo

1985 A Reconstruction of Hohokam Interregional Shell Production and Exchange within Southwestern Arizona. In *Proceedings of the 1983 Hohokam Symposium, Part II,* edited by A. E. Dittert, Jr. and D. E. Dove, pp. 459–472. Occasional Paper No. 2, Arizona Archaeological Society, Phoenix Chapter, Phoenix.

1993 Marine Shell Artifacts and Production Processes at Shelltown and the Hind Site. In *Shelltown and the Hind Site, a Study of Two Hohokam Craftsman Communities in Southwestern, Arizona*, edited by W. S. Marmaduke and R. J. Martynec, pp. 321–423. Northland Research, Inc., Flagstaff.

2000 Marine Shell Sample. In *Trade Corridors and Ethnic Boundaries: An Archaeological Survey of 12,089 Acres Along the Growler and San Cristobal Washes on the Barry M. Goldwater Range in Southwestern Arizona*, edited by M. C. Slaughter, D. B. Tucker, and A. Lascaux, pp. 481–486. Cultural Resource Report No. 98-181, SWCA Environmental Consultants, Tucson.

Huckell, Bruce B.

1979 *The Coronet Real Project: Archaeological Investigations on the Luke Range, Southwestern Arizona*. Archaeological Series No. 129. Arizona State Museum, Tucson.

Jernigan, E. Wesley

1978 *Jewelry of the Prehistoric Southwest.* University of New Mexico Press, Albuquerque.

Lumholtz, Carl

1990 *New Trails in Mexico: An Account of One Year's Exploration in North-Western Sonora, Mexico and South-Western Arizona, 1909-1910*. University of Arizona Press, Tucson. [Originally published 1912 by Charles Scribner's Sons, New York].

Lyon, Jerry D., Mark C. Slaughter, and David B. Tucker

2008 Shell Trade and Subsistence in the Western Paguería: The View from the Growler Valley. In *Fragile Patterns: The Archaeology of the Western Papaguería*, edited by Jeffrey H. Altschul and Adrianne G. Rankin, pp. 401–418. SRI Press, Tucson.

Mabry, Jonathan B.

2008 The Estero Morua-Lower Rio Sonoyta Project. Paper presented at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver, B.C.

Martynec, Rick and Sandy Martynec

2008 *Lost City, A Shell Jewelry Manufacturing Village*. Archaeological Series No. 2, Arizona Archaeological Society, Ajo Chapter.

Martynec, Rick, Rich Davis, and M. Steven Shackley

2011 The Los Sitios del Agua Obsidian Source (Formerly AZ Unknown A) and Recent Archaeological Investigations Along the Rio Sonoyta, Northern Sonora. *Kiva* 76 (4), in press.

May, Larry A.

2007 Pinacate Recon. In *Science on Desert and Lava: A Pinacate Centennial, Part I*, edited by Bill Broyles, pp.259–303. Journal of the Southwest 49(2).

McGuire, Randall H.

1982 Problems in Culture History. In *Hohokam and Patayan: Prehistory of Southwestern Arizona*, edited by Randall H. McGuire and Michael B. Schiffer, pp. 153–222. Academic Press, New York.

McGuire, Randall H. and Ann Valdo Howard

1987 The Structure and Organization of Hohokam Shell Exchange. *Kiva* 52(2):113-146.

Mills, Barbara J. and T. J. Ferguson

2008 Animate Objects: Shell Trumpets and Ritual Networks in the Greater Southwest. *Journal of Archaeological Method and Theory* 15(4): 338-361.

Mitchell, Douglas R.

1994 The Pueblo Grande Burial Artifact Analysis: A Search for Wealth, Ranking, and Prestige. In *The Pueblo Grande Project, Vol. 7: An Analysis of Classic Period Mortuary Patterns,* edited by Douglas R. Mitchell, pp. 129–206. Publications in Archaeology No. 20, Soil Systems Inc, Phoenix.

Mitchell, Douglas R. and Michael S. Foster

2000 Shell Middens Along The Sea of Cortez, Puerto Peñasco, Sonora, Mexico. *Journal of Field Archaeology* 27:27–41.

Mitchell, Douglas R. and M. Steven Shackley

1995 Classic Period Hohokam Obsidian Studies in Southern Arizona. *Journal of Field Archaeology* 22:291–304.

Morris, Earl H.

1928 *An Aboriginal Salt Mine at Camp Verde, Arizona.* Anthropological Papers of the American Museum of Natural History, Vol. 30, Part III: 77–97.

Nelson, Richard S.

1991 *Hohokam Marine Shell Exchange and Artifacts*. Archaeological Series 179. Arizona State Museum, Tucson.

Peterson, Jane, Douglas R. Mitchell, M. Steven Shackley

1997 The Social and Economic Contexts of Lithic Procurement: Obsidian from Classic Period Hohokam Sites. *American Antiquity* 62(2): 231–259.

Rankin, Adianne G., Lorraine M. Eiler, and Joseph T. Jaoquin

2008 Water and the Human Spirit: Traditional Sacred Natural Surface Waters. In *Fragile Patterns: The Archaeology of the Western Papaguería*, edited by Jeffrey H. Altschul and Adrianne G. Rankin, pp. 595–604. SRI Press, Tucson.

Renfrew, Colin

1977 Alternative Models for Exchange and Spatial Distribution. In *Exchange Systems in Prehistory*, edited by T.K. Earle and J.E. Ericson, pp. 71-90. Academic Press, New York.

Russell, Frank

1975 *The Pima Indians*. University of Arizona Press, Tucson. [Originally published 1908 in the Twenty-sixth Annual Report of the Bureau of American Ethnology, 1904-1908. Washington, D.C.]

Schiffer, Michael B. and Randall H. McGuire

1982 The Study of Cultural Adaptations. In *Hohokam and Patayan: Prehistory of Southwestern Arizona*, edited by Randall H. McGuire and Michael B. Schiffer, pp. 223–274.Academic Press, New York.

Shackley, M. Steven

1988 Sources of Archaeological Obsidian in the Southwest: An Archaeological, Petrological, and Geochemical

Study. *American Antiquity* 53: 752–772.
1995 Sources of Archaeological Obsidian in the Greater American Southwest: An Update and Quantitative Analysis. *American Antiquity* 60:531–551.
2005 *Obsidian: Geology and Archaeology in the North American Southwest.* University of Arizona Press, Tucson.

Shackley, M. Steven and David B. Tucker
2001 Limited Prehistoric Procurement of Sand Tank Obsidian, Southwestern Arizona. *Kiva* 66:345–374.

Slaughter, Mark C. and Annick Lascaux
2000 Trade Corridors and Ethnic Boundaries. In *Trade Corridors and Ethnic Boundaries: An Archaeological Survey of 12,089 Acres Along the Growler and San Cristobal Washes on the Barry M. Goldwater Range in Southwestern Arizona*, edited by Mark C. Slaughter, David B. Tucker and Annick Lascaux, pp. 511–526. Cultural Resource Report No. 98-181. SWCA Environmental Consultants, Tucson.

Tagg, Martyn D. and Michael P. Heilen
2008 Research Issues, Historic Context, and the National Register of Historic Places. In STAC 2003: Intensive Archaeological Survey of 4,945 Acres on the South Tactical Range, Barry M. Goldwater Range East, Arizona, edited by Martyn D. Tagg and Michael P. Heilen, pp. 45-98. Statistical Research Inc., Tucson.

Underhill, Ruth M.
1938 *Singing for Power: The Song Magic of the Papago Indians.* University of California Press, Berkeley.
1946 *Papago Indian Religion.* Columbia University Press, New York.

Walker, John
1860 Report to James L. Collins, Superintendent of New Mexico Indian Affairs, September 28, 1859. Report of the Commissioner of Indian Affairs, accompanying the Annual Report of the Secretary of the Interior for the year 1859, pp. 351–353, Washington.

TWO VILLAGES ON TUMAMOC HILL

Suzanne K. Fish
Paul R. Fish
Gary Christopherson
Todd A. Pitezel
James T. Watson

ABSTRACT

A prominent Tucson landmark, Tumamoc Hill has an extensive complex of stone trincheras features. It is the only such hill site in southern Arizona with substantial, well-documented occupations dating to the Early Agricultural (Cienega phase) and early Pioneer (Tortolita phase) periods. Massive walls and terraces encircling the hilltop represent one of the earliest communal-scale constructions in the U.S. Southwest during the Cienega phase. A diversity of other stone features is concentrated on the summit. Using current mapping techniques, augmented by excavations, recent University of Arizona investigations have generated data that allow an organizational assessment of Tumamoc's Tortolita phase village and insights into its place in regional settlement at the beginning of the Hohokam sequence.

Tumamoc Hill is an iconic, flat-topped peak (Figure 1) that affords an unsurpassed view east across the Tucson Basin, north as far as Picacho Peak, west to the Baboquiviri Mountains, and south halfway to the Mexican border. A prominent dark volcanic mass rising 228 m (700 ft) above the Santa Cruz River in today's downtown Tucson, Tumamoc must have been a defining element of the Tucson Basin landscape in the past as well. Archaeological remains dating from at least the Middle Archaic period to the present mark the hill's enduring significance for a continuing succession of visitors and residents.

Tumamoc Hill exemplifies a specialized site type that occurs mainly on volcanic hills throughout the U.S.-Mexico borderlands. Termed "trincheras sites," these are further defined by the presence of walls, terraces, and other features built of stone (Downum et al. 1994; Fish et al. 2007). Tumamoc possesses one of the most extensive and diverse complexes of trincheras features in southern Arizona (Figures 2 and 3). Massive walls and terraces surround the hill summit, where a wide array of additional features includes pithouses and other structures, residential walls and terraces, numerous bedrock mortars and cupules, extensive rock art, and an elaborate trail system.

RESEARCH BACKGROUND

The archaeology of Tumamoc Hill was systematically recorded by an Arizona Archaeological and Historical Society survey and mapping project, published in a 1979 special issue of *The Kiva* edited by David Wilcox and Stephen Larson. Project members mapped the layout of massive upper walls and terraces (Wilcox 1979), trails (Hartmann and Hartmann 1979), rock art (Ferg 1979), and ground bedrock features (Larson 1979), and they identified more than 100 rounded outlines or enclosures made of local stone (Larson 1979). In the absence of excavation, the predominantly circular cobble enclosures were interpreted as "sleeping

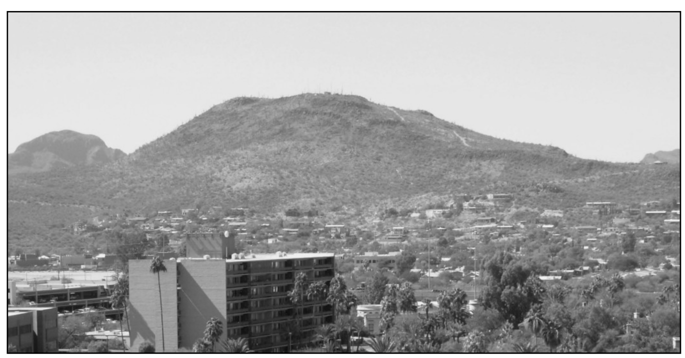


Figure 1. Tumamoc Hill from downtown Tucson, Arizona. Photograph by Paul Fish.

Suzanne K. Fish / School of Anthropology and Arizona State Museum, University of Arizona / sfish@email.arizona.edu
Paul R. Fish / School of Anthropology and Arizona State Museum, University of Arizona / pfish@email.arizona.edu
Gary Christopherson / Center for Applied Spatial Analysis, University of Arizona / garych@casa.arizona.edu)
Todd A. Pitezel / Arizona State Museum, University of Arizona / pitezel@email.arizona.edu
James T. Watson / School of Anthropology and Arizona State Museum, University of Arizona / watsonjt@email.arizona.edu

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 185-196

circles," the result of clearing the dense surface rocks to provide spaces for limited domestic activities and possibly ephemeral brush structures (Larson 1979:71–76; Wilcox et al. 1979:188–189). Study conclusions emphasized a defensive function for the massive walls and terraces around the summit (Wilcox 1979). The 1970s study attributed the trincheras features to the Hohokam of the late Sedentary or early Classic periods (Wilcox 1979:29) and possibly the Rillito or Rincon phases (Hartmann and Hartmann 1979:53–56). This interpretation was based on a surface collection of only 25 decorated sherds widely dispersed over the entire hill (Hartmann and Hartmann 1979:53). It was also noted, however, that there was an abundance of plain wares concentrated on the summit; plain ware densities were as high as 40 sherds per square meter (Larson 1979:76).

In 1985, a University of Arizona archaeological field school placed a single trench perpendicular to the wall of what was presumed to be a massive Hohokam terrace along the eastern summit edge to investigate the method of its construction and nature of the fill (Fish et al. 1986). A wholly unanticipated outcome was the recovery and direct dating of corn substantially older than the advent of ceramics in conjunction with Late Archaic period projectile points and burned daub. These materials were interpreted at the time as stratigraphically underlying the Hohokam terrace that had plain ware ceramics in its fill. Contrary to the then-current belief that corn and pottery appeared in the Southwest at roughly the same time (e.g., LeBlanc 1982; Plog 1980), Tumamoc Hill occupants clearly were farmers well before the everyday use of ceramic vessels. A Hohokam date for the major trincheras features, however, stood essentially unchallenged until a second field school investigation in 1998.

The 1998 expansion of the 1985 trench revealed that, rather than underlying the massive terrace, the early corn and projectile points came from a small pithouse without ceramics (Structure 8 in Figure 2) that was cut down from the terrace surface after the terrace was built. The pithouse depression had been reused during a subsequent occupation associated with plain wares and a few red-slipped ceramics. Previously radiocarbon-dated material collected from the 1985 trench (Fish et al. 1986:569, Table 5) inadvertently had been drawn from both the original and secondary pithouse occupations. The 1998 field school also excavated or tested seven of the cobble outlines or enclosures that are visible on the surface of the hilltop. This work confirmed that most alignments marked the basal stone walls of pithouses. These structures yielded plain wares, minor amounts of red wares, and small, contracting-stem points that appeared in the Tortolita phase, along with a mixture of larger and generally earlier point types (Wallace et al. 2007:57–63).

By 1998, a series of Tucson-area investigations had defined a long agricultural sequence preceding the appearance of Hohokam decorated pottery types (e.g., Huckell 1995, 1996; Mabry et al. 1996). According to this sequence, the small pithouse (typical of chronologically equivalent counterparts in Early Agricultural period settlements along the Santa Cruz River) was cut into the massive Tumamoc terrace during the middle-to-late interval of the Cienega phase (ca. 800 B.C. to A.D. 150) at the end of the Early Agricultural period. Together, the pottery, points, and radiocarbon dates from the later reuse of the terrace pithouse and from the cobble-outlined pithouses across the Tumamoc summit placed them in the Tortolita phase (ca. A.D. 475 to 700) of the ensuing Pioneer period (Wallace et al. 2007:58–59). A low percentage of red wares differentiates Tortolita phase assemblages from the solely plain ware assemblages of the preceding Agua Caliente phase (ca. A.D. 150 to 475) of the Early Ceramic period.

Archaeological investigations in southern Arizona and adjacent northwest Mexico during the late 1990s provided a regional framework for the realigned Tumamoc chronology. Massive terraces resembling those at Tumamoc Hill were studied on Cerro Juanaqueña and other hills in northwest Chihuahua (Hard and Roney 1998). They proved to be the work of early agriculturalists who had not yet adopted pottery, and their construction had begun even earlier than the Cienega phase dates from Tumamoc Hill (Roney and Hard 2002). Following the 1998 field school, other trincheras occupations dating to the era of initial plain ware ceramics were reported in southwest New Mexico (Roney 1999) and encountered during survey in northwest Sonora (Fish and Fish 2004:56).

University of Arizona field schools in 2005 and 2007 further confirmed the Tortolita phase affiliation of cobble-outlined pithouses throughout the Tumamoc summit by testing two more structures, selected for their rectangular shape and large size. Additionally, the 2005 and 2007 field schools conducted high resolution re-mapping of the massive encircling walls, trails, cobble outlines, and other hill features. They also documented for the first time the considerable extent of residential walls and terraces that modified the summit topography to facilitate village life. Guided by Gary Christopherson of the Center for Applied Spatial Analysis, researchers achieved these objectives through the use of geospatial technology, namely advanced global positioning system (GPS) receivers and total stations for the collection of data, and the development of a geographic information system (GIS) for data management and analysis (Christopherson et al. 2005). Results provide the basis for the quantified esti-

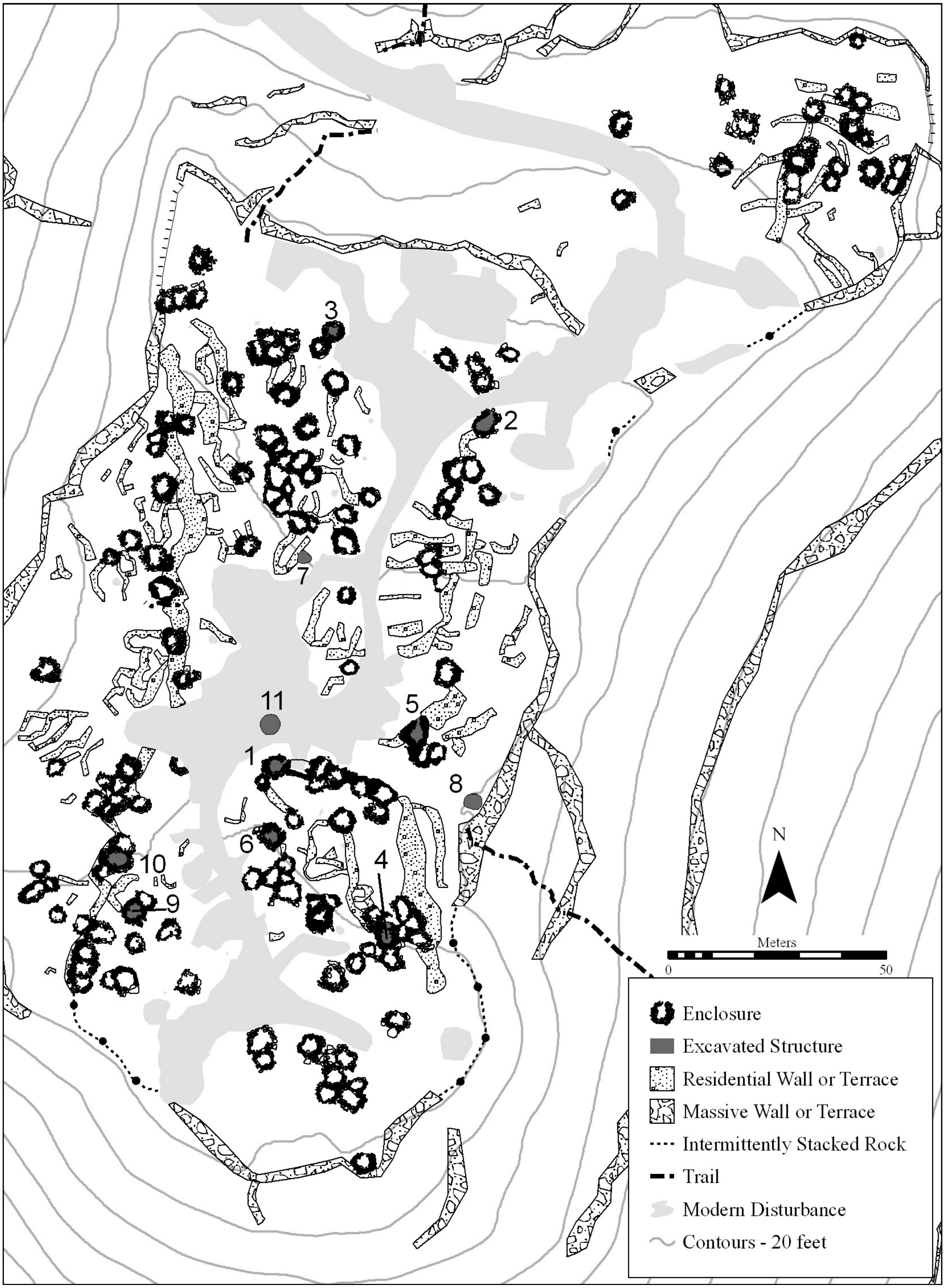


Figure 2. Excavated Tumamoc Structures. Round enclosures (Structures 1–7), Rectangular enclosures (Structures 9 and 10), Cienega/Tortolita phase pithouse (Structure 8), and Cienega/Tortolita phase community structure (Structure 11).

mates of construction effort and an analysis of Tortolita phase settlement structure discussed below.

CIENEGA PHASE VILLAGE: TUCSON'S FIRST PUBLIC ARCHITECTURE

The eastern terrace containing the small Cienega phase pithouse forms a segment of the massive linear features of roughly stacked volcanic boulders and cobbles that encircle the Tumamoc summit and the upper hill in variable tiers (Figure 3). For significant stretches, the term "terrace" is appropriate because the rock walls or berms hold sufficient rock and soil fill to create a level surface. In some of these stretches, the terrace fill also has sufficient width and depth to accommodate the dimensions of a pithouse. In other stretches, massive walls support little fill, and segments of both massive walls and terraces are sometimes connected by smaller walls or even single-boulder alignments. Free-standing walls and terraces are often wider than they are tall, with an average width of 2.4 m and a maximum width of 9 m. The standing heights of walls above ground surface almost never exceed 40 cm.

A very preliminary assessment of the effort invested in constructing these features is based on measurements of length and estimated volume of stone. Total length of all massive walls exceeds 1.9 km, and the total volume, calculated from regularly spaced measurements of wall cross-section, approximates 3,200 m^3. The larger boulders in the walls would have necessitated multiple persons for transport. Using Hard et al.'s (1999:139) labor figure of 1.9 person-hours per cubic meter of rock for the walls at Cerro Juanaqueña, Tumamoc's massive walls would have absorbed 1,013 person/days of labor at 6 hours per day, or the work of 100 persons for a little more than 10 days. In experimental terrace constructions at Cerro Juanaqueña, labor for the rock walls represents only about 40 percent of the total effort, which also entailed clearing the terrace area, laying it out, reinforcing the base, and filling it with stones and earth (Hard et al. 1999:136–138).

Although it is a rough estimate, the magnitude of effort associated with Tumamoc Hill's huge stone features strongly implies the coordinated work of many builders, especially if construction took place within a limited interval. The Cienega phase pithouse directly establishes an early construction date only for the eastern terrace segment on which it sat, but the size of this segment alone implies a degree of cooperative labor. Given the uneven topography of the hill, however, the encircling layout of the massive hilltop terraces and walls reflects a relatively uniform and continuous plan (Figure 3), suggesting general contemporaneity within the Cienega phase. Furthermore, this

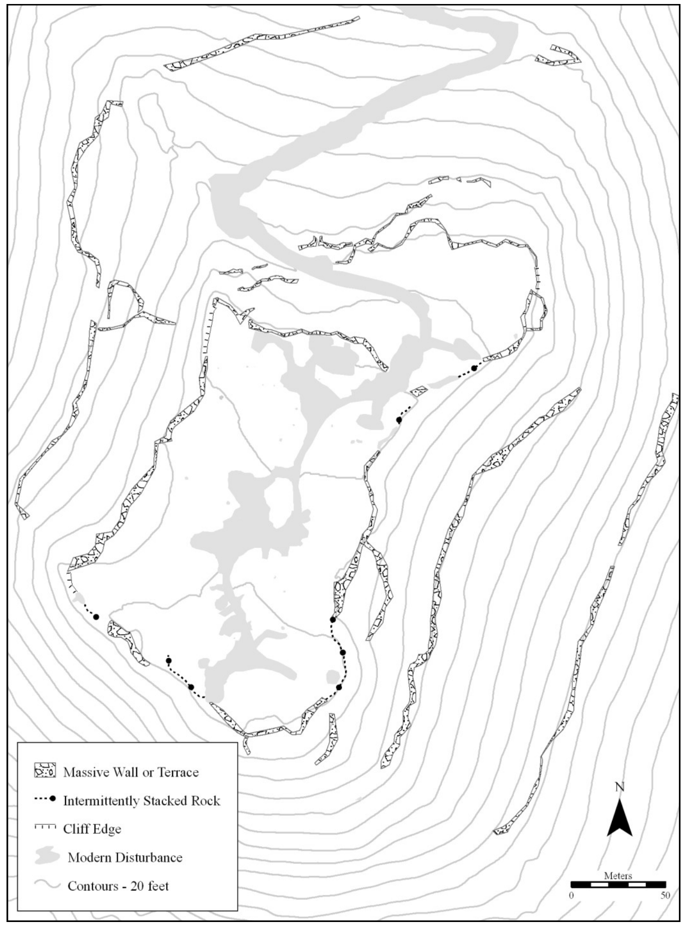


Figure 3. Massive walls and terraces encircling the Tumamoc summit.

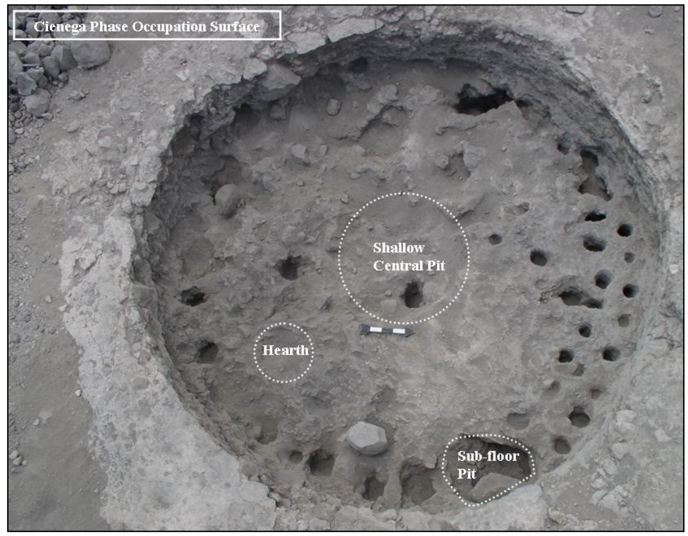
encircling pattern occurs only at Tumamoc Hill and not at any of the other Tucson area trincheras sites with later Hohokam occupations. A similar encircling layout at Cerro Juanaqueña is also firmly dated to an early agricultural era before the advent of common domestic pottery.

Tumamoc's eastern summit terrace at a minimum, and likely the massive linear features as a whole, constitute the earliest known "public" architecture in southern Arizona and possibly in the U.S. Southwest, in the sense that their construction was a sustained and coordinated enterprise entailing a communal-level investment of labor. Up to that time, Early Agricultural period farmers in Tucson had only come together at a comparable scale of effort to construct irrigation canals.

The single Early Agricultural period pithouse (Structure 8 in Figure 2) was purely a chance encounter while trenching the terrace; cobble outlines visible on the surface have all yielded Tortolita phase ceramic assemblages. Our current understanding of the extent of the Cienega phase residential component at the site is therefore based largely on the fact that the massive walls encircle the 6.4 ha (16 acres) summit area occupied by the later Tortolita village and that Early Agricultural period projectile point styles are scattered across the hilltop. In the year following the 2007 University of Arizona Archaeological Field School, James Watson's Indiana University-Purdue University, Indianapolis field school excavated a large, specialized structure in a central part of the summit (Figure 4). The identification of this structure suggests that additional Cienega dwellings were present. Like the small pithouse in the massive terrace, this community structure was first occupied during the Cienega phase and later reused during Tortolita times. The presence of a large, Cienega phase community structure, similar to those in other Early Agricultural period villages along the Santa Cruz floodplain (e.g., Freeman 1998; Halbirt and Henderson 1993; Mabry et al. 1996; Thiel and Mabry 2006), adds substance to the inference of a Tumamoc village at that time. Moreover, this Cienega phase community structure is centrally located on the summit. It is further noteworthy that both of the excavated Cienega phase structures were reused by subsequent Tortolita phase residents; removal of preceding floor deposits and the lack of Cienega phase diagnostics other than projectile points may obscure additional earlier occupations in some of the ceramic-bearing structures.

As with the small Cienega phase pithouse, no surface cobble enclosure was present to indicate the existence of the Cienega community structure (see Structure 11 in Figure 2). Instead, a modern utility road exposed the edges of its circular outline. It was cut 70 cm into the summit's solid caliche conglomerate substrate, and its nearly 16 m^2 floor plan recalls those of other Tucson community structures (Figure 4). An elongated, intentionally shaped rhyolite boulder with a battered upper surface was firmly embedded below the floor and protruded 25 cm above its surface. It is a distinctive feature that is duplicated in another excavated Cienega phase community structure on the river floodplain at the hill base (Homer Thiel, personal communication, 2008).

We characterize the Cienega phase occupation of Tumamoc Hill as a "village" with due caution, because it is based on direct information from only three known Cienega phase features: the massive eastern terrace which was likely built by multiple households, one domestic pithouse on the terrace surface, and the centrally located community structure. Botanical remains from the terrace pithouse span multiple seasons, consistent with an occupation of prolonged annual duration (Fish et al. 1986:565–566). This Tumamoc settlement overlooked in the floodplain immediately below a relatively dense contemporary occupation that included additional community structures and multiple canals (Thiel and Mabry 2006; also Homer Thiel, 2008, personal communication). Due to



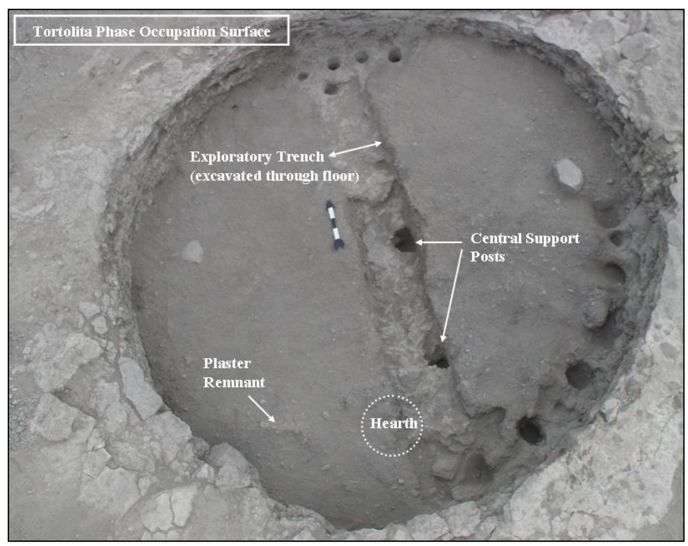


Figure 4. Cienega phase (above) and Tortolita phase (below) floor plans of the community structure. The elongated boulder protruding through the floors of both earlier and later floors is visible to the left of the sub-floor pit in the Cienega phase floor and near the upper right edge of the Tortolita phase floor.

its unique hilltop location, the settlement likely played an exclusive role in Cienega phase settlement pattern.

TORTOLITA PHASE VILLAGE: STRUCTURE AND ORGANIZATION

An early twentieth century perception of the Tortolita phase village, visibly demarcated by the cobble enclosures and as yet undisturbed by modern buildings and roads, is recounted in a newspaper article about the archaeological remains atop Tumamoc Hill. Archaeologists Byron Cummings and Robert Guilder (Anonymous 1919) insightfully reported, "The houses were probably one room affairs and were erected about a central plaza, streets radiating from the central point like the spokes of a wheel." They also provided an estimate of 250 structures. Their estimate is a potential maximum number of structures that has been reduced to an unknown degree in the following decades by extensive disturbance over nearly 20 percent of the central summit (Figure 2).

To capture the full range of residential infrastructure and to record the previously located enclosures in greater detail, the 2005 and 2007 field work emphasized total station mapping and the use of overhead photography. Residential retaining walls and terraces were mapped for the first time. Cross-sectional measurements of all these features afford a means to estimate volume and effort. Overhead cameras on booms produced images of enclosures that could be corrected for distortion with total station controls and combined into photographic mosaics to encompass adjacent or conjoined features. Plan views digitized from the photographs accurately portray the attributes of each enclosure, register the size of enclosed areas, and identify entryways more reliably than field observations (Figure 5). A new view of the Tortolita phase village on Tumamoc Hill emerges from the refined summit maps.

In addition to pithouses, villagers constructed a complex array of residential retaining walls and terraces to create level space for these houses, for possible ancillary structures such as ramadas or storage facilities, for outdoor activities, and to facilitate movement throughout the village (Figures 2 and 6). A few of the largest residential walls were built to ameliorate uneven summit topography at major changes in slope. The positioning of some residential terraces to intercept and retain surface runoff suggests their construction for dooryard gardens. In total, the effort invested in residential walls and terraces would have required about one-fourth of the labor for the massive encircling features (ca. 800 m^3 of stone compared to 3,200 m^3).

The 1970s project identified and mapped 125 enclosures (Larson 1979:79). The mapping program of the 2005 and 2007 field schools identified 152. This discrepancy is almost surely attributable, at least in part, to the difficulty of consistently discriminating and classifying enclosures amidst a variety of other cobble features. Cobble enclosures excavated in 1998 and 2008 revealed that most were pithouses outlined by the tumbled cobbles of former basal walls (Figures 7 and 8). They were cut into rocky soils overlying compact caliche substrates at varying depths up to 60 cm.

Five fully excavated pithouses (Structures 1, 2, 3, 7, and 8 in Figure 2) fell within a smaller-size range for the site and had the predominantly round shape of Tumamoc structures; elongated entries could be con-

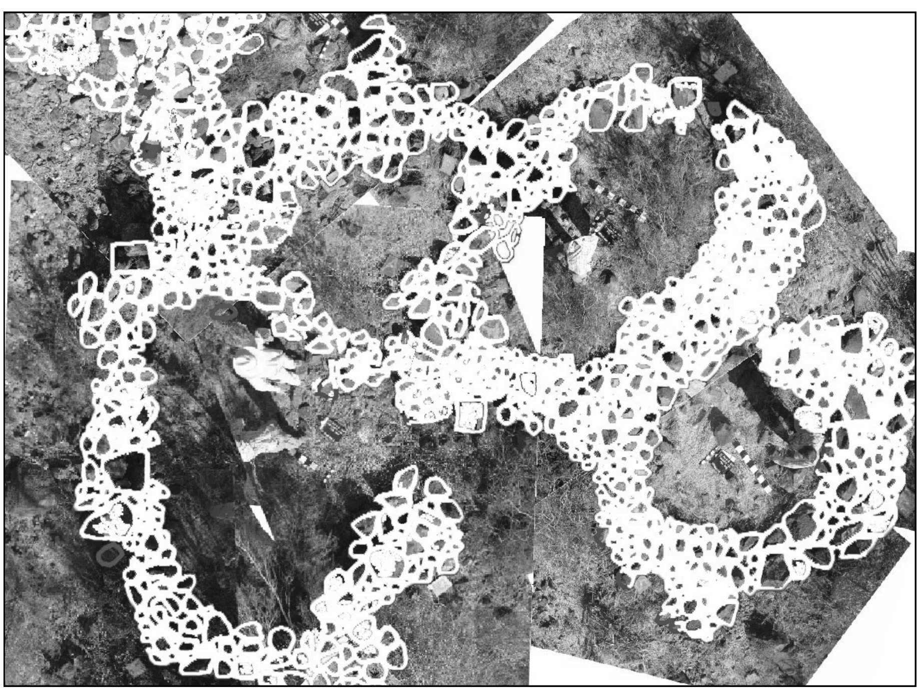


Figure 5. Digitized photo mosaic of Tumamoc Hill enclosures overlain by digitized maps.

firmed for four. In the absence of discernible post holes in heavily weathered floors, these small structures appear to have had bent-pole superstructures, anchored by poles around the pit at ground level rather than extending up from the floors. Burned daub with impressions implies that they had brush superstructures covered with hardened mud (Figure 6). Single-trench testing of three additional small round enclosures (Structures 4, 5, and 6 in Figure 2) failed to define floors and encountered bedrock at relatively shallow depths, although in each case the fill contained abundant sherds and other artifacts. These three enclosures may represent near-surface structures where summit soils were thinnest or bases for ancillary features such as ramadas. Assemblages included diverse vessel forms, chipped stone of local and exotic materials, formal and informal groundstone, and shell jewelry, as would be expected for a substantial and sustained occupation (Wallace et al. 2007:78–79, Table 3.4).

Two larger enclosures distinguished by their rectangular shape were also tested (Structures 9 and 10 in Figure 2). Floor exposure in one of these was sufficient to reveal a bowl-shaped hearth and two large postholes, probably part of a four-post roof-support pattern. The community structure (Structure 11 in Figure 2), first built during the Cienega phase, was a specialized element of the Tortolita phase village as well. A modified floor plan with two central posts marks a stratigraphically higher Tortolita phase floor over intervening fill (see Figure 4). When use of the Tortolita phase structure ceased, additional deposits accumulated before an apparently intentional effort to fill the large depression further by rolling or pushing cobbles and boulders into it.

Based on the exterior of the cobble outline, standardized measures of enclosure area were adjusted downward from maximal figures to reflect actual corresponding floor areas in excavated pithouses. Tumamoc structures range from just over 2 m^2 to nearly 22 m^2 (Figures 6 and 9). A medium-size range (6 m^2 to 15 m^2) of structures with round shapes is most common (n=135). A small number (n=6) with round outlines below 6 m^2 may reflect specialized use such as storage. A subset of the largest-size structures (n=6) also is rounded and spans 16 m^2 to 22 m^2. A shape that approaches rectangular distinguishes a fourth class of structures (n=5). Because the original shape of tumbled basal walls is somewhat conjectural, designation of a structure as rectangular necessitated consensus on the part of three observers, who carefully reviewed the digitized plans of all Tumamoc enclosures. Significantly, the floor areas of all five rectangular structures are tightly clustered between 14 m^2 and 16 m^2. The rather uniform floor area suggests that they shared a similar architectural template or function.

A majority of enclosures share conjoined basal walls (Figures 2 and 6). Basal walls connect groups of up to 10 structures that most likely housed kin. Conjoined enclosures sometimes include ancillary features as well as pithouses. For example, the smallest enclosures less than 6 m^2 are invariably attached to larger ones or sets of structures (Figure 6). The conjoined units on Tumamoc are suggestive of some degree of contemporaneity and continuity in residence. They are unlike later Hohokam courtyard groups, however, in the spatial relationships among structures. Entryways or even well-defined wall gaps are not discernible for every enclosure, but the many identified entries make it clear that the orientations of these structures primarily facilitated independent activities or privacy, rather than allowing common access to a shared extramural space.

Cummings and Guilder's (Anonymous 1919) observation of a mid-village plaza is in accordance with Henry Wallace's (ed., 2003) conclusion that plaza-centered community organization was instituted during the Tortolita phase at Tucson's Valencia Vieja. It also parallels the Vahki phase layout around a plaza at Snaketown on the Gila River (Wilcox et al. 1981). Unfortunately, the ability to affirm Cummings and Guilder's report of a plaza on Tumamoc Hill has been seriously compromised by the extent of modern disturbance, which is concentrated in the central zone of the site (Figures 2 and 6). The most likely location for a plaza lies in the vicinity of bladed roads, parking areas, and buildings. Although the community structure (Figure 4) was in use at some point during the Tortolita phase, its position in the central summit was determined by the original Cienega phase construction. In view of its stratigraphic history, the community structure may have been abandoned, and then filled intentionally when an open plaza was subsequently established later in the Tortolita phase.

As with the reference to the plaza, the 1919 description of the site by Cummings and Guilder is auspicious with regard to village structure. They described "streets" radiating out from the plaza, for which we found no convincing evidence. However, our recent mapping efforts did document a pattern that is likely related to this perception. Groups of conjoined and individual enclosures occur in loose, elongated clusters (Figures 2 and 6). Although some constituent features are undoubtedly missing due to modern disturbance, these clusters could be construed as predominantly extending outward from a central plaza. If this interpretation is correct, then Cummings and Guilder's "streets" may actually be the open areas between the clusters. In any case, the five rectangular and six largest-sized round enclosures are distributed throughout the clusters, regardless of how they are defined (Figure 2). Probable kin-based groupings of ordinary

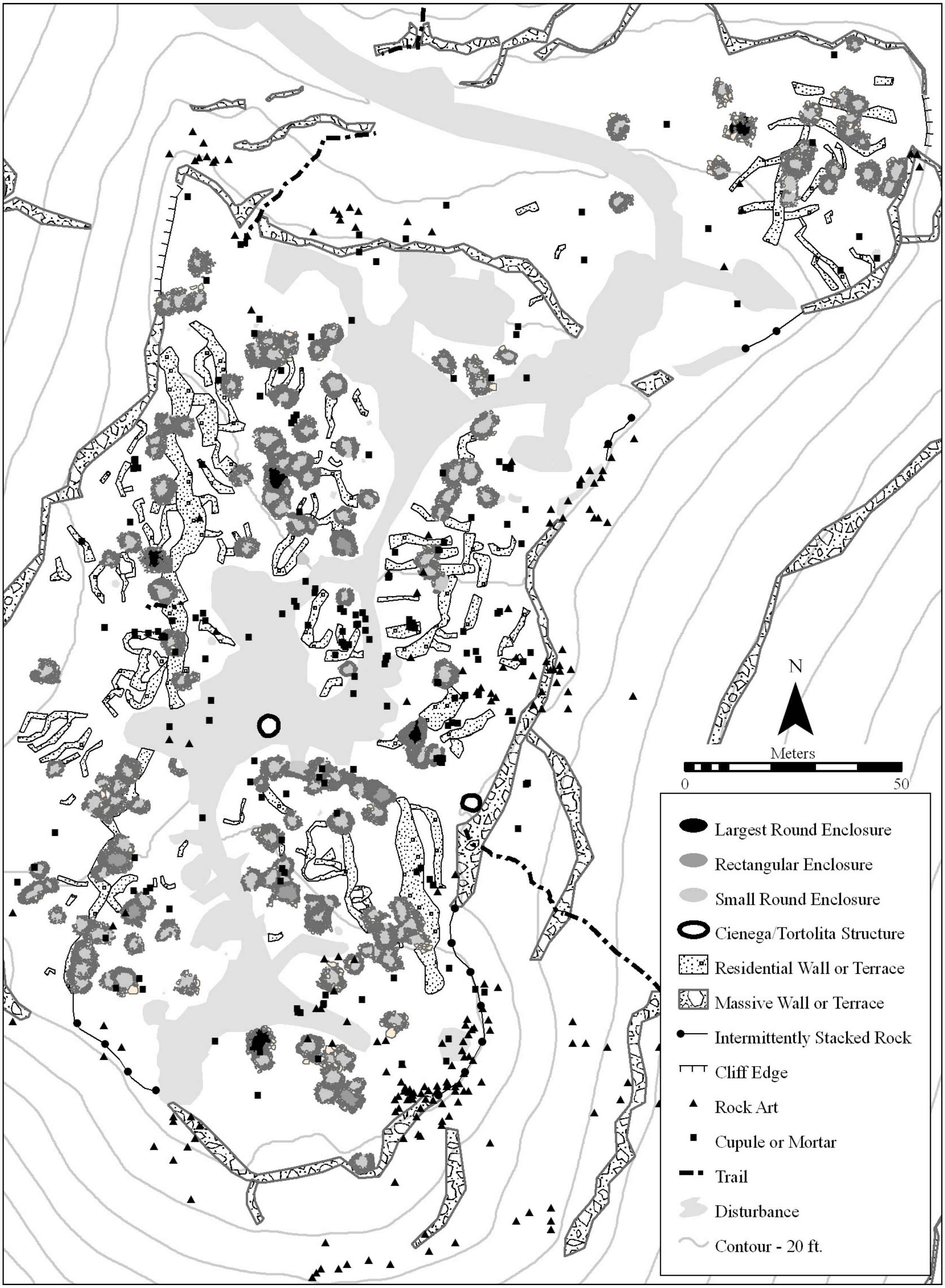


Figure 6. Tumamoc Hill village plan during the Tortolita phase.

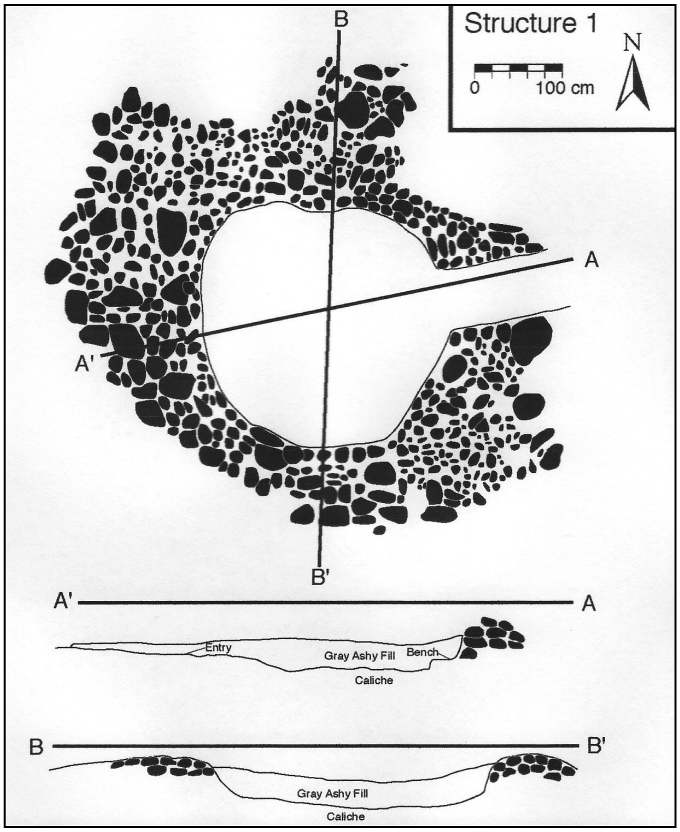


Figure 7. Plan and cross-section of a typical small round pithouse with an entryway within a cobble enclosure (Excavated Structure 1 in Figure 2).

houses appear to include one or both of these more specialized structure types.

The organizational unit proposed for Tortolita phase Valencia Vieja is structured around an oversized, square, kin leader's house fronting on the plaza. An associated cluster of smaller, rectangular residences behind it was arranged around a courtyard and also included a second, smaller square structure (Wallace 2003:344–363). With the exception of Valencia Vieja's largest outliers, the range of structure sizes for Tumamoc Hill and Valencia Vieja overlaps closely (Figure 9). Tumamoc's village includes only a few structures that are not round, however. Furthermore, neither the five rectangular enclosures nor the six largest round enclosures front a conjectured plaza, and courtyard groups are notably absent (see Figure 2). One plausible interpretation that explains why Tumamoc's organizational configuration diverges from that of Valencia Vieja is that Tumamoc's Tortolita occupation occurred during an earlier part of that phase than Valencia Vieja's main Tortolita occupation, which concluded with trends toward later Hohokam modes (Wallace and Lindeman 2003a:380–381). This explanation is supported by available radiocarbon dates (Wallace et al. 2007:58–59, Table 3.1; Wallace and Lindeman 2003b:126, Table 4.1). Another equally plausible interpretation is that Tumamoc's distinctive configuration reflects its unique settlement role embodied in a hilltop location.

TUMAMOC'S TRINCHERAS VILLAGES

The setting of both villages on Tumamoc Hill is unique among well-studied contemporary occupations in the Tucson Basin. No other Cienega phase settlement has been identified on a hilltop, surrounded by massive terraces and walls. The Tortolita phase village, without doubt one of the most populous Tucson settlements of its time, is further set apart from its neighbors in the valley below. James Heidke's (2003) examination of ceramic temper demonstrates basin-wide sources for Tumamoc vessels, a result that is in striking contrast with largely local pottery at all other analyzed Tortolita phase sites. Clustering near summit edges (Figure 6), numerous petroglyphs denote concentrated ritual behavior of a sort that, again, sets apart Tumamoc Hill from other contemporaneous Tucson Basin occupations. Unusual aspects of the earlier and later Tumamoc settlements are cited to support both the traditional interpretation that the foremost motive for trincheras occupations must have been defensive (LeBlanc 1999; Wallace et al. 2007:71–83; Wilcox 1979) and the proposition that elevated landforms of the U.S.-Mexico borderlands were often selected for distinctive types of residential settlement and for specialized ritual practices (Fish and Fish 2008; Wallace et al. 2007:83–92). Of course, these two interpretations need not be mutually exclusive.

Both the Early Agricultural and Pioneer period villagers may have appreciated Tumamoc Hill's defensive qualities. Wallace and colleagues (2007:82) suggest that the hilltop location in conjunction with walls and terraces partially or wholly reflects a Tortolita phase need for refuge in a time of increasing aggregation and competition for prime agricultural land. These authors

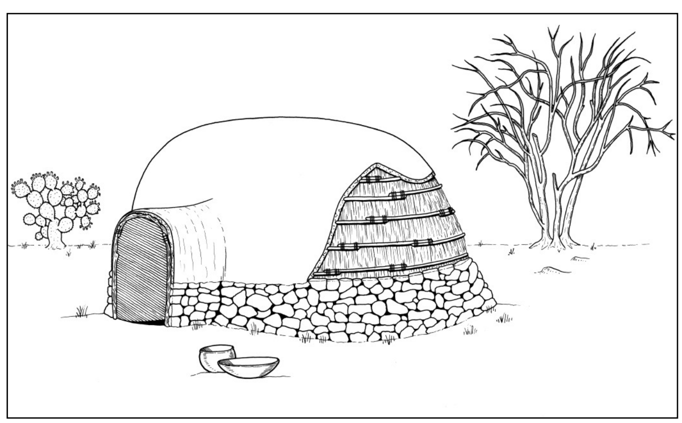


Figure 8. Artist's reconstruction of the small, round pithouse with an entryway in the Figure 7 plan and cross-section (Excavated Structure 1 in Figure 2). Drawing by Ronald Beckwith.

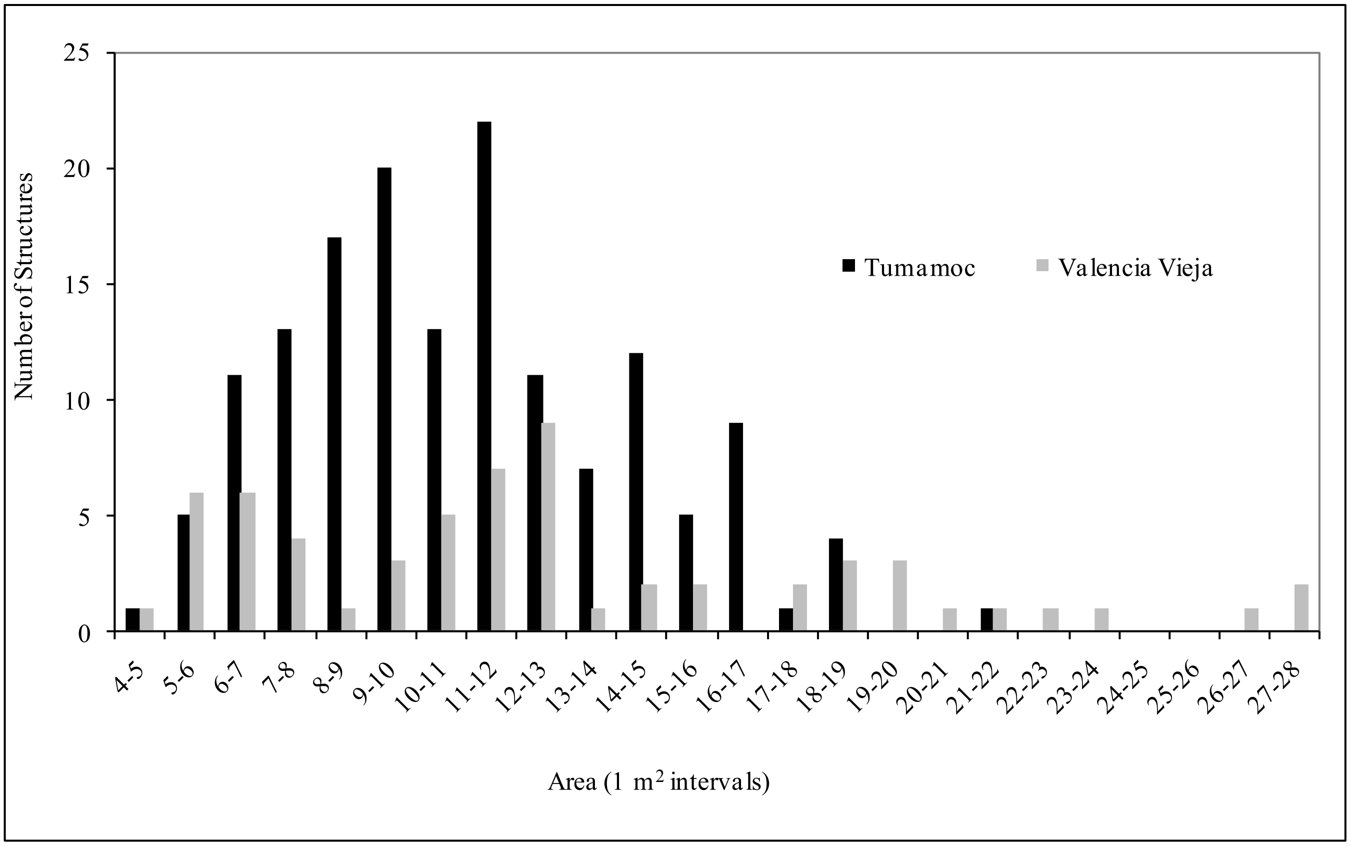


Figure 9. Tumamoc Hill (n=152) and Valencia Vieja (n=62) floor area comparison. Two small Tumamoc cobble outlines (< 4 m) are not included in this graph because they are interpreted as storage features and not structures.

(Wallace et al. 2007:91–92) argue, on the other hand, that Tumamoc Hill during Tortolita times was a large, prominent village distinguished from neighboring settlements by elevated placement, heightened visibility, imposing communal constructions, distinctive rituals, and more diversified exchange relations as indicated by pottery. A wide, berm-rimmed trail on the north provides easy access to the summit and could readily accommodate processions. The unique diversity of Tumamoc's Tortolita pottery sources (Wallace et al. 2007:68–69) may reflect periodic congregations on the hill for ritual events, trade, and other social interaction, or the unusually expansive ties of hill residents. No matter the primary settlement purpose, recent Tumamoc research contributes to the growing realization that many larger trincheras sites of all periods represent lofty and distinctive villages.

Acknowledgements. The Tumamoc Mapping Project was made possible over the years by talented teaching assistants Margaret Beck, John Chamblee, Chris Downum, Tom Fenn, Emiliano Gallaga, Matt Hill, Ryan Howell, Phil Leckman, Arthur MacWilliams, Jessica Munson, Matt Pailes, Todd Pitezel, and Abby Holeman; and numerous field school students from the University of Arizona and elsewhere. Phil Leckman and Todd Pitezel designed the Tumamoc Hill geodatabase. Gayle Hartmann and Peter Boyle led an Arizona Archaeological and Historical Society team that rigorously recorded the Tumamoc Hill petroglyphs. John Madsen and Susan Bartlett's grant from the Arizona State Historic Preservation Office to support a National Register of Historic Places nomination and management plan helped fund the 2007 mapping program. Finally, we acknowledge critical support from the Arizona State Museum, Center for Applied Spatial Analysis, and School of Anthropology at the University of Arizona throughout our investigations.

REFERENCES CITED

Anonymous
1919 Evidence of Ancient Civilization Found West of Tucson. *Arizona Daily Star* 23:1. Tucson.

Christopherson, Gary, Paul Fish, Suzanne Fish, John Chamblee, and Phil Leckman
2005 *Integrating ArcGIS and ArcPad in an Archaeological Field School Track*. ESRI Users Conference Proceedings, pp 140–159. ESRI, San Diego.

Downum, Christian E., Paul R. Fish, and Suzanne K. Fish
1994 Refining the Role of Cerros de Trincheras in Southern Arizona Settlement. *The Kiva* 59:271–296.

Ferg, Alan
1979 The Petroglyphs of Tumamoc Hill. *The Kiva* 45:95–118.

Fish, Paul R., Suzanne K. Fish, Austin Long, and Charles Miksicek

1986 Early Corn Remains from Tumamoc Hill, Southern Arizona. *American Antiquity* 51:563-572.

Fish, Suzanne K. and Paul R. Fish

2004 In the Trincheras Heartland: Initial Insights from Full-coverage Survey. In *Surveying the Archaeology of Northwest Mexico*, edited by Gillian E. Newell and Emiliano Gallaga, pp. 47–63. University of Utah Press, Salt Lake City.

2008 Una Mirada Desde Las Alturas: Círculos de Piedra, Corrales e Ideológia en Los Cerros de Trincheras. In *Memoria del Seminario de Arqueología del Norte de México*, edited by Elisa Villalpando and Cristina García, pp. 67–86. Instituto Nacional de Antropología e Historia and Museo Nacional de Antropología, Mexico, DF.

Fish, Suzanne K., Paul R. Fish, and M. Elisa Villalpando (editors)

2007 *Trincheras Sites in Time, Space, and Society*. The University of Arizona Press, Tucson.

Freeman, Andrea K. L. (editor)

1998 *Archaeological Investigations at the Wetlands Site, AZ AA:12:90 (ASM).* Technical Report No. 97-5. Center for Desert Archaeology, Tucson.

Halbirt, Carl D. and T. Kathleen Henderson (editors)

1993 *Archaic Occupation on the Santa Cruz Flats: The Tator Hills Archaeological Project.* Northland Research, Inc., Flagstaff.

Hard, Robert J. and John R. Roney

1998 A Massive Terraced Village Complex in Chihuahua, Mexico, 3000 Years Before Present. *Science* 279:1661–1664.

Hard, Robert J., Jose E. Zapata, Bruce K. Moses, and John R. Roney

1999 Terrace Construction in Northern Chihuahua, Mexico: 1150 B.C. and Modern Experiments. *Journal of Field Archaeology* 26:129–146.

Hartmann, Gayle H., and William K. Hartmann

1979 Prehistoric Trail Systems and Related Features on the Slopes of Tumamoc Hill. *The Kiva* 45:39–70.

Heidke, James M.

2003 Tortolita Phase Ceramics. In *Roots of Sedentism: Archaeological Excavations at Valencia Vieja, a Founding Village in the Tucson Basin of Southern Arizona*, edited by H. D. Wallace, pp. 145-191. Anthropological Papers No. 29. Center for Desert Archaeology, Tucson.

Huckell, Bruce B.

1995 *Investigations at Milagro: A Late Preceramic Site in the Eastern Tucson Basin*. Technical Report No. 94-5. Center for Desert Archaeology, Tucson.

1996 The Archaic prehistory of the North American Southwest. *Journal of World Prehistory* 10:305–373.

Larson, Stephen M.

1979 The Material Culture Distribution on the Tumamoc Hill Summit. *The Kiva* 45:71–82.

LeBlanc, Stephen A.

1982 Temporal Change in Mogollon Ceramics. In *Southwestern Ceramics: A Comparative Review*, edited by A. H. Schroeder. The Arizona Archaeologist 15:107–128. Phoenix.

LeBlanc, Stephen A. (editor)

1999 *Prehistoric Warfare in the American Southwest.* University of Utah Press, Salt Lake City.

Mabry, Jonathan B., Deborah L. Swartz, Helga Wocherl, Jeffrey J. Clark, Gavin H. Archer, and Michael W. Lindeman

1996 *Archaeological Investigations of Early Village Sites in the Middle Santa Cruz Valley: Descriptions of the Santa Cruz Bend, Square Hearth, Stone Pipe, and Canal Sites.* Anthropological Papers No. 18. Center for Desert Archaeology, Tucson.

Plog, Fred

1980 Explaining Culture Change in the Hohokam Preclassic. In *Current Issues in Hohokam Prehistory,* edited by David Doyel and Fred Plog, pp. 4–22. Anthropological Research Papers No. 23. Arizona State University, Tempe.

Roney, John R.

1999 Canador Peak: An Early Pithouse Period Cerro de Trincheras in Southwestern New Mexico. In *La Frontera: Papers in Honor of Patrick H. Beckett*, edited by Melha S. Duran and David T. Kirkpatrick, pp. 173–184. Archaeological Society of New Mexico, Albuquerque.

Roney, John R. and Robert J. Hard

2002 Early Agriculture in Northwestern Chihuahua. In *Traditions, Transitions, and Technologies: Themes in Southwestern Archaeology*, edited by Sarah Schlanger, pp. 160–177. University of Colorado Press, Boulder.

Thiel, J. H. and Jonathan B. Mabry (editors)

2006 *Rio Nuevo Archaeology, 2000-2003: Investigations at the San Agustin Mission and Mission Gardens, Tucson Presidio, Tucson Pressed Brick Company, and Clearwater Site.* Technical Report No. 2004-11. Desert Archaeology, Inc., Tucson.

Wallace, Henry D.

2003 The Development and Structure of an Ancient Desert Village. In *Roots of Sedentism: Archaeological Excavations at Valencia Vieja, a Founding Village in the Tucson Basin of Southern Arizona,* edited by H. D. Wallace, pp. 323-369. Anthropological Papers No. 29. Center for Desert Archaeology, Tucson.

Wallace, Henry D. (editor)

2003 *Roots of Sedentism: Archaeological Excavations at Valencia Vieja, a Founding Village in the Tucson Basin of Southern Arizona*. Anthropological Papers No. 29. Center for Desert Archaeology, Tucson.

Wallace, Henry D. and Michael W. Lindeman

2003a Valencia Vieja and the Origins of Hohokam Culture. In *Roots of Sedentism: Archaeological Excavations at Valencia Vieja, a Founding Village in the Tucson Basin of Southern Arizona*., edited by Henry D. Wallace, pp. 371-405. Anthropological Papers No. 29. Center for Desert Archaeology, Tucson.

2003b Chronometrics. In Roots of Sedentism: Archaeological Excavations at Valencia Vieja, a Founding Village in the Tucson Basin of Southern *Arizona*., edited by Henry D. Wallace, pp. 123-144. Anthropological Papers No. 29. Center for Desert Archaeology, Tucson.

Wallace, Henry D., Paul R. Fish, and Suzanne K. Fish

2007 Tumamoc Hill and the Early Pioneer Period Occupation of the Tucson Basin. In *Trincheras Sites in Time, Space, and Society*, edited by S. K. Fish, P. R. Fish, and

M. E. Villalpando, pp. 53-100. The University of Arizona Press, Tucson.

Wilcox, David R.
1979 Warfare Implications of Dry-laid Masonry Walls on Tumamoc Hill. *The Kiva* 45:15–38.

Wilcox, David R. and Stephen M. Larson
1979 Introduction to the Tumamoc Hill Survey. *The Kiva* 45:1–14.

Wilcox, David R., Thomas R. McGuire, and Charles Sternberg
1981 *Snaketown Revisited.* Arizona State Museum Archaeological Series No. 155. University of Arizona, Tucson.

Wilcox, David R., Stephen M. Larson, W. Bruce Masse, Gayle H. Hartmann, and Alan Ferg
1979 A Summary of Conclusions and Recommendations of the Tumamoc Hill Survey. *The Kiva* 45:187–195.

SOCIAL ORGANIZATION AND DIFFERENTIATION AT A HOHOKAM *CERROS DE TRINCHERAS*

Matthew C. Pailes

ABSTRACT

This paper examines the relation between domestic architecture and social differentiation at Cerro Prieto, an early Classic period (ca. A.D. 1150–1300) hillside village (cerro de trincheras) in the northern Tucson Basin. The Cerro Prieto data suggest that groups of affiliated households practiced an organizational strategy that prioritized human capital (i.e., wealth in people) over personal aggrandizement (i.e., wealth in things). The lack of communal architecture further suggests that the site's residents were reliant on the neighboring Los Robles platform mound settlement for higher-order community integration. The implications of this pattern for understanding possible regional differences in Hohokam socio-political organization are discussed.

The early Classic period in Hohokam society, ca. A.D. 1150 to 1300, is characterized by large-scale population movements, the widespread adoption of new ritual practices, and the appearance of specialized site types such as platform mound settlements and *cerros de trincheras*. Scattered across southern Arizona and northwestern Mexico, *cerros de trincheras* are large villages with stone architecture on low volcanic hills (S. Fish et al. 2007; McGuire and Villalpando 2007). In contrast to platform mound settlements, which have been extensively studied and form the basis for most current interpretations of Classic period socio-political organization (see papers in Mills 2000), *cerros de trincheras* remain poorly understood in the context of Hohokam social and political regional systems.

This paper attempts to expand the scale of analysis by presenting the results of recent survey work at Cerro Prieto, AZ AA:7:11(ASM), the largest trincheras site in southern Arizona. Discussion focuses on the nature of architectural variability at the site and the implications for understanding household and supra-household (e.g., house) organizational strategies. It also considers the ecological and economic conditions associated with these organizational strategies. Architectural data from Cerro Prieto suggest that labor considerations related to agricultural scheduling played a major role in structuring social relationships in early Classic period society. Also, in contrast to many platform mound settlements, there is little architectural evidence for personal aggrandizement (cf. Harry and Bayman 2000). It appears that social differentiation at the site was based on a "wealth in people" strategy, as opposed to a "wealth in things" strategy (see Guyer 1995; McIntosh 1999; Nyerges 1992). By extension, leadership strategies likely emphasized the cultivation of interpersonal ties rather than the accumulation of personal wealth.

Analysis and interpretation of Cerro Prieto's organizational structure is divided into four sections. First, in order to place the recent work at Cerro Prieto in a broader interpretive context, an overview of the Pre-Classic to Classic transition in the northern Tucson Basin is provided. This cultural-historical background is followed by a descriptive account of Cerro Prieto and the types of data recorded during recent survey work. Third, interpretations of the recorded architectural data are offered. These interpretations focus on the different scales of social organization at Cerro Prieto. Fourth, a conclusion section summarizes the inferences about social organization at the site. In addition, it identifies several large-scale processes that may partially account for organizational variability observed in Hohokam communities during the early Classic period.

Matthew C. Pailes / School of Anthropology, University of Arizona / mpailes@email.arizona.edu

Journal of Arizona Archaeology 2011, Volume 1, Number 2: 197-209

COMMUNITY ORGANIZATION IN THE NORTHERN TUCSON BASIN

Hohokam cultural developments in the northern Tucson Basin share basic similarities with the cultural-historical trajectory in the Phoenix Basin. The end of ballcourt construction and the subsequent adoption of platform mounds as the principal form of public architecture occurred in both regions at approximately the same time, ca. A.D. 1070 to 1300. Moreover, similar trends in ceramic sequences, architectural forms, and burial and ritual practices occurred in both areas at approximately the same time. These parallel cultural-historical developments are indicative of a shared belief system among populations in these neighboring geographic areas. However, there is some evidence that socio-cultural trends swept through communities in the Phoenix Basin first and then moved into Tucson Basin communities slightly later, possibly reflecting core-periphery relationships between the two regions (S. Fish and P. Fish 2006a).

In contrast to the shared ideological systems, important differences in subsistence bases existed among Hohokam populations in the Tucson and Phoenix basins. The Santa Cruz River of the Tucson Basin could not support the intensive irrigation agriculture possible along the Salt and Gila rivers of the Phoenix Basin. However, in the Tucson Basin, geographically constricted landforms with a greater diversity of ecological zones facilitated access to resources that were not easily accessible in the Phoenix Basin. These contrasting resource bases led to marked differences between the two regions in their respective means of production and in the resulting organization of large-scale social units.

Extensive research on the Marana community has provided a detailed understanding of settlement structure in the northern Tucson Basin (S.. Fish et al. 1992a; Rice 1987) and serves as a general model for the region. The term “community” is used here to refer to a set of geographically conscripted and inter-related settlements bound by ideological, economic and political means (P. Fish and S. Fish 2007; S. Fish and P. Fish 2000a, b). Communities are generally focused on a regional-center containing public architecture such as platform mounds. Irrigation agriculture fulfilled a much smaller portion of the subsistence needs than at most communities in the Phoenix Basin. Production bases such as *ak-chin* floodwater, xeric bajada, and other alternative cultivation methods were widely employed in the northern Tucson Basin (S. Fish et al. 1992b). These various subsistence strategies were used across a range of topographical conditions. Diversification of subsistence production across areas unlikely to suffer synchronous shocks reduced risk to the overall subsistence economy of the wider community. This reconstruction assumes effective social mechanisms were in place to ensure distribution to areas suffering periodic shortfalls (S. Fish et al. 1992c: 39).

This form of community organization required northern Tucson Basin communities to be geographically more expansive and diffuse than those of the Phoenix Basin. As in the Phoenix Basin, platform mound centers formed the hub of the community, and presumably engendered social integration through ritual, economic, and political events (Elson and Abbott 2000; S. Fish and P. Fish 2000b). It is possible that a disjunction resulted from the extension of Phoenix Basin ideological and political systems to local ecological conditions. Alteration and experimentation with ideology, political structures, and social systems seem likely in these contexts.

Another important distinction between the Tucson and Phoenix basins concerns continuity of occupied spaces. In the Phoenix Basin, the geologic requirements of suitable canal-head intakes, (i.e., subsurface bedrock dykes) placed limitations on settlement location. As a result, while not universally true, the largest Phoenix Basin settlements of the Pre-Classic and Classic periods were generally spatially proximate (Gregory 1991). In contrast, several of the largest sites in the northern Tucson Basin, including Marana, Los Robles, and Cerro Prieto, were all established in locales that were minimally occupied during the Pre-Classic period. The large size of these and other settlements indicates they were established by individuals and social groups who originated from multiple localities. Partitioning of resources and usufruct rights within these newly founded communities and settlements required integration of unrelated individuals and groups. The development of cohesive social units may have entailed an express desire to part with kinship-based systems of land tenure established during the Pre-Classic period (S. Fish et al. 1992c:39).

Considerable effort has been expended to identify evidence of differential access to material wealth both within and between communities (e.g. Bayman 1995; S. Fish and P. Fish 2000b:166–167; Harry and Bayman 2000; Howard 1987). Some research projects have examined communities at the inter-settlement level, but attempts focused on intra-settlement comparisons of material differences have proven largely unproductive (Bayman 1995; Harry and Bayman 2000). Architecture has proven to be one of the few material categories that visibly reflects differentiation at the household and supra-household levels (Craig 2001, 2007). Thus, the substantial adobe architecture of compound groups associated with platform mounds and with other large settlements implies notable status and/or wealth hierarchies at the settlement level of organization (P. Fish and S. Fish 2000:267).

Several generations of professional archaeologists have provided interpretations of the constituent social units of Hohokam communities in a variety of contexts (e.g., Bayman 1995; S. Fish and P. Fish 2000b). Often, these interpretations assume a normative view of Hohokam social organization in which the various units of analysis are treated as essentially equivalent, modular building blocks (cf. Abbott 2000; P. Fish and S. Fish 1991; Neitzel 1999). While recognizing the heuristic value of this approach, the assumption of equivalency among units has increasingly come under criticism (e.g., Craig 2007). For this reason, the following section focuses on the degree of variation expressed by these units. Explanations for some of this variability will then be offered based upon the context-specific ecological and social conditions.

CERROS DE TRINCHERAS IN REGIONAL CONTEXT

Cerros de trincheras sites are most commonly found in the Trincheras cultural area of northwestern Sonora. The largest and best known example of this site type is Cerro de Trincheras (O'Donovan 2002; Villalpando and McGuire 2009), which was constructed along the Rio Magdalena and occupied during the Cerros phase from approximately A.D. 1300 to 1450. Examples of *cerros de trincheras*, however, are present in the region as early as A.D. 400 (S. Fish and P. Fish 2004:60). *Cerros de trincheras* were also built in the Río Sonora region, where they likely date to the Protohistoric period; in the modern-day state of Chihuahua, where they are associated with the Early Agricultural period (Hard and Roney 2007; Roney and Hard 2004); and in the Papaguería, where most sites remain poorly dated (Stacy 1974). In the Tucson Basin, the trincheras site at Tumamoc Hill dates as early as 500 B.C. (Wallace et al. 2007). Interestingly, the site type was absent in the Tucson Bain throughout much of the Pre-Classic period before reappearing in the early Classic period, ca. A.D. 1150–1300. Furthermore, *cerros de trincheras* settlements in the Tucson Basin tend to occur within communities also containing platform mound settlements. Examples of paired *cerros de trincheras/*platform mounds include Martinez Hill and the Martinez Hill Platform Mound, Linda Vista Hill and Marana, and Cerro Prieto and Los Robles.

To some researchers, the broad geographical and temporal spread of *cerros de trincheras* indicates widely shared ideological precepts involving ritual use of hill top settings (S. Fish and P. Fish 2006b). If this is true, the associated ideology was likely incorporated within existing ideological systems rather than acting as a competing ideology exported from the core Trincheras area. Architecture at the summits of *cerros de trincheras* is often interpreted as ideological in nature and may have served as a locus for community integration (Downum 1995:1177; S. Fish 1999; S. Fish and P. Fish 2006b; O'Donovan 2004) in a manner analogous to platform mounds. The use of hill space for habitation and ritual may have also acted as a means of overt political expression due to its visibility (Downum 2007) and monumentality (Nelson 2007).

THE CERRO PRIETO SITE

Cerro Prieto is located in the northern Tucson Basin, ca. 13 km south of Picacho Peak. It rises 240 m above the flood plain of the Santa Cruz River, which is located approximately 3 km to the east. The Los Robles platform mound is located 6 km to the southeast. The site is situated near a highly productive portion of the Santa Cruz flood plain (see Aguirre 1983) where a subterranean bedrock dyke creates surface water flow amenable to *ak chin* and potentially canal irrigation. Xeric farming systems composed of rock piles, usually associated with agave cultivation (S. Fish et al. 1985), are present to the immediate northeast of the site. Various soil and water control features lie along the site's lower slopes; terraces located throughout the hill's habitation zone provide another means of agricultural production (S. Fish et al. 1984).

Large tabular andesite outcrops that provide the raw materials for agave knives are present on the upper slopes of Cerro Prieto. Agave knives were traded throughout the Hohokam region (Bernard-Shaw 1983:433–434). For example, knives produced from Cerro Prieto andesite have been found at the Los Robles mound site and were likely traded more widely, at least as far as the Marana mound site (S. Fish et al. 1992c:37).

In sum, with the high-productive capacities of adjacent agricultural land, access to a valued utilitarian trade item, and a potentially special place in the cosmological view of regional inhabitants, there was ample potential for differential accrual of wealth and power among the residents of Cerro Prieto. The site also contains a large number of highly visible, well preserved architectural features that provide a basis for assessing the material expression of differentiation. A number of cross-cultural studies have demonstrated that architecture is one of the best indicators of social differentiation in middle-range societies (e.g., Elson and Abbott 2000; Feinman and Neitzel 1984). These studies indicate that wealthy individuals and groups tend to live in larger, more ornate, and better-made dwellings than other people (Abrams 1994), and that wealthy households are typically larger and therefore require more residential space (Netting 1982).

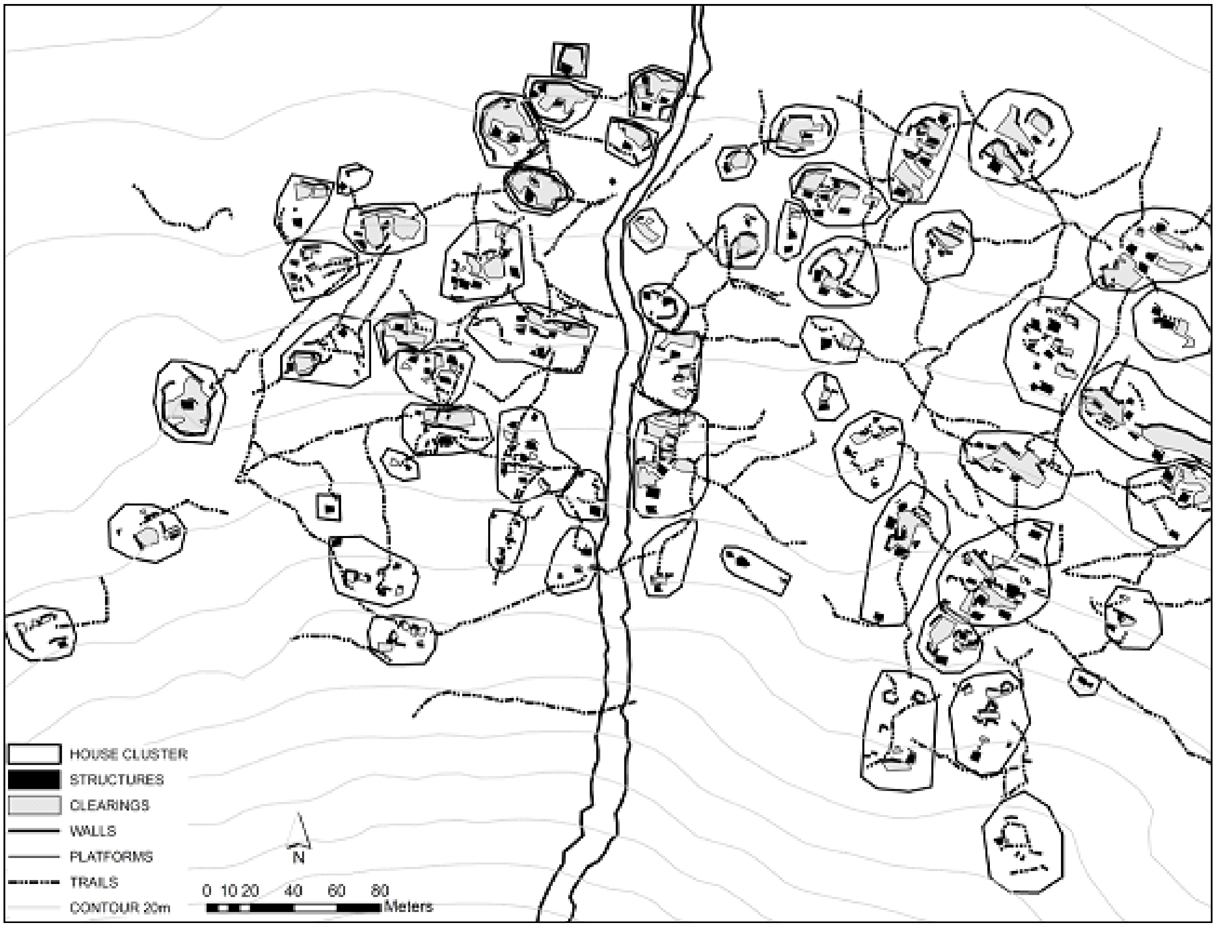


Figure 1. The re-surveyed habitation area of Cerro Prieto.

Survey Results and Interpretations

The archaeological survey of Cerro Prieto was designed to collect data on potential architectural variability across the site. The survey work was conducted periodically between June 2006 and July 2007. Survey teams focused on mapping the site with a Tremble Geo XT ®, which can locate stored points to within a meter (Figure 1). Teams recorded spatial information for more than 900 features, including over 200 structure foundations. A detailed discussion of the survey and its methodology is provided in Pailes (2008).

Cerro Prieto structures are generally well preserved and easily identifiable on the ground surface (Figure 2). Stone volumes of preserved structures indicate they were constructed with perishable super structures. A partial historical analog of a Cerro Prieto structure is provided in Figure 3. The excellent preservation at the site generally permitted accurate estimation of masonry and perishable wall portions. Based on available ceramic evidence, the site was likely occupied for a relatively short period during the Tanque Verde phase, ca. A.D. 1150–1300.[1] Contextual evidence, including a lack of dismantled structures to reuse building materials and an elaborate interconnected trail system (Figure 4), suggests that nearly all structures were occupied at the same time.

The size of individual structures varied significantly. Some of this variability is undoubtedly due to functional differences. For purposes of the following analysis, a distinction was drawn between structures that were likely used as dwellings and those that were likely used as storage or utility structures. Similar to most other studies of Hohokam room function (e.g., Crown 1985; Wilcox et al. 1981), room size was the main criterion used to distinguish between dwellings and storage structures. It was further assumed that socially viable households were unlikely to consist of less than three individuals. Based on Cook's (1972) estimation of 2.3 m^2 of space per individual—an estimate widely employed throughout the Hohokam region (e.g. Abbott and Foster 2003; Henderson 1987a; Wilcox et al. 1981)—a threshold figure of 6.9 m^2 was used to classify structures into the following functional categories: dwelling or storage facility.

Many of the dwellings and storage structures at Cerro Prieto cluster into spatially discrete groups. These house clusters are likely the Cerro Prieto correlate of Pre-Classic period courtyard groups (sensu Wilcox et al. 1981). They are also likely the equivalent of

Figure 2. Examples of structure foundations at Cerro Prieto.

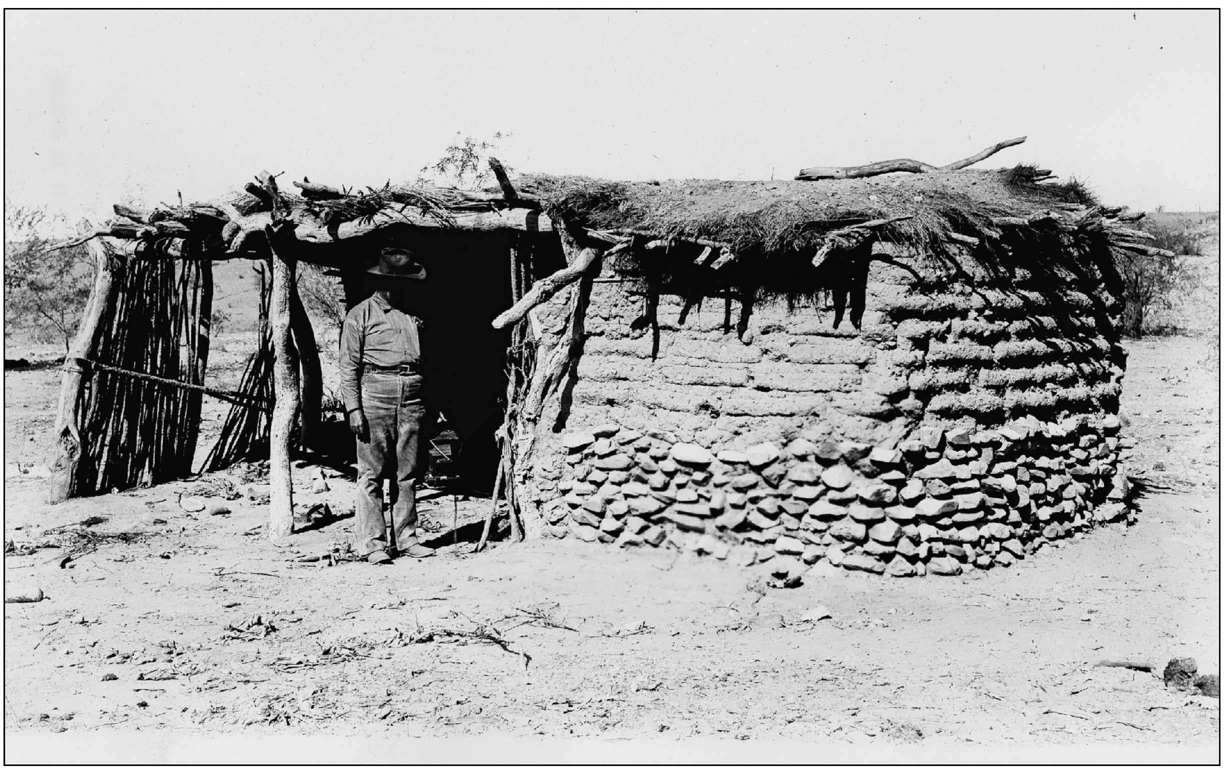


Figure 3. A turn of the century O'odham dwelling that serves as a partial analog for Cerro Prieto structures. The superstructure would likely consist of coursed adobe, and more care is evidenced in the construction of stone foundations at Cerro Prieto. Photo by William Dinwiddie, McGee Expedition 1894, 1895; University of Arizona Library, Special Collections.

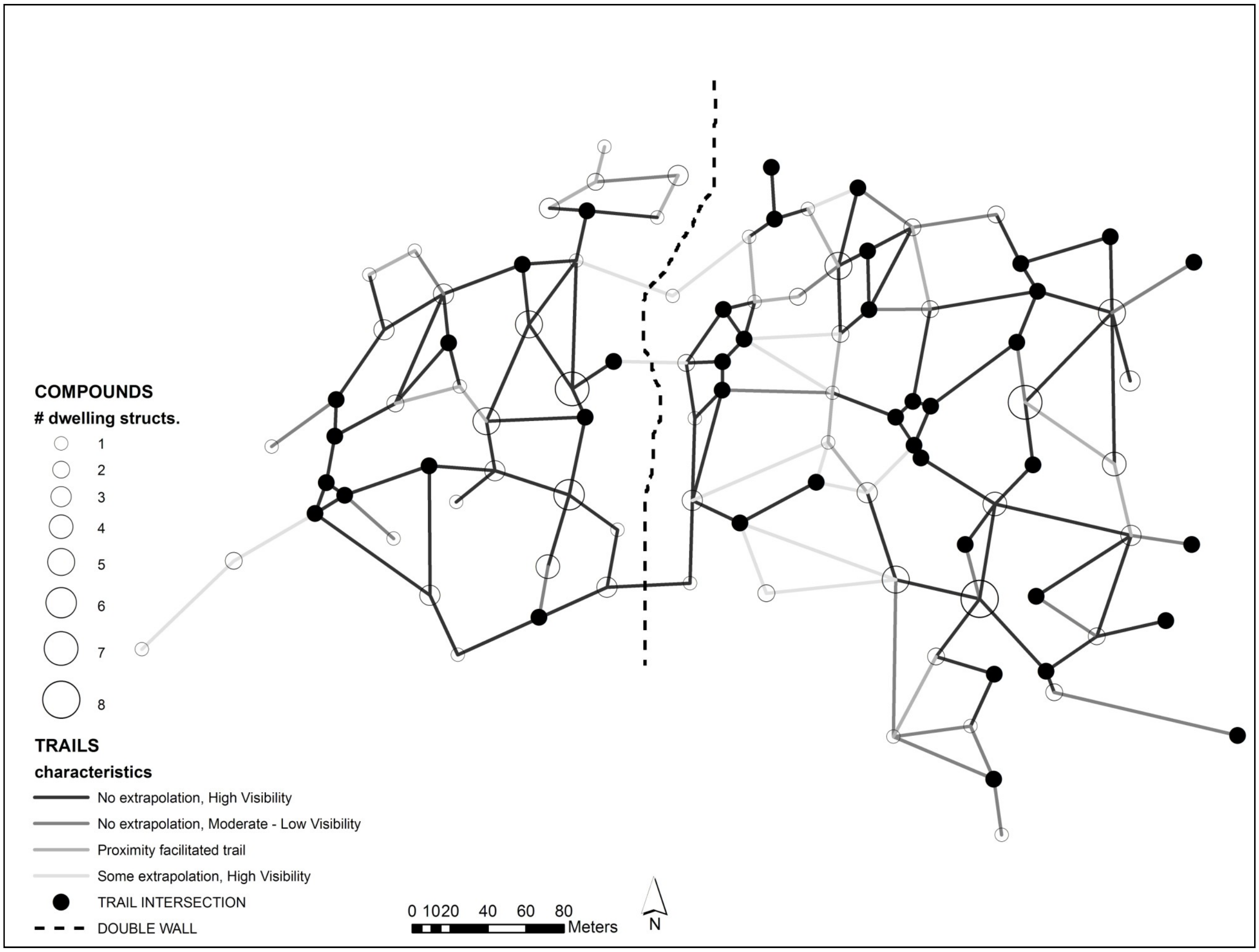


Figure 4. Schematic diagram of Cerro Prieto's trail system demonstrating likely simultaneous interaction of all residence areas.

Classic period compound groups (S. Fish and P. Fish 2000b:157; S. Fish and P. Fish 2006a:19; Wilcox 1991:268). The term "household" is often used to designate this scale of social inclusivity in the Hohokam literature. This analysis reserves the term "household" for cohabitants of an individual dwelling and interprets this more inclusive unit as representing a form of corporate organization corresponding to a multi-family household or supra-household group that acted along the lines of the social "houses" described by Levi-Strauss (1982). Houses typically consist of both material and immaterial property, such as titles, and subsume constituent member households and individuals (see papers in Beck 2007). They are the quintessential manifestation of corporate groups (cf. Hayden and Cannon 1982), and cooperate in production, distribution, transmission, and reproduction (Wilk and Netting 1984; Wilk and Rathje 1982). Houses are most often identified archaeologically by means of physical proximity of dwellings (for critiques of this practice see Abbott 2000:16; Rice 1990:34).

Due to the constraints of the hill's topography, Cerro Prieto residents were restricted to certain spaces for the placement of dwellings. For this reason, house clusters do not exhibit the familiar spatial patterns known from floodplain and bajada Hohokam settlements. As can be seen in Figure 1, the identification of house clusters is generally a straightforward process. The number of dwellings in most house clusters (Figure 5) is similar to courtyard groups of the Pre-Classic period. Many of the clearing areas adjacent to dwelling areas are presumably analogous to the yard spaces of Pre-Classic groups. The presence of domestic trash and lithic production debris indicates use of these areas as shared work spaces. Calcined human bone, indicative of cremation burials, is also periodically visible in clearings that have been disturbed by rodent activity. These burials almost certainly correspond to house-level cemeteries (see Mitchell 2003:110; Wallace and Lindeman 2003:387–388), and reflect significant social cohesion among members.

Other notable architectural features of the site include a pair of large walls made of piled cobbles and

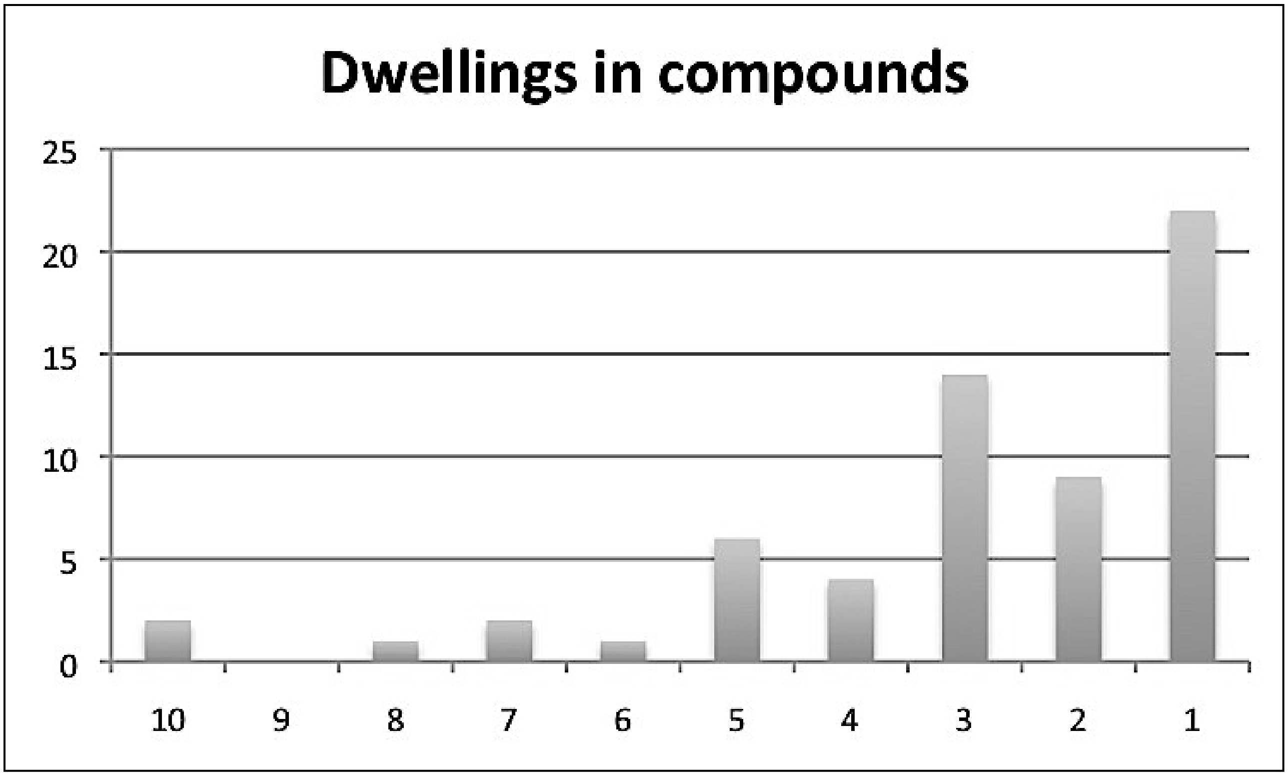


Figure 5. Histogram of house clusters. Each bar represents the number of constituent dwellings (i.e., households) within a house cluster.

boulders that roughly divides the village in half. This feature was a natural talus flow that appears to have been anthropogencially altered (Downum et al. 1993:83). It is unlikely that the walls served any kind of functional purpose to divert rainwater, because the feature terminates in a non-cultivable area. Rather, the walls likely performed a social function to delineate some division in social identity, such as a lineage or a dual division corresponding to the archaeological correlate of a village segment.

An area of non-domestic architecture consisting of approximately 16 structure foundations and associated ancillary walls and terraces is present on the summit of Cerro Prieto. The number of these features contrasts to summit architecture at other *cerros de trincheras* sites, which typically contain one predominant construction. A lack of domestic artifacts, ubiquitous among the foundations on lower slopes, indicates these features probably fulfilled a special role as a locus of ritual activity. The abnormal number of these features may indicate individual house clusters or other social groups who maintained separate ritual facilities.

Architecture and Social Differentiation at Cerro Prieto

Multiple scales of spatial and architectural analysis were performed in an attempt to derive meaningful patterns of social differentiation at Cerro Prieto. The analyses' results suggest socially meaningful spatial patterns among house clusters (houses) and individual dwellings (households). The village segment level of analysis, defined here in relation to the double wall feature, evidenced no significant variability visible in architecture. In other words, there were no significant differences in the number and size of individual rooms or house clusters with respect to the walled drainage.

The most obvious measure of variability among Cerro Prieto house clusters is their number of constituent dwellings. From the 1980s to the present day, there has been debate as to whether the differential size of Hohokam house clusters, as measured by the number of dwellings, was indicative of domestic cycling or differential success in attracting members (e.g., Doelle et al. 1987:89; Henderson 1987a:121–122; Howard 1985) (for general discussion, see Netting 1982; Wilk and Rathje 1982). In most cases, the answer appears to be both. However, at Cerro Prieto, differential success in attracting group members likely accounts for most of the observed variability.

This interpretation is inferred from the wider contexts of socio-politico reorganization across the region. As discussed above, Cerro Prieto and most primate centers of the northern Tucson Basin were established in previously unoccupied regions. The size of these settlements indicates that populations originated from disparate locales. Thus, the initial establishment of social groups at Cerro Prieto probably necessitated the incorporation of individuals from outside extant kinship and social networks. A brief period of occupation that provided little opportunity for domestic cycling further indicates differential attraction of members accounts for most apparent variability.

The most prevalent residential pattern at Cerro Prieto is that of several households grouped into a cluster, which shares associated terraces and clearing spaces. However, there are many exceptions to this basic pattern of house cluster composition. Of the re-surveyed portion of Cerro Prieto, 39 multi-dwelling house clusters and 22 isolated dwellings that were not clearly affiliated with a larger house cluster were identified. Previous research suggested that isolated dwellings represent founder households that did not sufficiently cycle through the growth process or attract exterior members to reach house status (Henderson 1987a:122; 1987b:112). This conclusion is supported by area measurements which demonstrate that the size of some isolated dwellings is approximately equivalent to the size of the largest and oldest structures within multiple dwelling clusters. Heads of houses (house clusters) presumably occupied these large dwellings.

At Cerro Prieto, a meaningful pattern among isolated dwellings emerges if they are divided on the presence or absence of courtyard encircling walls. Encircling walls are low earth and piled rock constructions that surround a dwelling or dwellings and associated yard spaces. The 17 isolated dwellings that lack these walls are relatively small in size and appear to be fairly nondescript. The five individual dwellings enclosed by courtyard walls are some of the largest structures in the re-surveyed portion of the site. The placement of the dwellings within these walls suggests that there were no premeditated plans to accommodate additions to the household. Downum and colleagues (1993:77) suggested that these isolated, enclosed dwellings and courtyards, along with approximately four other enclosed courtyards that contain multiple dwellings, also with centralized symmetrical layouts, were ritually significant spaces. This would provide a potential justification to draw on community labor disproportionately and may explain the construction of large dwellings in the absence of clear corporate affiliations that could provide necessary labor. The surface artifact assemblages of these yards indicate they were used for everyday domestic activities in addition to any possible specialized ritual activity.

There is also wide dispersion in dwelling size at Cerro Prieto, and a presumed, correlated dispersion in the investment of labor required to construct individual structures at the site. Among a sample of 176 structures, the size of dwellings ranges from 7.2 to 35.7 m^2, with a standard deviation of 5.15 m^2. However, there is only minimal evidence for escalating differentiation within a house cluster as the number of constituent dwellings increases. The largest dwelling in a house cluster does increase with overall cluster size, $r^2 = .37$ (prob > F <.0001).[2] This result, though, is likely impacted by sample size to a substantial degree. There is also a slight correlation between the number of households in a house cluster and the average size of a dwelling structure, $r^2 = .15$ (prob > F 0.02). This is likely an underestimate because larger house clusters are more likely to have larger than average storage structures that were mistakenly identified as small dwellings. Although tentative, these patterns indicate that members of house clusters generally distributed and/or used resources, including labor expended on dwelling structures, equitably. Only in those cases in which a house attracted a significant number of affiliated households did its leader or leaders feel secure in directing disproportionate resources to their personal dwellings. Even when a person or persons did invest more resources in a dwelling relative to other structures, aggrandizement remained subdued.

In an attempt to place the Cerro Prieto architectural data into a broader, comparative framework, the areas of individual household dwellings and aggregate house clusters were transformed into Gini index values (Lorenz 1905). Gini indices are a common means of gauging differentiation in modern economic models and have been espoused as a useful measure for interpreting relative inequality among prehistoric groups (McGuire 1983). The Gini coefficient ranges on a scale from zero to one, with zero representing perfect equality (i.e., equal access to resources) and one perfect inequality (i.e., concentration of resources). The individual household dwelling data (n=176) from Cerro Prieto falls at the notably low level of .21, implying that the overall size and labor investment in individual dwellings was fairly uniform across the site. In comparison, Craig (2001) in his analysis of the Pre-Classic settlement of Grewe derived values that varied over time from .17 to .43. If Cerro Prieto house cluster aggregate areas are compared (n=61), the significantly higher figure of .42 is obtained. Since this figure is based on the total amount of roofed space in a house cluster, which is indicative of population size, it provides a measure of inequality in access to labor potential, rather than the amount of labor invested in individual structures.

Several conclusions can be drawn from these results. Despite significant variability in dwelling size, as indicated by high standard deviation values, the architectural data from Cerro Prieto do not reflect stark demarcation visible in the built environment. There are notable differences, though, in the success of house clusters to attract additional members. A difference in member attraction is inferred from the application of the Gini index to the house cluster data. This result indicates that the heads of various houses (house clusters) at Cerro Prieto managed labor pools of significantly different sizes. Differential access to resources was not typically channeled into personal aggrandizement, but rather was directed toward group member attraction.

Thus, it would appear that leaders in the settlement used a “wealth in people” strategy to store and deploy available resources (see McIntosh 1999; Nyerges 1992). Such systems prioritize the importance of human capital and include strategies that range from enslavement to persuasion. In the case of Cerro Prieto, persuasive attraction of group members to the detriment of personal aggrandizement is the most plausible scenario.

The success or failure of many agricultural pursuits is often determined by the ability to coordinate simultaneous labor. This is especially true in settlement systems, such as Hohokam communities, that are heavily reliant on fragile infrastructure. As such, notable variance in the labor pool available to some houses may have resulted in substantial economic advantages in certain realms of production. Conversely, as indicated by the costly and large homes of the single structures within encircling walls, access to labor through a spatially proximate and distinct corporate group was not a necessary prerequisite for the control of labor. The presence of these large, isolated dwellings indicates that alternative means of production, possibly as ritual specialists, were available to some households. Minimally, it is clear that multiple competitive strategies, based in both economic and social capital, were open to the inhabitants of Cerro Prieto. These strategies were pursued with variable success through the settlement’s history.

Community Integration

During the recent survey work, a number of socially or ideologically important architectural elements related to communal activities were also recorded. Most of these are the aforementioned summit structures that almost certainly filled a ritual function. In addition, the large double wall can be tentatively classified as communal architecture as well. This feature’s size and position imply that it was constructed through cooperative effort and its function was almost certainly for some sort of social demarcation.

These investments were compared to a very coarse grained labor estimate of the Los Robles platform mound, a figure that was based on estimates calculated for other mounds (e.g., Craig and Clark 1994) and on construction material volume ratios. All the plausible communal architecture at Cerro Prieto equaled only 40 percent of the investment required for the construction of the Los Robles mound. This comparison suggests that heads of house clusters and other potential leaders at the Cerro Prieto settlement were unable to organize communal building efforts at levels marshaled at mound centers. This disparity in political consolidation may reflect qualitative differences in organizational precepts of these two specialized site types. Cerro Prieto was certainly integrated into the larger mound community and likely into its associated ideology. The social integration of Cerro Prieto into a larger Los Robles community is indicated by the spatial proximity of the two settlements and evidence for economic interaction. For instance, tabular andesite artifacts likely produced at Cerro Prieto have been found at Los Robles.

SUMMARY AND CONCLUSIONS

Significant organizational variability is apparent within Hohokam society, particularly at the household and house levels of analysis. One example of the *cerros de trincheras* settlement type, Cerro Prieto, exhibits a pattern of house organization that superficially resembles Pre-Classic courtyard groups. The architecture at Cerro Prieto reflects the use of at least two alternative organizational strategies. The construction and occupation of a singular or a few large structures surrounded by piled stone walls represents the material remains of one of these strategies. The households that occupied these structures were able to construct large dwellings without apparent corporate group affiliations. Their ability to mobilize exterior labor pools suggests they performed a specialized role in the community, or that they at least provided a service that curried favor with settlement residents. It remains unclear exactly how these households obtained and/or managed access to resources and labor; however, ideological specialization offers one plausible explanation.

The occupation and growth of multi-dwelling clusters with common yards and other associated features represent a second, more common organizational strategy, one that focused on a “wealth in people” approach (see McIntosh 1999; Nyerges 1992). Households that employed this tactic emphasized the attraction of other house-group members to the detriment of personnel aggrandizement. The architectural data from dwelling clusters at Cerro Prieto indicates that households which were members of these clusters shared the benefits of a corporate labor pool nearly equally. The size and construction of dwellings within each cluster were, in general, uniform. Moreover, the average size of the structures within relatively large dwelling clusters is larger than the average size of structures in smaller clusters. Although there is some evidence that house heads drew on the corporate labor pool increasingly disproportionately as house size increased, the trend is not robust. The lack of differentiation among dwelling within each of the clusters is consistent with the standard assumption that the Hohokam residential groups were approximate equals in material wealth. Such material equality was likely an outgrowth of the social contexts in which labor was managed. Hypotheses that seek to explain this pattern, though, should consider social-environmental contexts at a regional level.

The demands of agricultural scheduling likely also contributed to the organizational patterns observed at Cerro Prieto. Irrigation agriculture, as well as many other forms of agricultural production, require large amounts of simultaneous labor. However, given the rapid settlement of the Cerro Prieto region in a minimally occupied area and the general social tumult of the Pre-Classic to Classic transition, corporate groups probably could not claim rights of differential access to limited resources, such as land and water. In an open-access subsistence economy individual households have a high degree of freedom when selecting a labor investment strategy. In this case, independence was clearly an option. It is likely that households who chose an independent approach built and occupied many individual and isolated structures at Cerro Prieto. However, autonomous production likely included acceptance of some economic marginalization. This marginalization may be reflected in the smaller size of some of these structures. Alternatively, households could join a larger house group. The demand for labor in these contexts put households in the favorable positions of being able to command roughly equal parity in resource distributions with other house members. In short, the evidence suggests the economy of Cerro Prieto was labor limited as opposed to resource limited, and that the desire to attract house members suppressed material wealth disparities.

The architectural analysis of Cerro Prieto demonstrates that influential households and/or leaders minimized material disparities in wealth as they created other forms of inequality. The much higher Gini coefficient produced for inter-household clusters compared to individual dwellings demonstrates this clearly. As an important corollary, the analysis also highlights that interpretations of architectural data are predominantly dependent on the unit of social inclusivity utilized in the analysis. In other words, households in dwelling clusters appear to be socio-economic equals only because they were the currency gathered by more inclusive house units.

At the scale of individual settlements, community integration patterns, gauged by investment in communal architecture, indicate that Cerro Prieto lacked significant political consolidation above the level of individual houses. Thus, the village was likely reliant on a neighboring platform mound settlement for higher order community integration mechanisms. A lack of integrative architecture at this large site may be related to a high level of competition among the house cluster groups. The hypothesis of competition among clusters warrants future testing.

At a regional scale, it is important to ask why *cerros de trincheras* were constructed in the Tucson Basin and not in the Phoenix Basin. Several researchers have postulated that Hohokam organizational strategies were outgrowths of a reliance on canal irrigation and its inherent management requirements (e.g., Abbott 2003; Howard 2006; Hunt et al. 2005; Woodson 2010). In ethnographic studies of middle-range societies, ideology is frequently identified as the vehicle by which leaders manipulated the machinations of power (e.g., Elson and Abbott 2000; S. Fish and P. Fish 2000b). If this statement is accurate the ideological and social systems imported to the Tucson Basin from the Phoenix Basin may have been ill-suited for local managerial demands dictated by very different ecological and demographic conditions. Or perhaps the spreading ideology associated with platform mounds simply proved unsatisfactory to sub-populations of the Tucson Basin. Adopting an ideology common to other Sonoran Desert groups centered on hill top ritual while simultaneously participating in the predominant platform mound centered ideology may have provided one alternative (S. Fish et al. 2007). The persistence of Pre-Classic traits, such as house sizes akin to courtyard groups and cremation burials in house yards, may also point to dissatisfaction with the dominant ideology of the early Classic period. The short-lived occupation of Cerro Prieto may indicate that the forms of social organization based on this alternative system ultimately proved untenable in the wider social and ecological climate.

Notes

1. The chronology of site occupation is based on the presence of Tanque Verde wares on the site's surface and an absence of ceramics associated with the previous Rincon phase or Salado wares of the late Classic Tucson phase. In all likelihood, the site was not occupied for the entire length of the Tanque Verde phase but rather for ca. 50 years, as ethnographically predicted by the use life of a structure.

2. These analyses exclude isolated habitation structures and structures surrounded by piled stone walls since they include populations subject to economic conditions that differ from those under discussion.

Acknowledgments. Many thanks to Christian Downum, Douglas Craig and John Douglas who first recognized the significance of Cerro Prieto. Douglas Craig also provided critical data and many useful suggestions.

Thanks also to Suzanne and Paul Fish who provided advice on interpreting the architecture of Cerro Prieto, Meredith Reifschneider who provided access to labor estimate data, John Madsen who facilitated land access, Ismiel Byakara, Amy Clark, and Deanna Grimstead who volunteered as field crew, and Gary Christopherson who aided greatly with GIS analysis. This research was made possible by generous grants from the Rieker Scholarship fund, The Thompson Endowment, and the University of Arizona Department of Anthropology general scholarship fund. All errors and omissions are my own.

REFERENCES CITED

Abbott, David R.

2000 *Ceramics and Community Organization among the Hohokam*. University of Arizona Press, Tucson.

2003 The Politics of Decline in Canal System 2. In *Centuries of Decline during the Hohokam Classic Period at Pueblo Grande*, edited by D. R. Abbott, pp. 201–227. University of Arizona Press, Tucson.

Abbott, David R., and Michael S. Foster

2003 Site Structure, Chronology, and Population. In *Centuries of Decline during the Hohokam Classic Period at Pueblo Grande,* edited by D. R. Abbott, pp. 24–48. University of Arizona Press, Tucson.

Abrams, Elliot M.

1994 *How the Maya Built Their World: Energetics and Ancient Architecture*. University of Texas Press, Austin.

Aguirre, Y.

1983 Echoes of the Conquistadores: History of a Pioneer Family in the Southwest. Privately Printed. Copy on file in Arizona State Museum, University of Arizona, Tucson.

Bayman, James M.

1995 Rethinking 'Redistribution' in the Archaeological Record: Obsidian Exchange at the Marana Platform Mound. *Journal of Anthropological Research* 51:37–63.

Beck, Robin A. (editor)

2007 *The Durable House: House Society Models in Archaeology*. Occasional Paper No. 35. Center for Archaeological Investigations, Southern Illinois University, Carbondale.

Bernard-Shaw, Mary

1983 The Stone Tool Assemblage of The Salt-Gila Aqueduct Project Sites. In *Hohokam Archaeology along the Salt-Gila Arizona Project Volume VIII: Material Culture*, edited by L. S. Teague and P. L. Crown, pp. 371–444. Archaeological Series No. 150, Cultural Resource Management Division, Arizona State Museum, University of Arizona, Tucson.

Cook, Sherbourne F.

1972 *Prehistoric Demography*. Modular Publications No. 16. Addison-Wesley, Reading.

Craig, Douglas B.

2001 Domestic Architecture and Household Wealth at Grewe. In *Grewe Archaeological Research Project, Vol. III Synthesis*, edited by D. B. Craig. pp. 141–148. Anthropological Papers No. 99-1. Northland Research, Inc., Flagstaff and Tempe.

2007 Courtyard Groups and House Estates in Early Hohokam Society. In *The Durable House: House Society Models in Archaeology*, edited by R. A. Beck, pp. 463–446. Occasional Paper No. 35. Center for Archaeological Investigations, Southern Illinois University, Carbondale.

Craig, Douglas B., and Jeffery J. Clark

1994 The Meddler Point Site AZ V:5:4/26(ASM/TNF). In *The Roosevelt Community Developments Study, Vol. II: Meddler Point, Pyramid Point, and Griffin Wash Sites*, edited by M. D. Elson, D. L. Swartz, D. B. Craig and J. J. Clark, pp. 1–197. Anthropological Papers No. 13, Center for Desert Archaeology, Tucson.

Crown, Patricia L.

1985 Morphology and Function of Hohokam Small Structures. *The Kiva* 50:75–94.

Doelle, William H., Frederick W. Huntington, and Henry D. Wallace

1987 Rincon Phase Community in the Tucson Basin. In *The Hohokam Village: Site Structure and Organization*, edited by D. E. Doyel, pp. 71–95. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Glenwood Springs.

Downum, Christian E.

1995 Archaeological Investigations at Linda Vista Hill, 1980-1987. In *Archaeological Investigations at Los Morteros: A Prehistoric Settlement in the Northern Tucson Basin*, Volume 2, edited by H. D. Wallace, pp. 1155–1183. Anthropological Papers No. 17. Center for Desert Archaeology, Tucson.

2007 Cerros de Trincheras in Southern Arizona: Review and Current Status of the Debate. In *Trincheras Sites in Time, Space and Society*, edited by S. K. Fish, P. R. Fish and M. E. Villalpando, pp. 101–136. University of Arizona Press, Tucson.

Downum, Christian E., John E. Douglas, and Douglas B. Craig

1993 The Cerro Prieto Site. In *Between Desert and River: Hohokam Settlement and Land Use in the Los Robles Community*, edited by C. E. Downum, pp. 53–97. University of Arizona Press, Tucson.

Elson, Mark D., and David R. Abbott

2000 Organizational Variability in Platform Mound-Building Groups of the American Southwest. In *Alternative Leadership Strategies in the Prehispanic Southwest*, edited by B. J. Mills, pp. 117–135. University of Arizona Press, Tucson.

Feinman, Gary M., and Jill Neitzel

1984 Too Many Types: An Overview of Sedentary Pre-State Societies in the Americas. In *Advances in Archaeological Method and Theory*, Vol. 7, edited by M. B. Schiffer, pp. 39–102. Academic Press, New York.

Fish, Paul R., and Suzanne K. Fish

1991 Hohokam Political and Social Organization. In *Exploring the Hohokam: Prehistoric Desert Peoples of the American Southwest*, edited by G. J. Gumerman, pp. 151–175. University of New Mexico Press, Albuquerque.

2000 The Marana Mound Site: Patterns of Social Differentiation in the Early Classic Period. In *The Hohokam Village Revisited*, edited by D. E. Doyel, S. K. Fish, and P. R. Fish, pp. 245–275. American Association for the Advancement of Science, Southwestern and Rocky Mountain Division, Fort Collins.

2007 Community, Territory, and Polity. In *The Hohokam Millennium*, edited by S. K. Fish and P. R. Fish, pp. 39–47. School for Advanced Research Press, Santa Fe.

Fish, Suzanne K.

1999 Cerro de Trincheras Settlement and Land Use Survey. Report to the National Geographic Society for Grant 5856-97. Report on file, Arizona State Museum Archives, University of Arizona, Tucson.

Fish, Suzanne K., and Paul R. Fish

2000a Civic-Territorial Organization and the Roots of Hohokam Complexity. In *The Hohokam Village Revisited*, edited by D. E. Doyel, S. K. Fish, and P. R. Fish, pp. 373–390. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Fort Collins.

2000b The Institutional Contexts of Hohokam Complexity. In *Alternative Leadership Strategies in the Prehispanic Southwest*, edited by B. J. Mills, pp. 154–167. University of Arizona Press, Tucson.

2004 In the Trincheras Heartland: Initial Insights from Full-Coverage Survey. In *Surveying the Archaeology of Northwest Mexico*, edited by G. E. Newell and E. Gallaga, pp. 47–64. University of Utah Press, Salt Lake City.

2006a The Classic Period in the Tucson Basin. In *Hohokam Trajectories in Worldwide Perspective*, edited by P. R. Fish and S. K. Fish. University of Arizona Press, Tucson. [in prep.]

2006b Trincheras Sites: Settlement Patterns, Summits, and Ideology. In *Una Mirad Desede las Alturas: Circulos de Piedra, Corrales e Ideologia en los Cerros de Trincheras.* Seminario de Arqueología del Norte de México. Museo Nacional de Antropologia y Centro INAH Sonora, Mexico D.F.

Fish, Suzanne K., Paul R. Fish, and Christian Downum

1984 Hohokam Terraces and Agricultural Production in the Tucson Basin. In *Prehistoric Agricultural Strategies in the Southwest*, edited by S. K. Fish and P. R. Fish, pp. 55–71. Anthropological Research Papers No. 33, Arizona State University, Tucson.

Fish, Suzanne K., Paul R. Fish, and John H. Madsen

1992a *The Marana Community in the Hohokam World*. Anthropological Papers of the University of Arizona No. 56, University of Arizona Press, Tucson.

1992b Parameters of Agricultural Production in the Northern Tucson Basin. In *The Marana Community in the Hohokam World*, edited by S. K. Fish, P. R. Fish and J. Madsen, pp. 41–52. Anthropological Papers of the University of Arizona No. 56. University of Arizona Press, Tucson.

1992c Evolution and Structure of the Classic Period Marana Community. In *The Marana Community in the Hohokam World*, edited by S. K. Fish, P. R. Fish and J. H. Madsen, pp. 20–40. Anthropological Papers of the University of Arizona No. 56. University of Arizona Press, Tucson.

Fish, Suzanne K., Paul R. Fish, Charles Miksicek, and John Madsen

1985 Prehistoric Agave Cultivation in Southern Arizona. *Desert Plants* (7):107-112, 100.

Fish, Suzanne K., Paul R. Fish, and M. Elisa Villalpando (editors)

2007 *Trincheras Sites in Time, Space, and Society*. University of Arizona Press, Tucson.

Gregory, David A.

1991 Form and Variation in Hohokam Settlement Patterns. In *Chaco & Hohokam: Prehistoric Regional Systems in the American Southwest*, edited by P. L. Crown and W. J. Judge, pp. 159–193. School of American Research Press, Santa Fe.

Guyer, Jane

1995 Wealth in People, Wealth in Things—Introduction. *Journal of African History* 36:91–120.

Hard, Robert J., and John R. Roney

2007 Cerros de Trincheras in Northwestern Chihuahua: The Argument for Defense. In *Trincheras Sites in Time, Space, and Society*, edited by S. K. Fish, P. R. Fish and M. E. Villalpando, pp. 11–52. University of Arizona Press, Tucson.

Harry, Karen G., and James A. Bayman

2000 Leadership Strategies among the Classic Period Hohokam: A Case Study. In *Alternative Leadership Strategies in the Prehispanic Southwest*, edited by B. J. Mills, pp. 136–153. University of Arizona Press, Tucson.

Hayden, Brian, and Aubrey Cannon

1982 The Corporate Group as an Archaeological Unit. *Journal of Anthropological Archaeology* 1(2):132–158.

Henderson, T. Kathleen

1987a The Growth of a Hohokam Village. In *The Hohokam Village: Site Structure and Organization*, edited by D. E. Doyel, pp. 97–125. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Glenwood Springs.

1987b *Structure and Organization at La Ciudad*. Anthropological Field Studies No. 18. Office of Cultural Resource Management, Arizona State University, Tempe.

Howard, Jerry B.

1985 Courtyard Groups and Domestic Cycling: A Hypothetical Model of Growth. In *Proceedings of the 1983 Hohokam Symposium: Part 1*, edited by A. E. Dittert, Jr. and D. E. Dove, pp. 311–326. Arizona Archaeological Society, Phoenix.

1987 The Lehi Canal System: Organization of a Classic Period Irrigation Community. In *The Hohokam Village: Site Structure and Organization*, edited by D. E. Doyel, pp. 211–221. Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, Glenwood Springs.

2006 Hohokam Irrigation Communities: A Study of Internal Structure, External Relationships, and Sociopolitical Complexity. Unpublished Ph.D. dissertation, School of Human Evolution and Social Change, Arizona State University, Tempe.

Hunt, Robert C., David Guillet, David R. Abbott, James Bayman, Paul Fish, Suzanne Fish, Keith Kintigh, and James A. Neely

2005 Plausible Ethnographic Analogies for the Social Organization of Hohokam Canal Irrigation. *American Antiquity* 70(3):433–456.

Levi-Strauss, Claude

1982 *The Way of the Masks*. Translated by S. Modelski.

University of Washington Press, Seattle.

Lorenz, M. O.

1905 *Methods of Measuring the Concentration of Wealth.* Publications of the American Statistical Association 9(70):202–219.

McGuire, Randall H.

1983 Breaking Down Cultural Complexity: Inequality and Heterogeneity. In *Advances in Archaeological Method and Theory*, Vol. 6, edited by M. B. Schiffer, pp. 91–142. Academic Press, New York.

McGuire, Randall H., and M. Elisa Villalpando

2007 Excavations at Cerro de Trinceras. In *Trincheras Sites in Time, Space, and Society*, edited by S. K. Fish, P. R. Fish and M. E. Villalpando, pp. 137–164. University of Arizona Press, Tucson.

McIntosh, Susan Keech

1999 Pathways to Complexity: An African Perspective. In *Beyond Chiefdoms: Pathways to Complexity in Africa*, edited by S. K. McIntosh, pp. 1-30. Cambridge University Press, Cambridge.

Mills, Barbara J. (editor)

2000 *Alternative Leadership Strategies in the Prehispanic Southwest*. University of Arizona Press, Tucson.

Mitchell, Douglas R.

2003 Burial and Society. In *Centuries of Decline during the Hohokam Classic Period at Pueblo Grande*, edited by D. R. Abbott, pp. 107–127. University of Arizona Press, Tucson.

Nelson, Ben A.

2007 The Crafting of Places: Mesoamerican Monumentality in Cerros de Trincheras and Other Hilltop Sites. In *Trincheras Sites in Time, Space, and Society*, edited by S. K. Fish, P. R. Fish and M. E. Villalpando, pp. 230–246. University of Arizona Press, Tucson.

Netting, Robert McC.

1982 Some Home Truths on Household Size and Wealth. *American Behavioral Scient*ist 25:641–661.

Nyerges, E. A.

1992 The Ecology of Wealth-in-People: Agriculture, Settlement, and Society on the Perpetual Frontier. *American Anthropologist* 94(4):860–881.

O'Donovan, Maria

2002 *New Perspectives on Site Function and Scale of Cerro de Trincheras Sonora, Mexico: The 1991 Surface Survey.* Archaeological Series No. 195. Arizona State Museum, University of Arizona, Tucson.

2004 The Role of Cerro de Trincheras Sites in the Northwest Mexican and American Southwest Landscape. In *Surveying the Archaeology of Northwest Mexico,* edited by G. E. Newell and E. Gallaga, pp. 27–45. University of Utah Press, Salt Lake City.

Pailes, Matthew C.

2008 Wealth Differentiation and Social Organization at Cerro Prieto: An Early Classic Period, Hohokam Cerros de Trincheras. Unpublished MA thesis, Department of Anthropology, University of Arizona, Tucson.

Rice, Glen E.

1987 The Marana Community Complex: A Twelfth Century Hohokam Chiefdom. In *Studies in the Hohokam Community of Marana*, edited by G. E. Rice, pp. 249–254. Anthropological Field Studies 15. Office of Cultural Resource Management, Arizona State University, Tempe.

1990 Variability in the Development of Classic Period Elites. In *A Design for Salado Research*, edited by G. E. Rice, pp. 31–40. Anthropological Field Studies 22. Office of Cultural Resource Management, Arizona State University, Tempe.

Roney, John R., and Robert J. Hard

2004 A Review of Cerros de Trincheras in Northwestern Chihuahua. In *Surveying the Archaeology of Northwest Mexico*, edited by G. E. Newell and E. Gallaga, pp. 127–149. University of Utah Press, Salt Lake City.

Stacy, V. K. P.

1974 Cerros de Trincheras in the Arizona Papaguería. Unpublished Ph.D. dissertation, Department of Anthropology, University of Arizona, Tucson.

Villalpando, M. Elisa., and Randall H. McGuire

2009 *Entre Muros de Piedra: La Arqueología del Cerro de Trincheras.* Instituto Nacional de Antropología e Historia, Centro INAH Sonora, Hermosillo.

Wallace, Henry D., Paul R. Fish, and Suzanne K. Fish

2007 Tumamoc Hill and the Early Pioneer Period Occupation of the Tucson Basin. In *Trincheras Sites in Time, Space, and Society*, edited by S. K. Fish, P. R. Fish and E. Villalpando, pp. 53–100. University of Arizona Press, Tucson.

Wallace, Henry D., and Michael W. Lindman

2003 Valencia Vieja and the Origins of Hohokam Culture. In *Roots of Sedentism: Archaeological Excavations at Valencia Vieja: A Founding Village in the Tucson Basin of Southern Arizona*, edited by H. D. Wallace, pp. 371–406. Anthropological Papers No. 29. Center for Desert Archaeology, Tucson.

Wilcox, David R.

1991 Hohokam Social Complexity. In *Chaco & Hohokam: Prehistoric Regional Systems in the American Southwest,* edited by P. L. Crown and W. J. Judge, pp. 253–275. School of American Research Press, Santa Fe.

Wilcox, David R., Thomas R. McGuire, and Charles Sternberg

1981 *Snaketown Revisited: A Partial Cultural Resource Survey, Analysis of Site Structure and an Ethnohistoric Study of the Proposed Hohokam-Pima National Monument.* Archaeological Series No. 155, Arizona State Museum, Tucson.

Wilk, Richard R., and Robert McC. Netting

1984 Households: Changing Forms and Functions. In *Households: Comparitive and Historical Studies of the Domestic Group*, edited by R. R. Wilk, R. M. Netting, and E. J. Arnould, pp. 1–28. University of California Press, Berkeley.

Wilk, Richard R., and William L. Rathje

1982 Household Archaeology. *American Behavioral Scientist* 25(6):617–639.

Woodson, M. Kyle

2010 Re-drawing the Map of the Hohokam Canals in the Middle Gila River Valley. *Journal of Arizona Archaeology* 1(1):5–20.