Innovation in Context: The Process of Stylistic Change among Hohokam Potters in the Phoenix Basin, A.D. 800-1300

by

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A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved April 2013 by the
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ARIZONA STATE UNIVERSITY

May 2013

ABSTRACT

The causes and consequences of stylistic change have been a concern of archaeologists over the past several decades. The actual process of stylistic innovation, however, has received less attention. This project explores the relationship between the process of stylistic innovation on decorated pottery and the social context in which it occurred in the Hohokam area of south-central Arizona between A.D. 800 and 1300. This interval was punctuated by three episodes of reorganization, each of which was characterized to varying degrees by significant shifts in ideology, economics, and politics. Each reorganization episode was also accompanied by a rapid profusion of stylistic innovation on buff ware pottery. The goal of this study was to build a framework to understand the variation in the process of innovation as a response to different incentives and opportunities perceived in the changing social environment.

By bringing stylistic analyses and provenance data together for the first time in Hohokam red-on-buff studies, I investigated how the process of innovation was variously influenced by social reorganizations at three different periods of time: the 9th, 11th, and 12th centuries A.D. Four variables were used to evaluate the process of innovation at each temporal period: 1) The origin of a stylistic invention, 2) the rate of its adoption, 3) the pattern of its adoption, and 4) the uniformity of its adoption among all buff ware potting communities. To accomplish the task, stylistic innovations and provenance were recorded on over 3,700 red-on-buff sherds were analyzed from 20 sites in the Phoenix Basin.

The innovation process was found to vary with each reorganization episode, but often in different ways than expected. The results revealed the complexity and unpredictability of the process of stylistic innovation among the Hohokam. They also

challenged some assumptions archaeologists have made regarding the scale and extent of the changes associated with some of the reorganization episodes. The variables utilized to measure the innovation process were found to be effective at providing a composite picture of that process, and thus warrant broader application to other archaeological contexts.

ACKNOWLEDGMENTS

I owe a great deal of thanks to many people for the production of this paper. First, I want to thank my committee: David Abbott, Kate Spielmann, Michelle Hegmon, and Ben Nelson. The time they have spent reading and directing me through this project, and well before it began, is truly appreciated and it would not likely have been completed with a different committee. In particular, I am indebted to my Chair, Dave Abbott, who has provided immeasurable guidance throughout this process. All I know of Hohokam pottery comes from him. Likewise, I need to thank the manifold co-laborers in the graduate experience at Arizona State University who stimulated my thinking and encouraged my perseverance in this project.

Numerous other colleagues deserve my gratitude. Elizabeth Miksa provided the initial training on correlating sand samples with petrofacies through the use of a binocular microscope. Petrographic analysis for the Sonoqui Pueblo sherds was made possible by Gene Rogge and Pamela Cox of URS Corporation. All buff ware sherds from the Lower Santan Site were analyzed as part of an ongoing research project with the Gila River Indian Community Cultural Resource Management Program. Thanks to Andrew Darling, Sunday Eiselt, and M. Kyle Woodson for organizing and directing this research, along with Linda Morgan, Lorie Sinclair, and Eloise Pedro for providing much needed help with the collections. Analysis of the buff ware assemblages from all sites in the Agua Fria/New River area (with the exception of Palo Verde), along with the assemblage from AZ AA:1:124 (ASM) was done with the helpful assistance and ideas from Glen Rice, Christopher Watkins, Erik Steinbach, and David Bustoz at Rio Salado Archaeology, LLC. Arleyn Simon, Dolma Roder, Nathan Wilson, and Steven Schmich of the School of

Human Evolution and Social Change at Arizona State University allowed us access to curated materials. Arthur Vokes and Patrick Lyons generously provided access to curated collections at the Arizona State Museum. Material from Pueblo Grande Museum was accessed through the kind assistance of Holly Young.

I thank my wife, Sara, who has borne the brunt of the sacrifice in the completion of this dissertation, yet without complaint. Her love, support, encouragement, and patience were and are invaluable to any of my endeavors. I also thank my two boys, Stephen and John, whose frequent, but usually welcome, interruptions helped me to smile even through the formatting stage. Above all, I thank my Lord and Savior, Jesus Christ, who is everything to me.

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Chapter 1:

INTRODUCTION

Stylistic change in prehispanic pottery has been an on-going topic of research among archaeologists working in the U.S. Southwest. This unabated interest stems, in part, from the diverse questions that can be, and have been, profitably addressed through analyses of pottery style (e.g., chronology, social organization, identity, migration, etc.). While this research has demonstrated the usefulness of stylistic change in addressing such issues, less focus has been placed on examining the actual process of that change; that is, the process of stylistic innovation among potters. Innovation has been defined as the invention of a new way of doing things *and* the adoption of that new way of doing by a wider population; a social process, rather than an event (Torrence and van der Leeuw 1989). An understanding of this process is significant because it puts potters in an active role in responding to and creating demand for their product within their societies. They reacted to social conditions by making specific choices of if, when, and how they should innovate, or adopt an innovation (Hegmon and Kulow 2005; Kohler et al. 2004; van der Leeuw 2008).

The purpose of this project is to explore the relationship between the processes of stylistic innovation in decorated pottery and the social contexts in which they occurred in the Hohokam area of south-central Arizona between A.D. 800 and 1300. It is known that significant stylistic innovations in red-on-buff pottery were associated with particular episodes of social reorganization (Wallace 1995, 2001; Haury 1976). This project will explore how the innovation process varied in association with the specific nature of the reorganization in Hohokam society.

Over the last two decades, a great deal of research has focused on understanding the production and distribution of pottery across the Phoenix Basin. Contrary to the common assumption that pottery was essentially produced at a household level for household use, this new research demonstrated that for much of Hohokam history, most pottery was produced by specialists at a level unparalleled in the prehistoric southwest (Abbott 2009). Virtually every household was dependent on multiple specialists located in a handful of specific areas of the basin for a full complement of vessel forms and wares (Abbott 2003a, Abbott, Watts, and Lack 2007; Van Keuren et al. 1997). The wide-scale distribution of different forms and wares from such a limited number of production areas has led some to argue for the existence of market place exchange in the Sedentary period (Abbott 2006; Abbott, Smith, and Gallaga 2007).

One of those wares that was efficiently and widely distributed throughout the Phoenix Basin was Hohokam red-on-buff pottery (Abbott et al. 2001; Abbott, Watts, and Lack 2007; Lack et al. 2012). Red-on-buff pots are known to have been produced almost exclusively in the southern part of the Basin, and exchanged to sites across the basin and beyond for several centuries. Prior to A.D. 1100, these decorated pots routinely accounted for more than 20 percent of ceramic assemblages for most households and sites (Abbott 2009:535).

The stylistic development of these red-on-buff vessels has been well-documented (Haury 1937, 1945, 1976; Wallace 2001, 2004), but the process of that development, or stylistic innovation, has yet to be systematically explored.

The overarching contextual factors that are expected to have influenced the process of innovation differently over time were the incentives to innovate, the sense of interconnection among production groups, the relative degree of social integration, and ease of information flow associated with these reorganizations. I investigated the relationship between three different episodes of social reorganization and the process of innovations, assessed in terms of four variables: 1) The origin of a stylistic invention, or the specific potting community at which a stylistic invention first appeared, 2) the rate of its adoption; that is, the relative amount of time that elapsed from the invention to adoption by different potting communities, 3) the pattern of its adoption, through nearest-neighbors or not, and 4) the uniformity of its adoption among all buff ware potting communities.

The study of innovation in buff ware style across space and time has not been possible until now because such an investigation requires a tight control over both chronology and the organization of production that was not available to previous researchers. Recent advances in provenance analyses, however, have demonstrated that it is possible to distinguish different potting communities where specialization in buff ware ceramics occurred (Abbott, Watts, and Lack 2007; Miksa 2001). In addition, refinements to the red-on-buff chronological sequence over the past few years have significantly enhanced our ability to track changes to the stylistic sequence over short temporal intervals (Wallace 2001, 2004). This study combines these recent advances in buff ware chronology and provenance research for the first time to consider the process of innovation among specialist Hohokam potting communities.

For reasons outlined below, I expect that sweeping ideological changes between the early and late Gila Butte phases (ca. A.D. 800) created a strong social incentive for stylistic invention, and would have been accompanied by rapid and uniform innovation adoption by potting communities endeavoring to affiliate themselves with the new ideological themes, or even promote them. Economic reorganization, such as occurred at the onset of the middle Sacaton phase (ca. A.D. 1000-1020), in contrast, would have motivated artisans within a highly integrated society to invent with the promise of material, or economic, rewards, thus fostering competition among potting communities and non-uniform adoption of inventions by other groups – providing that multiple potting communities existed. Finally, the social fragmentation and balkanization of the late Sacaton and early Soho phases (A.D. 1070-1125) would have served as an incentive to innovate in order to maintain relevance for their product in the midst of a changing political, economic, and ideological landscape that included a shift towards more localized identities. It is expected that such reorganization would have led to many locations of innovation, and slower, less uniform innovation adoption.

Objectives

To investigate the process of innovation among buff ware artisans, I initiated a research program based on extant museum collections that proceeded in two stages. In the first stage, I identified buff ware potting communities through a provenance analysis of carefully selected buff ware sherds from multiple time periods and sites spread across the lower Salt River Valley, the middle Gila River Valley, the Queen Creek area, the Agua Fria/New River area, and the lower Gila River area (Figure 1.1). Because the buff ware potters often tempered their vessels with a sand component (in addition to crushed

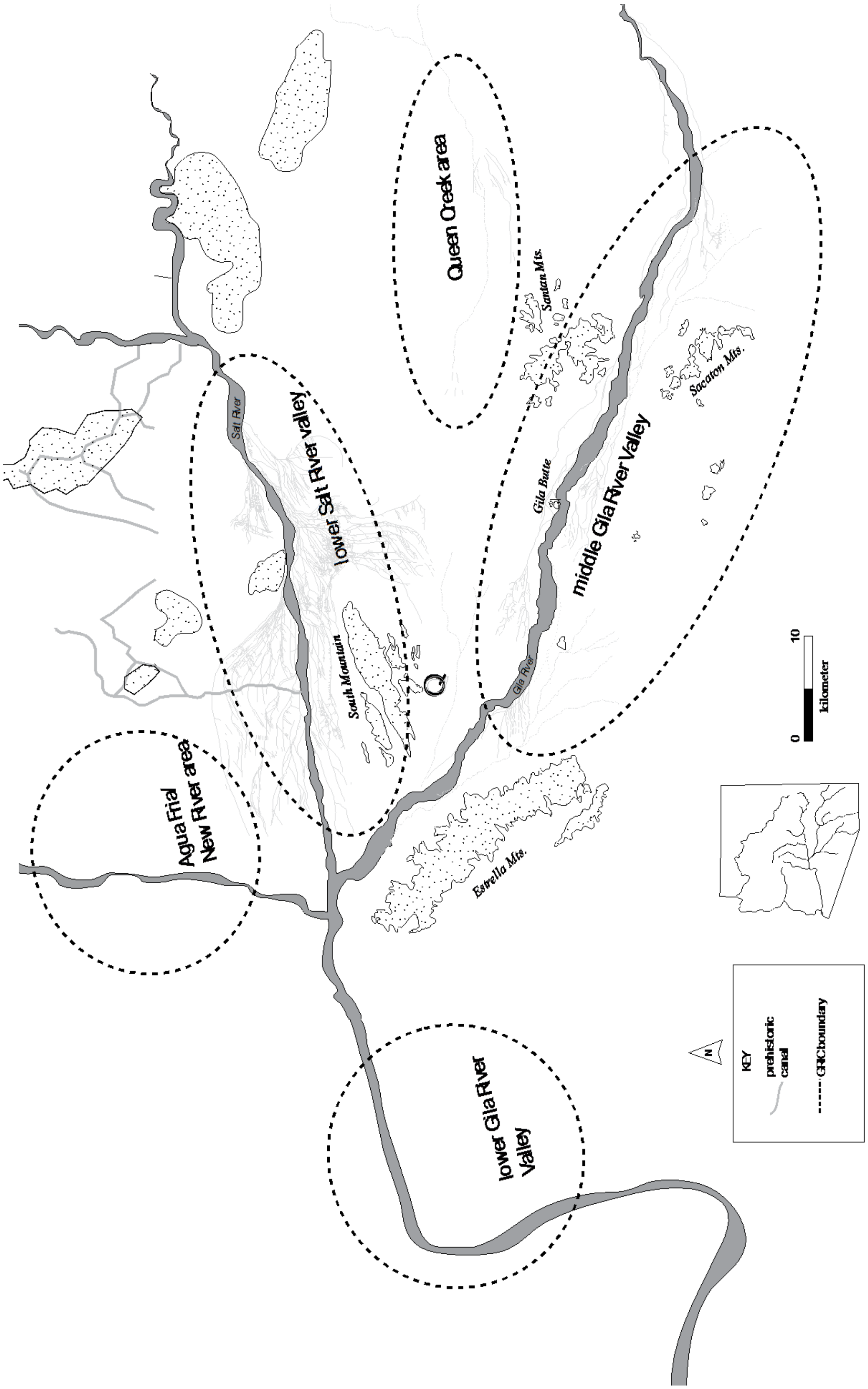


Figure 1.1. Map of the Hohokam area with regions mentioned in the text.

mica schist), many buff ware sherds can now be sourced to specific portions of the valley where the mineralogical constituents of local sands have been mapped in detail.

In the second stage of the project, I assessed innovation among the potting communities identified in the provenance analysis through a stylistic attribute analysis. Stylistic information from decorated buff ware pottery was recorded and analyzed in order to examine innovation at all stages of the manufacturing process, from the origin of innovations to the adoption by other potting groups. By applying the recent developments in chronology and provenance research, it was possible to measure four variables that describe the process of innovation: the origin of specific stylistic inventions, the rate at which they were adopted by those groups, the pattern of their dissemination to other potting communities, and the uniformity of the adoption of those inventions among different potting groups.

Chapter 2:

MEASURING INNOVATION

In most archaeological studies, the term *innovation* is used to describe a dramatic change in some sort of technology, such as the origin of pottery or metallurgy, or the domestication and spread of various agricultural products. Innovation is typically viewed as a thing, an event that happened at one point, and is left without theoretical development. Over the past twenty-five years, some archaeologists have begun to move away from the 'innovation as event' paradigm, and instead conceptualize innovation as a *process*. In this perspective, innovation is defined as the invention of novel forms by a person or group and their subsequent acceptance and use by a wider population (Torrence and van der Leeuw 1989:3). As a process, innovation consists of everything from the initial idea to its physical invention to its widespread adoption by a population. At each point of this process, the innovation is shaped by the social context in which it is embedded.

Some researchers have commented on how innovation studies over the past century have been overly focused on the results of innovation in society, rather than how society and innovation relate to one another (Russo in prep; van der Leeuw 2008). Van der Leeuw (2008:221), for example, comments that it is impossible for an individual to invent 'anything, at any time' because "existing material culture (and the concepts and relations it represents and instantiates) seems to constrain the range of inventions and innovations that may emerge." The contention of these researchers, therefore, is that we should be studying the variegated social, economic, political, and physical environments, along with the existing toolkits and product conceptualizations of the maker, and the dynamics within and between them, within which invention and innovation might or might not occur. In brief terms, these researchers call for a study of the complete network involved in the process of innovation.

Although the study of a complete network is never possible in archaeology, in this study I will endeavor to investigate the process of innovation in its relationship with the social, ideological, economic, and political realms. Although this study will focus on three periods of intensive innovative behavior, it is not my intention to suggest that innovative behavior did not occur at other times in Hohokam history, or that Hohokam potters were somehow static objects who tended to remain at rest until acted upon by an outside force. As in other areas of the world (Rabey 1989; Papousek 1989), potters in the Phoenix Basin were constantly engaging in innovative behavior to some degree (Wallace 2001). It is also true, however, that those periods of the most intense innovative activity occurred during particular episodes of social reorganization. It is assumed from the outset, therefore, that a strong relationship existed between changes in the social environment and stylistic innovation. The focus of this study is on the nature of that relationship; the interplay of innovation and social change.

A study of that interplay between innovation and social change can be enhanced by the concept of *communities of practice*. A community of practice describes a group of people that share a sustained pursuit of a shared enterprise that involves regular communication among its practitioners (Huntley 2006:121; Wenger 1998:45; Stark 1999, 2006). The members of a community of practice learn from and copy one another, often subconsciously, leading to products of similar technology and style (Gosselain 1998, 1999, 2000; Huntley 2006; Sassaman and Rudolphi 2001; Van Keuren 2006). This concept is especially helpful to studies like this one where it is impossible to look at individual potters and how they engaged in innovative behavior. A community of practice can serve as a kind of substitute for the individual; an extended individual that is more visible to the archaeologist through shared technology and style. As social reorganization occurs, the members of a community of practice are expected to act or react in a similar way.

Several ethnographic and archaeological studies have made significant progress in understanding how the social context relates to innovation. The contributions to Torrance and van der Leeuw's (1989) edited volume brought together a host of ethnographers, archaeologists, and modelers to examine innovation from various perspectives (see also Schiffer and Shennan 2010). This volume did much to shed light on the complexity involved in the innovation process. Likewise, Harrison and colleague's (2002) volume on the archaeology of innovation and science provided a number of case studies in which important innovations from around the world were described and analyzed as to their timing and success within their individual social contexts. While the significance of these volumes is acknowledged, the overriding focus for both, and most other studies of innovation past and present was on technological innovation. Far fewer studies have specifically addressed stylistic innovation in a systematically rigorous way. This lack of systematic research is unfortunate because style, like technology, has served, and continues to serve, important and multiple roles that affect social change and stability in all cultures. Those ethnographic and archaeological studies that have focused on stylistic innovation have generated valuable insights into the interplay between the social environment and the opportunities that did or did not exist for individuals or groups to experiment and innovate with style (Hegmon and Kulow 2005; Kohler et al. 2004; Parkinson 2006; van Pool and Savage 2010).

Three studies of stylistic innovation (one ethnographic and two archaeological) are briefly described below to aid in formulating a framework for the study of stylistic innovation that bridges anthropology/archaeology and contemporary economic theory. The goal of this section is to identify the variables that can be used to measure different points in the innovation process and to generate expectations for those measurements based on the prevailing social environment.

Ethnography

Several researchers have conducted anthropological and/or economic studies on the process of innovation on ethnographically documented craft production groups (Carlsen 1993; Causey 1999; Chibnik 2000, 2002; DeBoer 1992; Nash 1993; Stephen 1993; Stromberg-Pellizi 1993; Tice 1995; Dietler and Herbich 1989, 1998). Components of one of these studies (Chibnik 2000, 2002) are described here in order to help build a framework for understanding the relationship between the process of innovation and the larger social context in which it occurs.

Michael Chibnik studied woodcarvers in the state of Oaxaca, Mexico (Chibnik 2000, 2002) to examine how product differentiation, or innovation, related to the market system in which they participated. Three well-known woodcarving villages, Arrazola, San Martín Tecajete, and La Union Tejalapan, formed the basis of his investigation. Each village contained between 1,000 and 2,000 residents, and are all located within 30 kilometers of one another.

In the course of his study, Chibnik identified three aspects of Oaxaca wood-carving that encouraged innovation and specialization. First, for most customers, the craft was new, and they lacked preconceived notions of what traditional woodcarving should be. Second, the low cost of materials made experimentation affordable. Third, a high-end market for their products existed (or was found), allowing some especially skilled woodcarvers to spend much time on individualized pieces for which they were specifically commissioned.

The conditions and motivation for innovation having been set, Chibnik assessed the innovation process, itself, by borrowing a framework from contemporary economics and market research known as the product life cycle (Capron 1978; Karlsson 1988; Onkvist and Shaw 1989). This framework generalizes the various stages of a typical product, from its initial appearance to its decline in popularity and production. The cycle consists of five stages: 1) introduction, 2) early growth, 3) late growth, 4) maturity, and 5) decline. It serves, in part, as a predictive tool, but also as a baseline from which significant deviations can be usefully investigated.

Introduction Stage

In the introduction stage, a product or innovation is usually manufactured by only a few individuals or groups, and sales are generally quite low. In the case of the Oaxacan woodcarvers, experimentation and innovation began with three artisans who were attempting to increase their sales by diversifying their stylistic repertoire in the 1950s (Chibnik 2002:33). The distribution of the products from these first producers to consumers was slow, and carvers could only perform their craft on a part-time basis. Beginning in the late 1960s, however, a few were able to introduce their work to a larger stage in Mexico. Government agencies began to hold contests and award prizes to woodcarvers, a practice that encouraged innovation and a fluorescence of new styles. In response to the rising popularity and promotion of this artwork, several potters began to leave their farms and specialize in woodcarving in the early 1970s.

Early Growth Stage

The increased exposure and sales led to greater interest from store owners, wholesalers, and American tourists in the mid-1980s. This influx of people with capital resulted in rapidly increasing sales, and prompted many villagers to take up the craft of woodcarving, initiating the early growth stage of the product life cycle. In order for these new artisans to attract buyers from the more established woodcarvers, many chose to innovate to differentiate themselves. The early growth stage is, therefore, also the stage when competitors are attracted to enter the market. In general, however, competition is not at its most intense during this period.

Late Growth Stage

The late growth stage is the time of the most intense competition as the market for a particular product or set of products stabilizes. Typically, during this stage, the strong firms, or groups, or individuals tend to force out the weak, thus decreasing the overall number of production groups or individuals. In the Oaxacan case, over time, stylistic innovation led to the differentiation of places with individual styles in the woodcarving tradition. Buyers sought out carvings associated with the three particular villages. Interestingly, the more a village was known for its own style, the more vulnerable that village was to having its style copied by less proficient carvers in other places. This practice of copying led those being copied to continue to innovate in an effort to develop specialties that could not be so easily copied. These artists often attempted to develop unique styles that demonstrated their technical ability, and so attracted customers.

Also, in this stage, product differentiation and market segmentation occurs in which certain producers specialize to meet the desires of particular types of customers (Berrigan and Finkbeiner 1992; Weinstein 1987). Specialties now include expensive pieces commissioned by collectors, inexpensive miniatures for Oaxacan store owners or wholesalers in the U.S., and medium-priced pieces for tourists. Some artisans specialize in more than one type. Most artisans now occupy a niche in this segmented market.

Maturity Stage

The maturity stage begins when sales of a particular product or type of product remain stable but cease to grow. During this stage, prices are quite competitive and most sales are to loyal, repeat customers. Among the Oaxacan woodcarvers currently in this stage, sales have leveled off. Many artisans are primarily supported by only a few clients. Many of the artisans have established particular stylistic niches, which has reduced the overall competition that had existed between producers.

Interestingly, the reduced competition has not resulted in a reduction in the number of producers. Chibnik notes three possible reasons why this is the case. First, most production units are family workshops that can sustain economic difficulties more successfully than a capitalistic firm which has to pay its employees. Second, there are few options available for a woodcarver to step into if woodcarving is abandoned. Third, it is not difficult for a woodcarver to change specialty if the one currently engaged in is not economically sustainable.

Decline Stage

This stage consists of a decline in sales to the point where the product is simply pulled out of the market altogether. According to Chibnik (2000:227), the two most common reasons for why decline occurs are, 1) technological obsolescence, and 2) changing consumer tastes. The Oaxacan woodcarving industry has not entered this phase yet, but there is little doubt that eventually the consumer base will move on. Innovation may occur in an attempt to curb the decline, but the success of those innovations will depend on how well the market tastes are read by the producers.

Significance

This study (Chibnik 2000) provides an avenue of comparison by assessing the process of innovation from the perspective of the product life cycle model. Although the obvious contextual differences that exist between the Oaxacan woodcarving case study of the last 50 years and the Hohokam buff ware pottery case study from 1,000 years ago must be respected, they do not preclude the application of the model to the latter case. In fact, the differences in the socio-economic contexts can serve as starting points for assessing the differences that may have existed in the innovation process.

Archaeology

One of the most helpful recent studies linking stylistic innovation to the larger social context is Hegmon and Kulow's (2005) investigation of Mimbres Black-on-white pottery. The goal of their research was to delve into the relationship between agency and structure (sensu. Giddens 1979, 1984) by developing a methodology for detecting innovations over a 400 year period. Their theoretical approach was based on the premise that the act of painting a design was a form of agency, and that the larger 'style' in which that painted design occurred can be thought of as a structure. The structure refers to the overall design tradition in which any individual design or innovation occurred.

Hegmon and Kulow follow the definition embraced in this study, that innovation is a process that involves a novel idea (i.e., invention) and the successful adoption or acceptance of that invention by the wider cultural sphere (Torrance and van der Leeuw 1989). By adopting this perspective, they view innovations as those novel designs or experiments painted at a particular time, which are subsequently incorporated into the design corpus and thus change the structure. Those novel forms (inventions) that were introduced but not adopted into the stylistic structure were labeled as isolated anomalies. Only those novel forms that became part of the stylistic structure or repertoire were considered to be innovations. In other words, innovations were considered to be successful inventions. I adopt this perspective in this study.

The particular social context in which Hegmon and Kulow investigated innovation was the changing Mimbres landscape of southwest New Mexico from the second half of the Late Pithouse Period through the entirety of the Classic period (A.D. 750-1150). Hegmon and Kulow discuss how these periods were marked by a general increase in agricultural intensification and settlement density. The Late Pithouse Period was characterized by lower settlement density than the subsequent Classic period, pit house architecture, and ceremonial architecture in the form of great kivas. A dramatic shift occurred in all three of these components, marking the transition to the Mimbres Classic Period. At this time, settlement density and aggregation increased, above-ground pueblo architecture became the norm, and great kivas were abandoned in favor of small kivas and plazas (Creel and Anyon 2003; Hegmon 2002; Hegmon and Kulow 2005).

The results of Hegmon and Kulow's study unequivocally demonstrated that the beginning of the Classic Period was a time of increasing experimentation and invention in design on Mimbres Black-on-white pottery. The detection of a high number of isolated anomalies and innovations from this period revealed that not all stylistic inventions were successful, but many others did succeed in that they were accepted and became incorporated into the overall design structure. Thus, at the same time that major changes were occurring in social and ritual organization, major changes were also occurring in painted designs.

Hegmon and Kulow (2005:330-331) argue that situations of overarching social stress may have allowed and encouraged more intense stylistic experimentation and innovation. Several archaeologists and anthropologists have documented an association between a social environment characterized by social and/or environmental change or stress on a large scale and experimentation and innovation in individual components of a cultural system (Aldenderfer 1993; Knauft 1985; Ortner 1989; Rappaport 1968; Schachner 2001; Whiteley 1988). As noted by Schachner (2001:171), such social environments do not, in themselves, cause or guarantee experimentation, but they do provide and arena in which individual agents or groups have more opportunity and incentive to bring about structural change. Inventions are often more successful in such conditions because the structure is already being challenged. In other words, in times of stress or social disruption, individuals are motivated to invent by the perceived new opportunity to benefit themselves or others by doing something different.

Cohen and Sauermann (2007) define three types of incentives for innovative behavior to occur: extrinsic, intrinsic, and social. Extrinsic incentives are generally those considered by economists that result in pecuniary rewards, such as money or promotions. Intrinsic incentives, in contrast, have personal satisfaction or challenge as their reward. Social incentives are those intangible rewards that originate from the individual's desire or need to gain social approval (Fehr and Falk 2002; Gagne and Deci 2005). While it is probable that more than one of these types of incentives are simultaneously involved in an individual's decision to innovate (Wade 1989), it is usually the case that one tends to dominate depending upon the profession and work environment of the individual (Cohen and Sauermann 2007).

In addition to incentive, a consideration of intentionality is also helpful to understanding the innovation process. In most of those studies cited above, innovation was viewed as an intentional action by a limited number of individuals or groups to take advantage of a changing social environment (Aldenderfer 1993; Schachner 2001; Whitely 1988). Hegmon and Kulow (2005) suggest that through an understanding of the innovation context it may be possible to determine intentionality. In their study of Mimbres pottery designs, they argue that because of the symbolic importance of decorated pots to all members of Mimbres society (as evidenced in their widespread distribution to all households) any stylistic change would invite, or even require, examination by the members of that society. Therefore, most innovations would have likely been intentional.

The same argument can be made for Hohokam Red-on-buff pottery. Buff ware pottery was widely, and relatively evenly, distributed throughout the lower Salt River valley as part of every household's ceramic inventory (Abbott et al. 2001, 2007b; Abbott 2009). This indicates that buff ware was consumed by virtually all members of Hohokam society. In addition, few would question the assumption that buff ware pots and their designs possessed symbolic importance given their prevalence in burials (Abbott 1985), and the motifs shared across different types of media, such as other ritual items and rock art (Wallace et al. 1995). It is probable, therefore, that most innovations in buff ware pottery were the results of intentional actions by individual artisans.

Measuring the Innovation Process

In this study, I investigated how the particular form of social change or disruption among the Hohokam influenced the innovation process across space, and the relative diversity of innovations among groups. In so doing, three periods of social reorganization will be assessed, dating to the 9th, 11th, and 12th centuries A.D. Each of these reorganizations involved ideological, economic, and political changes, in varying degrees of emphasis. For each reorganization, I measured four variables that describe the innovation process: 1) The origin of a stylistic invention, 2) the rate of its adoption, 3) the pattern of its adoption, and 4) the uniformity of its adoption. These variables do not by any means exhaustively cover the complexities of the process of innovation; rather, the strength of these variables lies in the fact that each describes a different part of the innovation process that can be measured archaeologically, and when taken together, generate a comprehensive picture of that process. As is shown below, test expectations can be generated for each variable based upon prevailing social conditions (Table 2.1).

These variables were derived from contemporary theoretical perspectives on innovation, largely based on a capitalist economic perspective. My application does not imply that such economic conditions existed among the Hohokam; rather, I draw on this area of research in which innovation has been most closely studied in order to utilize

Table 2.1. Summary of expectations regarding the process of innovation for each of the four variables measured.

	Variables relating to the process of stylistic innovation	ideological change (social integration)	economic reorganization	political/social fragmentation
		1	2	3
A	**origin**	few (even 1) origin locations	few origin locations initially; multiple origins soon follow	multiple origins
B	**relative timing of adoption**	adoption over short period of time (perhaps within one time segment) due to strong interconnection fosterd by integration	adoption over a relatively longer time period due to economic competition	adoption over longest time period due to weak interconnection among loosely integrated populations
C	**pattern of adoption**	non-linear adoption pattern possible because of high degree of interconnection and integration	non-linear adoption pattern possible because of high degree of interconnection and integration	nearest neighbor (linear) adoption pattern due to the lack of social integration
D	**uniformity of adoption**	highly uniform adoption	heterogeneous adoption	heterogeneous adoption

principles that have been successfully employed to generate expectations for the innovation process. In some cases the principles are modified to a more general format in order to be applicable to the Hohokam situation. In other cases, principles were deemed to not be transposable to the Hohokam, and were therefore not pursued.[1]

Origin of Stylistic Inventions

For the archaeologist, the origin of an invention simply refers to the production location where the invention was first materialized (not necessarily where it was first idealized). As used here, the origin of an invention refers to the distribution of locations of inventions; that is, the potting communities engaged in innovative behavior. It is reasonable to expect innovative behavior wherever there are 1) perceived opportunities, 2) available resources, 3) incentives, 4) perceived benefits that outweigh the perceived risks, and 5) capabilities to manage the process (Metcalfe 2006). Writing from a purely capitalist economic perspective, Metcalfe's (2006) perceived opportunities seem to imply that persons/firms are always seeking to invent. From an anthropological perspective, however, this cannot be assumed. Here, perceived opportunity is taken as an opportunity (determined by a particular social circumstance) that carries with it an incentive to innovate that may not have existed before. In order for an invention to become an innovation by virtue of its adoption and wider acceptance, it is necessary for an individual or group to have the capabilities to manage the process and a sufficient position within a network from which the invention could diffuse to potential adopters (Abrahamson and Rosenkopf 1993, 1997; Granovetter 1985, 1992).

Ideological, economic, and political reorganizations can all serve as potential incentives (perceived opportunities) for invention, but in different ways. Ideological change carries with it a strong social motivation for innovative behavior in situations where producers are directly involved in the display or promotion of ideology through their products. Because of this connection, changes in group ideology often result in producers changing their products. Examples of this type of relationship abound in the archaeological and anthropological literature on style (e.g., Crown 1994; DeMarrais et al. 1996; Plog 1990; Spielmann 1998; Wade 1989). With ideological changes, innovations are often disseminated from people or places of authority or ritual importance (Spielmann

2002). Within these few places, innovators often have to have the approval or support of leaders of opinion (Bargatzky 1989).

Ideologically focused reorganization, therefore, is expected that innovation would have originated at a small number of locations (perhaps only one) that would have strongly influenced the rules of conformity for the expression of the new ideology, especially in a situation in which the ideological change was concerned with social integration (see Table 2.1. A1). Presumably, those few locations would have been important ritual centers that had access to and influence over a wide network of potential adopters.

Economic reorganization, in contrast, would carry with it a pecuniary incentive for innovative behavior. Based on the product life cycle model described above, I expect that innovation would begin with a small number of individuals or groups that first perceived the new economic opportunities. As more producers or production groups began to see the new opportunities, they would seek to take advantage of those opportunities, thus spawning innovation from multiple sources (see Table 2.1. A2) that are in competition with one another (Causey 1999; Chibnik 2002, 2004; Runnels 1985; Stromberg-Pellizi 1993).

Political/social reorganization can also provide a strong social and/or economic incentive for innovative behavior as individuals or groups who are already involved in a specific industry strive to maintain their relevance as identities and networks of cooperation and interaction are restructured or newly created. Innovative behavior in the midst of such changes depends upon how the socio-political landscape is restructured. A change to a more cohesive, integrated landscape concerned with conformity would likely result in the innovative behavior originating at one (or a few) politically important places (Vaughn 2006). A change to a more socially fragmented landscape, in contrast, would likely lead to innovative behavior at more locations (see Table 2.1. A3) (Vaughn et al. 2006).

Rate of Adoption

The rate of innovation adoption refers to the amount of time taken from the invention to its adoption by other producers. Numerous studies in the economic literature have been devoted to the topic of the timing, or rate, of innovation adoption (Griliches 1957; Karlsson 1988; Mansfield 1961). Although they most often focus on economic advantage, it is easy to broaden this to include any type of personal, social, or economic advantage. According to these researchers, the reason producers adopt innovations at different rates is either because they do not all expect instantaneous adoption to be advantageous or they lack information about the innovation (Bolton 1993).

Karlsson (1988:17) provides a helpful list of how the adoption process is slowed. If potential adopters have information on an innovation, then slow (or non-) adoption by potential adopters could be the result of 1) an inherent risk aversion for that particular producer group, 2) adoption is not seen as profitable in the short-term, 3) psychological inertia (based on an unfavorable history of adoption, 4) institutional factors that constrain adoption decisions, and 5) supply constraints.[2]

These studies suggest that access to information about an innovation (where it originated; who has already adopted it; how successful it seems to be) is crucial to the rate of adoption. The degree of social integration would therefore be a critical factor in the rate of adoption. In the broadest terms, social integration can be defined as the degree to which a person is actively involved in a broad range of social relationships (Brissette et al. 2000:54). In this study, the term is used primarily to assess or describe the level at which dispersed individuals are able to share information and/or goods through social, economic, religious, or political institutions (Ford 1972; Mahoney 2000:26). The concept of interconnection is related to integration, but is used broadly in this study to refer to the idea of commonality shared among dispersed members of a population, regardless of the physical connection promulgated by institutions, structures, or artifacts.

Anthropological research on the transmission of style, while not completely discounting the potential influence of information flow on the adoption of innovations, has demonstrated that it is usually not the critical factor in the rate of adoption. Instead, styles are thought to be adopted as a result of identification with a certain group, movement, or belief (Crown 1994; Kohler 2004; Hegmon and Kulow 2005; Hodder 1977, 1981; Plog 1978, 1980; Wiessner 1983, 1997). Social integration is, therefore, important not simply because it allows for the easy transfer of information, but also because it provides a sense of interconnection among individuals, families, and other social groups.

The sense of interconnection associated with social integration fosters unity in accepting or resisting change. In other words, if change is resisted, it is resisted by all (or the majority), and if change is accepted, it is accepted by all (or the majority). A highly integrated society, therefore, could be conducive to either innovation or resistance to innovation. When innovation does occur, it is likely to be encouraged or promoted by the society at large. The expectation for the process of innovation in such a society is, therefore, that different potting communities would adopt those innovations rapidly. In contrast, a loosely integrated society would result in a slower adoption process because of the weaker sense of connection among group members.

Ideological change that is specifically concerned with promoting integration and interconnectedness would, therefore, be expected to result in rapid innovation adoption (see Table 2.1. B1). An economic change, in which new opportunities were created and competition was more pronounced, should result in a slower adoption process as groups observe an innovation's success before adopting (see Table 2.1. B2) (Bolton 1993; Chibnik 2002, 2004; Onkvisit and Shaw 1989). Political and social fragmentation would result in a weakly integrated society in which a sense of interconnection was not present. In addition, information about innovations would not be as readily obtained, nor would the incentive to conform be as great. These factors would be expected to lead to much slower adoption among other producers (see Table 2.1. B3).

Pattern of Innovation Adoption

The pattern of innovation adoption refers to the general path of adoption, whether it was a function of physical distance or social ties that transcended distance. Several models have been proposed to address this issue, three of which are discussed here. The first is 'neighborhood effect' on the spatial diffusion of innovation. This model simply emphasizes the importance of physical distance, in which "the closer a potential adoption unit to the source of innovation or to another unit that has already adopted… the greater the probability that it will adopt" (Cohen 1972:14-15; see also Hägerstrand 1952, 1967).

The second model is the relational perspective on innovation, or 'social cohesion' model (Coleman et al. 1957; Lundvall 1992; Pavitt 1984). In this model, innovation adoption occurs among those groups that are well-integrated more readily than those that are socially isolated. From an anthropological perspective, the well-integrated groups have a high sense of interconnectedness among members, and it is these groups, therefore, that adopt innovations from one another first.

The third model embraces structural equivalence. This model states that the most important factor in innovation adoption is the status of individuals or 'firms' (Burt 1980, 1987; Johnson 1986). Structural equivalence can be defined as two actors who have identical relations and hence jointly occupy a single position (Meeus and Faber 2006). Actors who see others of the same status adopt an innovation will also tend to adopt that innovation. This model does not nullify the relational perspective, but sees it as secondary in importance.

As measured in this study, the pattern of innovation adoption examines whether or not interconnection was primarily among close neighbors, or if interconnections were based on factors other than physical distance so that innovations spread in a non-linear fashion (see analyses by Bowser 2000; DeBoer 1990; Parkinson 2006). It was not possible to rank sites, groups, or individuals in a way that would test the structural equivalence model.

Based on these models, therefore, it is expected that the pattern of innovation adoption would depend on the degree of social integration and sense of interconnection. If ideological, economic, or political reorganization occurred in a society that was weakly integrated, and whose members had little sense of interconnection, then the nearest-neighbor model of adoption would be expected (see Table 2.1. C3). On the other hand, if social integration was high, and social interconnection was strong, it is expected that producers would adopt the innovations of those groups with whom they were mostly closely connected socially, regardless of physical distance (see Table 2.1. C1 and C2).

The second part of the pattern of innovation considered here is the order in which different production groups adopted innovations. The purpose here is to identify any consistencies in who the early adopters were versus the late adopters both within and between reorganization episodes. I will ascertain whether certain production groups within a particular episode of reorganization consistently adopted innovations early or late, and then compare these patterns between reorganization episodes to determine if the same groups were consistently early or late adopters in different social, economic, and political contexts.

Uniformity of Innovation Adoption

The uniformity of innovation adoption refers to the percentage of potential adopters that adopted an invention, regardless of the length of time taken to adopt. In the literature, uniformity is interchangeable with the extent of innovation adoption (Abrahamson and Rosenkopf 1993, 1997). Economists tend to generalize the uniformity of innovation adoption (or diffusion) from the standpoint of a perceived advantage that outweighs the risks (David 1969; Davies 1979; Quirmbach 1986). Bandwagon theories have also been popular in explaining the extent of innovation (including increasing returns theories – see Abrahamson and Rosenkopf 1997; Learning theories – Mansfield 1961; Rogers 1995; and Fad theories - Banerjee 1992; Bikhchandani et al. 1992; Meyer and Rowan 1977). These theories generally follow a similar pattern in which an increase in the number of innovation adopters creates new information about the innovation which then generates stronger bandwagon pressure to adopt (Abrahamson and Rosenkopf 1997; Banerjee 1992; Bikhchandani et al. 1992; Mansfield 1961; Rogers 1995).

Abrahamson and Rosenkopf (1997) identify three types of bandwagon theories: Increasing returns theories, learning theories, and fad theories. Increasing returns theories argue that an increase in the number of adopters of an innovation leads to an increase in the profitability of that innovation, which in turn causes more potential adopters to adopt. Learning theories assume that potential adopters need information about the innovation's profitability before they adopt. Therefore, an increase in the number of adopters generates more information about its profitability, thereby allowing potential adopters to either adopt or not adopt the innovation (Mansfield 1961; Rogers 1995). Fad theories argue that the important factor in the extent of innovation adoption is information a potential adopter has of who has already adopted it. This information creates a social bandwagon pressure to conform (Abrahamson and Rosenkopf 1993; Banerjee 1992; Bikhchandani et al. 1992; Meyer and Rowan 1977).

According to Abrahamson and Rosenkopf (1997), increasing returns theories are unrealistic because they assume that the profitability of innovations is unambiguous. While learning and fad theories are more realistic because they do assume some degree of ambiguity concerning an innovation's profitability among potential adopters, they fall short in that they also assume that bandwagon pressures to adopt are the same for each potential adopter. In response, Abrahamson and Rosenkopf argue that social networks play a large role in this process. It is not, they argue, just the number of adopters (and the information that generates) that influences the decision for potential adopters to adopt, but the structure of the social network and the potential adopter's position within that network (see also Granovetter 1985, 1992).

The question of whether or not individuals or groups will adopt an innovation at all is heavily influenced by how easily knowledge and information flows through social networks (Lundvall 1992). Again, the assumption is that the more integrated groups are within a society, the more easily information flows.

As discussed above, anthropological research has shown that many factors other than information flow and integration contribute to variation and similarity in style among artisans. Social integration is still important, however, because of the interconnection among group members that it cultivates. Not only would this sense of connection be conducive to rapid innovation adoption (when innovation, in fact, occurs), but also to highly uniform adoption. In contrast, a poorly-integrated economy would more likely be characterized by a low level of uniformity. Again, if ideological change is concerned with social integration, then those producers whose products are closely tied to displaying and/or promoting ideology would be expected to adopt innovations in a uniform manner (see Table 2.1. D1). A change emphasizing a shift in economic relationships resulting in increased competition, on the other hand, would likely lead to either 1) a heterogeneous adoption pattern, where not everyone adopted each other's innovations, or 2) the dominance of one or a few groups so that their influence was such as to force the competition out completely, or force them into adopting their innovations as that became the standard for the consumer base (see Table 2.1. D2) (Chibnik 2000, 2002). Political and social fragmentation should result in the least uniform adoption of innovations due to the decrease in overall social integration (see Table 2.1. D3). As was noted for the rate of innovation adoption above, however, other factors may have existed that acted as restraints on the uniformity of adoption (see Karlsson 1988:17).

Summary

Innovation is best conceived not as an event, but as a process involving opportunities, incentives, invention, and adoption by a wider group. No part of this process can be adequately understood apart from an in-depth consideration of the social context in which innovation occurred. In addition, the archaeologist cannot examine all aspects of the innovation process, and must, therefore delineate which aspects are measureable and most useful for describing the process as a whole. By combining ethnographic, archaeological, and contemporary economic theories on innovation, I have delineated four variables to describe the innovation process of Hohokam buff ware pottery in the midst of social reorganizations.

Chapter 2 Notes

[1] Principles and variables related to patenting, marketing, and advertising were not deemed relevant to this study.

[2] Two of Karlsson's (1988:17) reasons were not included as they relate specifically to capitalist economic situations

Chapter 3:

THE SOCIAL CONTEXT FOR STYLISTIC INNOVATION AMONG THE HOHOKAM

The following outline of Hohokam culture history emphasizes three episodes of social reorganization, each of which is associated with significant stylistic innovations in buff ware pottery. These styles rapidly appeared on several media in the Hohokam region, including buff ware pottery, rock art, textiles, and shell (Wallace 1995, 2001:258-259; Wallace et al. 1995), and correlate with the episodes of social reorganization. These reorganizations provided the social context within which artisans made decisions on how to form and decorate their buff ware vessels. By applying the general expectations for those variables of the innovation process discussed above to the Hohokam social environment over time, more specific expectations can be generated for each episode of reorganization.

The issue of chronology is explored in detail in Chapter 5; however, some introductory words are necessary prior to the discussion on social reorganizations below. Throughout this study, I refer to three levels of temporal division of the Hohokam cultural sequence (Table 3.1). The period and phase divisions have been well-established in Hohokam archaeology since Winifred and Harold Gladwin (Gladwin and Gladwin 1929, 1933) and Emil Haury's (1937, 1945, 1976) foundational endeavors, though dates for the starting and ending points for these divisions have fluctuated (Crown 1981, 1984; Dean 1991; Doyel 1974; Haury 1976; Wallace 1995). More recently, Wallace (2001, 2004) has subdivided

Table 3.1. Chronology utilized in this study.

Period	Phase	Time Segment	Time, A.D.
Classic	Civano	Civano	1300 – 1350/1450
	Soho	Soho	1125/1150 – 1300
Sedentary	Sacaton	Late Sacaton	1100 – 1125/1150
		Middle Sacaton 2	1070/1080 – 1100
		Middle Sacaton 1	1020 – 1070/1080
		Early Sacaton	950 – 1020
Colonial	Santa Cruz	Santa Cruz	850/900 – 950
	Gila Butte	Late Gila Butte	800 – 850/900
		Early Gila Butte	750 – 800
Pioneer	Snaketown	Late Snaketown	730 – 750
		Early Snaketown	700 – 730
	Sweetwater	Sweetwater	675 – 700
	Estrella	Estrella	650 – 675
	Vahki	Vahki	480 – 700
	Red Mountain	Red Mountain	?-480

many of these phases into several smaller temporal units called time segments. It is this smallest temporal division that is most important for this study in innovation.

Pre-Gila Butte (? - ~A.D. 750)

Little is known about the social environment in this early period in the Phoenix Basin (Figure 3.1). It is perhaps best to place the beginning of the Hohokam occupation in the Basin sometime prior to the 6th century A.D., during the Red Mountain phase of what has traditionally been called the Pioneer period (see Chapter 5: Issues in Chronology; Cable and Doyel 1987). This period seems to have been characterized by seasonal occupation of small villages, with subsistence patterns combining small-scale agriculture in the floodplains in the summer with gathering other resources in the winter

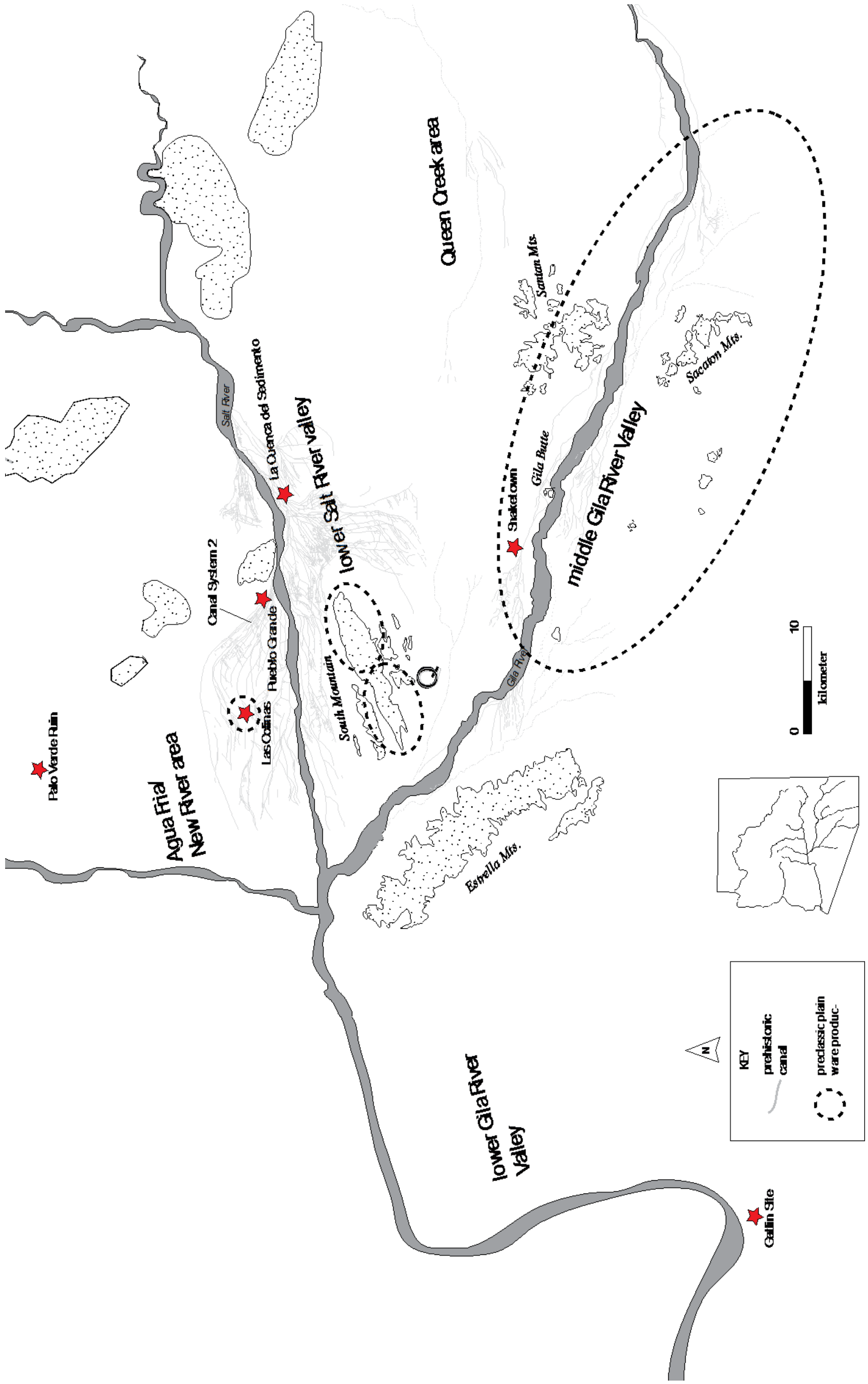


Figure 3.1. Features and sites mentioned in the texts.

(Cable and Doyel 1987). It is unclear precisely when canal irrigation agriculture began, but data from La Cuenca del Sedimento on the Lehi-Mesa terrace suggests at least small, rudimentary canals were in use by the succeeding early Vahki phase (A.D. 475-500 A.D.) (Henderson 1989). At Snaketown, several large pithouses were constructed around a large central plaza during this period, but their exact function is unknown (Wilcox et al. 1981:143).

During the earliest part of the Red Mountain phase, plain ware pottery was likely produced at a local, household level by non-specialists who engaged in significant amounts of exchange with other groups (Abbott 2009:533, 545).[1] By the subsequent Vahki phase, however, plain ware production was centered at the eastern half of South Mountain, evidencing what Abbott (2009:545, 552) views as the beginnings of specialized production in the Phoenix Basin. Potters in this area were to dominate plain ware production over the next 550 years (Abbott 2009:Figure 2).

Prior to the beginning of decorated ceramics in the mid-7th century A.D., stylistic expression was present in rock art and likely other perishable materials (e.g., basketry, textiles). Nonfigurative, abstract designs characterize the rock art of this period. Specific motifs of this style, labeled Style 1 by Wallace and colleagues (1995:34), include parallel lines, ladders, combs or rakes, and grids.

Decorated pottery first began to be made at sites along the middle Gila River in the Phoenix Basin in the Estrella phase (mid-7th century A.D.). This early decorated pottery was characterized by the application of a red mineral paint to gray or brown pottery, predominantly bowls. Designs, painted with fingers or brushes, were typically broad-lined, forming simple parallel line designs, chevrons, and triangles in sectioned layouts (Haury 1937, 1976; Wallace 2004:73).

Over the subsequent Sweetwater (A.D. 675-700) and Snaketown (A.D. 700-750) phases, Hohokam potters began to develop more sophisticated manufacturing and decorative techniques (Figure 3.2). Calcium carbonate nodules were intentionally added to the clay, apparently to achieve a lighter surface color. In addition, firing conditions were better controlled to achieve the same result (Abbott 2008; Abbott and Love 2001; Haury 1976:160; Weismann 1987). Both of these developments resulted in the gradual replacement of gray and brown painted pottery with buff painted pottery. Linework became finer and more sophisticated, culminating in the Snaketown style layout, distinguished by hachure-filled scrolls and other motifs.

Episode 1: Early/Late Gila Butte transition (~A.D. 800)

Relatively uniform and stable social conditions seem to have prevailed over the course of the Pioneer period. The Gila Butte phase as a whole dates to about A.D. 750 to 850/900. The middle of the phase, around AD 800 was a time of rapid and widespread ideological and ritual reorganization (Wallace 2001; Wallace al. 1995; Wilcox 1991a). Significantly, there is little evidence for economic changes accompanying the ideological reorganization. Plain ware pottery, for example, continued to be made in the same places at relatively similar scales (Abbott 2009). A major component of this reorganization was the introduction of ballcourts, which were first constructed across the basin in the Late Gila Butte Phase (Wilcox 1991a; Wilcox and Sternberg 1983; Wilcox et al. 1981). These structures are thought to have been derived from Mesoamerican cultures to the south,

Figure 3.2. Red-on-gray/buff stylistic elements typical of the late Snaketown time segment, preceding the first episode of reorganization.

where ballcourts had been a regular part of the public architecture of most villages for centuries (Wilcox 1991b).

In Mesoamerica, the ballgame was inextricably linked to cosmology and religion (Freidel et al. 1993:337-391; Gillespie 1991; Leyenaar and Parson 1988; Scarborough and Wilcox 1991). For example, among the Maya, the ballgame was the central feature of the story of the Hero Twins' victory over the lords of the Xibalba (the Maya underworld) (Tedlock 1985). In this saga, the ballcourt was the arena in which the cosmic battle of good versus evil was played out. According to Freidel and colleagues (1993:348), "this myth embodied their concepts of justice, proper behavior, and how to defeat evil … For the Maya, the confrontation with death, evil, and disease took place in the ballcourt." The fact that many ballgames seem to have ended, or climaxed, with human sacrifice testifies to the game's ritual associations.[2] Gillespie (1991:317) has even argued that the decapitation sacrifices associated with ballgames served as a metaphor for the separation of seasons marked by the movements of celestial bodies; thus linking the ballgame with agricultural fertility (see also Pasztory 1972).

The Mesoamerican ballcourts were often placed in the heart of the ceremonial complexes of large cities (Gillespie 1991; Schele and Miller 1986:246-247) where they likely functioned as much in the capacity of ritual drama and procession than as actual ball playing arenas. Among the Classic Maya, ballcourts were like portals to the underworld, serving as "crucial implements of political and religious performance" (Freidel et al. 1993:355; see also Schele and Freidel 1991).

It is difficult to determine how much of the associated ideology was imported with the ballgame into the Hohokam area of the Southwest U.S. The fact that the form of the Hohokam ballcourts changed from the rectangular and flat forms of Mesoamerica to oval-shaped arenas with sloping floors and earthen berms in southern Arizona suggests a significant difference in, at least, how the game was played (Wilcox 1991b; Wilcox and Sternberg 1983). It would not be surprising if the beliefs associated with the ballgames also were different. Ballcourts also varied considerably in form throughout Mesoamerica, even within culture areas (Adams 1991:162). Different groups across Mesoamerica seemed to have used ballcourts to emphasize different ideological, religious, or political themes and boundaries (Gillespie 1991). Unfortunately, the rich iconography surrounding the ballgame in Mesoamerica is lacking in the Hohokam area.

Whatever the differences between Mesoamerican and Hohokam ballgames were, several factors indicate that the game and the courts represent a fundamental ideological shift among the Hohokam (Wallace 1995, 2001:258; Wallace et al. 1995; Wilcox 1991a). First, the courts were rapidly adopted across the Hohokam area within a few generations of their introduction into southern Arizona, ballcourts were constructed in most major villages in the Phoenix Basin (Wilcox 1991b). Secondly, the scale at which the courts were quickly adopted was impressive. By the time the ballcourts ceased to be used, over 200 courts had been constructed at approximately 200 sites, from Tucson to Flagstaff (Marshall 2001; Wilcox and Sternberg 1983; Wilcox 1991:47). Third, the placement of ballcourts in village centers speaks of their importance in social life. Most ballcourts were located adjacent to plaza areas, where most of the exchange of goods and ideas likely took place (Doyel 1991a). Fourth, the architecture of the ballcourts suggests an emphasis on corporate participation through viewing – functioning in a way perhaps more akin to the great kivas or plazas to the north and east, where public dances and ceremonies were performed in front of large audiences. Doyel (1991b:9) has estimated that the large ballcourt at Snaketown, for instance, could have accommodated 500 people standing or seated along the surrounding berms. All of this evidence taken together points toward the rapid adoption of Hohokam ballcourts by geographically separated Hohokam populations, and served to both integrate and, possibly, delineate social groups (Wilcox 1991a:48, 1991b; Gillespie 1991).

At the same time as the introduction of ballcourts into the Hohokam area, a new mortuary complex was widely adopted (Braniff 1972, 1998; Carot 2001; Wallace et al. 1995; Wilcox 1991a). The iconography and artifacts associated with this new mortuary complex again point towards its origins in Mesoamerica.

Other changes, though not of Mesoamerican origin, also indicate a fundamental ideological shift at this time. Whereas flexed burials had been the norm in the preceding Pioneer period, cremations in cemeteries located near supra-household groups became the rule in the early part of the Colonial period. Palettes and stone bowls made of imported materials became commonplace in burials. At some sites, iron-pyrite mirrors similar in design to those from the Chalchihuites area of Zacatecas in northwest Mexico have been found with burials or ceremonial caches (McGuire and Villalpando C. 2007; Wilcox 1991a:51). For the most part, however, the new religious ideas took on a local, Hohokam shape, apparently reinterpreting Mesoamerican ideas in ways that could be understood, used, and built upon by the populations who occupied the Gila and Salt River valleys (see Wilcox 1991a:52-53).

The presence of both ballcourts and new mortuary rituals from Mesoamerica suggests that the Hohokam rapidly adopted new ideas about death, perhaps linked with fertility and the agricultural cycle. Wilcox (1991a:52) postulates that religious leaders may have adopted these Mesoamerican hallmarks as a way to legitimize their power and position, although archaeological evidence of powerful religious leaders among the Hohokam is scant for the Gila Butte phase.

Stylistic shifts were another important component of the reorganization that included these new forms of public architecture and mortuary ritual. Labeled Style 2 by Wallace (1995:34), this shift included a change in rock art from an emphasis on abstract designs and parallel lines to new geometric shapes and naturalistic life-forms (Wallace 1991, 1995:601, 2001:258; Wallace 1995:34). The same stylistic shift also occurred in portable media, such as shell jewelry and ground stone (e.g., palettes and censers); items which were distributed widely across Arizona (Wallace 1995:35).

Style 2 is also used on red-on-buff pottery (Figure 3.3). Although Style 1 was not completely replaced by Style 2, there was a shift from hachure-filled designs in the Snaketown style to an emphasis on horizontal, organized banding and repeated, sometimes spiraling, elements (Wallace 1995:35-36; 2001:258). Free-floating fringes were commonly utilized in these new layouts. A new corpus of small element motifs was also introduced at this time. Solid-filled naturalistic imagery also became more common, as opposed to the abstract, geometric, and hachure-filled designs of the preceding period. Both human and animal figures are common, with the former often portrayed in dances, hunts, or fertility themes (Wallace 1995:37).

All of the patterns described above point to the middle of the Gila Butte phase (~A.D. 800) as a time of considerable social and ideological change. Within a relatively short period of time (one or two generations), the Hohokam had adopted a new ideology and ritual system rooted in Mesoamerican beliefs. Wallace and colleagues (1995) have argued that this new ideology was first adopted and developed in the Phoenix Basin, spreading from there to outlying areas, such as the Tucson Basin. They postulate that a single person or group of leaders with strong ties to northern Mesoamerica provided the

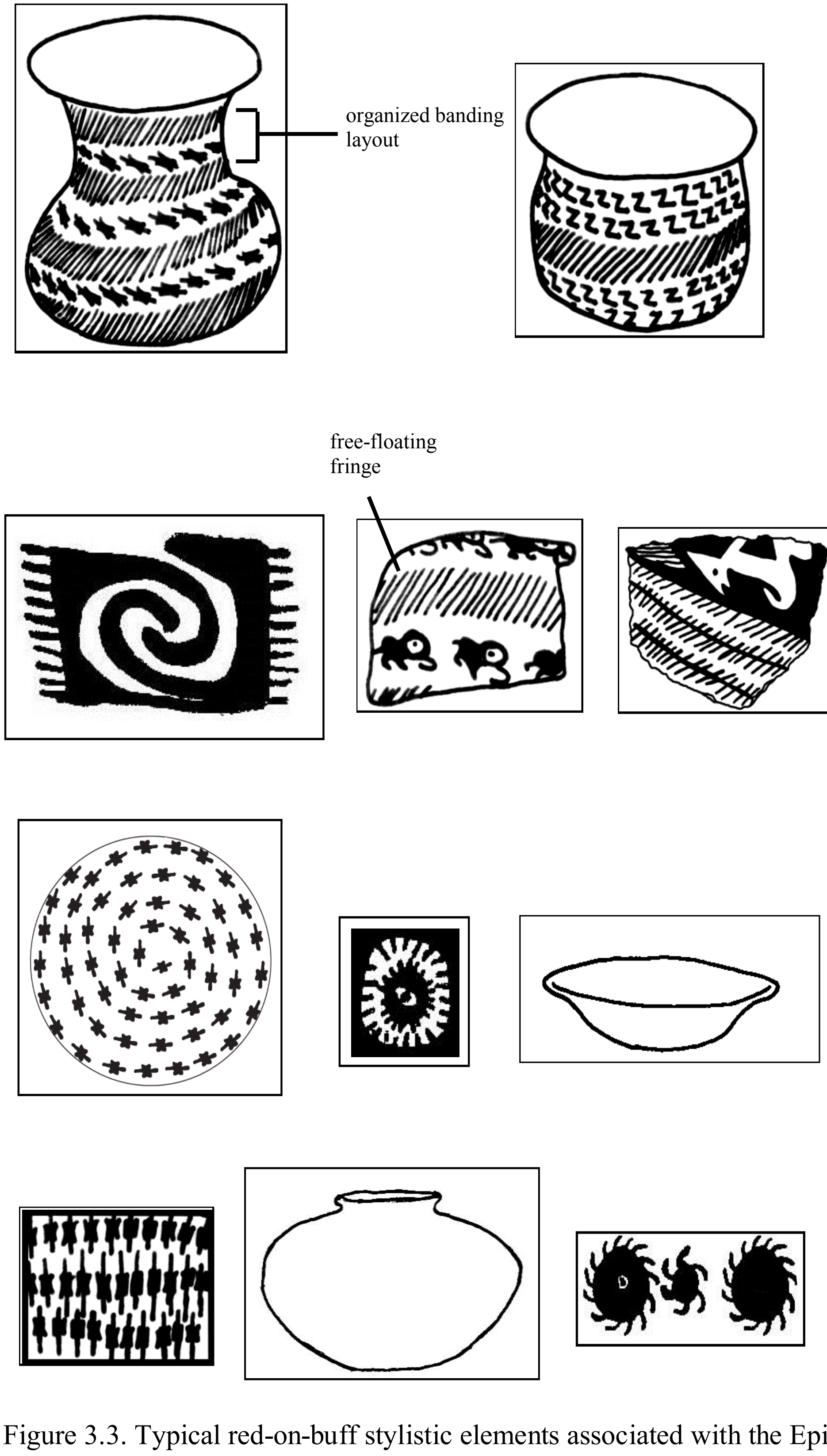


Figure 3.3. Typical red-on-buff stylistic elements associated with the Episode 1 reorganization.

impetus for this adoption (Wallace 1994). The rapidity and scale at which this new ideology was adopted, along with the re-interpreted form of the ballcourt, suggests that this ideology cut across previously existing social boundaries and integrated socially distant persons, families, and groups (Wallace et al. 1995:609).

Expectations

In spite of the ideological reorganization that occurred between the early and late Gila Butte time segments, economic conditions remained relatively unchanged. Because there is no evidence for significant changes in the organization of plain ware pottery production at this time (Abbott 2009), I do not expect significant changes to have occurred in the organization of buff ware production.

Because decorated buff ware pottery played an important role in the display and promotion of Hohokam ideology (Wallace et al. 1995; Wilcox 1991a), changes in the ideological/ritual structures of Hohokam society would involve innovation in buff ware style. It is expected that innovation would have originated at a small number of locations (as few as one) with the ritual or political influence to disseminate the rules for the expression of a new ideology to other groups. The rate of adoption is expected to have been rapid due to the strong sense of interconnection and social integration that allowed most Hohokam to rapidly accept other expressions of this ideology. The sense of interconnection would have provided the incentive to conform to a new ideology among producers, while social integration would have provided the channels for information and ideas to easily flow between different producers and production groups. Because social integration played such an important part in this reorganization episode, the pattern of innovation adoption is expected to have diffused from the origin potting community to those potting communities with whom they shared the closest social and economic ties. Finally, the uniformity of innovation adoption among different production groups is expected to have been high, again, because of the sense of interconnection and integration evident in other expressions of this ideology (e.g, ballcourts).

Episode 2: Early/Middle Sacaton transition (~A.D. 1020)

The next significant reorganization occurred at the end of the 10^{th} century, marking the transition from the early to middle Sacaton time segments. The nature of this change contrasts markedly with that of A.D. 800. Whereas the first episode was characterized by an emphasis in ideological and ritual shifts in the *absence* of large-scale economic change, this episode was distinguished by an economic shift with little apparent change in the ideological or ritual domain (Wallace 2001:259). The ballcourt system continued, reaching its maximum extent at this time, with over 230 ballcourts at approximately 200 different sites (Marshall 2001). The previously established mortuary complex also continued.

Prior to the middle Sacaton time segment, most pottery was made in only two areas. The first was the eastern half of South Mountain, where potters utilized South Mountain Granodiorite temper to supply more than 50 percent of all plain ware pottery (mostly jars) to residents of the lower Salt River Valley (Abbott 2009). The other major production area was at an unknown number of locations in the middle Gila River Valley. These potters supplied the settlements in the lower Salt River Valley with the majority of their bowls, with most of those being decorated buff wares (Abbott 2009). A significant number of small-sized red-on-buff jars were also imported into the lower Salt River Valley at this time. The residents of the middle Gila River Valley obtained plain ware jars and bowls, along with decorated jars and bowls, from local sources, as evidenced by the abundant coarse-grained mica schist used to temper the pottery in that area (Kelly n.d.).

The economic shift that occurred at the onset of the middle Sacaton phase was marked by a more sophisticated division of labor than had previously existed (Abbott 2009; Abbott, Watts, and Lack 2007; Abbott, Smith, and Gallaga 2007). Pottery production was dominated by specialist groups, each of which produced a narrow range of vessel forms, so that no one production area produced the full range of vessel forms necessary for an individual household (Abbott 2009). Instead, each household possessed ceramic vessels from multiple production areas.

At this time, the eastern half of South Mountain (north and/or south sides) ceased to dominate the supply of plain ware vessels to the residents of the lower Salt River Valley for the first time in approximately 500 years (Abbott 2009). In addition, potters from this area now limited themselves to a single vessel form, large, thick-walled ollas. Two new plain ware production centers arose either as a cause or consequence of the decline of the eastern half of South Mountain producers. One was located in the western half of South Mountain, where large, thick-walled ollas, essentially identical to those produced in the eastern half of South Mountain, were produced. These ollas were tempered with the distinctive Estrella Gneiss (Schaller 1994). Like their counterparts manufactured in the eastern half of South Mountain, these ollas were distributed throughout the lower Salt River Valley.

The second new location of plain ware pottery production was the large village of Las Colinas, located north of the Salt River on Canal System 2. Two large clay settling basins fed by canals have been located at this site, testifying to the copious amounts of pottery produced there (Abbott 1988; Nials and Fish 1988). These potters tempered their vessels with phyllite from the nearby Phoenix Mountains to supply the villages on the north side of the Salt River with large jars.

Potters living in the middle Gila River Valley continued to supply the majority of the decorated bowls and jars to villages throughout the Phoenix Basin. The Queen Creek area also supplied a small percentage of the decorated buff ware bowls and jars to the lower Salt River Valley at this time (Lack et al. 2012).

Based on the scale, complexity, and distributional patterns of ceramics during the middle Sacaton phase, the argument has been made for the existence of a regionally organized economy in which specialist producers flourished and marketplace exchange played a significant role (Abbott 2006; Abbott, Watts, and Lack 2007; Abbott, Smith, and Gallaga 2007). The ballgame may have been directly associated with this new economic system because ballgame events would have been ideal venues for exchange (Abbott 2006; Abbott, Smith, and Gallaga 2007; Doyel 1979, 1985, 1991a, 1991b, 1991c; Wilcox 1991a; Wilcox and Sternberg 1983). Wilcox (1991b; see also Wilcox and Sternberg 1983) has argued that many ballgame events occurred on a calendrical cycle, and thus provided a known place and motivation for exchange. Abbott and colleagues (2007b) tested this idea for the middle Sacaton phase Hohokam system, and argued that the ceramic evidence supports such a periodic marketplace system.

The stylistic changes associated with this reorganization in the middle Sacaton 1 time segment have also been well-documented (Wallace 1995, 2001, 2004; Wallace et al. 1995). Style 3, as Wallace (1995:37) labels it, occurred on ceramics, textiles and shell, but only to a limited extent in rock art. Wallace (2001:259) sees the adoption of Style 3 as more gradual than the adoption of Style 2 had been which he attributes to the religious nature of the Style 2 designs. He suggests that these motifs were part of an ongoing adherence to a general ideology or belief system.

On buff ware ceramics, Style 3 was characterized by nonfigurative, basketweave layouts that sector the design field and form discrete panel spaces (Wallace 1995:37; 2001:259; Zaslow 1977). Organizational banded layouts were no longer used, and there is a general trend toward more rectilinear motifs. Single-capped fringing became more common, used to adorn panel borders. New small elements were introduced, most often used as centerline motifs within panels or as fills in the voids of large solids (Figure 3.4).

Expectations

In contrast to the Episode 1 reorganization, this reorganization was characterized by significant economic changes, particularly in the organization of plain ware pottery production. I expect, therefore, that significant changes would have also occurred in the organization of buff ware production. In particular, following the trend from the plain ware production, I expect that more buff ware production centers would have risen as new opportunities for exchange appeared in the form of a marketplace economy.

Given the high level of integration and sense of interconnection of this period, coupled with a lack of ideological and political changes, I suggest that stylistic innovation among buff ware artisans was largely motivated by economic rewards. If so, several expectations can be made regarding the process of innovation. First, following the product life cycle model (Chibnik 2002; Karlsson 1988), I expect that innovations would have originated with those few individuals or production sources that perceived an economic opportunity near the beginning of the reorganization. Soon other potters would

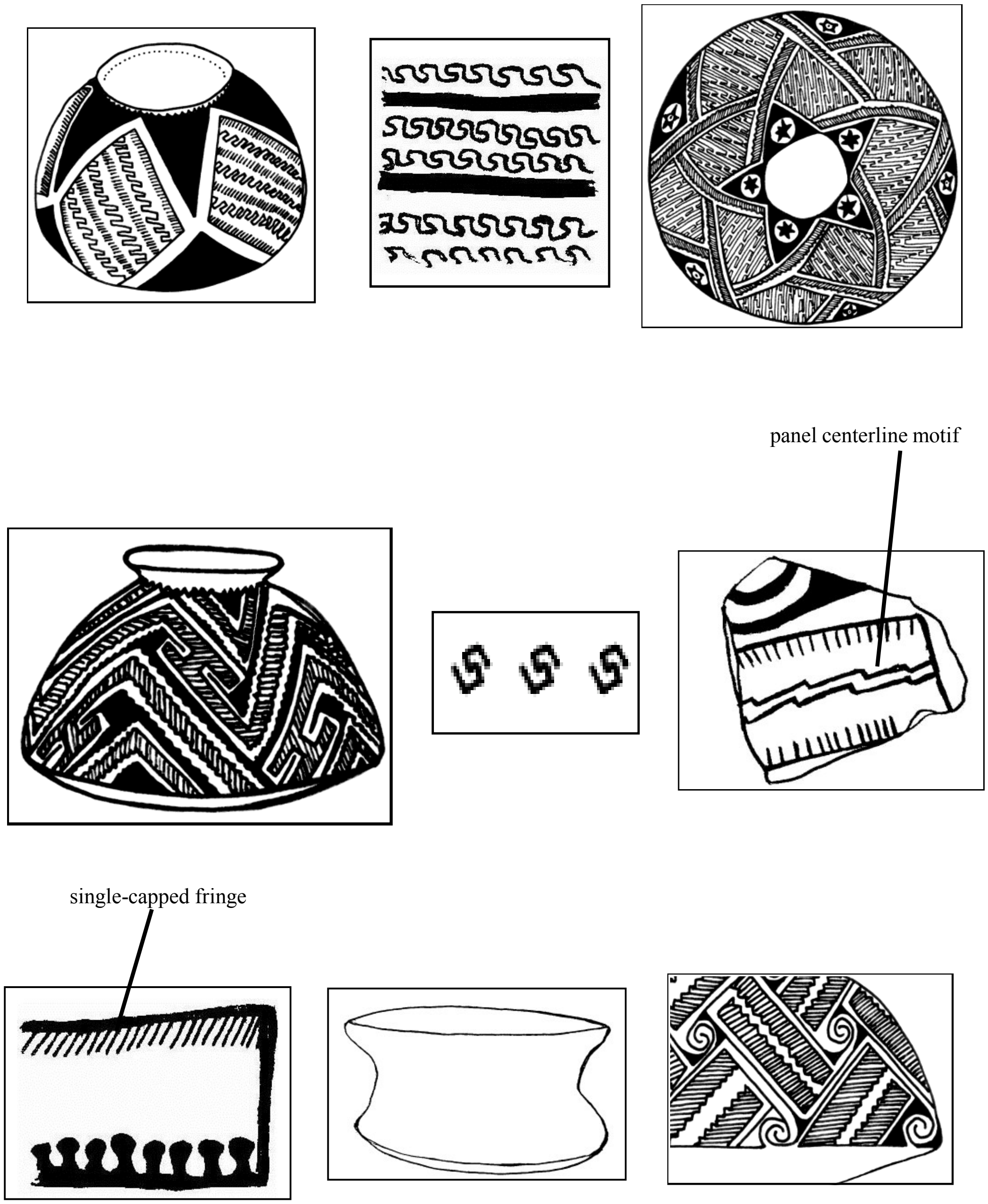


Figure 3.4. Typical red-on-buff stylistic elements associated with the Episode 2 reorganization.

see the same opportunities, and innovations would have quickly originated at multiple locations (Causey 1999; Chibnik 2002; Stromberg-Pellizi 1993). In general, I expect that the rate of adoption would be somewhat slower than in the late Gila Butte phase because of this economic competition[3]. The pattern of innovation adoption is, again, expected to have moved from the origin community to those potting communities with the closest social ties. Lastly, I expect that this episode of change was characterized by a less uniform adoption pattern than in the late Gila Butte phase due to potters both imitating successful innovations and creating new ones in a competitive market. Another possibility, drawn from the product life cycle model, is that dominant production groups would force out smaller groups altogether, resulting in a cornering of the market (Chibnik 2002).

Episode 3: Late Sacaton Phase/early Soho phase (~A.D. 1100-1125/50)

The last social reorganization considered here occurred between A.D. 1100 and 1125/50. This reorganization was marked by significant changes in demographics, economic organization, ideology, ritual, and politics. There was a dramatic shift from interdependence, social integration, and specialized production to territorialism, social fragmentation, and local production and consumption of plain ware pottery (Abbott 2000, 2003a).

Demographic shifts are evident in that major villages, such as Snaketown, were abandoned, and new villages established (Doyel 2000). Significant population movements associated with these abandonments led to a dramatic rise in population in the lower Salt River Valley (Cordell et al. 1994). For example, at Pueblo Grande, at least eight new habitation areas were established by the early Soho phase (Abbott 2003a:208). It has been suggested that at least some of this population increase may have come from people seeking refuge from the increasing violence along the margins of the Ancestral

Puebloan and Mogollon territories from the north and east (LeBlanc 1999; Wilcox et al. 2001).

Residential architecture shifted from the exclusive use of pit houses to villages containing both pit houses and above-ground adobe wall structures (Doyel 2000). Often, these above-ground structures were grouped into walled adobe compounds.

Coinciding with the demographic changes was a shift in economic organization that essentially reversed the trend of the previous five centuries. As described above, prior to the Episode 3 reorganization, plain ware pottery production had been concentrated at a handful of production areas. Although changes to this organization of production had occurred in the Episode 2 reorganization, the fundamental principle of a small number of specialist production communities still prevailed. In contrast, the changes to the organization of plain ware production that occurred in the Episode 3 reorganization resulted in a change to that fundamental organizational principle. Instead of plain ware made by specialists at a handful of communities, it was now made at locations throughout the lower Salt River Valley (Abbott 2000a, 2009). Production became localized, and distribution was largely confined to individual canal systems.

At this time, there was also a rapid collapse of the entire ballcourt system at the end of the 11th century. Existing ballcourts were abandoned and construction of new courts ceased in both the Phoenix and Tucson Basins (Abbott, Smith, and Gallaga 2007; Doyel 2000; Doelle and Wallace 1991:319-321). Doyel (2000) noted that ballcourts were abandoned at Pueblo Grande and Las Colinas (see also Abbott 2006) in the lower Salt River Valley, and at the Gatlin site in the lower Gila River Valley about this time, while Abbott and colleagues (2007b) argued the same for Palo Verde Ruin, located in the uplands north of Phoenix. The rapid demise of what had been the primary ritual focus in Hohokam villages indicates that significant ideological and ritual changes occurred at the end of the middle Sacaton 2 time segment that were implemented across the Hohokam culture area in a short period of time.

The ritual, and perhaps political, focal point of villages shifted from ballcourts to platform mounds by the beginning of the Classic period (Bayman 2001; Doyel 2000). Although these mounds were by no means architecturally uniform across time or space in southern Arizona, their placement at central locations within villages and communities is a testimony to their importance in public life. Initially, in the early and middle Sacaton time segments, platform mounds seem to have been small ceremonial features overshadowed by the integrative and popular ballcourts. After the abandonment of the ballcourts, however, the mounds took on an increasingly important role, functioning perhaps as monuments that, rather than integrating a community or communities, served to establish or mark territorial rights of particular descent groups (Abbott 2000:204-206; Elson and Abbott 2000; Elson 1998). In the final stage (Civano phase) of their development, rooms with domestic features were constructed on many mounds, suggesting that they may have served as elite or semi-elite residences (Doyel 1974, 2000).

Artifactual changes also signal a shift in ideology. Most of the artifacts associated with the ceremonial complex of the preceding era, including palettes, carved shell and bone, figurines, ceremonial projectile points, and censers were no longer used (Bayman 2001; Doyel 1980, 2000; Haury 1976). Red-on-buff ceramics, which had long been important ideological transmitters, decreased significantly and became restricted to jar forms (Crown 1991). At the same time, non-local decorated ceramics and obsidian were increasingly imported, a pattern which to Bayman (2001:285) suggests the emergence of political alliances among elites and/or an increase in migrants from the Puebloan area.

Burial patterns also changed as inhumation was preferred over cremation in most villages (Ambler 1961; Brunson 1989; Doyel 1974, 1980, 1981; Haury 1976; Mitchell 1994). The co-occurrence of both burial types has been interpreted as signaling of ethnic affiliation (Gladwin and Gladwin 1934), competing religious beliefs (Doyel 1991; Wilcox and Sternberg 1983), or status (Brunson 1989). In any case, the contrast in burial patterns between the pre-Classic and Classic Hohokam is conspicuous, and clearly reflects an ideological shift in much of the Hohokam world (Bayman 2001:290; McGuire 1992).

Once again, significant stylistic innovation in buff ware pottery was also part of the changes associated with this reorganization. This third episode of reorganization was not identified by Wallace as a separate stylistic horizon. Rather, he sees the stylistic changes as part of a continuing development of Style 2 (1995:37). The basic design template of sectioned designs with discrete panels continued to dominate the design field and few new motifs are invented, rather, old motifs are used in new ways. Despite these continuities, some of the most dramatic changes in the whole buff ware sequence occurred at this time, making Casa Grande Red-on-buff (Soho phase) the most easily distinguished of all red-on-buff types. Several shifts contribute to this change. The proportion of bowls declines drastically in the late Sacaton time segment, so that by the Soho phase, they are virtually absent (Wallace 2001:252). Jar forms change dramatically, with tall, decorated necks or collars, and handled pitchers dominating assemblages. The paneling appears very different from the preceding time segments with a shift toward open panels, widely spaced panels (Figure 3.5). For these reasons, I suggest that we view the stylistic changes of the late Sacaton/Soho time segments as significant changes associated with the massive social upheaval that characterized this period.

Expectations

The breakdown of economic integration in the Episode 3 reorganization was characterized specifically by the dramatic shift in the organization of plain ware production from concentrated manufacture at a small number of locations to localized manufacture centered on individual canal systems. This shift in plain ware production leads me to expect similar changes in the organization of buff ware production. I expect that several more buff ware production communities would have risen at this time, and that production would have been spread much more evenly across the many manufacturing groups.

Because of the breakdown in large-scale social and economic integration at this time, it is expected that innovation in pottery style would have originated at multiple locations. The rate of adoption is expected to have been the slowest of the three episodes of change due to the fact that the degree of social integration was at its lowest, thus contributing to a low sense of interconnection, as well as a slow flow of information between groups. The pattern of innovation adoption is expected to conform more to a nearest neighbor model; that is, the pattern for adoption was likely based more on physical distance to the origin community than social ties to that community. Because of the low sense of interconnection and information flow of this episode, it is expected to have been characterized by the least uniform adoption.

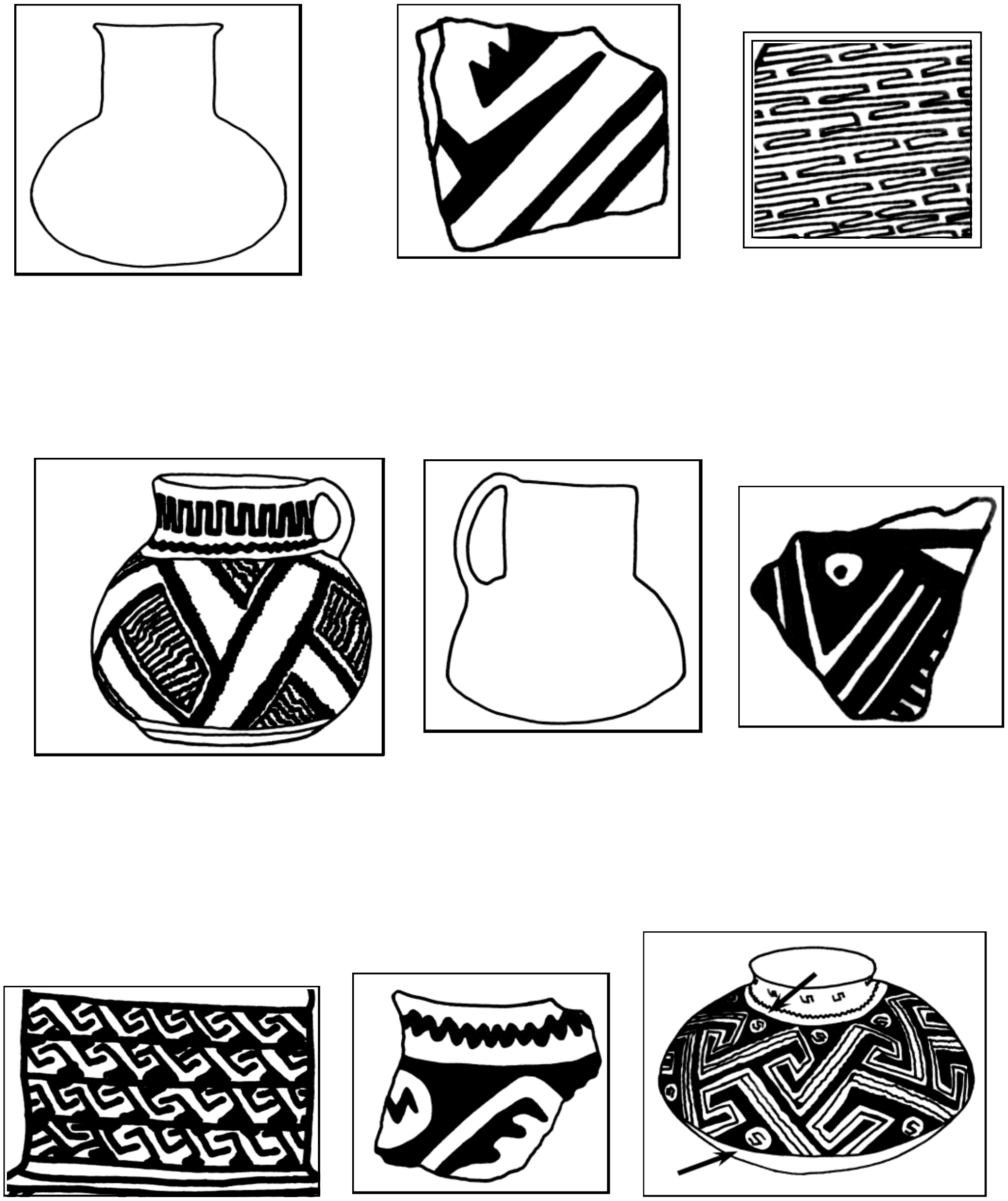


Figure 3.5. Typical red-on-buff stylistic elements associated with the Episode 3 reorganization.

Summary

The descriptions of social reorganizations presented above provide the contextual framework for evaluating the process of stylistic innovation among buff ware potters

(Table 3.2). The expectations for buff ware production are presented in Table 3.3. The expectations for innovation for each reorganization episode are presented in Table 3.4. The first episode of reorganization (early/late Gila Butte transition, ~A.D. 800) emphasized ideological shifts and social interconnection without significant changes in economic processes. Within this social environment, I expect no significant changes in buff ware production from the early to late Gila Butte time segments. Regarding stylistic innovation, I expect innovations in buff ware pottery to have originated at a small number (as few as one) of locations, and then to have been rapidly adopted by all, or nearly all, potting communities, beginning with those who were most socially close to the origin community.

The second episode of reorganization (early/middle Sacaton transition, ~A.D. 1020) emphasized an economic shift toward a more sophisticated division of labor and the possible implementation of a market place economy at the peak of socio-economic interdependence throughout the Phoenix Basin. I expect, therefore, that one or two new significant buff ware production groups would arise in the same manner as they did in the lower Salt River Valley among plain ware potters. I expect multiple locations of stylistic innovation during this reorganization, a slower rate of adoption, beginning with those who were most socially close to the origin community, and less overall uniformity of adoption among all production groups.

The third episode of reorganization (late Sacaton/early Soho phase, ~A.D. 1100-1125/50) emphasized major shifts in the social, ideological, economic, and political realms. I expect to see dramatic shifts in the organization of buff ware production, so that

Table 3.2. Summary descriptions of changes associated social reorganizations.

Reorganization	Cultural and Material Indicators
~A.D. 800 mid/late Gila Butte transition	▪ ballcourts constructed ▪ central plazas become focal points ▪ Mesoamerican-derived mortuary complex and iconography ▪ stylistic innovation in buff ware pottery
~A.D. 1000-1020 early/mid Sacaton transition	▪ more sophisticated division of labor ▪ two new major plain ware production zones ▪ possible marketplace economy ▪ stylistic innovation in buff ware pottery
~A.D. 1100-1125 late Sacaton/early Soho	▪ social fragmentation/balkanization ▪ shift to local pottery production and consumption ▪ collapse of ballcourt system ▪ platform mound becomes focal point of large villages ▪ inhumation becomes the preferred treatment of the dead ▪ stylistic innovation in buff ware pottery

Table 3.3. Expectations for the organization of buff ware production among the Hohokam.

A.D. 800 mid/late Gila Butte transition	A.D. 1000-1020 early/mid Sacaton transition	A.D. 1100-1125 late Sacaton/early Soho phase
no significant changes in buff ware production	one or two new significant buff ware potting groups	shift to localized buff ware manufacture and many new production locations and changes in relative proportions of potting groups

Table 3.4. Expectations for the process of innovation among the Hohokam.

Variables relating to the process of stylistic innovation	A.D. 800 mid/late Gila Butte transition	A.D. 1000-1020 early/mid Sacaton transition	A.D. 1100-1125 late Sacaton/early Soho phase
origin	few (even 1) origin locations	few origin locations initially; multiple origins soon follow	multiple origins from the beginning
rate of adoption	adoption over short period of time (perhaps within one time segment) due to strong interconnection and integration	adoption over a relatively longer time period due to economic competition	adoption over longest time period due to weak interconnection among loosely integrated populations
pattern of adoption	potentially non-linear adoption pattern	potentially non-linear adoption pattern	nearest neighbor (linear) adoption pattern due to the lack of social integration
uniformity of adoption	highly uniform adoption	heterogeneous adoption	heterogeneous adoption

changes are evident in the number and relative proportions of different production groups. I expect that stylistic innovation occurred at multiple locations, and that innovation adoption occurred at the slowest rate and with the least degree of uniformity of the three reorganization episodes. I expect a nearest neighbor pattern of innovation adoption at this time. The following sections evaluate the data from which these expectations were tested.

Notes for Chapter 3

[1] The data from the Red Mountain phase is virtually confined to the site of Pueblo Patricio (Henderson 1995), making all interpretations extremely tenuous.

[2] Perhaps the most famous sacrificial scene associated with a ballgame are the reliefs literally carved into walls of the ballcourt at Chichen Itza (see Freidel et al. 1993:374-383; Schele and Freidel 1990:373-374). In this scene, a player (presumably the loser of the game) is ritually decapitated, re-enacting the famous scene from the Here Twins saga as recorded in the Popol Vuh (Tedlock 1985). Other such scenes associated with ballcourts are found at the ceremonial center of El Tajin, in Veracruz and in Yaxchilan, in Chiapas (Schele and Miller 1986:241-264). It is no coincidence that prominent skull racks were placed in the direct vicinity of the ballcourts at both Chichen Itza and the Aztec capital of Tenochtitlan (Schele and Miller 1986:243).

[3] For the effect of competition on innovation see Causey (1999), Runnels (1985), and Stromberg-Pellizi (1993).

Chapter 4:

PREVIOUS HOHOKAM STYLISTIC ANALYSES

Over the last 75 years, many researchers have explored the issue of Hohokam red-on-buff stylistic variation. Early studies made broad comparisons between Hohokam buff ware and other ware types in the Southwest to delineate the differences between cultural groups (Amsden 1936; Clark 1935; Crown 1984:205). Other studies examined design symmetry to describe the continuity of buff ware style over time (Zaslow 1980, 1983; Zaslow and Dittert 1977). As both Crown (1984:205) and Neitzel (1984:160) note, those early studies all assume that buff ware ceramics were stylistically homogenous in any given time period.

Several studies were undertaken to test this assumption by focusing on stylistic variability across space (Crown 1984; Lindauer 1988; Masse 1982; Neitzel 1984). It is this research on spatial variation in buff ware style that is most relevant to the present study on the process of stylistic innovation among buff ware producers. Below I briefly summarize three of the most extensive stylistic studies of Hohokam red-on-buff pottery. All three made important contributions but, because detailed control over production loci has not previously been available, none could provide many insights on the patterning of stylistic variability or how that might relate to processes of stylistic innovation. I then consider studies by researchers in the Tucson Basin who have pioneered a methodology to control for the necessary variables to undertake a study of stylistic variability and innovation.

Crown (1984)

As part of the massive Salt-Gila Aqueduct Central Arizona project, Patricia Crown examined over 8,000 red-on-buff sherds from 14 sites in the eastern edge of the Phoenix Basin (1984). These sites were clustered in three different drainage areas (Siphon Draw, Queen Creek, and the Gila River) which served as Crown's comparative spatial control. The sites in these drainages were all within approximately 20 kilometers of one another, with uninhabited areas of 7 to 10 kilometers in between each.

Crown hypothesized that vessels made in different areas would likely exhibit distinct stylistic attributes, revealing micro-traditions, or regional styles (1984:216). While Crown recognized that the buff ware vessels may have not all been locally produced, she did assume that the most abundant temper type recorded likely represented local production. Wisely, however, she also stated that:

> "For the most part, the assumption is made in this study that the vessels that were used, broken, and discarded at a site were stylistically acceptable to the users of the vessels. Thus, if vessels were not manufactured at the site, at least they were obtained and used by the inhabitants of the site and presumably were aesthetically appropriate to them." (1984:216)

Crown found an overarching stylistic tradition that included the same elements and motifs in three geographic areas. She also reported clear differences in the popularity and use of stylistic attributes among the three drainage areas. She found statistically significant differences among the three areas for Santa Cruz – Sacaton phase contexts. She noted, for example, that buff ware sherds from the Siphon Draw drainage were characterized by small, repeated elements while those from the Queen Creek and Gila River drainages were characterized by larger, and more varied, attributes (1984:238). In addition, Queen Creek designs were typically better executed compared to the other two areas. Differences between the drainage areas were also found to be consistent across vessel forms and through time. She concluded that stylistic variation was a useful measure of social group membership and manufacturing traditions (1984:241).

Neitzel (1984)

Based on ceramics examined from a handful of excavated sites, buff ware had been perceived as homogenous across most of the southern desert of Arizona (Clarke 1935:49; Gladwin and Gladwin 1929a, 1929b, 1930a, 1930b, 1935; Hanna 1931; Haury 1932; Hawley 1930; Schmidt 1928). Neitzel's stylistic analysis was predicated, in large part, in challenging this culture area approach by examining red-on-buff pottery from a geographically scattered sample of contexts from across south-central Arizona to assess stylistic variability across space.

She found that stylistic differences were observable on red-on-buff pottery at three different scales: 1) between the Salt and middle Gila River Valleys (the Hohokam "core" area), 2) among major river valleys of the southern desert, and 3) between the Hohokam "core" and "periphery" areas. At the smallest scale (the Salt and Gila River Valleys) Neitzel reported that ceramics from the two areas could be distinguished based on style between 78 and 88 percent of the time. At the next scale, she found that buff ware could be accurately classified according to major river valley (lower Salt, middle Gila, Santa Cruz, and Gila Bend) 52 percent of the time. At the largest scale, buff ware ceramics could be identified as to "core" or "periphery" 89 percent of the time. No attempt was made to compare red-on-buff ceramics at a scale smaller than the Salt and Gila River Valleys.

Lindauer (1988)

Lindauer evaluated regional interaction in the Hohokam area through a stylistic analysis of red-on-buff pottery. While his study was not necessarily focused on delineating stylistic variation among geographic areas, it did provide useful information pertaining to this issue. In an examination of line widths, he found that statistically significant differences in comparisons of different drainages (e.g., Gila Bend and middle Gila) (1988:240), and suggested that potters in these areas used different kinds of brushes. Lindauer also noted that the data were more ambiguous than expected, possibly because local production did not occur in significant amounts in all of the areas he tested, and that a great deal of exchange may have occurred (1988:246-247).

Limitations of these Studies

All of these studies, while making important contributions, were limited in their interpretive power by the lack of control over vessel or sherd provenance. Crown, herself, stated that "If truly local manufacture is not indicated, the problem then is complicated by the necessity of evaluating how many production loci might have existed and determining the size of the areas serviced" (1984:240). We now know that buff ware production was concentrated in the middle Gila River valley, and from there was subsequently widely exchanged throughout the Hohokam area; thus the assemblages studied by these researchers probably contain significant amounts of pottery that was not locally made. It has also been shown that at least some red-on-buff assemblages represent a mixture of wares from different production sources within the middle Gila River Valley, indicating that consumers obtained buff ware vessels from a variety of sources (Abbott, Watts, and Lack 2007; Lack and Watkins 2009; Lack et al. 2006; Lack et al. 2012).

A second limitation of these studies was the general lack of chronological precision available to the researchers at the time. Wallace (2001:187) has suggested that much of the variation recorded in these previous studies could have been due to within-phase temporal variability that was not recognized until recently. In the studies described above, the researchers had to assume contemporaneity among deposits that were compared using the long-lived temporal phase designations in use at the time. In doing so, style was viewed as static for the duration of each phase, which could be nearly 200 years in some cases.

An Integrative Approach towards Stylistic Variability: A View from the Tucson Basin

This review of previous buff ware stylistic analyses highlights two crucial variables that must be controlled if stylistic variation is to be understood: chronology and provenance. A fine-scale chronology is essential for many reasons, including establishing site and feature contemporaneity, accurately dating events and organizational shifts, and evaluating stylistic changes associated with those events and organizational shifts. Control over buff ware production sources is necessary for understanding the organization behind the stylistic shifts.

The value of combining these variables in such a manner has been demonstrated with analyses of Hohokam ceramics in the Tucson Basin, over 100 kilometers to the southeast (Heidke 1990; Wallace and Heidke 1986). Prior to these studies, style had been assumed to develop uniformly across production communities. These researchers were able to test this assumption by documenting the stylistic and technological variability of Hohokam red-on-brown sherds from two sites in the northern Tucson Basin occupied during the Rincon phase (A.D. 950-1150). Because the Rincon phase had been subdivided into smaller time segments (Wallace 1986), the stylistic developments could be traced over short intervals of time, in a manner akin to what is attempted in the present study.

By combining the attribute analysis with a provenance analysis, Heidke (1990:121) argued that intraregional styles, associated with different production loci, could be discerned within the Tucson Basin red-on-brown wares. For example, the subtype Middle Rincon Red-on-brown was shown to consist of at least two different styles, each associated with a different production area. The most diagnostic attributes for delineating these styles were small elements. Specifically, the small element H was correlated with the Catalina/Rincon sand petrofacies, while the small element Z was correlated with the Cat Mountain petrofacies. Other attributes that distinguished these styles from one another were sectioned layouts and fringes (Heidke 1990:124). Following Graves' (1981:306-307) ideas concerning discontinuous spatial design variation, they concluded that the stylistic variation correlated with the two production areas indicated different social groups intentionally expressing group identity.

Research Direction

In Chapter 8, I explore stylistic innovation among buff ware potters for the first time by bringing this integrative approach used in the Tucson Basin into the heart of the Hohokam culture area, the Phoenix Basin. I first examine buff ware chronology, especially recent advances that allow us to track stylistic shifts over much shorter temporal intervals than has previously been possible. I then describe the sampling procedures for this study utilizing those advances in chronology. This chapter is followed by an examination of the advances in our understanding of buff ware production, including the application of those advances to determine the number of potting groups manufacturing buff ware vessels over the course of the pre-Classic era.

Chapter 5:

ISSUES IN CHRONOLOGY

Winifred and Harold Gladwin (Gladwin and Gladwin 1929, 1933) and Emil Haury's (1937, 1945) seminal research on the Hohokam red-on-buff typological sequence has been the standard for Hohokam chronology and ceramic research for the past 70 years (Figure 5.1). Their work provided the basic framework in Hohokam archaeology of long temporal periods (Pioneer, Colonial, Sedentary, and Classic) subdivided into shorter phases (Vahki, Estrella, Sweetwater, Snaketown, Gila Butte, Santa Cruz, Sacaton, Soho, and Civano). It is a testament to the quality of that work (and Haury's [1976] subsequent research) that ceramicists are still largely working within that typological paradigm.

Since the first half of the 20th century, various revisions, clarifications, and proposed sequences have been developed (Crown 1981, 1984; Dean 1991; Doyel 1974; Haury 1976; Wallace 1995). In recent years, however, it has become increasingly apparent that none of the proposed typological and chronological sequences are narrow enough to address the complex and important archaeological questions that have arisen from the plethora of archaeological data generated over the last 30 years in the Phoenix area. While temporal phases of 100-200 years in length allow us to general trends, they inevitably mask many of the complexities involved in social organization, as well as the historical processes that led to change. It is far from ideal, for example, to have to assume contemporaneity between sites or features that may have been chronologically separated from one another by 150 years. Such assumptions lead to considerable misinterpretations of population estimates, community organization, social complexity, etc.

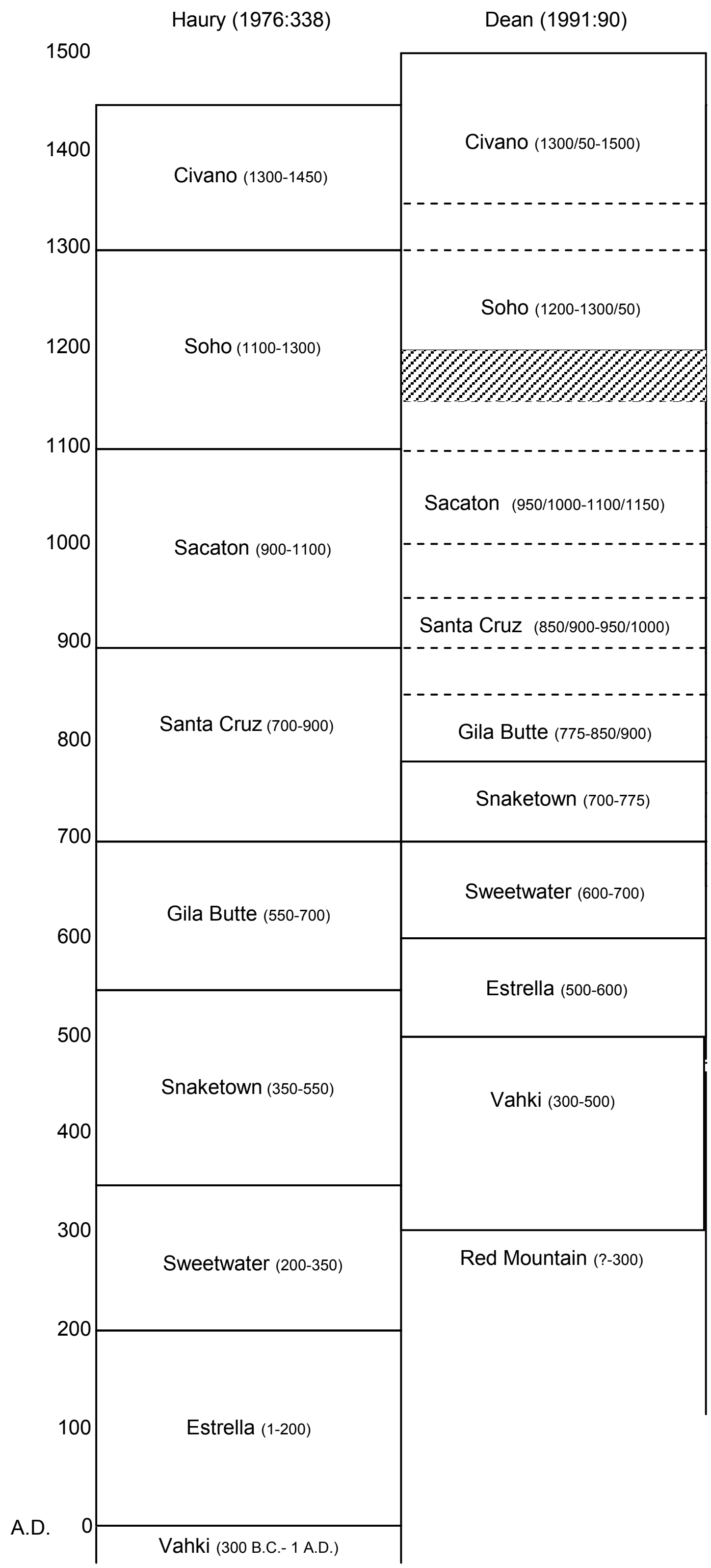


Figure 5.1. Previously established Hohokam chronological sequences.[1]

A Refined Seriation

The problems inherent in using such broad chronologies prompted Henry Wallace (2001, 2004) to produce a refined time seriation of the Hohokam Red-on-buff sequence. His refinement made use of unmixed and rapidly-filled depositional contexts, detailed stylistic attribute analysis, and multidimensional statistical techniques "to refine the Snaketown to Soho phase Middle Gila Buffware ceramic sequence to provide greater temporal control, and to do so in a manner that can be replicated and easily applied by other researchers" (Wallace 2001:179). Wallace's refinement required selection of contexts that were unmixed and rapidly filled. Such contexts had the highest potential of including assemblages dating to the same narrow time range. Thus, in his analysis, all sherds within the same context were considered to be of the same phase or time segment (Wallace 2001:192). That phase or time segment designation was based on a consideration of all of the sherds within the context.

Wallace chose contexts from 14 sites with a wide geographic distribution in the lower Salt and middle Gila River Valleys (in my summary of his work, I combine his 2001 and 2004 studies). He included sherds representing the entire buff ware sequence, from the Snaketown through Soho phases. The percentage of mixing within each context was determined by prior knowledge of the decorative sequence (from Haury for Wallace's 2001 study, and Wallace's own 2001 study for his 2004 seriation). As Wallace writes, "Each round of analysis and testing forms the basis for the next round, and at each turn, one has a more precise understanding of the stylistic and technological sequence and a greater capability of selecting traits that will further elucidate the sequence" (2004:47).

Wallace recorded more than 170 stylistic and technological attributes on 1,964 sherds. Not all of these attributes proved to be temporally significant, but all were important in type definitions. A catalog of whole vessel designs was compiled to aid the documentation of attributes on sherds, being especially useful for recording attributes pertaining to design layout, types of paneling and banding, and other attributes typically larger than the average sherd (Wallace et al. 2004:52).

To order the actual sequence, Wallace used nonmetric multidimensional scaling (MDS), a form of proximity analysis that provided a goodness-of-fit of the seriation model (2004:53). The results were then tested against independent chronological information, including stratigraphic relationships and archaeomagnetic dates (Wallace 2001:206).

The study resulted in the successful time seriation of 53 contexts (Wallace 2004:64). A total of 114 temporally sensitive attributes, each with a specified temporal range, have been identified and described (Wallace 2001:Appendix J, 2004:Table 3.7; see also Abbott et al. 2012), and many have been illustrated (Abbott et al. 2012).

Wallace's refinement resulted in the subdivision of the nine traditionally recognized phases into 14 time segments (Figure 5.2). Each time segment was defined by multiple technological and stylistic attributes. The narrowest time segments were less than 30 years in length (Estrella, Sweetwater, early Snaketown, late Snaketown, and middle Sacaton 2) while the longest was approximately 70 years (early Sacaton).[2] In comparison to Dean's (1991:90-91) proposed sequence, in which each phase averages over 100 years in length, Wallace's refined sequence is comprised of time segments averaging approximately 50 years.

Testing the Seriation

While the refined time seriation has been employed in an increasing number of ceramic research projects (Abbott 2000; Lack et al. 2006; Lack and Watkins 2009; Lack et al. 2010; Lack 2007; Wallace et al. 2002; Watts and Lack n.d.; Watts et al. n.d.), there had been no an independent, systematic test of the refinement on a large assemblage excavated with contemporary techniques., recently excavated assemblage. For that reason, I applied the refined seriation to the buff ware assemblage from the Lower Santan Site (GR-522), recently excavated by the Gila River Indian Community (GRIC) Cultural Resource Management Program (see Lack in prep). Funding for this portion of the research project was provided by GRIC and the Laboratory of Sonoran Ceramic Research.

Three factors made the Lower Santan assemblage an ideal assemblage with which to test Wallace's refined seriation. First, the total buff ware assemblage from these intact contexts was quite large. Second, a large number of intact deposits with high numbers of refits and reconstructible vessels were excavated, indicating that these contexts were likely deposited over short temporal intervals. Such contexts were desirable because they were most likely to contain coeval stylistic attributes. Secondly, Third, the contexts spanned the entirety of the Sacaton phase; a temporal interval Wallace divided into four shorter time segments.

Three tests were conducted to evaluate Wallace's refined seriation. The first considered the consistency of attributes on individual sherds. If different attributes with non-overlapping or adjacent temporal ranges were found to co-occur on the same sherd, then the temporal ranges for individual attributes are not accurate and the seriation would

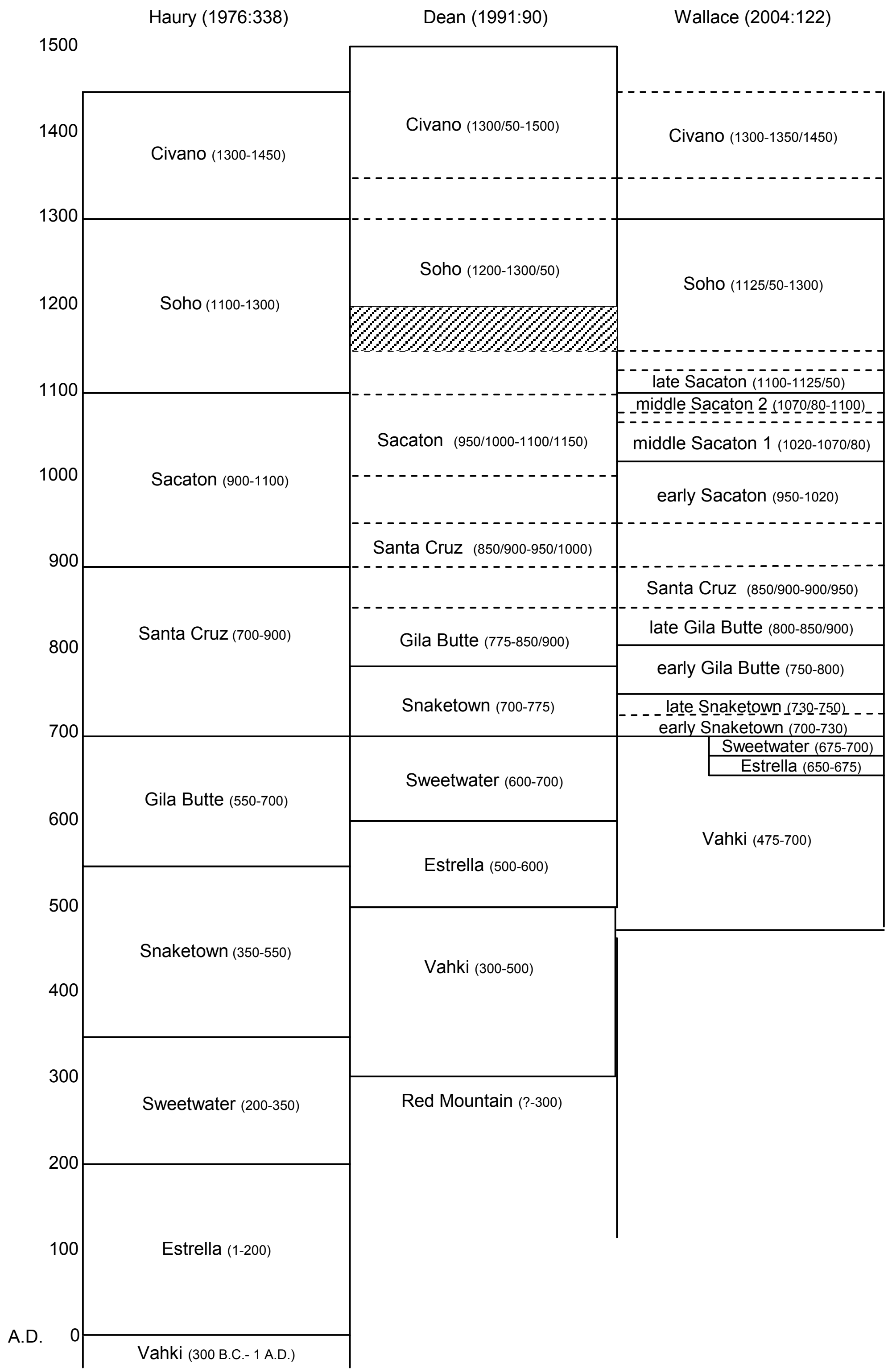


Figure 5.2. Wallace's (2004:Figure 3.23) refinement of the Hohokam chronological sequence.

be unreliable. The second test considered the consistency of attributes within the same depositional context. If different attributes with non-overlapping or adjacent temporal ranges were found to co-occur within the same depositional context, then the context is either temporally mixed or the seriation is inaccurate. The third test compared the percentages of individual attributes within a single depositional context and for particular time segments with the expected percentages derived from Wallace's seriation. If many attributes from the Lower Santan assemblage were consistently and significantly under- or overrepresented compared to the expected percentages derived from Wallace's refinement, then the validity of Wallace's refinement would need to be amended.

Methods

A total of 3,119 buff ware sherds were examined individually. These sherds represented all buff ware sherds >9cm² from 178 selected feature and 49 sub-feature contexts. GRIC researchers selected these contexts based on their potential for providing intact assemblages from which the analyst could obtain the most useful information. Multiple sherds that were pieces of the same vessel, determined by refitting sherds, matching paste color, texture, temper, and design style consistency, were coded as a single sherd. All reconstructible vessels in the sampled contexts were included in the attribute analysis, and were counted as one sherd.

Attributes identified by Wallace (2004:Table 3.7, Figure 3.22) as temporally diagnostic were recorded for each sherd. Each attribute was assigned a number, which was used to code each attribute when encountered on a sherd (Figure 5.3).[3]

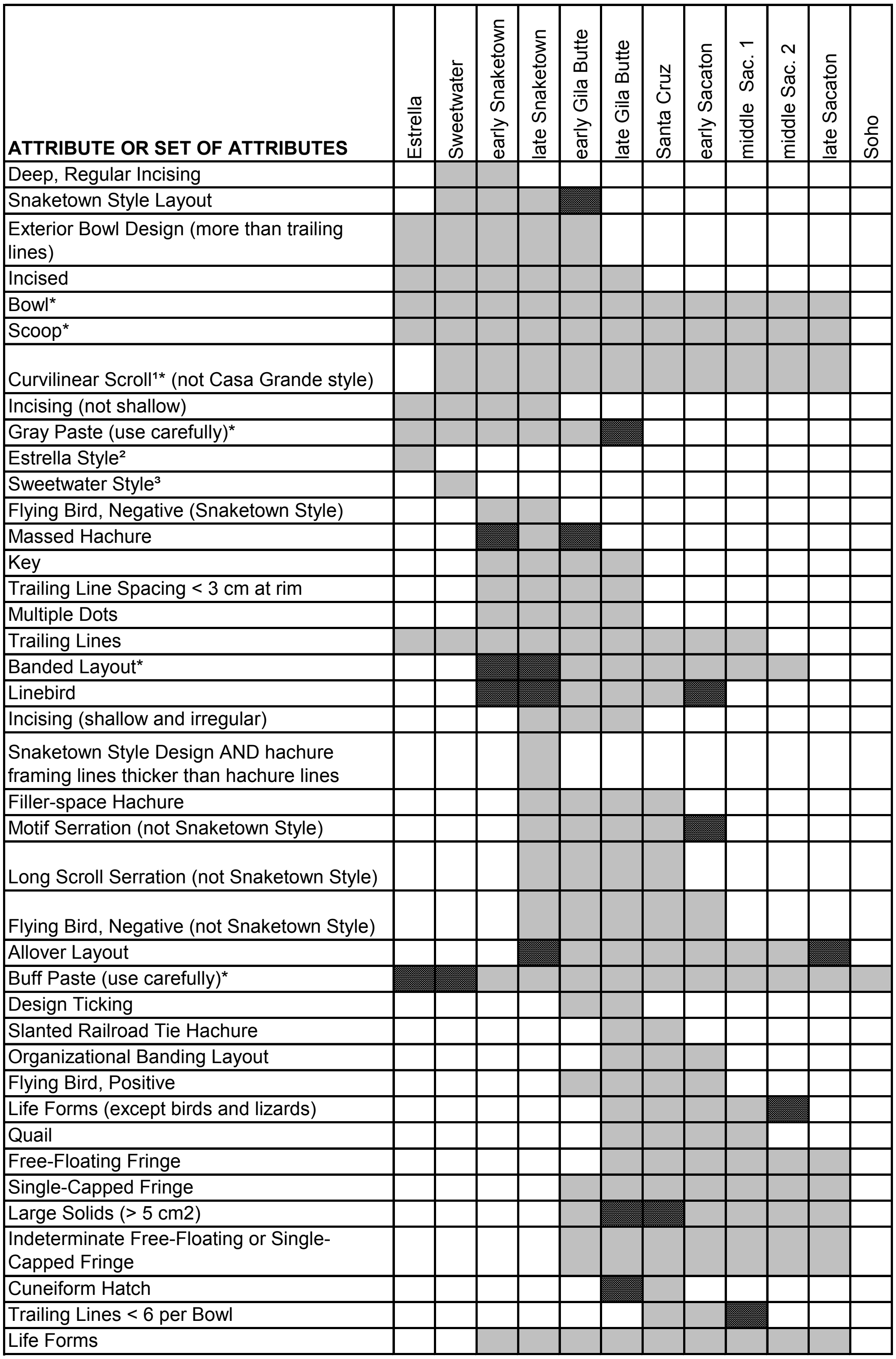


Figure 5.3. Chart of temporally sensitive attributes on buff ware and brown-paste variants.

ATTRIBUTE OR SET OF ATTRIBUTES	Estrella	Sweetwater	early Snaketown	late Snaketown	early Gila Butte	late Gila Butte	Santa Cruz	early Sacaton	middle Sac. 1	middle Sac. 2	late Sacaton	Soho
Everted Jar Rim												
Gila Shoulder												
Panel with a Centerline Motif												
Wavy-capped Fringe (single- or double-capped)												
Panel with a Serrated Margin												
Filler Hachure*												
Surfaces*												
Crenulated Line in a Panel												
Gila Shoulder <120 degrees												
Gila Shoulder, Knife-edged												
Outline Line and Stagger												
Rectilinear Scroll												
Double-capped Fringe (not Snaketown style) in Indeterminate Layout												
Lines Motif												
Solid Void Motif												
Double-Capped Fringe (straight or wavy), as Panel or Panel Border												
Tapered Lines												
Upper Freeline (jars only)												
Pitcher												
Open Panel												
Decorated Neck*												
Classic (mold inset) Shoulder												
Tall Neck (jars only)												
Polish AND gray paste												
tool polishing over painted lines (smearing visible)												
Coil-based incising AND line width ≥ 4mm												
Coil-based incising												
Coil-based incising AND line width < 4mm												
Hachure-filled design plus thickest line width <2.1mm												
Negative life form, repeated, not in rim solid, not Snaketown Style												
All-over layout, spiraling small elements, elements touching or average <2mm												
Trailing line , short (<3cm), more than 3 lines, spacing <4cm at rim												
Compressed globular-body jar with short flared rim												
Flare-rimmed bowl												
Flare-rim bowl, shallow, flat-bottomed												
Small, geometric element group D, nos.: 18, 19, 20, 21, 26, 28, 29, 40, 41												

Figure 5.3. Continued

ATTRIBUTE OR SET OF ATTRIBUTES	Estrella	Sweetwater	early Snaketown	late Snaketown	early Gila Butte	late Gila Butte	Santa Cruz	early Sacaton	middle Sac. 1	middle Sac. 2	late Sacaton	Soho
Small element group A, nos.: 30, 34, 35, 58, 63, 70, 1, 2, 73, 80, 81, 83, 84, 85, 86, 95, 96, 99, 103, 113, 114						■	■	■	■			
Crenulated Line						■	■	■	■	■	■	■
Fringed curvilinear scroll						■	■	■	■	■	■	■
Organizational Banding + full rim line								■				
Large, repeated life form or geometric element (average max. length > 5cm)								■	■	■		
Wipe-marked jar interior								■	■	■	■	
Line-demarcated panels (>50% line demarcated)								■	■	■	■	■
Jar with sectioned design								■	■	■	■	■
Small elements used as panel centerline								■	■			
Design element diversity >4									■			
Zipper motif									■			
Two or more voids within single solid with small elements									■			
Panel, at least partly line demarcated, >1 centerline motif									■			
Panel, at least partly line demarcated, zipper, curvilinear scroll, or other border elaboration (except fringing, ticking, or sawteeth)									■			
Panel, at least partly line demarcated, multiple duplicate elements used as panel centerline									■			
Cauldron (concave or vertical wall)									■	■		
Cauldron with Gila shoulder									■	■		
Small, geometric element group E, nos.: 32, 33, 65, 78, 82, 89, 98, 101, 110, 115, 116, 118, 123, 125									■	▓	▓	
Panel, isolated (completely line demarcated)									■	■		
Panel, at least partly line demarcated (no parts where panel border elaboration is attached to an adjacent solid)									■	■		
Banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width > 5mm)									■	■		
Design field separation from rim, bowl interiors only											■	
Semi-flare-rimmed hemispherical bowl											■	
interlocking rectilinear fret											■	■
Small, geometric element group B, nos.: 65, 66, 87, and any variation thereof								■	■	■	■	■
Small, geometric element group C, no.: 64, 67, 68, 69, 90, and minor variations									■	■	■	■

Figure 5.3. Continued.

Test 1: Attribute Co-occurrence on the Same Sherd

The first test of the seriation considered whether or not stylistic attributes whose temporal ranges (according to Wallace's seriation) neither overlap nor belong to an adjacent time segment co-occurred on individual sherds. For example, consider Figure 5.4. On this sherd, both temporally diagnostic attributes overlapped in their temporal ranges. If this sherd also displayed a tapered line (whose temporal range is late Sacaton – Soho time segments), then there would be mixing of non-overlapping or adjacent temporal ranges. A significant number of sherds on which such attributes co-occur would indicate that Wallace's temporal ranges were not accurate for particular attributes, and the refined seriation would be unreliable.

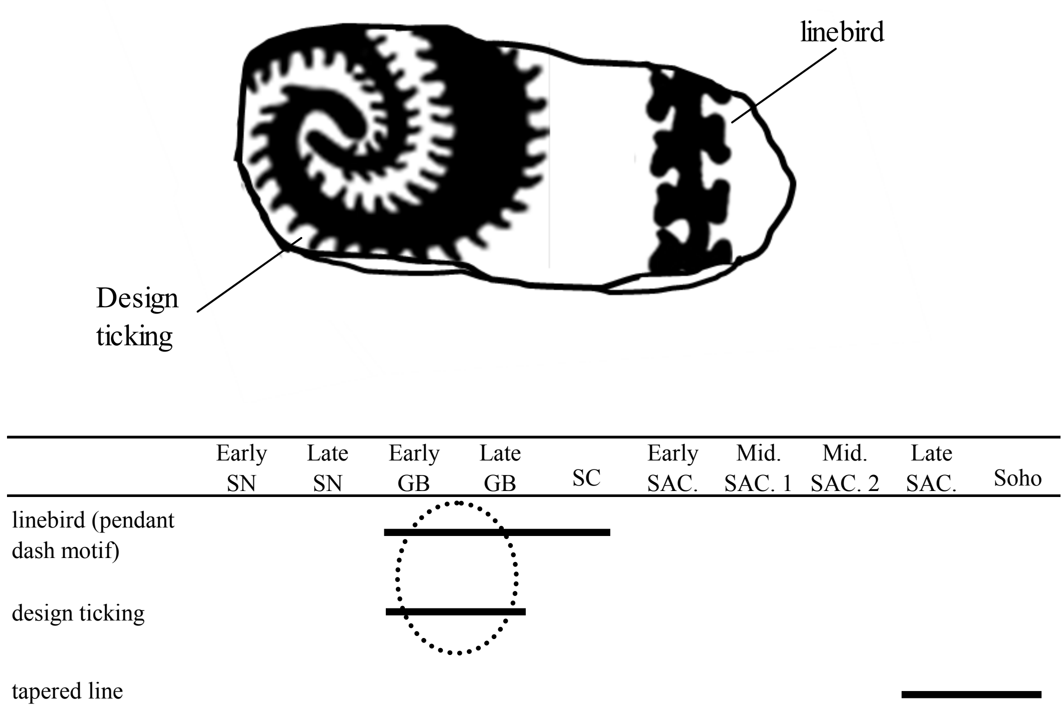


Figure 5.4. Example of attribute co-occurrence and temporal overlap on the same sherd.

Results

All attributes were recorded on a sample of 3,119 buff ware sherds; each sherd representing a single vessel. A total of 54 different temporally diagnostic attributes were identified, with 1,522 attributes recorded (Table 5.1). These attributes were compared on a sherd by sherd basis. The results revealed that the attributes on 99.9 percent of all sherds either overlapped in their temporal ranges or were of adjacent temporal ranges. Only one sherd possessed multiple attributes with non-overlapping or adjacent temporal ranges. In other words, only one sherd out of the 3,119 analyzed possessed temporally contradictory, or mixed, attributes on the same sherd/vessel. In this test, therefore, Wallace's refined seriation was nearly perfect.

Test 2: Attribute Co-occurrence within the Same Depositional Context

Wallace's refinement was based on buff ware sherds selected from contexts meeting several specific criteria (2004:61), three of which are employed here. First, a reasonable expectation of rapid fill, such as pit structures and pits, as opposed to most midden deposits and other features that showed evidence of slow, continual deposition over time. Hornos were also avoided due to their constant cleaning and refilling. Second, only buff ware sherds tempered with coarse-grained mica schist were included in an attempt to minimize the potential effect of decorated wares produced outside of the middle Gila River valley. Lastly, Wallace's minimum sample size for a single context was 18 buff ware sherds, each representing a different vessel. Each sherd measured >9cm², and possessed potentially temporally significant attributes. This number was reduced to 10 for this study in an effort to increase the sample size.[4]

Table 5.1. Frequencies of all temporally diagnostic attributes in the Lower Santan study.

CODE	ATTRIBUTE OR SET OF ATTRIBUTES	Total
14	Curvilinear Scroll[1]* (not Casa Grande style)	189
26	Trailing Lines	105
29	Incising (shallow and irregular)	1
38	Allover Layout	1
51	Slanted Railroad Tie Hachure	1
52	Organizational Banding Layout	19
53	Flying Bird, Positive	19
54	Life Forms (except birds and lizards)	15
55	Quail	1
56	Free-Floating Fringe	54
57	Single-Capped Fringe	180
58	Large Solids (> 5 cm^2)	50
59	Indeterminate Free-Floating or Single-Capped Fringe	24
62	Cuneiform Hatch	1
66	Life Forms	5
74	Diamond Panel Layout	1
76	Everted Jar Rim	41
77	Gila Shoulder (>120 degrees)	2
78	Panel with a Centerline Motif	22
80	Wavy-capped Fringe (single- or double-capped)	113
81	Panel with a Serrated Margin	3
82	Filler Hachure*	1
91	Crenulated Line in a Panel	9
92	Gila Shoulder <120 degrees	49
93	Gila Shoulder, Knife-edged	4
95	Outline Line and Stagger	
96	Rectilinear Scroll	86
97	Double-capped Fringe (not Snaketown style) in Indeterminate Layout	1
101	Lines Motif	2
102	Solid Void Motif	43
111	Tapered Lines	10
112	Upper Freeline (jars only)	74
114	Pitcher	1
121	Open Panel	47
122	Decorated Neck*	53
124	Tall Neck (jars only)	39
172	All-over layout, spiraling small elements, elements touching or average <2mm	1
195	Small element group A, nos.: 30, 34, 35, 58, 63, 70, 1, 2, 73, 80, 81, 83, 84, 85, 86, 95, 96, 99, 103, 113, 114	14
200	Crenulated Line	72
203	Fringed curvilinear scroll	12
209	Wipe-marked jar interior	7
217	Line-demarcated panels (>50% line demarcated)	6
220	Jar with sectioned design	103
222	Small elements used as panel centerline	
224	Design element diversity >4	2
227	Zipper motif	2
235	Panel, at least partly line demarcated, zipper, curvilinear scroll, or other border elaboration (except fringing, ticking, or sawteeth)	2
238	Panel, at least partly line demarcated, multiple duplicate elements used as panel centerline	11
245	Cauldron (concave or vertical wall)	1
250	Small, geometric element group E, nos.: 32, 33, 65, 78, 82, 89, 98, 101, 110, 115, 116, 118, 123, 125	3
255	Panel, isolated (completely line demarcated)	2
260	Banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width > 5mm)	2
270	Design field separation from rim, bowl interiors only	2
284	Small, geometric element group C, no.: 64, 67, 68, 69, 90, and minor variations thereof	14
	Total number of attributes	**1522**

Because each context was chosen according to these criteria, it was assumed that all of the sherds from each of those contexts would be contemporaneous and expected that stylistic attributes would co-occur according to Wallace's (2001, 2004) refinement. In other words, each attribute's temporal range should either overlap or, in the case of transitional contexts, be adjacent in time to all other attributes on different sherds within that same depositional context. Stylistic and morphological traits that were considered by Wallace to be temporally diagnostic were recorded for each buff ware sherd (see Figure 5.3).

Sample

Based on Wallace's criteria for context selection (see above), 24 features from the Lower Santan site were chosen to evaluate his refinement. A total of 633 sherds with temporally sensitive attributes were analyzed from these features (Table 5.2). The majority of the features were pit structures, with the exception of two borrow pits and one roasting pit. These features were included because they contained a high proportion of large and refitting sherds, and general temporal contemporaneity based on traditional type definitions. These qualities suggested that relatively rapid deposition was probable among these features (Wallace 2001:187).Two features (374 and 376) were part of a Classic period compound. Both features had significant quantities of Salado Polychromes along with small numbers of red-on-buff ceramics. Because of the small number of buff wares, assemblages from these two features were combined in the subsequent analyses.

Mixing of attributes within a single context was defined as sherds with attributes whose temporal ranges was not either overlapping or adjacent to the temporal

Table 5.2. Features chosen from the Lower Santan Site for an assessment of Wallace's (2001, 2004) refinement of the buff ware typological sequence.

Feature	Feature type	Total # of sherds with measurable attributes
141[1]	Pit House	25
152	Pit House	11
161[1]	True Pit House?	24
166[1]	True Pit House	213
188	Pit House	14
262[1]	Pit House	24
320[1]	Pit House	19
383	Pit Room	13
384	Pit Room	10
635	True Pit House?	14
669	Borrow Pit	14
784[1]	True Pit House	18
785	Pit Room	14
867	True Pit House?	14
868	Pit House	12
874[1]	Pit House	39
979	True Pit House?	23
1062	Borrow Pit	18
1089	Pit House	11
1093[1]	True Pit House?	21
1136	Roasting pit	27
1181	Large Nonthermal Pit	13
1296	Borrow Pit	34
374[2]	surface structure	5
376[2]	surface structure	3
	Total	633

[1]includes subfeatures

[2]Classic features (based on the presence of Salado polychromes) combined due to small sample sizes.

ranges of all other attributes within that context, according to Wallace's refinement. The percentage of mixed attributes was calculated by dividing the

number of attributes with non-overlapping or adjacent temporal ranges by the total number of attributes in the context.

Results

Frequencies and percentages of those attributes for each of the 24 chosen features are presented in Table 5.3 (see also Appendix A for a full list of specific attribute frequencies per feature and their temporal ranges). The mixing of attributes was less than

Table 5.3. Percentage of mixing within each depositional context.

Feature	pct. mixing
141	0.0%
152	6.3%
161	3.0%
166	1.0%
188	0.0%
262	0.0%
320	4.5%
383	0.0%
384	0.0%
635	11.1%
669	0.0%
784	4.0%
785	33.3%
867	0.0%
868	0.0%
874	0.0%
979	8.0%
1062	0.0%
1089	0.0%
1093	0.0%
1136	0.0%
1181	0.0%
1296	2.0%
374 and 376	9.1%

10% in 22 of 24 contexts, and less than 5% in 19 contexts. In the vast majority of cases, therefore, attributes on sherds within the same depositional context contained either overlapping or adjacent temporal ranges. These results also strongly support of Wallace's red-on-buff refinement.

Test 3: Percentages of Attributes within the Same Depositional Context

The last test compared the percentages of particular attributes of a particular time segment at the Lower Santan Site with those calculated by Wallace for the same attributes in his seriation (2004:Table 3.6). If the Lower Santan features are dated according to Wallace's refinement, the observed percentages of individual attributes should be relatively consistent with the expected percentages derived from Wallace's for particular time segments. For example, Wallace recorded that single-capped fringe occurred on 22.8 percent of sherds from late Sacaton contexts. All contexts that dated to the late Sacaton time segment from the Lower Santan Site ought to contain a similar percentage of sherds with single-capped fringe.

In order to make this comparison, it was first necessary to date each of the 24 chosen contexts utilizing Wallace's refinement. Once these features were dated to particular time segments, the observed percentages of particular attributes from the Lower Santan Site could be directly compared to the expected percentages derived from Wallace (2004:Table 3.6). In order to date each of the feature assemblages it was necessary to date the individual sherds within them.

Dating Sherds

Ceramic type was based on temporally diagnostic attributes identified by Wallace (2001:Appendix J; 2004:Table 3.7) that included painted designs, vessel forms, and paste characteristics (see Figure 5.3 for this list). Each attribute was dated to a specific time segment, or (more commonly) to a range of time segments over which it occurred. To type any given sherd using this methodology, all diagnostic attributes on a sherd were considered. The final type designation was the result of the temporal overlap among all the attributes on the sherds. The majority of sherds were not typed to a single time segment (e.g., middle Sacaton 1), but to a range of time segments (e.g., early Sacaton – middle Sacaton 2) because most attributes were in use over the course of more than one time segment. The sherd could, therefore, belong to any one of those time segments in which the attribute, or combination of attributes, was in use.

For example, consider a typical red-on-buff bowl rim sherd with several different temporally diagnostic design attributes (Figure 5.5). According to Wallace (2004), free-floating fringe has a temporal span from the late Gila Butte phase to the late Sacaton phase (see Figure 5.3). The positive flying bird motif dates from the early Gila Butte to the early Sacaton phase. When these two attributes are combined on the same sherd, the temporal range narrows to the late Gila Butte to the early Sacaton phase. The presence of exterior trailing lines that are closely spaced (<3cm) has a temporal range from the early Snaketown to the late Gila Butte phase. The only temporal phase in which all three of these attributes co-occurred was in the late Gila Butte phase. Therefore, a sherd with all three motifs can be typed as Late Gila Butte Red-on-buff.

This method has proven to be more conservative, more accurate, and more objective than previous buff ware temporal analyses (Abbott et al. 2012). It is more conservative because it recognizes that many stylistic attributes were utilized over several time segments. It is more objective because it identifies specific attributes and provides temporal ranges for each attribute, thus allowing different researchers to code individual sherds in the same way. It is more accurate because it identifies more attributes as temporally sensitive, and also uses multiple attributes on a single sherd to narrow the temporal range, sometimes to a single time segment.

Dating Features

The 24 selected features were dated using fairly conservative rules in an effort to be as consistent and objective as possible. Confidence levels were established for the temporal assignment of each feature based on the number of diagnostic sherds per feature and the precision of the ceramic type assignments.

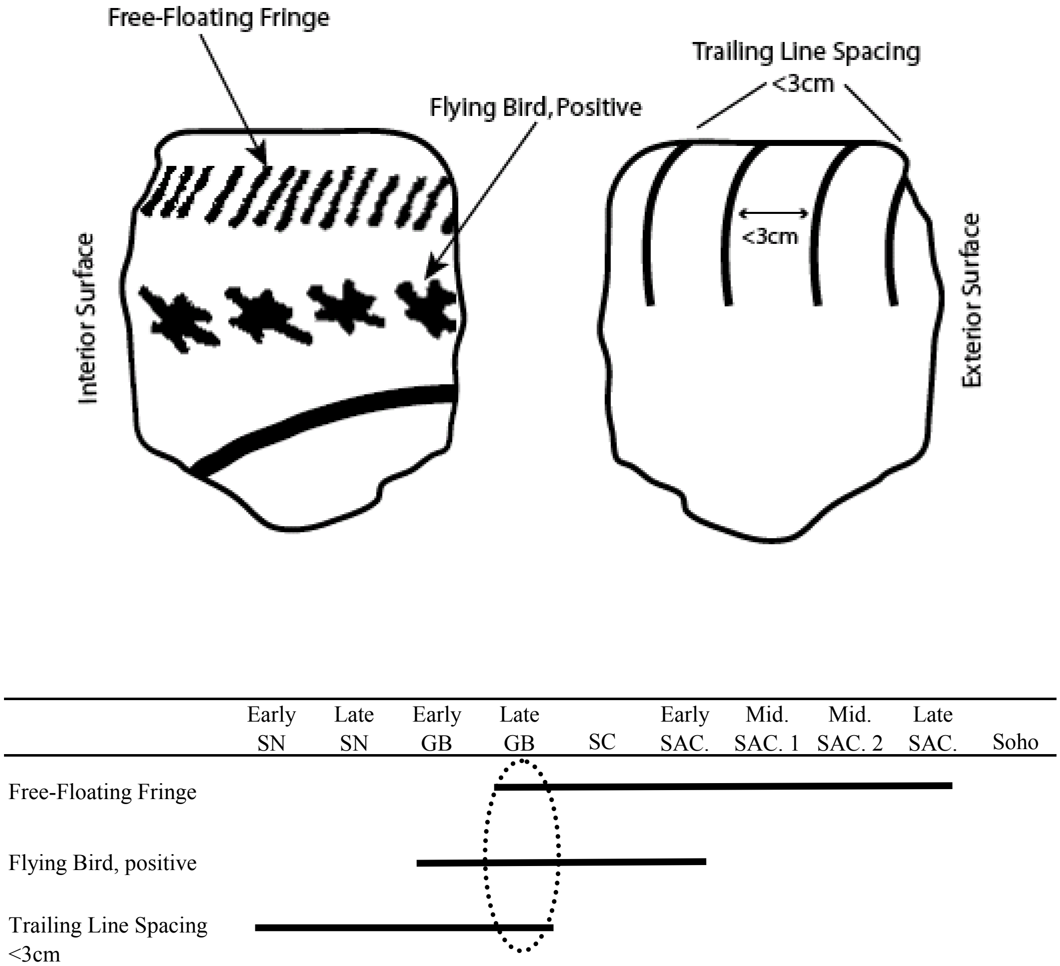


Figure 5.5. Example of how a buff ware sherd was dated in this study.

- Rule 1: one sherd alone, regardless of its diagnostic quality, is not sufficient for any temporal designation of a context
- Rule 2: low-confidence level dating
    - 2 sherds dating to the same temporal range *and* no more than 1 sherd dating to any other non-overlapping phase
        - e.g., 2 early Sacaton and 1 Santa Cruz = early Sacaton

Or

    - 3 – 4 overlapping sherds *and* no more than 1 sherd dating to any other non-overlapping phase
        - e.g., 2 early Gila Butte-late Sacaton, 1 early Sacaton-Casa Grande, 1 early Sacaton-middle Sacaton 2, and 1 Casa Grande = early Sacaton-middle Sacaton 2
- Rule 3: medium-confidence level dating
    - 3 sherds dating to the same temporal range *and* no more than 1 sherd dating to any other non-overlapping phase
        - e.g., 3 middle Sacaton 1 and 1 late Gila butte = middle Sacaton 1

Or

    - 5 – 7 overlapping sherds *and* no more than 1 sherd dating to any other non-overlapping phase
        - e.g., 1 late Snaketown-late Gila Butte, 4 early Sacaton-late Sacaton, and 2 middle Sacaton 1-late Sacaton = middle Sacaton 1-late Sacaton
- Rule 4: high-confidence level dating
    - 4 or more sherds with same temporal range *and* no more than 1 sherd dating to any other non-overlapping phase
        - e.g., 4 Early Sacaton + 1 middle Sacaton 1 = Early Sacaton

Or

    - 8 or more overlapping sherds *and* no more than 1 sherd dating to any other non-overlapping phase

- e.g., 4 early Sacaton-late Sacaton, 3 middle Sacaton 1-late Sacaton, 2 middle Sacaton 1-middle Sacaton 2, and 1 Santa Cruz = middle Sacaton 1-middle Sacaton 2

Using these dating rules, all 24 features were assigned to a particular time segment or time segment range, along with a confidence level for that date assignment (Table 5.4). Note that several features were assigned to more than one temporal range at different confidence levels; an action necessary to allow for the narrowest possible temporal range for each feature.

Using the aforementioned methods, all features dated within the early Sacaton – Civano time frame. At the high confidence level, ten features dated to a single time segment; four more features potentially dated to the transition between two time segments; six other features were assigned to two adjacent time segments; and the remaining seven features were assigned to slightly more broad temporal ranges. Combining the high and medium confidence levels resulted in 18 of the 24 contexts being assigned to either a single time segment or two adjacent time segments.

Results

Comparisons of the attribute percentages from the Lower Santan Site with the expected percentages derived from Wallace's seriation were made only with a select number of the total possible attributes. This limitation was due to the fact that Wallace did not publish the percentages for all of the recorded attributes. In addition, factors such as discrepancies in sherd size and vessel part representation contributed to the limited nature of the comparison. Nevertheless, the percentages of 12 attributes (including the percentages of bowls and jars) for each feature were compared to the expected

Table 5.4. Temporal assessments for the 24 chosen depositional contexts. A dash "-" indicates a span of time; a slash "/" indicates a transition between time segments.

		Temporal Assessment		
feature	feature type	high confidence	medium confidence	low confidence
141*	Pit House	LSAC/SOHO	-	-
152	Pit House	LGB-LSAC	ESAC-MSAC2	-
161*	True Pit House?	LGB-MSAC1	ESAC/MSAC1	-
166*	True Pit House	ESAC/MSAC1	-	-
188	Pit House	MSAC1-LSAC	-	-
262*	Pit House	MSAC1-MSAC2	-	-
320*	Pit House	ESAC-LSAC	MSAC1-LSAC	-
374 and 376**	multiple	SOHO-CIVANO	-	-
383*	Pit Room	LSAC-CIVANO	-	-
384	Pit Room	LSAC-CIVANO	-	-
635	True Pit House?	MSAC1-SOHO	-	-
669	Borrow Pit	MSAC1	-	-
784*	True Pit House	-	ESAC/MSAC1	-
785*	Pit Room	LSAC/SOHO	-	-
867*	True Pit House?	MSAC1-MSAC2	-	-
868*	Pit House	LSAC-SOHO	-	-
874*	Pit House	MSAC1	-	-
979	True Pit House?	MSAC2/LSAC	-	-
1062	Borrow Pit	LGB-LSAC	MSAC1	-
1089*	Pit House	MSAC1-MSAC2	-	-
1093*	True Pit House?	LSAC	-	-
1136	Roasting pit	LSAC	-	-
1181	Large Nonthermal Pit	MSAC1-MSAC2	-	-
1296	Borrow Pit	LSAC/SOHO	-	-

*includes subfeatures

**features part of Classic period compound combined

percentages derived from Wallace for a particular time segment, or adjacent time segments. A proportions test was performed for each attribute per feature (Hoel and Jessen 1982:245-247). A statistically significant result ($\alpha = .05$) indicated that there was a high probability that the observed percentages differed from the ones expected based on Wallace's results. Overall, the great majority (88%) of attributes from the Lower Santan Site were consistent with the expected percentages.

It was expected that the percentages of some attributes would differ from the expected due simply to sampling error, and, by chance alone, a statistically significant difference would be obtained. It was, therefore, important to identify any attributes that were consistently different within the same time segment. For example, of the two features that were potentially transitional between the early Sacaton and middle Sacaton 1 time segments, Feature 166 showed significant differences among three attributes (trailing lines, flying bird, and life forms), while Feature 784 showed significant difference in only one attribute (wavy-capped fringe). Because the same attribute was not shown to be statistically different in both features, the differences that were identified in each one were not considered important overall.

This same method was applied to the other features. A comparison of attributes from the seven features dating to the middle Sacaton phase (combining middle Sacaton 1 and 2) revealed several relatively consistent differences in the observed vs. expected percentages of particular attributes. In all but one feature, there were significant differences in fringe treatment. In four features, single-capped fringe was much lower than expected for middle Sacaton contexts; and was never higher than expected. Even if all indeterminate free-floating or single-capped fringe records were counted as single-capped fringe, the result would still be significantly lower than the expected percentage. At this time, the discrepancy between the observed and expected percentages of single-capped fringe cannot be explained. Wavy-capped fringe was significantly different in three of the nine middle Sacaton features, and in each case, its percentage was always higher than expected. Special attention should be paid to fringe treatments in the future to determine whether or not Wallace's refinement needs amendment.

The two features dating to the late Sacaton time segment (1093 and 1136), were also both associated with significant differences in wavy-capped fringe, as well as in single-capped fringe. The differences were even greater than in the preceding middle

Sacaton. Once again, this difference cannot be explained at present, and indicates that fringe treatments need to be subjected to more systematic analysis.

No consistently significant differences in attribute percentages were evident among the four features dating to the late Sacaton to Soho phases. Only the presence of trailing lines in two of the features was somewhat problematic. Because trailing lines are not expected to occur at all after the middle Sacaton phase, those sherds on which they occurred were either mixed in from the earlier time segment, or represent a slightly longer holdover of this attribute at the Lower Santan Site. Finally, of the five features dating to the Soho phase, no significant differences were identified between the observed and expected percentages of attributes. This result is tentative, however, due to the small number of comparable attributes for this phase.

Summary Assessment of Wallace's Refinement

This evaluation of Wallace's refinement to the Hohokam buff ware sequence (2001, 2004) was undertaken to evaluate the accuracy of his refinement to that sequence. In the three tests described above, it was found that 1) only three sherds (0.01%) were identified that possessed multiple attributes inconsistent with one another according to Wallace's refinement; 2) in 22 of 24 features, individual attributes co-occurred only with other attributes expected from Wallace's seriation more than 90% of the time; and 3) only fringe treatments were represented in different proportions than expected (during the middle and late Sacaton time segments). Overall, these tests overwhelmingly support the refinement as both accurate and replicable, and thereby a reliable tool to use to evaluate the process of stylistic innovation in buff ware pottery at different points in time.

Chapter 5 Notes

[1] Dean (1991) is unsure of dates for the transition from the Sacaton to Soho phases, as indicated by the hatched area.

[2] Wallace's Soho time segment actually encompasses ~150 years, but only the beginning of this segment is pertinent to this study.

[3] Given the temporal range of the assemblage, sherd size, etc., the majority, but not all, of Wallace's (2001, 2004) temporally diagnostic attributes were included in Figure 5.3.

[4] An additional criterion used by Wallace was that there must be less than 7 percent mixing of sherds >9cm² from non-adjacent time segments. This criterion was not used because the purpose of the study was to evaluate whether or not the attributes used to define those time segments were accurate measures.

Chapter 6:

SAMPLING STRATEGY

In order to assess the process of innovation by combining red-on-buff style and provenance, it was vital to take care in the sampling procedure. Because spatial and temporal control were necessary to track innovations from their origins to their widespread adoption, specific criteria were utilized to locate appropriate contexts.

In this chapter, I describe the sampling procedure used in this study. I begin by describing the spatial extent and specific site locations from which buff ware sherds were obtained. Next, I describe the temporal range of the contexts examined. Finally, the criteria and rationale for context selection are listed.

Sampling Procedures

A total of 3,751 decorated red-on-buff sherds from 198 separate contexts were analyzed for temper, design, and vessel form information (Appendix B). Contexts were chosen based on their high temporal integrity as determined in the temporal assessment described in the previous section. The sherds from these contexts represented the early Gila Butte to the Civano phases (A.D. 750 - 1300). The number of sherds sampled varied considerably both among sites and time segments.

The contexts were chosen from 20 different sites scattered throughout the Phoenix Basin and peripheral areas (Figure 6.1). A high priority was given to sampling as many sites as possible from as many different areas as possible. The vast majority of analyzed sherds came from sites in the lower Salt River Valley and middle Gila River Valley. These areas were the most populated in the Phoenix Basin prehistorically, and they are the areas which have received the most attention from archaeologists (Table 6.1).

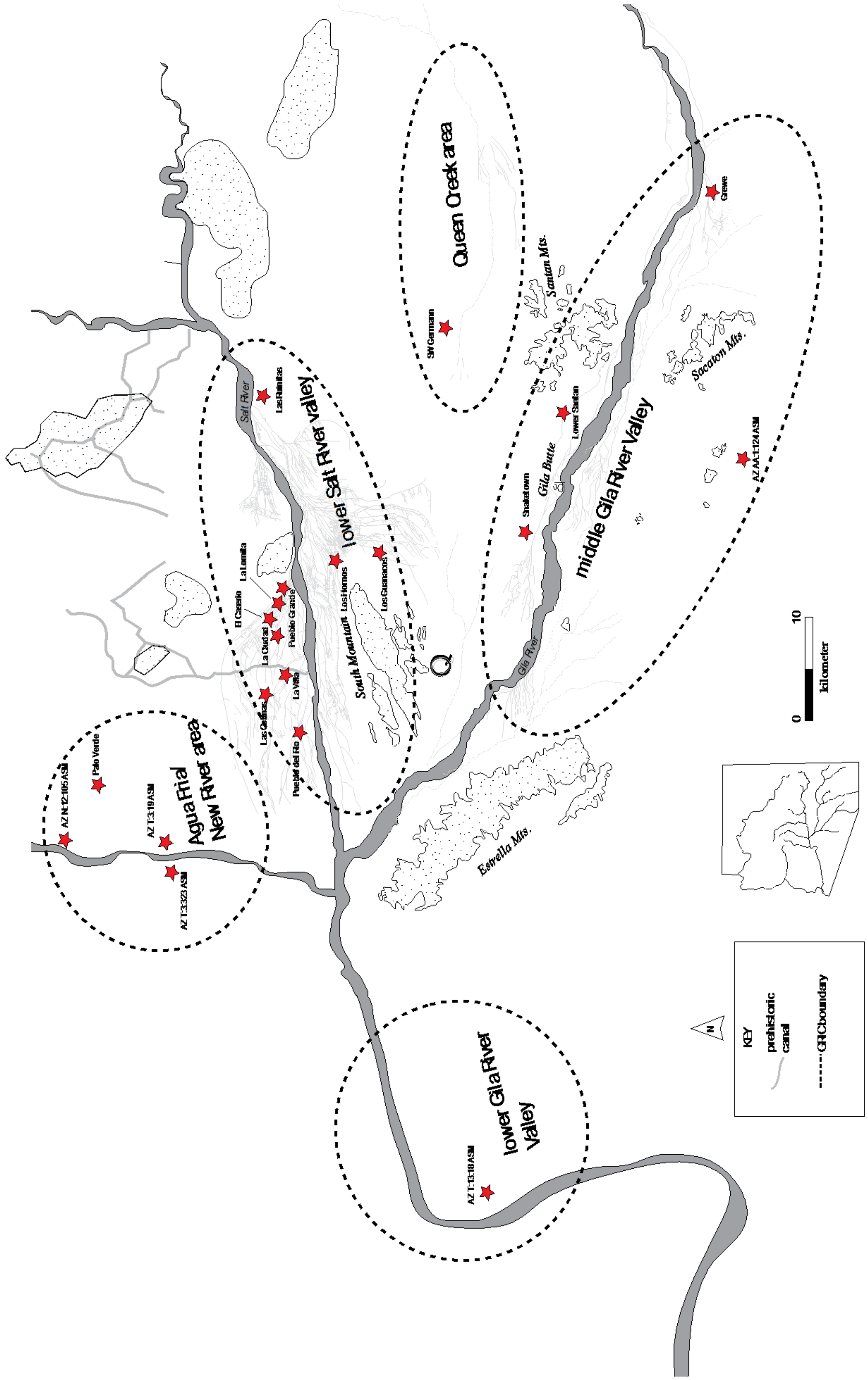


Figure 6.1. Sites sampled for buff ware provenance and stylistic analysis.

Table 6.1. List of sampled sites and buff ware counts by region.

lower Salt River Valley	ct	pct
El Caserio	111	2.9%
La Ciudad	374	9.9%
La Lomita	182	4.8%
La Villa	172	4.5%
Las Colinas	369	9.8%
Las Ruinitas	162	4.3%
Los Guanacos	87	2.3%
Los Hornos	408	10.8%
Pueblo del Rio	40	1.1%
Pueblo Grande	103	2.7%
Total	2008	53.5%

middle Gila River Valley	ct	pct
Grewe	201	5.3%
Lower Santan	571	15.1%
AZ AA:1:124(ASM)	73	1.9%
Snaketown	551	14.6%
Total	1396	37.2%

Queen Creek area	ct	pct
SW Germann	160	4.2%
Total	160	4.2%

uplands north of Phoenix	ct	pct
Palo Verde	78	2.1%
AZ T:3:19 (ASM)	11	0.3%
AZ N:12:105(ASM)	10	0.3%
AZ T:3:323(ASM)	59	1.6%
Total	158	4.2%

lower Gila River Valley	ct	pct
AZ T:13:18(ASM)	29	0.8%
Total	29	0.8%
Total	**3751**	

Considerably fewer contexts and sherds were analyzed from the Queen Creek area, the uplands north of Phoenix, and the lower Gila River Valley because most contexts at sites excavated in these areas did not meet the criteria for selection outlined below. There was also substantial variation in the number of sherds analyzed from each site, ranging from 571 sherds at the lower Santan Site to 10 sherds from AZ N:12:105 ASM.

All contexts were dated using Henry Wallace's refined red-on-buff seriation (2001, 2004). Because this study was concerned with the timing of particular innovations by different potting groups, and contexts were dated using many of these innovations, the issue of circularity had to be addressed. For example, vessels made by Potting Group A were deposited during the early Sacaton and vessels made by Potting Group B were deposited in the subsequent middle Sacaton 1 segment. Potting Group B, however, was slow to adopt innovations and so retained the style of the preceding period. For the archaeologist studying these two contexts, both of these deposits would be dated to the early Sacaton time segment, and the rate of innovation would be analytically invisible.

This problem was addressed through several objective tests of Wallace's refined seriation. These tests are reported in Chapter 5 (see also Lack in prep). In brief, these tests confirmed the validity of Wallace's seriation as a precise method of establishing temporal ranges for each specific stylistic innovation. Each temporal range was a conservative estimate of the earliest and latest dates for that attribute. In addition, nearly all contexts contained temporally diagnostic sherds from vessels produced in multiple production groups. In this way, the multiple groups served as checks to avoid dating the entire context on the basis of sherds from one production group.

In order to track an innovation from its invention to its subsequent adoption by different potting communities over time, it was essential to obtain samples from as many chronologically consecutive time segments as possible, including contexts that were transitional between two time segments (e.g., early Sacaton/middle Sacaton 1). Contexts were chosen from 16 chronologically consecutive time segments and transitional segments, beginning in the early Gila Butte and ending in the Soho-Civano (Figure 6.2). These contexts encompassed the entire time period that buff wares were produced in the Phoenix Basin, save the earliest parts of the sequence (Estrella Red-on-gray, Sweetwater, and Snaketown phases). The chosen contexts also encompassed the three episodes of reorganization around which this study is organized. By encompassing all three of these episodes of reorganization along with the time segments that immediately preceded and followed, the chosen contexts allowed me to investigate how these wide-scale changes

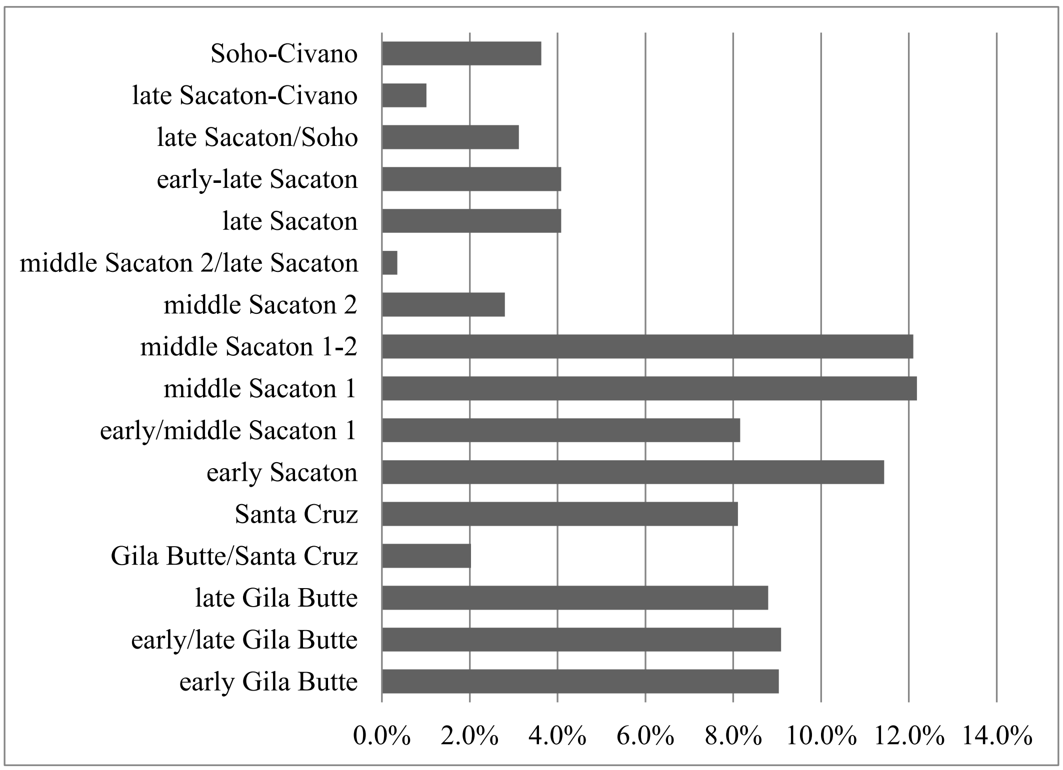


Figure 6.2. Percentage of buff ware chosen from each time segment and transitional segment.

may have influenced the potters relationships with each other and the further technological and stylistic development of their craft.

Once again, considerable variation existed in the sample sizes for each time segment due to the availability of contexts meeting the criteria described above. Contexts with substantial numbers of decorated buff wares dating to the later phases of the buff ware sequence (late Sacaton – Soho/Civano) were much more difficult to find because buff ware production declined substantially in the Classic period (Abbott 2006; Lack et al. 2012).

Context selection criteria and rationale for selection

Contexts were selected that had the greatest potential of containing cultural material deposited over a short period of time. One of Wallace's (2001) guidelines for selecting contexts used in his seriation was to focus on high density trash deposits, such as pits and pit structures that were sealed after deposition. Both Heidke (1995:278) and Wallace et al. (1992:9-11) reported that such deposits were associated with large average sherd sizes and high refit rates, both attributes being indicative of rapid deposition episodes. A similar pattern was identified at the lower Santan Site (Lack in prep). For this reason, sealed pits and pit structures were the preferred contexts utilized in this study. Middens were avoided because of their tendency to remain exposed to deposition over long periods of time. Burials were not considered for this study because they were more likely to contain heirloom vessels from much earlier time periods.

The rigorous criteria are necessary to track the process of innovation over short periods of time. First, contexts needed to be unmixed and tightly dated. It was essential to use contexts that did not exhibit significant evidence of what Wallace called "skip time segment mixing" (2004:62). This phrase refers to sherds that dated to non-temporally adjacent time segments. An example of skip time segment mixing would be a particular context that contained significant numbers of sherds dating to the late Gila Butte time segment along with significant numbers of sherds dating to the early Sacaton time segment. Because the late Gila Butte and early Sacaton time segments are not adjacent in time to one another (they are separated by the Santa Cruz time segment), this context would be considered mixed, and unavailable for selection. In this study, then, only contexts that contained sherds assigned to a single time segment (e.g., late Sacaton) or adjacent time segments (e.g., late Sacaton and Soho) were included in the analysis. Inevitably, many contexts contained a small percentage of sherds mixed in from non-adjacent contexts. In such cases, Wallace's (2001) criteria of less than7 percent skip time segment mixing was employed. Using these criteria, all sherds within each context could be treated as coeval.

Chapter 7:

BUFF WARE PRODUCTION

In order to measure the four variables that I am using to describe the innovation process, it is first necessary to determine the number and locations of buff ware production areas in operation for each temporal period. Once this information is obtained, it is possible to identify both the earliest appearances of stylistic innovations and their pattern and timing of adoption by other production areas.

In this chapter, I begin with a review of the literature on buff ware production, describing first the direct evidence for production followed by the indirect evidence. I then develop the methods used in this analysis to determine buff ware production through temper grouping. The results of the analysis are then presented for all temporal intervals under consideration, in which the relative percentages of buff ware associated with different production groups are compared. Finally, these results are evaluated in light of the current models of Hohokam social, economic, political, and ideological change.

Evidence of Buff Ware Production

Despite the vast amount of buff ware pottery produced and consumed by the Hohokam of the Phoenix Basin over the course of several centuries, very little was known about the organization of Hohokam Red-on-buff production prior to the last decade. Although the overall volume of buff ware production was known to be high, and a few production locations had been identified, the available information was very general. More recently, researchers have developed a much more detailed understanding of buff ware production, making it possible to address issues such as the number of potting communities, interaction among potters, technological and design variation across space, networks of exchange, etc. The progress in buff ware sourcing is largely the result of a shift from reliance primarily upon direct archaeological evidence obtained through excavations to indirect evidence obtained through compositional analyses.

Direct evidence

The early investigations of Hohokam buff ware production relied chiefly upon *direct* archaeological evidence, in which excavations had identified specific pottery production locations. Surprisingly little direct evidence of any type of pottery production (plain, red, or buff) has been identified in the Phoenix Basin. Out of several thousand known prehistoric sites in the Basin, Woodson (2011:128) identifies only seven as containing "unambiguous, direct evidence for on-site pottery production". Of these seven, only two, Snaketown and the Maricopa Road Site, are known to have been used in part for buff ware manufacture (Figure 7.1).

All of the direct evidence for buff ware production has come from the middle Gila River area. The best example comes from the identification of formal production areas at and near the Preclassic period site of Snaketown, located on the north side of the middle Gila River. Excavations at Snaketown itself revealed a possible buff ware workshop (Haury 1976:194-197; Figure 12:2). It measured approximately 15 x 9 meters and was bounded by six houses, five of which were likely occupied contemporaneously during the Sacaton phase. These five houses were all outward facing, presumably to prevent excessive exposure to the smoke from pottery firing episodes. This workshop included five clay-mixing basins along with seven pottery-firing pits with associated ash and re-fired sherds, suggestive of rudimentary kilns. Haury (1976:197) doubts that all of these pits were in use at the same time. An abundance of pottery-making tools (e.g., anvils)

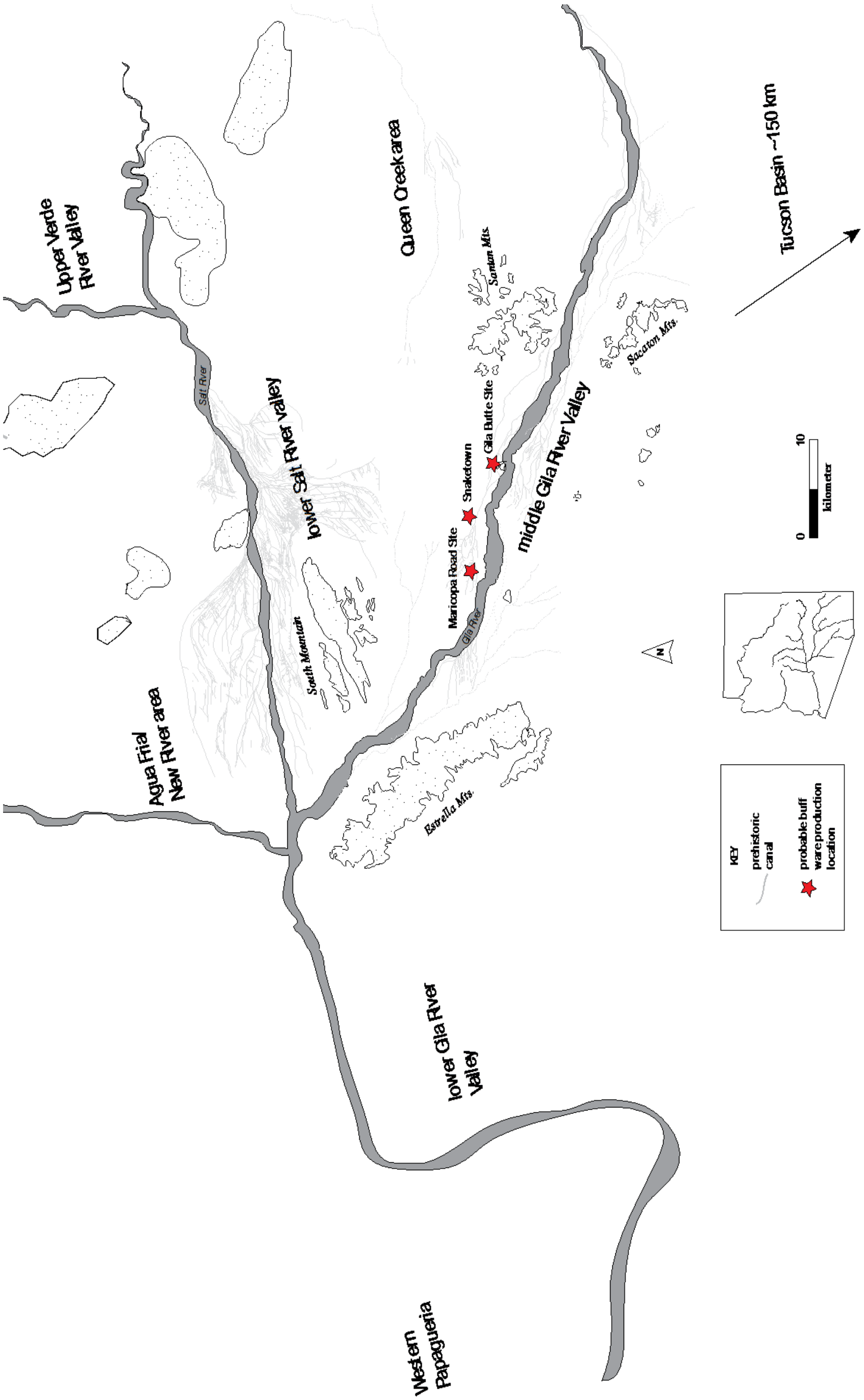


Figure 7.1. Sites and areas associated with probable buff ware production locations.

were found in the same vicinity as these pottery-manufacturing features, along with pigments, and raw lumps of clay (Seymour and Schiffer 1987). A portion of this raw clay has been shown to fire to a buff color, suggesting that at least some of the pottery produced there was buff ware (Abbott and Love 2001).

The only other residential site exhibiting unequivocal, direct evidence of buff ware manufacture is the Maricopa Road Site, located on the Gila River approximately 8 km west of Snaketown (Lascaux and Ravesloot 1993). As at Snaketown, a possible Sacaton phase buff ware production workshop was discovered at the site, as was evident by three clay-mixing basins with associated potters tools, hematite, and raw mica schist most likely used as tempering material. A possible firing area was also discovered adjacent to the manufacturing area. Unfortunately, excavations were limited to a smaller section of what may have been a larger pottery making area.

Some researchers have also argued for direct evidence of buff ware production at the Gila Butte Site based on the extensive prehispanic mica schist mines dug into the side of Gila Butte (Haury 1976:192; Motsinger 1993; Rafferty 1982a, 1982b; Walsh-Anduze 1993). It is estimated that thousands of tons of schist would have been extracted from these mines. If these mines had been used exclusively for the acquisition of mica schist for buff ware tempering material, it would suggest a highly concentrated and specialized operation. One argument in support of this interpretation is the identification of a prehistoric trail connecting the Gila Butte mines to the site of Snaketown. This connection led Motsinger (1993) to suggest that the Gila Butte Site and Snaketown once controlled the entire buff ware industry.

Abbott (2001b:127), however, has cautioned against employing the Gila Butte mines as direct evidence for specialized, exclusive control, of buff ware manufacture, for several reasons. First, numerous sources of coarse-grained mica schist existed in the Gila River Valley and Queen Creek areas, and any of these would have been a potential source of suitable coarse-grained mica schist for buff ware temper. Second, even if the mines were solely utilized for the purpose of obtaining pottery tempering material, the majority of that schist need not have been used for buff ware manufacture. It is known that potters along the middle Gila River were also major producers of plain ware pottery that was tempered with the same coarse-grained mica schist as the buff wares (Abbott 2009; Abbott, Watts, and Lack 2007). In addition, , even a casual observation reveals that middle Gila potters producing Sacaton Phase pottery tempered plain ware with a much greater quantity of coarse-grained mica schist than they did their buff ware. It is, therefore, likely that much, if not most, of the schist excavated out of the Gila Butte mines was utilized in plain ware, rather than buff ware, manufacture (Abbott 2000b:582).

In addition, it is very difficult, if not impossible, to determine the total length of time these mines were in use, let alone how much was mined during a particular phase. It is perhaps better to state that Gila Butte was likely one source, and perhaps a major source, of tempering material for buff ware pottery for an unknown period of time.

Based on this direct evidence for buff ware production, Woodson (2011:143) drew several important conclusions. First, he inferred that during the Sedentary period, most buff wares were manufactured at closely spaced villages on the north side of the middle Gila River. Second, it is clear that at some sites during this period, mass production of pottery, likely including buff wares, occurred. This mass production, he argues, supports the idea of community specialization of buff wares developed to meet the high demand for buff wares across the Phoenix Basin (2011:143; see also Abbott 2000, 2009; Doyel 1980). Much of this production appears to have occurred within or adjacent to residential areas, rather than away from the settlements. He attributes this pattern to the concern for specialists to be near the raw materials, resources, and production areas.

While the data garnered from direct archaeological evidence of buff ware production are undoubtedly significant, barring the discovery and documentation of more production features from different time periods and locations, little more can be said concerning the organization of production and exchange based on direct evidence alone. For this reason, archaeologists have turned toward the indirect evidence.

Indirect evidence

Various lines of *indirect* evidence have likewise been used to make inferences concerning the organization of buff ware production, specifically, to infer production at certain locations, or by particular potting communities of unknown geographic location. One line of evidence is a simple argument from abundance; that is, unusually high percentages of buff ware sherds at certain sites are indicative of local production. Typically, buff ware percentages in Sacaton Phase contexts at sites in the lower Salt and middle Gila River valleys hovered around 20 percent (Abbott, Watts, and Lack 2007; Gregory 1988). In contrast, at the buff ware producing villages of Snaketown (Haury 1937:Fig. 107), the Maricopa Road Site (Lascaux and Ravesloot 1993), and (possibly) the Gila Butte Site (Rafferty 1982a:211), buff ware percentages ranged from 40-60 percent. Most recently, an unusually high percentage (54%) of buff ware was reported for site AZ AA:1:124 (ASM), a large, sprawling village dating to the Sacaton phase located south of the Sacaton Mountains (Lack and Watkins 2009).

More promising has been the indirect evidence for buff ware manufacture from compositional analyses of the sherds. The basis for these studies comes from geological mapping and sampling of raw materials from much of the Phoenix Basin (Miksa 2001; Miksa et al. 2004; Schaller 1994). These studies have demonstrated that the Phoenix Basin contains a high diversity of rock and sand types that are mineralogically distinct. To date, 15 zones of different sand compositions, called petrofacies, have been distinguished in the middle Gila River and Queen Creek areas (Miksa 2001; Miksa et al. 2004 – see Methods below). Nine other petrofacies have been distinguished for the lower Salt River valley (Miksa 1995; Miksa et al. 2004; Schaller 1994). These raw materials have been compared to the clay, schist, and sand components observed in Hohokam pottery to link individual vessels to production areas on the landscape. The extreme geologic diversity of the Phoenix Basin makes this method highly effective, as has been demonstrated for plain and red ware production in the lower Salt River valley (Abbott 1993, 1994, 1995, 2000a, 2006, 2009; Abbott and Walsh-Anduze 1995).

The sourcing of Hohokam buff ware ceramics has lagged behind that of plain wares in large part because all buff wares were at least partially tempered with coarse-grained mica schist, a material that was naturally abundant at several different locations within the middle Gila River Valley. At the gross level, the mica schist indicates production somewhere in the middle Gila or Queen Creek areas. This in itself is an important conclusion because it indicates a concentrated area of manufacture for a product that was distributed in large quantities to the rest of the Phoenix Basin and beyond. On the other hand, because it is not possible to distinguish between the schist sources within the larger production area once the schist has been crushed and added as temper to a vessel (Miksa 2001), we cannot determine the number of production locations or gain detailed insights into the organization of production.

Two recent analytical techniques, however, are being employed to remedy this situation. The first concentrates on those buff ware sherds that contain a sand fraction in addition to the crushed mica schist. The sand contained in these sherds can often be sourced to a particular sand petrofacies, as described in the methodology section below (Miksa 2001; Miksa et al. 2004). Petrographic analysis has been used to confirm petrofacies assignments, which subsequently allowed researchers to begin to identify petrofacies with the use of a low-powered microscope (Abbott, Watts, and Lack 2007; Lack and Watkins 2009; Lack et al. 2006a and b; Lack et al. 2010; Lack et al in press).

The second technique focuses on the chemistry of the clay and/or schist particles of the buff ware vessels. Abbott (2001a) was able to identify at least three probable buff ware production sources by analyzing the clay chemistry with an electron microprobe, though these sources could not all be confidently placed geographically. Spatial locations have been identified, however, for at least two production sources along the middle Gila River through the use of chemical assays of the mica crystals in the schist temper fragments generated from Laser Ablation ICP-MS (Darling et al. 2007; see also Cogswell et al. 2005). Local production has also been identified through chemical analyses of clays in the lower Gila River area (Abbott 2000b; Beck and Neff 2007).

Both mineralogical and chemical techniques have confirmed that a large quantity of the buff ware pottery consumed in the lower Salt River valley was produced by potters situated along the middle Gila River. At least some was also consumed in outlying areas, such as the upland zone north of the lower Salt River valley and in the Western Papaguería (Abbott 2000b:614-615).

It has also become clear, however, that a significant amount of buff ware was produced outside of the middle Gila area. Local production of buff wares has been confirmed for the Queen Creek area (Lack et al. 2010) and the lower Gila River area (Abbott 2000b), and suggested for other areas, such as the upper Verde River valley and the Tucson Basin (Abbott 2000b:614). In addition, a significant number of brown-paste variants of buff ware vessels were produced in the lower Salt River Valley, likely for local consumption (Abbott 1994b). These brown-paste variants were essentially equivalent to red-on-buff pottery in their stylistic attributes, differing only in the clay and temper composition and surface color. While they were not produced in large volumes in all time periods, they represent a significant proportion of decorated vessels during the Gila Butte phase at settlements in the lower Salt River Valley (Abbott and Gregory 1988).

Communities of Practice

Because the acquisition and addition of temper to the clay would have been a regular, important, and intentional part of the fabrication process, I can infer that the buff ware potters who tempered their vessels with certain, distinctive material may have belonged to a distinct community of practice (see discussion in Chapter 2). If so, I expect other technological attributes follow the same pattern. Several recent studies have demonstrated that significant technological differences did exist among the temper groups utilized in this study (Kelly n.d.; Lack et al. 2010; Lack n.d.; Watts et al. 2012).

These studies indicate, therefore, that temper groups are a valid indicator of distinct communities of practice. For this reason, each temper group is treated as a separate potting group.

The methodology developed by geologists and archaeologists for identifying these potting groups representing distinct communities of practice is presented in the next section. I then describe the compositional characteristics of each identified temper group. As the basic units of comparison over time, these groups are the foundation of the study of stylistic innovation that is presented in Chapters 8 and 9.

Identifying Potting Groups: Methodology

This study relies on the indirect evidence of buff ware production gained primarily from analyses of buff ware sherds containing a sand fraction in their tempering material. The techniques used in this study were developed by archaeologists and geologists working closely together to sample, describe, and map the sands of the Phoenix Basin (Heidke and Miksa 2000; Miksa and Heidke 2001; Miksa et al. 2004; Lombard 1987). In order for this venture to be useful to ceramicists, these researchers carefully outlined their study according to five goals (Miksa et al. 2004:9-13). First, they determined the underlying geology and clearly defined the "genetic relationships between similar but geographically distinct locations" (Miksa et al. 2004:9). This initial work was conducted in the lower Salt and middle Gila River Valleys first by Schaller (Schaller 1994) in conjunction with the Pueblo Grande archaeological project (Abbott and Schaller 1992, 1994). Miksa and colleagues (1995a, 1995b, 2001; Miksa et al. 2004) have since significantly expanded on this work.

The second goal of these researchers was to sample sands to determine the geographical extent of each petrofacies. They collected 87 sand samples from washes in the lower Salt River valley and 236 in the middle Gila River Valley to provide a representative cross-section of the entire area used by Hohokam potters.

Third, they described the sands quantitatively and qualitatively to facilitate direct comparison with tempering materials in the ceramics. Of the 87 samples collected from the lower Salt River Valley, 80 were thin-sectioned and petrographically point counted. Of the 236 samples collected from the middle Gila River Valley, 180 were thin-sectioned and petrographically analyzed (Miksa et al. 2004:13, 16). Point counting was done using a modified Gazzi-Dickinson technique (Miksa and Heidke 2001; Miksa et al. 2004:16) In this technique, sand-size minerals are counted according to their individual grain type, irrespective of whether or not they occur within a larger rock fragment. The advantage of this technique is that it enables the petrographer to compare sands from the same source regardless of how much variability exists in the individual components due to the distance traveled from its bedrock source (Miksa et al. 2004:16).

Considerable compositional variation was found across the lower Salt and middle Gila River Valleys, ranging from lithic-volcanic (abundant rhyolitic, felsic, and basaltic grains) to lithic-metamorphic (schist-abundant) to mineralic (dominated by quartz and feldspar crystals along and/or white and/or pink granite). Accessory minerals were also identified in most samples.

The fourth goal of these researchers was to analyze each sample quantitatively in order to place them in a sophisticated series of statistical analyses in order to evaluate and improve the petrofacies model previously developed. First, they placed the samples in a correspondence analysis to assess the relationship between the petrofacies and its composition (Heidke and Miksa 2000; Miksa et al. 2004:20). They followed this analysis with a discriminant analysis model that allowed the researchers to compare predicted petrofacies membership with actual petrofacies membership. Using this model, predictions were correct 85.5 percent of the time; higher than any previous models (Miksa and Castro-Reino 2001; Miksa et al. 2004:25). Through this procedure, nine petrofacies have been distinguished in the lower Salt River Valley and 15 petrofacies in the Gila River Basin (Figure 7.2) (Miksa et al. 2004:Table 2.7).

The last goal of the researchers was to summarize the quantitative and qualitative data for each petrofacies so that ceramicists could directly compare the temper in pottery with the previously analyzed sands. To facilitate this process, they developed a key that included descriptions of the composition of each sand petrofacies along with comments on the visual appearance of the sand under a binocular stereomicroscope (Miksa et al. 2004:31). They then developed a flow chart to serve as a step-by-step sand (or sand temper) identification guide (Miksa et al. 2004:Figure 2.12a).

The present study relied on the key and flowchart developed in those studies to inexpensively characterize and identify the petrofacies of production for most buff ware sherds using low-powered microscopy. A reference collection of the 180 point-counted sand samples was also used to differentiate sands from the different sections of the middle Gila and Queen Creek areas. In addition, each petrofacies had a corresponding small grain box that contained individually identified particles of rock and mineral types along with other comparative samples.[1]

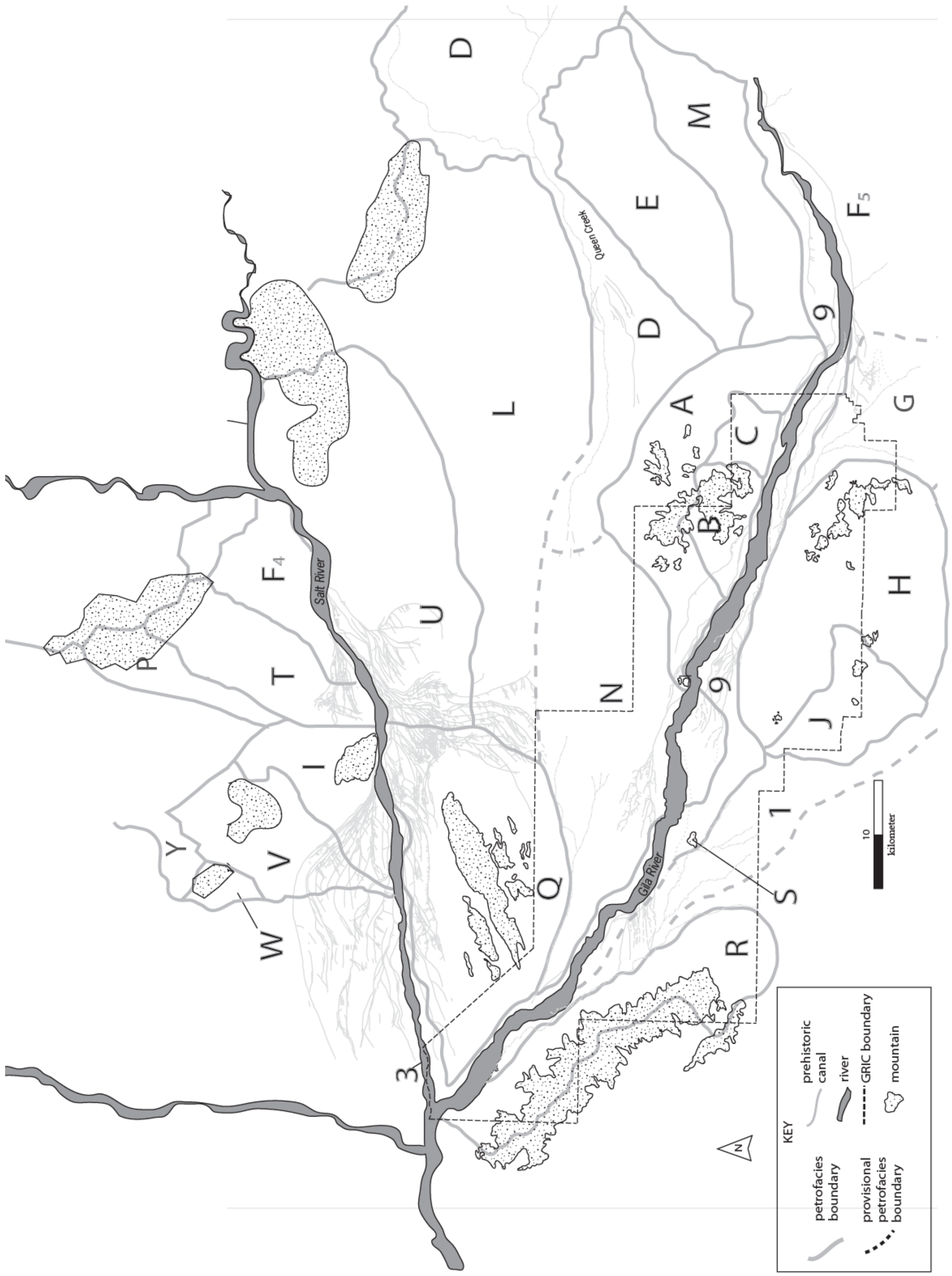


Figure 7.2. Petrofacies in the lower Salt and middle Gila River Valleys (adapted from Howard 1991; Kelly n.d.; Miksa et al. 2004).

A binocular microscope was used to view the fresh cross-section of each sherd, at 10-30x magnification (Figure 7.3). The flowchart process could usually be streamlined by immediately categorizing the sand temper as either mineralic or lithic-volcanic. From there, the presence/absence of certain minerals and/or rock types was sometimes diagnostic of a petrofacies or subset of petrofacies; but more often, the relative proportions of minerals and/or rock types were the key to making a petrofacies determination.

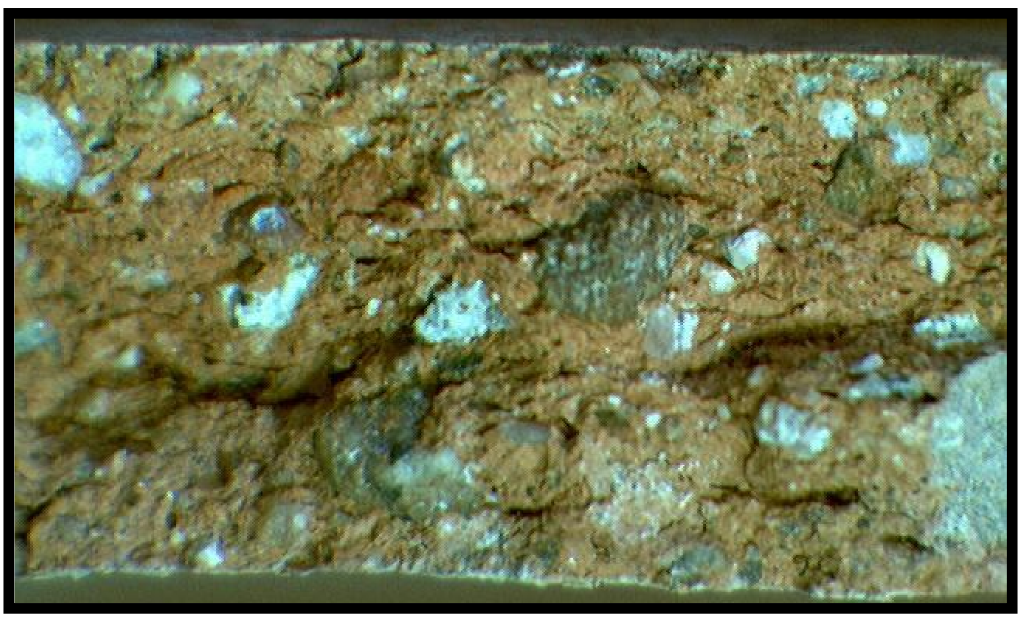


Figure 7.3. Cross-section of a buff ware sherd at 10x.

Temper Groups

Several different temper types were identified among the buff wares. All buff wares were tempered either partially or completely with coarse-grained mica schist. Often, sand was added along with the mica schist. As Miksa, Castro-Reino, and Lavayen (2004:39-44) have noted, however, the correspondence between a well-described and identifiable sand sample and the presence of that sand in a sherd is not always obvious. The complications are especially prevalent in buff wares due to the mixing of tempers (added schist and caliche) along with the usual partial concealment of minerals within the clay paste. For this reason, many sherds could only be generically identified as belonging to a group of mineralogically similar, and geographically adjacent, petrofacies. This grouping of petrofacies also led to an increase in the sample sizes of comparative groups. In addition, many buff ware sherds were tempered solely with coarse-grained mica schist and did not contain a sand fraction in the temper component.

Petrofacies N and D were the only individual petrofacies to be treated as their own potting groups, labeled the Snaketown and Queen Creek groups, respectively. Petrofacies A, B, and C were grouped together to create a general Santan Mountains group. Petrofacies H, G, and F5 were grouped together to form a general southeast middle Gila group. An even more generic category eastern Middle Gila was used for all sherds that contained a sand fraction that contained sands from either Petrofacies A, B, C, F5, G, or H. All vessels produced in the lower Salt River Valley were treated as one group, regardless of the specific petrofacies in which they were produced. The last group comprised sherds containing temper from the lower Gila River area, west of the confluence between the Salt and Gila Rivers. All sherds tempered solely with mica schist were grouped together as schist-only sherds. Detailed descriptions of each temper group follow:

Snaketown Group

This temper used by this group was characterized by abundant free quartz, plagioclase crystals, and felsic volcanic rocks (Miksa et al. 2004:Table 2.7). In addition, metamorphic rocks can comprise 10-20%, with rarer amounts (<5%) of opaques, micas, hornblende, pyroxene, and epidote. Typically, grains are small and well-rounded, eventually grading into larger, subangular grains of similar mineralogy characteristic of the neighboring petrofacies D. Petrofacies N is located on the north side of the middle Gila River, and includes two of the sites from which we have the most compelling evidence of in situ buff ware production: Snaketown (Haury 1976:194-197; Seymour and Schiffer 1987] and the Maricopa Road Site (Lascaux and Ravesloot 1993).

Santan Mountains Group

This more generic category combined sands from Petrofacies A and C, both of which border the Santan Mountains. Petrofacies B is also located in the Santan Mountains area, but sand from this petrofacies is easily distinguished on the basis of common volcanics. Petrofacies A and C are both dominated by granite, with the granite from Petrofacies A being almost entirely white granite while the sand from Petrofacies C contains higher proportions of pink granite (Miksa et al. 2004:Table 2.7). Biotite, epidote, and chlorite were also present in each petrofacies. In ideal circumstances, these petrofacies would be readily distinguishable from one another on the basis of a significant percentage of schist (>10%) that comprises Petrofacies A. Unfortunately, it was often difficult to make a distinction between schist that was a component of the sand from Petrofacies A and the crushed schist that was added separately. The Gila Butte site, from which some have argued for buff ware production (Haury 1976:192; Motsinger 1993; Rafferty 1982a, 1982b), is situated on the border of Petrofacies A and N.

Southeast middle Gila Group

This category combined sands from the mineralic Petrofacies F5, G, and H. These petrofacies are adjacent to one another, located south and southeast of the Santan Mountains temper group on the south side of the middle Gila River. Petrofacies F5 was characterized by abundant light-colored granite, which could be white, gray, yellow, and pink. Schist, biotite, gneiss, and phyllite also occurred, though in small percentages (Miksa et al. 2004:Table 2.7). Mafic minerals were rare. Petrofacies G was dominated by quartz and feldspar along with rare micas such as chlorite, biotite, and muscovite. This petrofacies was also often characterized by the presence of a variety of volcanic grains. Foliated metamorphics, such as schist, phyllite, and gneiss were generally absent. Petrofacies H was characterized by abundant amounts of white and pink granite (often with attached epidote), and a variety of rock fragments and minerals, such as biotite, chlorite, magnetite, and hornblende.

Eastern Middle Gila Group

This category served as a generic category for those sherds tempered with mineralic sands from either the Santan Mountains (Petrofacies A or C) north of the Gila River, or from two mineralic petrofacies directly across the river (Petrofacies F5 or H). All are dominated by granite (mostly white), and only distinguished from one another by the relative proportions of yellow granite, pink granite, mafic minerals, and various metamorphics such as muscovite and biotite. This category was used when there was not enough visible sand to make distinctions among these petrofacies.

Queen Creek Group

Sand from Petrofacies D (Queen Creek vicinity) has been described (Miksa et al. 2004:Table 2.7) as having a lithic-volcanic composition, with common vitric and felsic volcanics, as well as grains of rhyolite. Often, a yellowish-brownish diabase is observed. A smaller percentage (<10%) of lithics are usually present, including basalt, dacite, obsidian, and maroon colored volcanics. An altered granite is not uncommon. Another distinguishing trait of this petrofacies is the large grain size, especially compared to that of the mineralogically similar Petrofacies N.

Lower Salt River Valley Group

This generic group included sand from any source in the lower Salt River Valley. They were combined in order to increase the sample size. The most common sand was South Mountain granodiorite. The distinguishing attribute of this rock type was its mylonitic texture resulting from the ductile deformation and partial recrystallization of the quartz crystals in combination with the fracturing of some feldspar crystals during metamorphosis (Reynolds 1985; Schaller 1994:34). Under low-powered magnification, this process can be recognized by the co-occurrence of snow-white feldspar and grayish translucent quartz on individual fragments. Hornblende and biotite crystals can occur in minor amounts. The granodiorite often has a jagged appearance due to its tendency to fracture angularly along short, intersecting planes.

Lower Gila Group

This temper category consisted of a coarse-grained mica schist fraction combined with sand characteristic of the lower Gila River valley. Due to the lack of petrographic work on sands from the lower Gila River valley, the area has not been divided into separate petrofacies. Abbott (2000a:597) includes a list of diagnostic qualities of lower Gila River tempering materials: sands dominated by weathered or altered felsic and mafic volcanics, typically having a glassy appearance; crushed mica schist that was less foliated, more fine-grained, and richer in biotite and chlorite; little to no added caliche; and the possibility of grog or sherd temper. The sherds examined in this study generally conformed to this description, but not uniformly. While the sand fraction was essentially identical, the schist texture and mineralogy, along with the caliche content, were not consistent enough to prove reliable indicators of lower Gila buff ware. Sherd temper was found to be rare, but present.

schist- only Group

Many buff ware sherds were tempered solely with coarse-grained mica schist. This schist, known as Pinal schist, is located in a wide variety of areas, and is especially prominent in the middle and lower Gila River valleys, as well as the Queen Creek area (Miksa 2001b). This schist was characterized by large, individual platelets of muscovite mica with a pearly luster. This luster gave sherds a sparkling, glitter-like appearance when held in the sunlight. Large fragments of the schist were usually platy, banded, and composed of quartz, feldspar, and muscovite. Irregular clumps of translucent quartz crystals were common, as well as black spots of tourmaline or magnetite in the mica crystals.

The schist-only group was one of the most prominent groups identified in this study. Because these sherds did not contain a sand fraction, however, they could not be sourced to a particular petrofacies. A serious consideration, therefore, had to be made as whether to include this group in the analysis or not. In the final analysis, the schist-only group was included in the study because it likely represented a distinctive community of practice, as demonstrated below.

The Viability of Including the schist-only Group

Over the last two decades, analysts have been frustrated in their attempts at understanding buff ware production, in part, by the large quantities of sherds tempered solely with coarse-grained mica schist. New research, however, has thrown enough light on this issue to warrant two general conclusions: 1) the schist-only group likely represents a legitimate community of practice, justifying its inclusion as a separate potting group in this study, and 2) the production locale of this community of practice was most likely in the vicinity of Gila Butte.

Various lines of evidence led me to treat sherds tempered only with schist as being manufactured by a distinct community of practice. The studies described below have demonstrated that potters who tempered their buff ware vessels solely with coarse grained mica schist also shared several other technological attributes that set them apart from other potting communities, indicating regular communication among their manufacturers (Huntley 2006:121; Wenger 1998:45; Stark 1999, 2006). Even if the geographic location of this community of practice cannot be known with precision at this point, it can be usefully included in this study as a major buff ware manufacturing community whose members were united in a shared enterprise and a common method of production suggesting regular communication.

Two lines of enquiry support these conclusions. The first was technological analyses of buff ware vessels, in which various technological variables were measured and compared among temper groups to determine how similar or different the schist-only group was to other groups. The second line of enquiry compared chemical assays of individual mica platelets in the sherds. These assays were compared with assays of raw schist samples from the geographic landscape (Kelly 2013).

Two recent studies have attempted to discern communities of practice based on technological attributes rather than on geology. The first compared those buff ware sherds tempered with Snaketown petrofacies sand, those tempered with non-Snaketown petrofacies sand, and those tempered with schist-only from the ceramic assemblage of Pueblo del Rio, in the lower Salt River Valley (Lack et al. 2010). Only 11 percent of the sherds tempered with schist-only had high porosity, compared to 63 percent of sherds from the Snaketown petrofacies. Potters from the schist-only group also tended to produce vessels with slightly darker surfaces than those from the Snaketown group, as 33 percent were found to be light to gray brown compared to nine percent for the Snaketown group.

Although no statistically significant differences were found between the schist-only group and the non-Snaketown sand groups, they were dissimilar in a number of ways. The amount of caliche added to the clay, for example, was much lower in the schist-only group (67% low) compared to the non-Snaketown group (46% low). Surface color also tended to be lighter on schist-only tempered vessels, with 67 percent classified as yellow white/tan compared to 54 percent for the non-Snaketown sand group.

In the second study, buff ware sherds were analyzed from the site of La Plaza, on the south side of the lower Salt River Valley (Watts et al. 2012). The focus of that study was to compare only the Snaketown group with the schist-only group. The results again revealed differences between these two groups. For example, compared to sherds tempered with Snaketown petrofacies sand, 31 percent of schist-only sherds were characterized by an orange pink color, compared to only six percent of sherds from the Snaketown group; a statistically significant difference (Watts et al. 2012:Table 8-13). Another statistically significant difference was in the size of mica platelets[2], as the average size of mica platelets for schist-only sherds was 8.1 mm, while the average size for sherds from the Snaketown groups was 5.8 mm (Watts et al. 2012:Table 8-12). Finally, the percentage of sherds tempered that classified as having high caliche content was greater among schist-only sherds (45%) compared to those tempered with Snaketown area sand (18%).

In another recent study, Kelly (2013) found that schist-only tempered sherds were associated with a much higher proportion of small jars than other temper groups in the Gila Butte and Santa Cruz phases. For example, in the Gila Butte phase, the average bowl to jar ratio for schist-only tempered sherds was 1.0, while the ratio for Petrofacies N and A/B/C/H was 2.5, and Petrofacies F5/G was near 2.0. In addition, aperture diameters varied significantly in the Gila Butte phase between schist-only (avg. 4 cm) tempered sherds and those from other temper groups, such as Petrofacies N and A/B/C/H (avg. +14 cm). Similar differences were found through the early Sacaton time segment.

These technological analyses give reasons to believe that the schist-only group represents a legitimate community of practice, separate from other buff ware potting communities unified by a shared technological style. Regardless of geographic location, the vessels produced by this potting community may be usefully compared with those from all other potting communities identified in this analysis. Fortunately, progress is being made in tracing the geographic source of this group through chemical analyses.

Kelly (2013) has usefully summarized the history of chemical research on mica schist in buff ware sherds. She notes that, although Pinal Schist occurs throughout the Gila River Valley, its chemical composition varies considerably throughout the region. For example, both Miksa (2001b) and Walsh-Anduze (1993) found chemical differences among schist from Gila Butte, Pima Butte, and Sacaton Butte. These studies all based their conclusions on the use of Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS).

Although these studies were successful in differentiating raw mica schist sources, the use of a bulk chemical analysis (ICP-MS) created problems when applying it to buff ware sherds. Although ICP-MS allowed the detection of essential trace elements, it included the composition of several mineral types within the clay paste of the sherds, rather than solely measuring the composition of the mica schist.

Kelly's own research, therefore, sampled schist from red-on-buff sherds using Time of Flight-Laser Ablation-Inductively Coupled Plasma-Mass Spectroscopy (TOF-LA-ICP-MS). This method allows for the targeting of specific points on a sample to obtain a chemical assay, so that minerals within the clay paste can be avoided. Because the schist fragments are heterogeneous, the assays were focused on the mica platelets. This method has proven to be the most promising avenue for sourcing the schist and clay in buff ware sherds, as mica platelets in buff ware sherds have been matched to samples from Pima Butte, Gila Butte, Rattlesnake Hill, and Enid (Cogswell et al. 2005; Darling et al. 2007; Neff and Dudgeon 2006).

Kelly's results show that the vast majority of red-on-buff sherds tempered solely with mica schist were manufactured in Petrofacies A, H, or N, with the majority (59%) of the sherds matching most closely with the raw samples from the Gila Butte area, on the border of petrofacies A and N. The next most common source (29%) for the schist was from Rattlesnake Hill, located in the northern portion of Petrofacies A. The remaining cases were matched with Pima Butte and Enid, another 15 and 31 km to the west, respectively.

This evidence is the most compelling to date for placing the schist-only temper group in a specific geographic location. Unfortunately, more evidence of this type is needed before making a definitive statement. For the rest of this study, therefore, sherds tempered with schist-only are regarded as belonging to a separate potting group, and as generally located near the Santan Mountains and Snaketown areas.

Summary of Temper Groups

A total of eight different temper groups were recognized in this study, some representing single sand petrofacies, and others representing combinations of petrofacies. Each of these temper groups, including the schist-only group, is treated as a separate potting group from this point forward. In the following section I present the results of the provenance analysis. These results provide a context of production for the innovation analysis in Chapters 8 and 9.

Buff ware production results

A total of 3,584 buff ware sherds from tightly dated contexts at 15 different sites were sourced to a potting group using a low-powered microscope (Table 7.1). The results were grouped by time segment and recovery context (Table 7.2). No clear trend emerged in the number of potting groups producing buff ware from the early Gila Butte through the late Sacaton time segments. The number of potting groups identified for each time segment ranged from three to eight groups, with an average of between six and seven groups. The highest number of identified potting groups for any time segment occurred during the Santa Cruz segment (N = 8), when all potting groups identified during the analysis were found in either high or low proportions. The most conspicuously absent potting group was the lower Gila group, occurring in only three time segments. The limited appearance of this potting group was not surprising given the much larger distance between this group and any of the others. These data indicate that at least six to eight potting communities were supplying buff ware (and the brown-paste variant) vessels to consumers throughout the Phoenix Basin for perhaps 350 years (A.D. 750-1100/1125).

The decrease that occurred in the number of potting groups in the transition from the late Sacaton to the Soho time segments (from an average of 6.6 groups to 4.7 groups) was somewhat unexpected given the changes that have been documented in the organization of plain ware production during this same temporal interval (Abbott2000, 2009). In those studies, it was found that prior to the late Sacaton time segment, plain ware was produced in a very small number of locations from which it was exported to the rest of the inhabitants of the lower Salt River Valley. During the Classic period (Soho and

Table 7.1. Potting groups by site and time segment.

Site	Time Segment	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
La Ciudad	early Gila Butte	8	5	0	3	0	7	8	13	44
		18.2%	11.4%	0.0%	6.8%	0.0%	15.9%	18.2%	29.5%	
La Ciudad	late Gila Butte	1	8	3	10	0	35	13	178	248
		0.4%	3.2%	1.2%	4.0%	0.0%	14.1%	5.2%	71.8%	
La Ciudad	early Gila Butte-late Gila Butte	0	0	0	1	0	3	3	21	28
		0.0%	0.0%	0.0%	3.6%	0.0%	10.7%	10.7%	75.0%	
La Ciudad	Santa Cruz	2	0	0	1	1	9	9	32	54
		3.7%	0.0%	0.0%	1.9%	1.9%	16.7%	16.7%	59.3%	
La Ciudad	Total	11	13	3	15	1	54	33	244	374
		2.9%	3.5%	0.8%	4.0%	0.3%	14.4%	8.8%	65.2%	
La Villa	early Gila Butte	15	9	1	4	0	40	11	41	121
		12.4%	7.4%	0.8%	3.3%	0.0%	33.1%	9.1%	33.9%	
La Villa	Gila Butte/Santa Cruz	1	0	0	1	1	0	0	4	7
		14.3%	0.0%	0.0%	14.3%	14.3%	0.0%	0.0%	57.1%	
La Villa	Santa Cruz	2	6	1	0	0	1	22	12	44
		4.5%	13.6%	2.3%	0.0%	0.0%	2.3%	50.0%	27.3%	
La Villa	Total	18	15	2	5	1	41	33	57	172
		10.5%	8.7%	1.2%	2.9%	0.6%	23.8%	19.2%	33.1%	
Los Hornos	early Gila Butte	46	7	4	5	0	7	58	46	173
		26.6%	4.0%	2.3%	2.9%	0.0%	4.0%	33.5%	26.6%	
Los Hornos	Gila Butte/Santa Cruz	10	0	0	2	1	6	16	34	69
		14.5%	0.0%	0.0%	2.9%	1.4%	8.7%	23.2%	49.3%	
Los Hornos	early Sacaton	2	2	1	0	0	1	22	6	34
		5.9%	5.9%	2.9%	0.0%	0.0%	2.9%	64.7%	17.6%	
Los Hornos	middle Sacaton 1-2	20	1	2	2	0	2	39	63	130
		15.4%	0.8%	1.5%	1.5%	0.0%	1.5%	30.0%	48.5%	
Los Hornos	Total	78	10	7	9	1	16	135	149	406
		19.2%	2.5%	1.7%	2.2%	0.2%	3.9%	33.3%	36.7%	
Pueblo del Rio	early Gila Butte/late Gila Butte	0	0	0	1	0	0	2	5	8
		0.0%	0.0%	0.0%	12.5%	0.0%	0.0%	25.0%	62.5%	
Pueblo del Rio	late Gila Butte	0	0	0	1	0	8	9	14	32
		0.0%	0.0%	0.0%	3.1%	0.0%	25.0%	28.1%	43.8%	
Pueblo del Rio	Total	0	0	0	2	0	8	11	19	40
		0.0%	0.0%	0.0%	5.0%	0.0%	20.0%	27.5%	47.5%	
Snaketown	early Gila Butte/late Gila Butte	15	0	1	0	0	1	52	10	79
		19.0%	0.0%	1.3%	0.0%	0.0%	1.3%	65.8%	12.7%	
Snaketown	early Gila Butte-late Gila Butte	53	0	0	1	0	0	50	60	164
		32.3%	0.0%	0.0%	0.6%	0.0%	0.0%	30.5%	36.6%	
Snaketown	Santa Cruz	6	0	0	0	0	0	9	22	37
		16.2%	0.0%	0.0%	0.0%	0.0%	0.0%	24.3%	59.5%	
Snaketown	early Sacaton	4	0	0	0	0	0	10	5	19
		21.1%	0.0%	0.0%	0.0%	0.0%	0.0%	52.6%	26.3%	
Snaketown	middle Sacaton 1	16	2	0	14	0	0	89	62	185
		8.6%	1.1%	0.0%	7.6%	0.0%	0.0%	48.1%	33.5%	
Snaketown	middle Sacaton 1-2	13	0	0	6	0	0	22	24	65
		20.0%	0.0%	0.0%	9.2%	0.0%	0.0%	33.8%	36.9%	
Snaketown	Total	107	2	1	21	0	1	232	183	549
		19.5%	0.4%	0.2%	3.8%	0.0%	0.2%	42.3%	33.3%	
Grewe	late Gila Butte	5	12	0	0	0	0	4	29	50
		10.0%	24.0%	0.0%	0.0%	0.0%	0.0%	8.0%	58.0%	
Grewe	early Sacaton	19	19	1	6	0	0	60	44	149
		12.8%	12.8%	0.7%	4.0%	0.0%	0.0%	40.3%	29.5%	
Grewe	Total	24	31	1	6	0	0	64	73	199
		12.1%	15.6%	0.5%	3.0%	0.0%	0.0%	32.2%	36.7%	
RSA 323	early Gila Butte-late Gila Butte	0	0	0	0	7	10	4	38	59
		0.0%	0.0%	0.0%	0.0%	11.9%	16.9%	6.8%	64.4%	

Table 7.1. Continued

Site	Time Segment	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
El Caserio	Santa Cruz	3	0	0	0	0	0	9	3	15
		20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	60.0%	20.0%	
El Caserio	early Sacaton	6	2	0	0	0	7	47	33	95
		6.3%	2.1%	0.0%	0.0%	0.0%	7.4%	49.5%	34.7%	
El Caserio	Total	9	2	0	0	0	7	56	36	110
		8.2%	1.8%	0.0%	0.0%	0.0%	6.4%	50.9%	32.7%	
La Lomita	Santa Cruz	4	8	1	0	0	0	11	28	52
		7.7%	15.4%	1.9%	0.0%	0.0%	0.0%	21.2%	53.8%	
La Lomita	early Sacaton	6	0	0	0	0	1	41	18	66
		9.1%	0.0%	0.0%	0.0%	0.0%	1.5%	62.1%	27.3%	
La Lomita	middle Sacaton 1-2	6	1	1	0	0	1	34	21	64
		9.4%	1.6%	1.6%	0.0%	0.0%	1.6%	53.1%	32.8%	
La Lomita	Total	16	9	2	0	0	2	86	67	182
		8.8%	4.9%	1.1%	0.0%	0.0%	1.1%	47.3%	36.8%	
Las Colinas	Santa Cruz	7	17	0	0	0	8	12	58	102
		6.9%	16.7%	0.0%	0.0%	0.0%	7.8%	11.8%	56.9%	
Las Colinas	early Sacaton/middle Sacaton 1	2	1	2	3	0	0	2	8	18
		11.1%	5.6%	11.1%	16.7%	0.0%	0.0%	11.1%	44.4%	
Las Colinas	middle Sacaton 1	11	2	1	5	0	0	18	35	72
		15.3%	2.8%	1.4%	6.9%	0.0%	0.0%	25.0%	48.6%	
Las Colinas	middle Sacaton 1-2	2	2	0	0	0	0	2	8	14
		14.3%	14.3%	0.0%	0.0%	0.0%	0.0%	14.3%	57.1%	
Las Colinas	middle Sacaton 2 - late Sacaton	20	5	10	8	0	0	22	52	118
		16.9%	4.2%	8.5%	6.8%	0.0%	0.0%	18.6%	44.1%	
Las Colinas	late Sacaton	8	1	4	3	0	0	19	10	45
		17.8%	2.2%	8.9%	6.7%	0.0%	0.0%	42.2%	22.2%	
Las Colinas	Total	50	28	17	19	0	8	75	171	369
		13.6%	7.6%	4.6%	5.1%	0.0%	2.2%	20.3%	46.3%	
Las Ruinitas	early Sacaton	0	0	0	1	0	0	17	3	21
		0.0%	0.0%	0.0%	4.8%	0.0%	0.0%	81.0%	14.3%	
Las Ruinitas	middle Sacaton 1-2	11	7	1	6	0	0	99	14	138
		8.0%	5.1%	0.7%	4.3%	0.0%	0.0%	71.7%	10.1%	
Las Ruinitas	Total	11	7	1	7	0	0	116	17	159
		6.9%	4.4%	0.6%	4.4%	0.0%	0.0%	73.0%	10.7%	
SW Germann	early Sacaton	0	1	8	2	0	0	31	2	44
		0.0%	2.3%	18.2%	4.5%	0.0%	0.0%	70.5%	4.5%	
SW Germann	Soho	4	3	6	35	0	0	11	26	85
		4.7%	3.5%	7.1%	41.2%	0.0%	0.0%	12.9%	30.6%	
SW Germann	Total	4	4	14	37	0	0	42	28	129
		3.1%	3.1%	10.9%	28.7%	0.0%	0.0%	32.6%	21.7%	
Lower Santan	early Sacaton/middle Sacaton 1	11	0	25	4	0	0	138	78	256
		4.3%	0.0%	9.8%	1.6%	0.0%	0.0%	53.9%	30.5%	
Lower Santan	middle Sacaton 1	7	0	6	1	0	0	30	20	64
		10.9%	0.0%	9.4%	1.6%	0.0%	0.0%	46.9%	31.3%	
Lower Santan	middle Sacaton 1-2	1	0	0	0	0	0	28	11	40
		2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	70.0%	27.5%	
Lower Santan	late Sacaton	5	0	10	3	0	0	28	9	55
		9.1%	0.0%	18.2%	5.5%	0.0%	0.0%	50.9%	16.4%	
Lower Santan	late Sacaton/Soho	16	0	9	4	0	0	43	26	98
		16.3%	0.0%	9.2%	4.1%	0.0%	0.0%	43.9%	26.5%	
Lower Santan	late Sacaton-Civano	0	0	8	0	0	0	15	15	38
		0.0%	0.0%	21.1%	0.0%	0.0%	0.0%	39.5%	39.5%	
Lower Santan	Soho-Civano	3	0	2	1	0	0	7	7	20
		15.0%	0.0%	10.0%	5.0%	0.0%	0.0%	35.0%	35.0%	
Lower Santan	Total	43	0	60	13	0	0	289	166	571
		7.5%	0.0%	10.5%	2.3%	0.0%	0.0%	50.6%	29.1%	

Table 7.l. Continued

Site	Time Segment	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
Palo Verde	early Sacaton/middle Sacaton 1	1	0	3	3	0	1	3	20	32
		3.1%	0.0%	9.4%	9.4%	0.0%	3.1%	9.4%	62.5%	
Palo Verde	middle Sacaton 1	3	1	0	7	0	0	6	28	46
		6.5%	2.2%	0.0%	15.2%	0.0%	0.0%	13.0%	60.9%	
Palo Verde	Total	4	1	3	10	0	1	9	48	78
		5.1%	1.3%	3.8%	12.8%	0.0%	1.3%	11.5%	61.5%	
Los Guanacos	middle Sacaton 1	8	8	2	1	0	0	20	47	87
		9.2%	9.2%	2.3%	1.1%	0.0%	0.0%	23.0%	54.0%	
Pueblo Grande	late Sacaton	4	1	22	0	0	0	8	18	53
		7.5%	1.9%	41.5%	0.0%	0.0%	0.0%	15.1%	34.0%	
Pueblo Grande	late Sacaton/Soho	3	0	4	0	0	0	1	11	19
		15.8%	0.0%	21.1%	0.0%	0.0%	0.0%	5.3%	57.9%	
Pueblo Grande	Soho	2	1	5	7	0	0	0	16	31
		6.5%	3.2%	16.1%	22.6%	0.0%	0.0%	0.0%	51.6%	
Pueblo Grande	Total	9	2	31	7	0	0	9	45	103
		8.7%	1.9%	30.1%	6.8%	0.0%	0.0%	8.7%	43.7%	

Table 7.2. Number of potting groups producing buff ware by time segment.

Time Segment	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snaketown	schist-only	Number of potting groups identified
early Gila Butte	X	X	X	X		X	X	X	7
early Gila Butte/late Gila Butte	X		X	X		X	X	X	6
late Gila Butte	X	X	X	X		X	X	X	7
early Gila Butte - late Gila Butte	X			X	X	X	X	X	6
Gila Butte/Santa Cruz	X			X	X	X	X	X	6
Santa Cruz	X	X	X	X	X	X	X	X	8
early Sacaton	X	X	X	X		X	X	X	7
early Sacaton/middle Sacaton 1	X	X	X	X		X	X	X	7
middle Sacaton 1	X	X	X	X			X	X	6
middle Sacaton 1 - 2	X	X	X	X		X	X	X	7
middle Sacaton 2 - late Sacaton	X	X	X	X			X	X	6
late Sacaton	X	X	X	X			X	X	6
late Sacaton/Soho	X		X	X			X	X	5
late Sacaton - Civano			X				X	X	3
Soho - Civano	X	X	X	X			X	X	6

Civano phases), however, plain ware became much more localized, being produced at many more locations throughout the lower Salt River Valley. The results from this analysis of buff ware, however, appeared to demonstrate the opposite; that is, that fewer production loci were manufacturing buff ware in the Soho and Civano phases.

To better understand this pattern, the percentages of each potting group were examined for each time segment (Table 7.3). The first trend to note is the dominance of the Snaketown and schist-only potting groups for nearly the entire course under observation. Together, these two groups manufactured and distributed at least half of the buff ware sampled in this project. Output dominance was lowest among these two potting groups in the early and late part of the sequence, and highest from the early through middle Sacaton time segments (Figure 7.4).

Other trends to notice include the relatively consistent presence, often in significant amounts, of buff ware manufactured by the Santan Mountains potting group, the early significance and subsequent absence of the lower Salt River Valley potting group, the sudden rise in significance of the Queen Creek group in the late Sacaton time segment, and the dramatic increase in the southeast middle Gila group in the latest segment. These trends are evaluated in the next section.

Overall, the results of the provenance analysis revealed that, from the early Gila-Butte to the Soho-Civano time segments, there were always multiple buff ware potting groups producing significant quantities of pottery. This result is important because it demonstrates that innovation and innovation adoption among multiple groups was possible in each time segment. In the next section, the specific production results are evaluated in light of the three episodes of reorganization described in Chapter 3. This

Table 7.3. Potting group distribution by time segment.

Time Segment	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snaketown	schist-only	Total
early Gila Butte	69	21	5	12	0	54	77	100	338
	20.4%	6.2%	1.5%	3.6%	0.0%	16.0%	22.8%	29.6%	
early - late Gila Butte	68	0	1	3	7	14	112	135	340
	20.0%	0.0%	0.3%	0.9%	2.1%	4.1%	32.9%	39.7%	
late Gila Butte	6	20	3	11	0	43	26	221	330
	1.8%	6.1%	0.9%	3.3%	0.0%	13.0%	7.9%	67.0%	
Gila Butte/Santa Cruz	11	0	0	3	2	6	16	38	76
	14.5%	0.0%	0.0%	3.9%	2.6%	7.9%	21.1%	50.0%	
Santa Cruz	24	31	2	1	1	18	72	155	304
	7.9%	10.2%	0.7%	0.3%	0.3%	5.9%	23.7%	51.0%	
early Sacaton	37	24	10	9	0	9	228	111	428
	8.6%	5.6%	2.3%	2.1%	0.0%	2.1%	53.3%	25.9%	
early/middle Sacaton 1	14	1	30	10	0	1	143	106	305
	4.6%	0.3%	9.8%	3.3%	0.0%	0.3%	46.9%	34.8%	
middle Sacaton 1	46	13	9	29	0	0	163	192	452
	10.2%	2.9%	2.0%	6.4%	0.0%	0.0%	36.1%	42.5%	
middle Sacaton 1-2	53	11	4	14	0	3	224	141	450
	11.8%	2.4%	0.9%	3.1%	0.0%	0.7%	49.8%	31.3%	
middle Sacaton 2 - late Sacaton	20	5	10	8	0	0	22	52	117
	17.1%	4.3%	8.5%	6.8%	0.0%	0.0%	18.8%	44.4%	
late Sacaton	17	2	36	6	0	0	55	37	153
	11.1%	1.3%	23.5%	3.9%	0.0%	0.0%	35.9%	24.2%	
late Sacaton/Soho	19	0	13	4	0	0	44	37	117
	16.2%	0.0%	11.1%	3.4%	0.0%	0.0%	37.6%	31.6%	
late Sacaton - Civano	0	0	8	0	0	0	15	15	38
	0.0%	0.0%	21.1%	0.0%	0.0%	0.0%	39.5%	39.5%	
Soho - Civano	9	4	13	43	0	0	18	49	136
	6.6%	2.9%	9.6%	31.6%	0.0%	0.0%	13.2%	36.0%	
Total	395	134	159	154	34	151	1253	1488	3584
	11.0%	3.7%	4.4%	4.3%	0.9%	4.2%	35.0%	41.5%	

evaluation of the organization of production is critical to understanding the process of innovation because the organization of pottery production was a vital component of the Hohokam socio-economic environment. The manifold changes that accompanied each reorganization episode, therefore, must include changes (or the lack thereof) in the organization of production if the process of stylistic innovation is to be understood.

Discussion

The first episode of reorganization that occurred in the late Gila Butte time segment was characterized primarily as an ideological reorganization (see Chapter 3). There is little

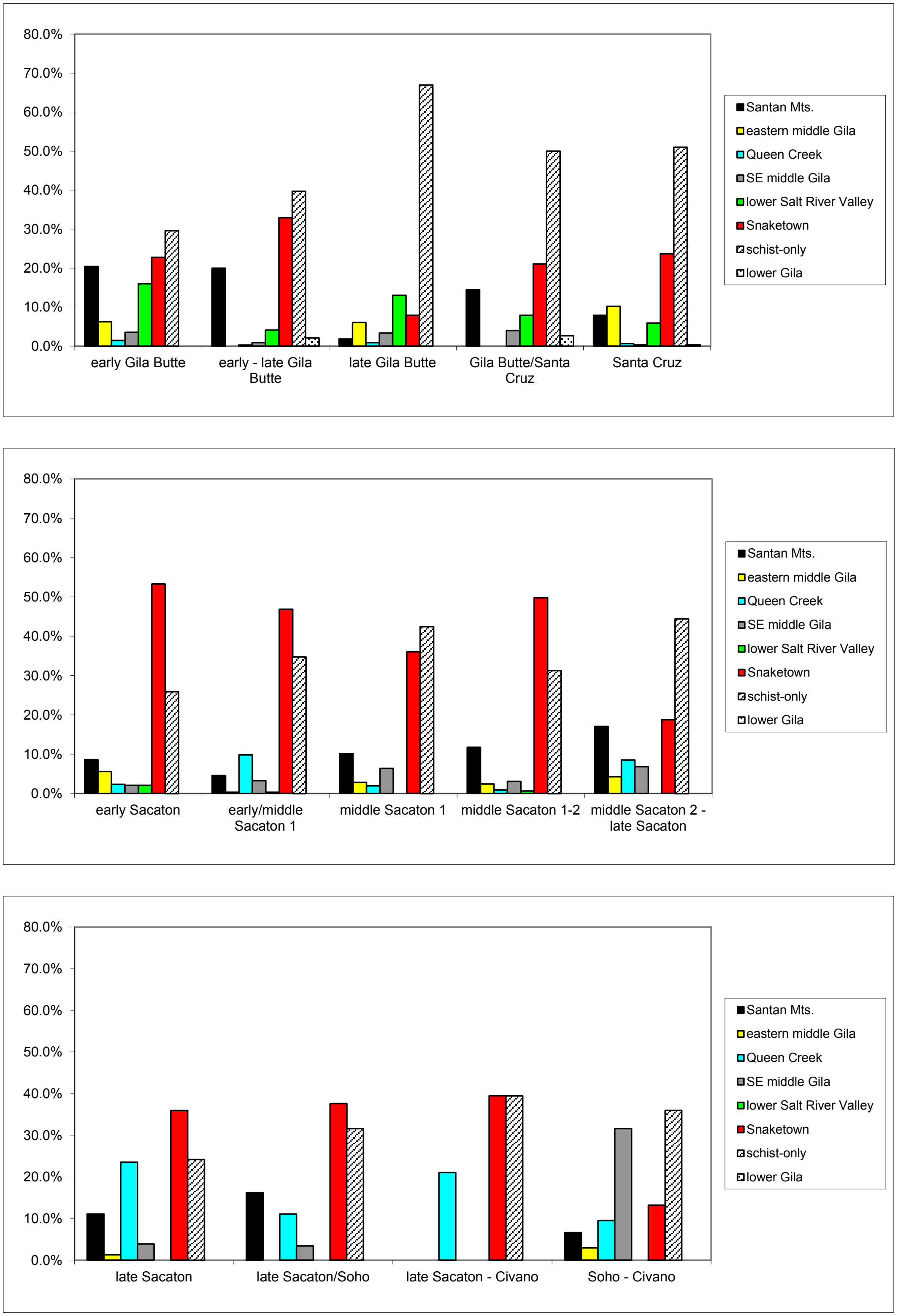


Figure 7.4. Potting group distribution over time.

evidence to suggest that significant economic changes accompanied this shift. The organization of plain ware production, for instance, was not significantly altered at that time. As such, it was not expected that significant differences in the organization of buff ware production would have occurred.

The results presented above, however, reveal that changes did occur in the organization of buff ware production at the time of the ideological organization.
The major distinguishing mark of the two most relevant time segments to the Episode 1 reorganization (early-late Gila Butte and late Gila Butte) was the increase in both the Snaketown and schist-only potting groups, from a combined total of 52 percent of the buff ware to 72 percent. From this point on to the late Sacaton-Civano segment, the Snaketown and schist-only potting groups were dominant, combining to account for over 70 percent of the buff ware production until the middle Sacaton 2 time segment, and over 50 percent until the late Sacaton-Civano segment.

The association between the increase in the proportion of Snaketown and schist-only potting groups and the concurrent ideological reorganization (reorganization Episode 1) in the late Gila Butte time segment needs to be explained. It is possible that this association is coincidental; merely reflecting a general trend of increasing proportions of buff ware vessels from these potting groups over time. On the other hand, the potting groups may have *intentionally* participated in the creation and/or promotion of a new ideology while other groups did not do so to the same extent. The stylistic analysis reported in Chapter 8 tests this proposition by identifying the specific potting groups responsible for the stylistic innovations associated with this new ideology. If the origins of these stylistic innovations were more often affiliated with the Snaketown and schist-only potting groups compared to other groups, then the proposition would be supported. If the origins of innovations were more often affiliated with other potting groups, or evenly distributed among all potting groups, the proposition would not be supported. In that case, the increase in the Snaketown and schist-only potting groups would require a different explanation.

The second episode of reorganization occurred at the onset of the middle Sacaton 1 time segment. In contrast to the Episode 1 reorganization, it was suggested that the nature of this second reorganization episode was more economic than ideological. At this time, several significant shifts in the organization of plain ware production occurred (Abbott 2009; Abbott, Watts, and Lack 2007), and it was, therefore, expected that changes in the organization of buff ware production may have occurred, as well. Specifically, it was expected that some new major production communities would arise in the same manner as plain ware production communities arose in the lower Salt River Valley.

Once again, however, the results (see Table 7.3) were unexpected. The two time segments most relevant to the Episode 2 reorganization were the early/middle Sacaton 1 and middle Sacaton 1 time segments. Between these time segments there were only slight decreases in the proportions of the Santan Mountains, eastern middle Gila, and lower Salt River Valley potting groups. The most notable change was the eight percent increase in the Queen Creek potting group; an increase that was not sustained over the next two time segments.

The fact that few changes occurred in buff ware production during the second episode of reorganization suggests that buff ware producers responded to changing economic conditions differently than plain ware potters in the lower Salt River Valley. If a market system did come into existence at this time (Abbott, Watts, and Lack 2007; Abbott, Smith, and Gallaga 2007), it was thought that it would have provided the means for some buff ware potting communities to thrive at the expense of others by creating a more competitive environment. While it is true that the Snaketown and schist-only potting groups were most dominant in the middle Sacaton time segments, the results presented above reveal that these two groups had already been dominant over the last several time segments.

The stylistic analysis in Chapter 8 addresses the possibility that, although major changes did not occur in the proportions of the various potting groups during the Episode 2 reorganization, changes did occur in the origins and adoption patterns of the stylistic innovations associated with that reorganization. If the process of stylistic innovation did change at this time, and a market system existed, such a system would be expected to influence stylistic innovation by adding a stronger element of competition between potting groups.

The third episode of reorganization was characterized by political, economic, and ideological changes manifested in several different types of media and contexts. It was also at this time that the manufacturing site of Snaketown was abandoned. It was assumed that changes in any or all of these spheres would have affected the organization of buff ware production. It was expected, therefore, that substantial changes would have occurred in the number of potting groups and the relative proportions of buff ware they produced in the middle Sacaton 2 – late Sacaton and late Sacaton time segments.

In this case, the general expectations were met. First, the proportions of sherds produced by the Snaketown and schist-only potting groups decreased substantially for the first time in over 250 years. These two groups still accounted for 63 - 60 percent of the total, but the drop of 18 percent from the middle Sacaton 1 – 2 time segment revealed that the organization of buff ware production was affected by the shifts occurring in other spheres of social and economic life. Second, there were definite increases in the quantity of buff ware produced by both the Queen Creek and Santan Mountain potting groups. From this point to the end of the buff ware sequence, the Queen Creek potting group continued to be a significant producer.

Not all expectations for this reorganization episode were met. One such expectation was that more potting groups would come online at this time, in a similar way to the lower Salt River Valley, where plain ware production became localized (see Abbott 2000, 2003). On the contrary, the middle Sacaton 2 – late Sacaton and late Sacaton time segments were represented by six and seven potting groups, respectively; while the late Sacaton/Soho and late Sacaton – Civano time segments were represented by three to five groups (see Table 7.2).

One reason why the number of buff ware potting groups did not increase at this time may have been simply due to the decreasing demand for buff ware, in general. Prior to the late Sacaton, buff ware consistently accounted for approximately 20 percent of ceramic assemblages, but subsequently dropped to 5 percent in the late Sacaton and Soho time segments (Abbott, Watts, and Lack 2007:347). It is not likely that new potters or communities would turn to buff ware production when the demand for buff ware was rapidly decreasing.

This chapter has laid the necessary groundwork for the stylistic analysis that follows in the next two chapters by establishing a context of production in which innovation occurred in each reorganization episode. In combining the production and stylistic data, the variables selected to describe the process of innovation are evaluated based on the expectations outlined in Chapters 3.

Chapter 7 Notes

[1] All sands, grain boxes, and initial training were generously provided by Elizabeth Miksa.

[2] Mica size may have been a product of either differences in the parent rock material or in the amount of crushing a potter engaged in as part of their ceramic recipe. Either way, a difference in practice is evident.

Chapter 8:

STYLISTIC INNOVATION

Having established the production context of Hohokam Red-on-buff over time through a provenance analysis of more than 3,500 sherds, it was now possible to conduct a stylistic analysis from which a systematic investigation of the innovation process could be attempted. The provenance analysis provided information on how many buff ware potting groups were in operation at any given time and how much buff ware each group distributed to residential communities across the Phoenix Basin. The purpose of the stylistic analysis is to record which stylistic attributes were associated with each potting group at any given time. The intention is to combine these two types of analyses to determine when and where stylistic innovations first appeared (origin), how quickly they were adopted by other potting groups (rate), which group adopted which innovation (pattern), and how many groups adopted each innovation (uniformity). The results were often surprising compared to what was expected, leading me to question some of my initial assumptions, not only about the innovation process, but also about the Hohokam social environment at different points in time.

I begin this chapter with a description of the methods used for the stylistic analysis, including illustrations of the innovations recorded. I then summarize all of the stylistic elements recorded for each episode of reorganization. Next, I provide a discussion of potential problem with sample size, and how it was managed. I then proceed to present the results for the four variables used to describe the process of innovation in this study: the origins of stylistic innovations, the rate of adoption, the pattern of adoption, and the uniformity of adoption. I conclude the chapter by comparing my findings with what Wallace and colleagues' (see Wallace 1995, 2001; Wallace et al. 1995) have described as horizon styles among the Hohokam.

Stylistic Analysis Methods

The stylistic analysis was conducted on the same sherds examined in the provenance analysis described above. To be included in the stylistic analysis, it was necessary for an individual sherd to meet one of the following criteria: 1) any sherd that possessed a painted design beyond that of a single line or two intersecting lines (except in the case of trailing lines on bowl exteriors), or 2) any shoulder sherd, as the degree of sharpness was compared among temper groups.

Vessel form is related to vessel function; and vessel function is related to the context in which a type of vessel was used (Carr 1995; Wobst 1977). For this reason, vessel form was assumed to have influenced the specific stylistic motifs and layouts applied to a buff ware vessel. In addition, some designs were aesthetically or practically more appropriate on bowls rather than jars, and vice versa (Plog 1980; Crown 1984:222-224). All sherds examined in this analysis were coded as either bowls or jars. Decoration on the interior vs. exterior was the determining factor in treating scoops as bowls (usually interior decoration) and cauldrons as jars (exterior decoration).

Because this study was a sherd, rather than a whole-vessel, analysis, it was often difficult to ascertain large structural characteristics of buff ware style, such as design layout, panel types, and panel borders. This limitation precluded the retrieval of important information regarding design symmetry and sectioning that has proved valuable in other anthropological and archaeological studies of style (Van Keuren 1999, 2000; Washburn 1983; Washburn et al. 1988). It is hoped, therefore, that this study will provide a useful framework and methodology that can be applied to whole buff ware vessels in the future.

After each sherd was placed into a temper group according to the procedures outlined in the previous chapter, stylistic attributes were compared for each time segment. All stylistic attributes were taken directly from Wallace's coding system (2004: Appendix B), as these constitute the most exhaustive Hohokam red-on-buff stylistic corpus to date. A large number of attributes were recorded that were not ultimately included in the analysis because they were not found to be temporally diagnostic by Wallace (2004:52).

Wallace's (2001, 2004) seriation has largely defined the stylistic corpus for Hohokam Red-on-buff as it existed at different points in time. The specific changes to that corpus over short segments of time were treated as stylistic innovations. The majority of innovations examined in this study were those that accompanied the three periods of social reorganization outline above (Figure 8.1). I refer to the innovations associated with each reorganization episode as stylistic suites.

These methods of identifying and recording buff ware provenance and stylistic innovations were combined to measure the four variables previously outlined that described the process of innovation: the origin of an innovation, the rate of adoption, the pattern of adoption, and the uniformity of adoption.

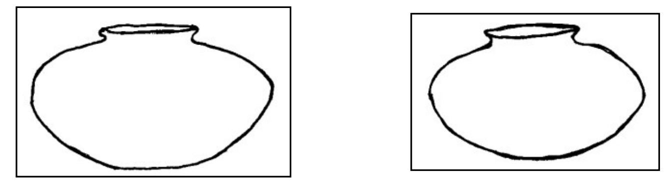
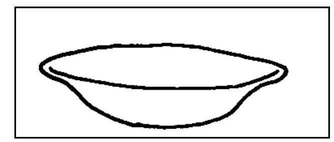
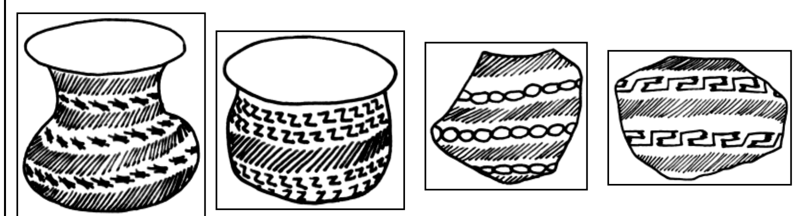
REORGANIZATION EPISODE 1 INNOVATIONS: LATE GILA BUTTE		
Compressed globular-body jar with short flared rim (not applicable to miniatures or very small jars)	LGB-SC	
Outcurved or Flare-rimmed bowl, shallow, flat-bottomed	LGB-SC	
Organizational Banding Layout	LGB-ESAC	
Slanted Railroad Tie Hachure	LGB-SC	

Figure 8.1. Innovations for each of the three episodes of reorganization. Temporal ranges assigned by Wallace (2001, 2004).

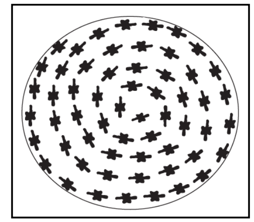
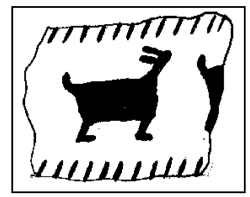
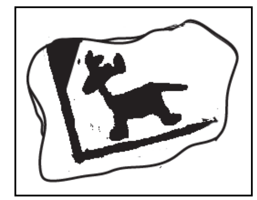
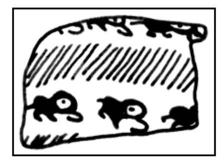
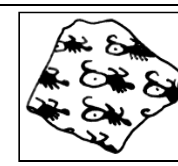
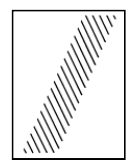
REORGANIZATION EPISODE 1 INNOVATIONS: LATE GILA BUTTE		
All-over layout, spiraling small elements, elements touching or average <2mm apart from one another	LGB	
Life forms, except birds and lizards (because some bird and lizard forms occur pre-LGB, they are excluded)	LGB-MSAC1, rare post-MSAC1	  
Quail	LGB-MSAC1	  
Free-Floating Fringe	LGB-LSAC[1]	

Figure 8.1. Continued.

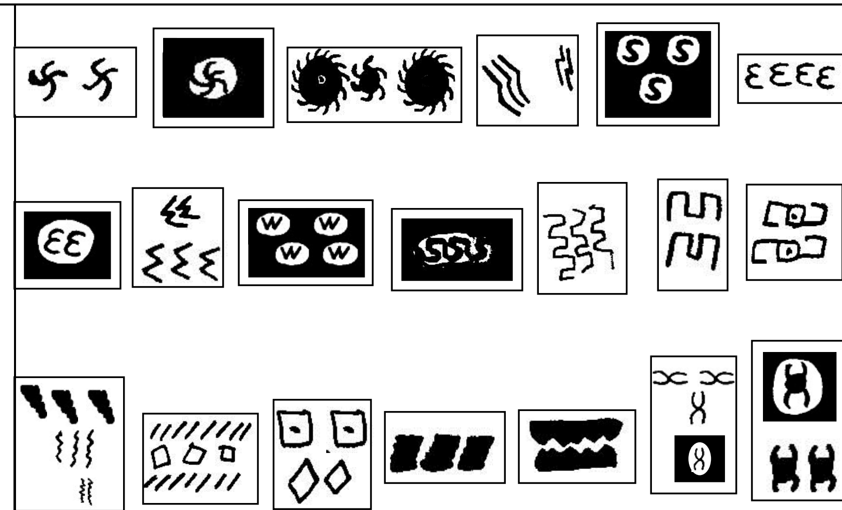
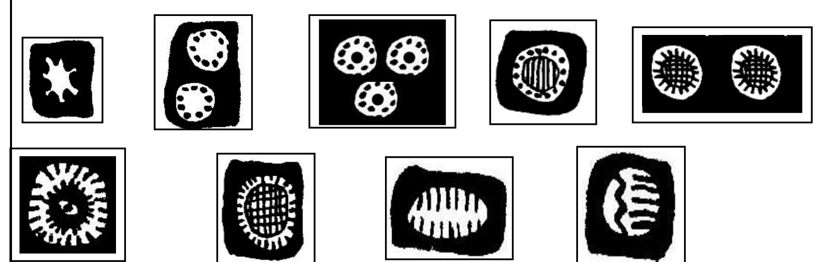
REORGANIZATION EPISODE 1 INNOVATIONS: LATE GILA BUTTE		
Small, element group A, nos.: 30, 34, 35, 58, 63, 70, 71, 72, 73, 80, 81, 83, 84, 85, 86, 95, 96, 99, 103, 113, 114 (Date range only applies to primary design field. All elements are sometimes present in secondary design fields.)	LGB-MSAC1	
Small, geometric element group D, nos.: 18, 19, 20, 21, 26, 28, 29, 40, 41 (Date range only applies to primary design field. All elements are sometimes present in secondary design fields.)	LGB-SC	

Figure 8.1. Continued.

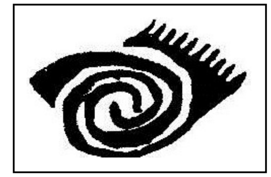
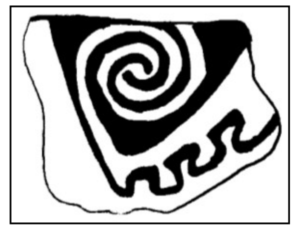
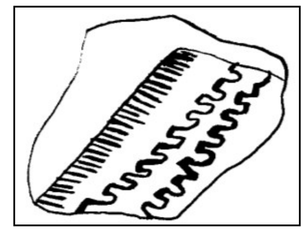
REORGANIZATION EPISODE 1 INNOVATIONS: LATE GILA BUTTE		
Fringed curvilinear scroll	LGB-SOHO	 
Crenulated line	LGB-SOHO	 

Figure 8.1. Continued.

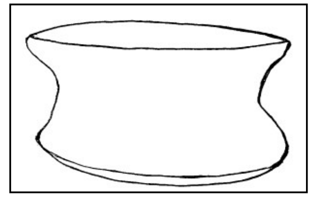
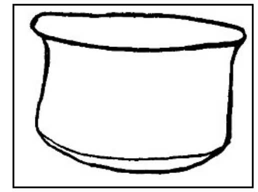
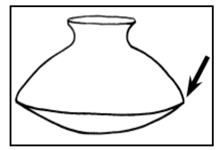
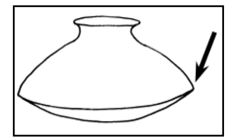
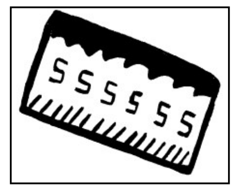
REORGANIZATION EPISODE 2 INNOVATIONS: MIDDLE SACATON 2		
Cauldron (concave and vertical wall)	MSAC1, possible cases in MSAC2	 
Gila Shoulder ≤120 Degrees	MSAC1-MSAC2	 
Panel, isolated, completely line demarcated (Does not include cases where double-capped fringes are used as panels)	MSAC1-MSAC2	 
Rectilinear Scroll	MSAC1-SOHO	 

Figure 8.1. Continued.

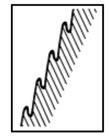
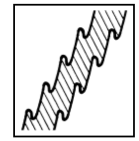
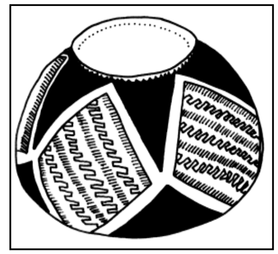
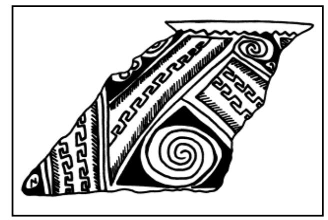
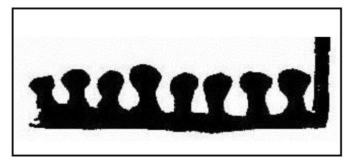
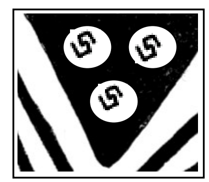
REORGANIZATION EPISODE 2 INNOVATIONS: MIDDLE SACATON 2		
Wavy-capped Fringe (single- or double-capped)	MSAC1-LSAC	 
Crenulated Line as centerline motif in a Panel (Appears uncommon in MSAC2)	MSAC1-MSAC2	  
Zipper motif (May only occur [and may only be diagnostic] as a panel border elaboration)	MSAC1	
Two or more voids within single solid with small elements	MSAC1	

Figure 8.1. Continued.

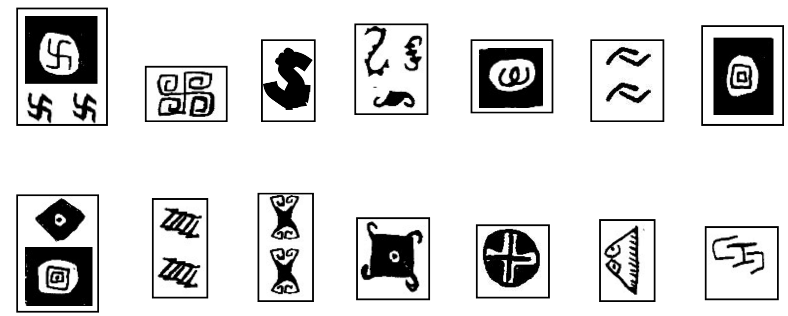
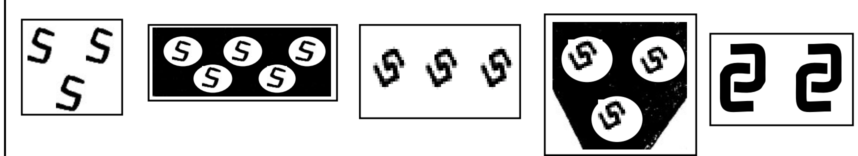
REORGANIZATION EPISODE 2 INNOVATIONS: MIDDLE SACATON 2		
Small, geometric element group E, nos.: 32, 33, 65, 78, 82, 89, 98, 101, 110, 115, 116, 118, 123, 125 (Date range only applies to primary design field. All elements are sometimes present in secondary design fields.)	MSAC1, unknown if also MSAC2 and LSAC	
Small, geometric element group C, nos.: 64, 67, 68, 69, 90, and minor variations thereof (from Haury Figure 12.99) (Date range only applies to primary design field. All elements are sometimes present in secondary design fields.)	MSAC1-SOHO	
Design element diversity > 4	MSAC1	no illustration

Figure 8.1. Continued.

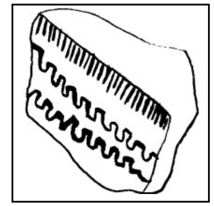
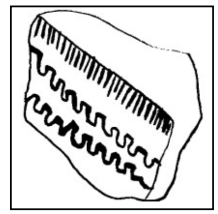
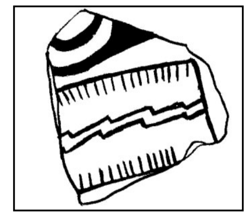
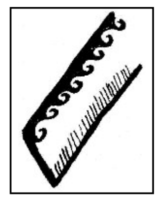
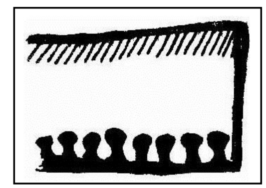
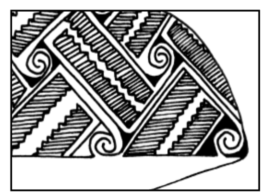
REORGANIZATION EPISODE 2 INNOVATIONS: MIDDLE SACATON 2		
Panel, at least partly line demarcated, >1 centerline motif	MSAC1	
Panel, at least partly line demarcated, multiple duplicate elements used as panel centerline (Most common are wavy or zigzag/job lines, crenulated lines, and free-floating fringes)	MSAC1	 
Panel, at least partly line demarcated, zipper curvilinear scroll, or other border elaboration (except fringing, ticking, or sawteeth)	MSAC1	 
Panel, at least partly line demarcated (does not have any parts where panel border elaboration is attached to an adjacent solid)	MSAC1-MSAC2	 

Figure 8.1. Continued.

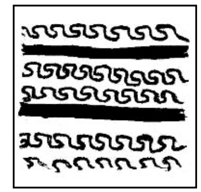
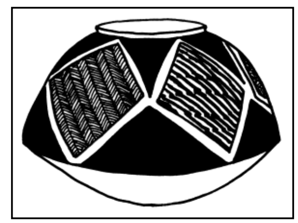
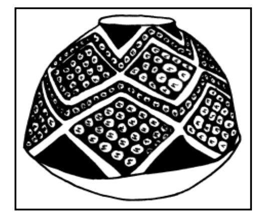
REORGANIZATION EPISODE 2 INNOVATIONS: MIDDLE SACATON 2		
Banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width > 5mm)	MSAC1-MSAC2	
Diamond Panel Layout (floating diamond layout)	MSAC1	 

Figure 8.1. Continued.

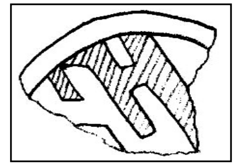
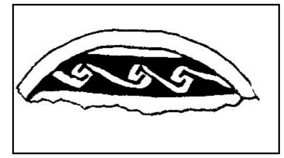
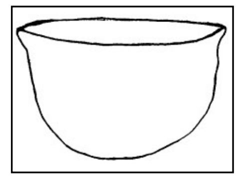
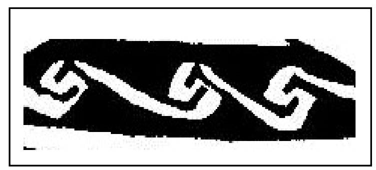
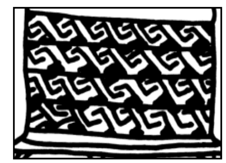
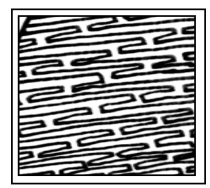
REORGANIZATION EPISODE 3 INNOVATIONS: LATE SACATON/SOHO		
Design field separation from rim, bowl interiors only (may not be applicable to flare-rim bowls and interior-decorated cauldrons)	LSAC	 
Semi-flare-rimmed hemispherical bowl	LSAC	
Interlocking rectlinear fret	LSAC-SOHO	 
Outline Line and Stagger	LSAC	

Figure 8.1. Continued.

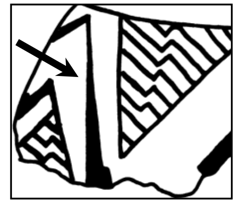
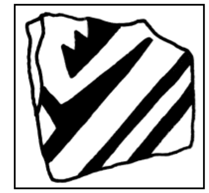
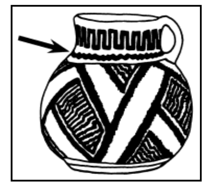
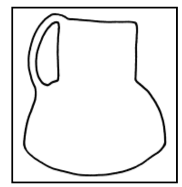
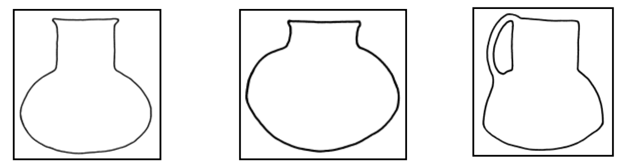
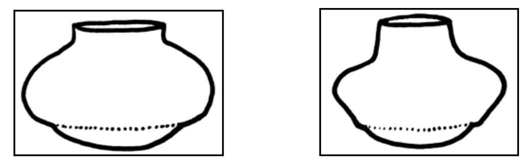
REORGANIZATION EPISODE 3 INNOVATIONS: LATE SACATON/SOHO		
Tapered Lines	LSAC-SOHO	 
Upper Freeline, jars only (Do not confuse with upper band envelope line on MSAC1 jars and cauldrons)	LSAC-SOHO, MSAC2-SOHO rare	 
Pitcher	LSAC-SOHO, possibly only SOHO	
Open Panel (difficult to identify on small sherds)	SOHO	

Figure 8.1. Continued.

REORGANIZATION EPISODE 3 INNOVATIONS: LATE SACATON/SOHO		
Tall Neck (jars and pitchers only)	SOHO	
Classic (mold inset) Shoulder	SOHO	

[1] Wallace suggested an MSAC2 ending date for these attributes, but we feel more comfortable with an LSAC ending date in our experience with different assemblages.

Abbreviations: LGB = late Gila Butte; SC = Santa Cruz; ESAC = early Sacaton; MSAC1 = middle Sacaton 1; MSAC2 = middle Sacaton 2; LSAC = late Sacaton

Figure 8.1. Continued.

Determining the origin of an innovation required the identification of a particular stylistic innovation in its early occurrences. Stylistic attributes and tempering material were recorded for each sherd within chosen contexts, so that the particular potting group employing the use of a particular innovation at an early date could be determined. The rate of innovation adoption was measured by comparing the origin of an innovation with the length of time it took other communities to adopt that innovation. Wallace's refined seriation allows that length of time to be measured in the span of *decades*, rather than centuries. The pattern of innovation adoption was measured by comparing the place of production with the rate of adoption; that is, tracing the spatial spread of adoption. This measure was only possible on those innovations that took more than a single time segment to be adopted. Finally, the uniformity of innovation was measured by determining how many total potting communities adopted a specific innovation, regardless of the timing of its adoption. Each innovation, therefore, was assessed as to how uniformly adopted it was across the total spectrum of buff ware producers.

In many cases, I could not discern the actual potting group responsible for the origin of an innovation for those time segments in which multiple temper groups were represented. In those cases, it was highly unlikely that a particular stylistic innovation was independently invented by more than one group. I assumed in this study that each innovation would have originated with one group. Those cases in which multiple temper groups were associated with the earliest appearances of an innovation were examples of different production groups that adopted a particular innovation quickly after its invention. For this study, it was not possible to delineate a stylistic invention adopted by other potting groups within a single time segment or transition between time segments.

The only way to measure the four variables describing the process of innovation was to combine provenance and stylistic data as outlined above, so that the dynamics of stylistic change from a spatial and temporal perspective could be observed. In the results section that follows, several unexpected patterns were observed from this combination.

Summary of Stylistic Analysis Results

The results of the analysis reveal that a greater level of autonomy existed among buff ware potting groups than was expected during the first and second reorganization episodes, along with greater uniformity than expected in the third episode. The results also call for reconsideration not only of my expectations, but also of the assumptions made about the social environment.

In this analysis, eight stylistic innovations belonging to the Episode 1 reorganization were recorded on bowl sherds, while seven were recorded on jar sherds (Table 8.1)[1]. The most frequently occurring attribute of this stylistic suite, for both bowls and jars, was free-floating fringe, followed by crenulated lines.[2] Both of these attributes had long use lives, with free floating fringes being used until the late Sacaton time segment, and crenulated lines growing in popularity in the middle Sacaton through Soho time segments.

Of the 13 stylistic innovations recorded from the Episode 2 reorganization, only six were common to both bowls and jars. The most frequently occurring attribute of this stylistic suite varied considerably by vessel form. For example, the most frequently

Table 8.1. Frequencies of stylistic innovations by reorganization episode and vessel form.

Epidosde 1

Bowls	count	Jars	count
51 slanted railroad tie hachure	21	51 slanted railroad tie hachure	11
52 organizational banding layout	18	52 organizational banding layout	49
54 life forms (except birds and lizards)	24	54 life forms (except birds and lizards)	29
55 quail	1	55 quail	2
56 free-floating fringe	88	56 free-floating fringe	119
190 small, geometric element group D	2		
195 small element group A	22	195 small element group A	23
200 crenulated line	31	200 crenulated line	78
203 fringed curvilinear scroll	21	203 fringed curvilinear scroll	35

Episode 2

Bowls	count	Jars	count
80 wavy-capped fringed (single- or double-capped)	8	80 wavy-capped fringed (single- or double-capped)	86
91 crenulated line in a panel	5	91 crenulated line in a panel	16
		92 Gila Shoulder <120 degrees	47
		93 Gila Shoulder, knife-edged	8
96 rectilinear scroll	12	96 rectilinear scroll	86
		233 panel, at least partly line demarcated, >1 centerline motif	2
235 panel, at least partly line demarcated, zipper, curv. Scroll, or other border elaboration (except fringing, ticking, or sawteeth)	1		
238 panel, at least partly line demarcated, multiple duplicate element used as panel centerline	11	238 panel, at least partly line demarcated, multiple duplicate element used as panel centerline	14
245 Cauldron (concave or vertical wall)	8		
250 small, geometric element group E	2		
255 panel, isolated (completely line demarcated)	1		
		260 banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width >5mm)	1
284 small, geometric element group C	16	284 small, geometric element group C	12

Episode 3

Bowls	count	Jars	count
95 outline line and stagger	5	95 outline line and stagger	12
111 tapered lines	3	111 tapered lines	12
		112 upper freeline (jars only)	84
		121 open panel	71
		122 decorated neck	67
		124 tall neck	56
270 design field separation from rim, bowl interiors only	1		

occurring attribute on bowl sherds, small, geometric element group C, was relatively infrequent on jar sherds. Instead, jar sherds were most frequently decorated with wavy-capped fringe and rectilinear scrolls.

Of the 10 stylistic innovations associated with the Episode 3 reorganization, three were recorded on bowl sherds, while six were recorded on jar sherds. The low number of attributes on bowl sherds was due to the small number of bowls produced during this time period (Figure 8.2). The most frequently occurring stylistic innovation on bowl sherds was the outline line and stagger. Upper freelines, exclusive to jars, were the most frequently recorded attribute of this stylistic suite.

Sample Size

Throughout this study, it became obvious that sample size was an issue in comparing stylistic innovation and adoption among the eight identified potting groups. It was usually the case, for example, that my samples for any given time segment were dominated by two groups, leaving the remaining groups to comprise a very small percentage of the sample. The identification of innovations were, therefore, biased toward the more dominant potting groups.

For this reason, it was necessary to determine whether or not a correlation existed between sample size and the number of innovations recorded for each potting group. Scatterplots were generated for each time segment, plotting the number of innovations against the sample size for each potting group. Dozens of scatterplots were created that included a trendline representing the expected number of innovations for any given

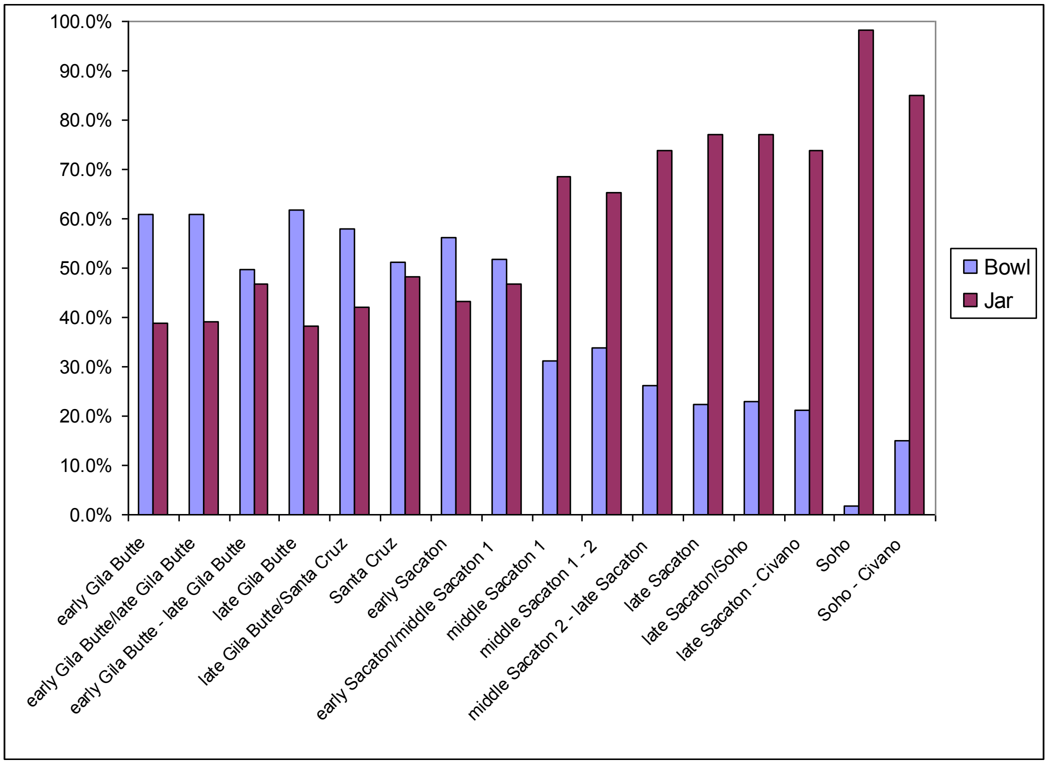


Figure 8.2. Vessel form comparison over time.

sample size. The presence of more than one innovation above or below the expected for a given potting group was considered significant.

As an example, take the number of Episode 1 innovations for bowl sherds in the early Gila Butte time segment (Figure 8.3). Sherds from two potting groups, the lower Salt River Valley and the Snaketown groups, contained 1.35 and 1.25 fewer innovations than expected given their sample size. All other potting groups, with the exception of the unrepresented lower Gila River Valley group, contained sherds displaying more innovations than expected. None of these groups, however, contained sherds displaying more than one innovation than expected, which was the required number to be considered significant.

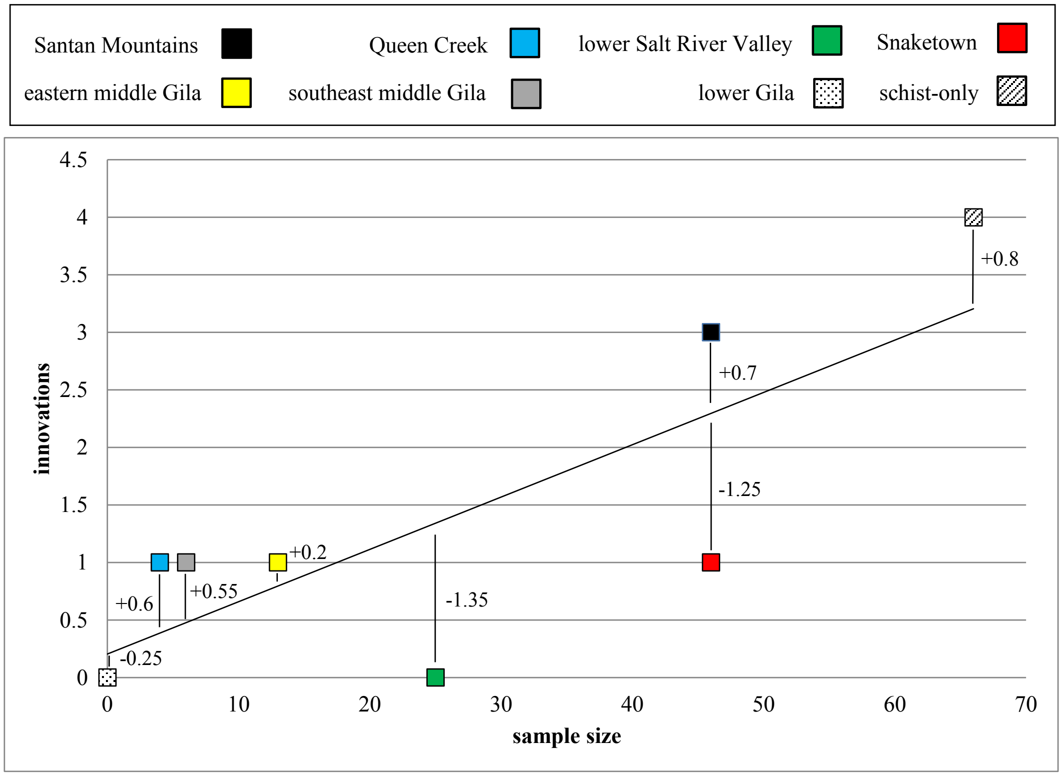


Figure 8.3. Example of a regression to evaluate the correlation between sample size and the number of innovations identified with individual potting groups. This is a plot of Episode 1 reorganization innovations by sample size for bowl sherds in the early Gila Butte time segment.

In the end, the results confirmed that a general correlation existed between sample size and number of innovation; however, considerable variation existed within this general pattern. Many exceptions occurred in which either more or fewer innovations than expected were recorded on sherds from a particular potting group. Because so much variation existed in these regressions for different time segments, each had to be considered separately, as each variable of innovation was explored.

Origin

Considerable variation was observed in the origin of stylistic innovations both within and between the three episodes of reorganization. The number of potting groups that were associated with the earliest appearance of an innovation (i.e., the diversity of potting groups) ranged from a single group to five different groups within a single episode of reorganization. Comparisons between groups likewise showed that within a single reorganization episode, as few as three potting groups or as many as seven could be associated with the earliest appearance of all innovations in that particular episode. This variation is first described for each of the three episodes of reorganization, and is then summarized to provide a comparative and comprehensive picture of the origins of stylistic innovation over time.

Episode 1

The earliest recorded appearances of Episode 1 reorganization innovations on both bowls and jars occurred in the early Gila Butte time segment (Table 8.2). The earliest appearances of all other Episode 1 innovations (with the exception of quails) occurred during either the early-late Gila Butte or late Gila Butte time segments.

The earliest appearances of stylistic innovations associated with the first episode of reorganization occurred with a wide array of potting groups, with innovative activity (the invention, or origins, of innovation) potentially occurring in seven of the eight identified potting groups. I use the word “potentially” because in those cases in which multiple potting groups were associated with the earliest appearances of an innovation it

Table 8.2. Date and potting groups of the Episode 1 reorganization innovations.

Santan Mountains (black)	Queen Creek (blue)	lower Salt River Valley (green)	Snaketown (red)
eastern middle Gila (yellow)	southeast middle Gila (grey)	lower Gila (dotted)	schist-only (hatched)

Episode 1 reorganization - BOWLS

Attribute*	Production group associated with origin	Earliest occurrence
51 - slanted railroad tie hachure	Santan Mountains; southeast middle Gila; schist-only	early Gila Butte
52 - organizational banding layout	Santan Mountains; Snaketown; schist-only	early - late Gila Butte
54 - life forms (except birds and lizards)	Santan Mountains; Snaketown; schist-only	early Gila Butte
55 - quail	Queen Creek	early/middle Sacaton 1
56 - free-floating fringe	Santan Mountains; eastern middle Gila; schist-only	early Gila Butte
190 - small, geometric element group D	schist-only	late Gila Butte
195 - small element group A	schist-only	early - late Gila Butte
200 - crenulated line	Snaketown	late Gila Butte
203 - fringed curvilinear scroll	Queen Creek; schist-only	early Gila Butte

Episode 1 reorganization - JARS

Attribute*	Production group associated with origin	Earliest occurrence
51 - slanted railroad tie hachure	Queen Creek; Snaketown; schist-only	early Gila Butte
52 - organizational banding layout	Santan Mountains; lower Salt River Valley; schist-only	early Gila Butte
54 - life forms (except birds and lizards)	Santan Mountains; southeast middle Gila; schist-only	early Gila Butte
56 - free-floating fringe	Santan Mountains; eastern middle Gila; lower Salt River Valley; Snaketown; schist-only	early Gila Butte
195 - small element group A	schist-only	early Gila Butte
200 - crenulated line	lower Salt River Valley; schist-only	late Gila Butte
203 - fringed curvilinear scroll	eastern middle Gila; lower Salt River Valley; Snaketown; schist-only	early Gila Butte

* One "quail" was recorded, but it occurred in an early/middle Sacaton 1 context - later than it is known to have originated (Wallace 2004)

was not possible to determine the single potting group responsible for its origin (see discussion in previous chapter).

Only two (25%) innovations small, geometric element group D and small element group A) were associated exclusively with a single potting group. Unfortunately, the small, geometric element group D occurred only twice, and the small element group D once, in the large schist-only sample; too few to make any definitive statements regarding an exclusive origin with this loosely-defined group.

The sample sizes of each of the eight recorded potting groups led me to expect that the earliest appearances of innovations should occur most frequently on sherds from the schist-only potting group; understanding that this group may be more geographically dispersed and less unified than other potting groups. After the schist-only group, innovations should originate most frequently on sherds from the Snaketown, Santan Mountains, lower Salt River Valley, eastern middle Gila River Valley, southeastern middle Gila River Valley, Queen Creek, and lower Gila River Valley groups, respectively. The results of the regression revealed that these expectations were met, with the exception that the lower Gila River Valley potting group was not associated with any innovations in their earliest appearances (Figure 8.4).

The regression analysis revealed that each potting group, with the exception of the lower Gila River group, was potentially involved in the same amount of innovative activity as every other group. This result was unexpected in the light of the model outline earlier in this study (see Table 3.2), which predicted that this reorganization episode would be characterized by innovations originating with one or a few groups.

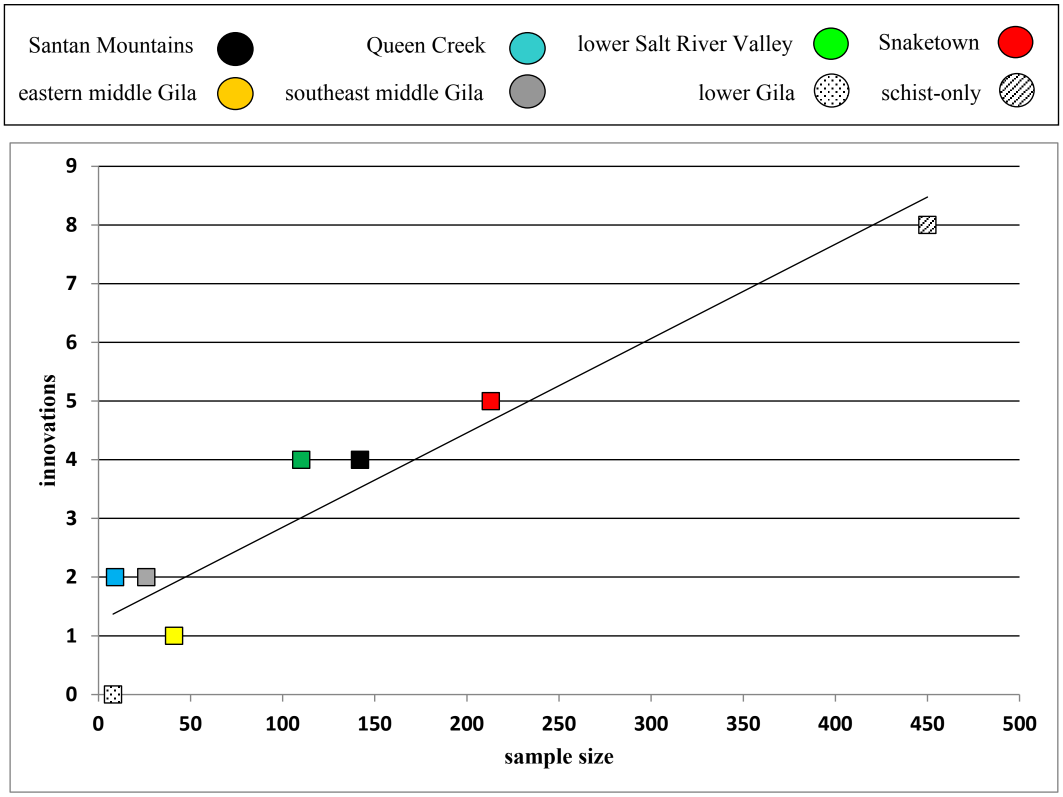


Figure 8.4. Regression analysis of stylistic innovations by sample size for the Episode 1 reorganization.

Episode 2

The earliest appearances of stylistic innovations associated with the Episode 2 reorganization was less diverse in their origins than in the first episode of reorganization, especially among bowl sherds (Table 8.3). With the exception of rectilinear scrolls, the earliest recorded appearances of Episode 2 reorganization innovations occurred in the early Sacaton time segment. Nearly all other innovations first appeared in the early/middle Sacaton or middle Sacaton 1 time segments.

The respective sample sizes from each potting group led me to expect that the earliest appearances of innovations should occur most frequently with the Snaketown

Table 8.3. Date and potting groups of the Episode 2 reorganization innovations.

Santan Mountains ●	Queen Creek ●	lower Salt River Valley ●	Snaketown ●
eastern middle Gila ●	southeast middle Gila ●	lower Gila ●	schist-only ●

Episode 2 reorganization - BOWLS

Attribute	Production group associated with origin	Earliest occurrence
80 - wavy-capped fringed (single- or double-capped)	schist-only	middle Sacaton 1
91 - crenulated line in a panel	Snaketown	middle Sacaton 1
96 - rectilinear scroll	Santan Mountains	early Gila Butte
235 - panel, at least partly line demarcated, zipper, curv. Scroll, or other border elaboration	Snaketown	middle Sacaton 1
238 - panel, at least partly line demarcated, multiple duplicate elements used as panel centerline	Snaketown	early/middle Sacaton 1
250 - small, geometric element group E	schist-only	early/middle Sacaton 1
255 - panel, isolated (completely line demarcated)	schist-only	middle Sacaton 1
284 - small, geometric element group C	Snaketown; schist-only	early/middle Sacaton 1

Episode 2 reorganization - JARS

Attribute	Production group associated with origin	Earliest occurrence
80 - wavy-capped fringed (single- or double-capped)	eastern middle Gila	early Sacaton
91 - crenulated line in a panel	Santan Mountains; southeast middle Gila; Snaketown; schist-only	middle Sacaton 1
92 - Gila Shoulder <120 degrees	schist-only	early Sacaton
93 - Gila Shoulder, knife-edged	Snaketown; schist-only	middle Sacaton 1
96 - rectilinear scroll	eastern middle Gila	Santa Cruz
233 - panel, at least partly line demarcated, >1 centerline motif	schist-only	middle Sacaton 1
238 - panel, at least partly line demarcated, multiple duplicate elements used as panel centerline	Santan Mountains; Queen Creek	early Sacaton
260 - banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width >5mm)	Santan Mountains	late Sacaton/Soho
284 - small, geometric element group C	Snaketown	early/middle Sacaton 1

potting group, followed by the schist-only and Santan Mountains groups. The southeastern middle Gila, eastern middle Gila, and Queen Creek groups were not expected to be associated with the earliest appearance of more than one stylistic innovation in the Episode 2 reorganization. The regression analysis revealed three unexpected results (Figure 8.5). The Snaketown potting group was associated with the earliest appearance of fewer innovations than expected, while both the schist-only and Santan Mountain groups were associated with the earliest appearance of more innovations than expected.

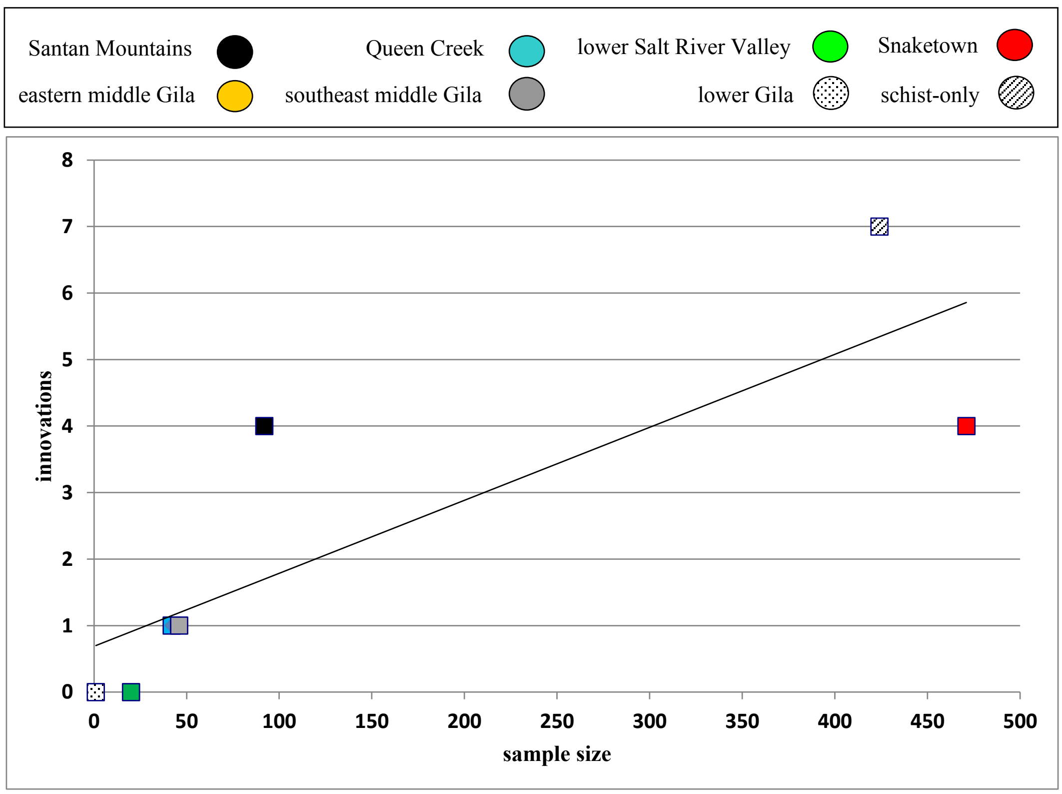


Figure 8.5. Regression analysis of stylistic innovations by sample size for the Episode 2 reorganization.

These results indicated that the most innovative potting group in the Episode 2 reorganization was the schist-only group, despite the fact that the Snaketown group likely manufactured a slightly larger quantity of buff ware vessels at this time. Even with the ambiguity regarding the location and unity of the schist-only group, it is significant that the group producing the most buff ware, the Snaketown group, contains fewer sherds displaying innovations than other producers. The results also suggest that the comparatively small-scale Santan Mountains potting group was also more involved in innovative behavior than the Snaketown group. On the other hand, the data could be the product of very rapid adoption of innovations by one or two of these groups rather than the invention of those innovations (see discussion below).

Combining bowls and jars together revealed that the earliest appearance of eight innovations (62%) was associated with single potting groups, while five (38%) were associated with multiple groups. These data also support the notion that the Snaketown potting group was not as heavily involved in innovative activity as was expected from their large manufacturing output.

Episode 3

The earliest recorded appearance of an Episode 3 reorganization innovation occurred in the middle Sacaton 1 time segment (Table 8.4). In fact, nearly half of the innovations associated with the Episode 3 reorganization first appeared in the middle Sacaton 1 time segment, demonstrating that much of the stylistic shifts in the third reorganization episode involved the popularization of rare, pre-existing motifs and

Table 8.4. Date and potting groups of the Episode 3 reorganization innovations.

Santan Mountains ● (black)	Queen Creek ● (turquoise)	lower Salt River ● (green)	Snaketown ● (red)
eastern middle Gila ● (yellow)	southeast middle Gila ● (gray)	lower Gila (stippled)	schist-only (hatched)

Episode 3 reorganization - BOWLS

Attribute	Production group associated with origin	Earliest occurrence
95 - outline line and stagger	Santan Mountains, Snaketown	middle Sacaton 1
111 - tapered lines	Santan Mountains, eastern middle Gila	late Sacaton
270 - design field separation from rim, bowl interiors only	schist-only	late Sacaton

Episode 3 reorganization - JARS

Attribute	Production group associated with origin	Earliest occurrence
95 - outline line and stagger	Snaketown, schist-only	middle Sacaton 1
111 - tapered lines	schist-only	late Sacaton
112 - upper freeline (jars only)	Snaketown, schist-only	middle Sacaton 1
121 - open panel	Santan Mountains, Queen Creek, schist-only	late Sacaton
122 - decorated neck	Snaketown	middle Sacaton 2/late Sacaton
124 - tall neck	Snaketown	middle Sacaton 2/late Sacaton

elements. Newer attributes first appeared in the middle Sacaton 2/late Sacaton and late Sacaton time segments.

Based on the sample sizes for each potting group, I expected the earliest appearances of innovations to once again occur most often on sherds from the schist-only and Snaketown groups, followed by the Santan Mountains group (Figure 8.6). This

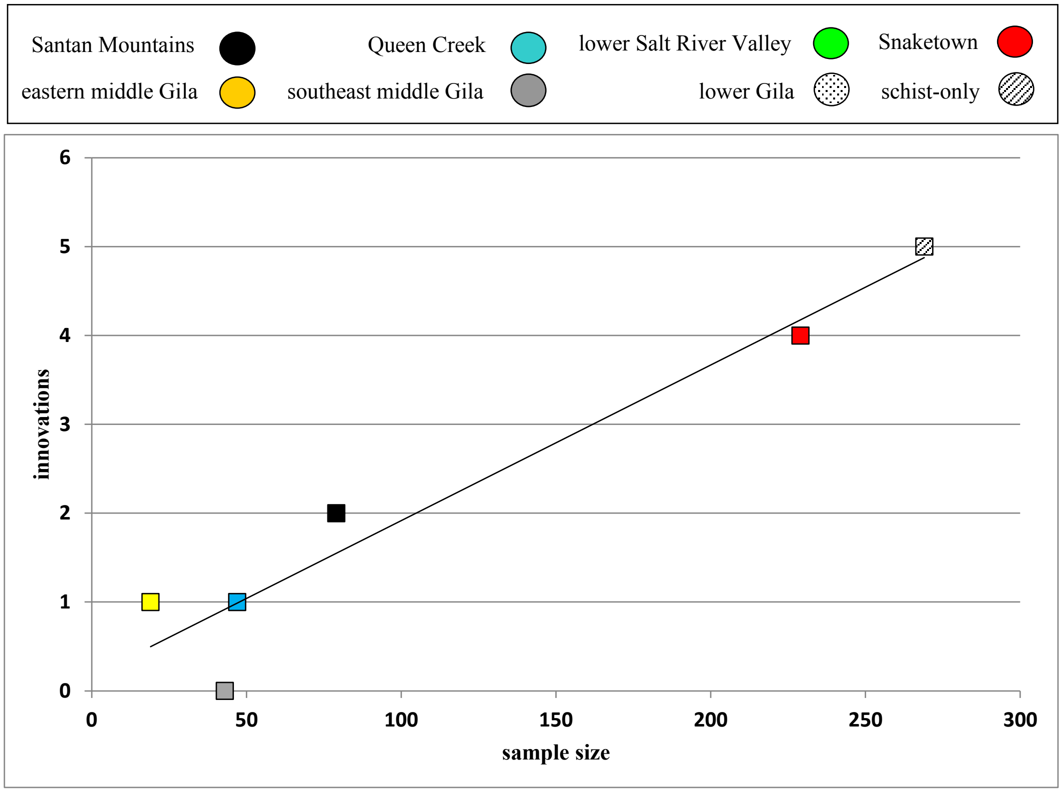


Figure 8.6. Regression analysis of stylistic innovations by sample size for the Episode 2 reorganization.

expectation was met in every case. No potting groups contained significantly more or fewer innovations than expected in their earliest appearances, indicating that each potting group was involved in inventing new stylistic motifs and/or layouts to some extent.

Another factor, however, needs to be taken into account before accepting the above conclusion. Four (57%) innovations were associated exclusively with one potting group in their earliest appearances, while three (43%) innovations were associated with multiple potting groups. Only the Snaketown and schist-only groups demonstrated good evidence of innovative behavior, as they were the only groups exclusively associated with individual innovations, suggesting that innovation during this reorganization episode was, in fact, dominated by these two groups.

A comparative picture of the origins of innovations

The results revealed significant differences in the origins of stylistic innovations between the three episodes of reorganization. The primary issue at hand was the number of potting groups involved in innovative activity. By innovative activity, I mean the act of inventing new stylistic motifs or elements only. Each of these groups was actively involved in adopting innovations that originated elsewhere.

Although the Episode 1 reorganization appeared to have involved a higher diversity of groups potentially involved in innovative activity compared to the other two reorganization episodes, there is reason to doubt the reality of this appearance. Although a higher diversity of groups was associated with the earliest appearances of innovations in the Episode 1 reorganization, there were almost no instances of innovations being exclusively associated with one particular group in their origins. That is to say, for any given innovation, the high diversity of groups possessing that innovation in the time segment in which it first appeared is a product of the very rapid adoption (see "rate of innovation adoption" below) of that innovation by multiple groups, rather than the independent invention of multiple groups. For this reason, it is impossible to say how many potting groups were actually involved in inventive behavior in the first episode of reorganization.

The Episode 2 and 3 reorganizations revealed more instances of individual innovations being associated exclusively with single potting groups. Inventive behavior was slightly more diverse in the Episode 2 reorganization, especially among the schist-only and Santan Mountains potting groups. The Snaketown group exhibited more inventive behavior in the Episode 3 reorganization than it did in the Episode 2 reorganization (see discussion in Chapter 9).

Overall, these results demonstrate that potentially all stylistic innovations in buff ware pottery associated with the three episodes of reorganization originated in the middle Gila River Valley (Petrofacies A, B, C, F5, H, G, J, N). Within the middle Gila River Valley, stylistic inventions were associated with the schist-only potting group, the Santan Mountains, and the Snaketown area. There was no evidence that the Queen Creek, lower Salt River Valley, or lower Gila River Valley potting groups were exclusively associated with the origins of any individual innovations, and therefore, they do not seem to have been heavily involved in innovative activity during any of the three reorganization episodes.

Rate of Innovation Adoption

The rate of the adoption of stylistic innovations was measured as very rapid, rapid, slow, and very slow. These measurements should, in part, relate to the degree of integration and sense of interconnection among potting communities at any given point in time, based on the assumption that the more rapid the adoption of many innovations, the higher the degree of interconnection and integration; the lower the rate of adoption, the lower the degree of interconnection and integration.

Very rapid adoption refers to adoption within a single time segment (e.g., late Gila Butte) or transition period between time segments (e.g., late Gila Butte/Santa Cruz) (generally within 30-50 years). As discussed above, the earliest appearance of many stylistic innovations were associated with multiple potting groups. In those cases, it was not possible to determine the specific potting group with which a particular innovation originated because adoption occurred within a single time segment. For example, innovation X originated on bowls in the early Gila Butte time segment with the Santan Mountains and schist-only potting groups (Figure 8.7). It is not known which of these two potting groups was the actual source of this innovation, but it is known that it originated with one of those groups and was very rapidly adopted by the other within that same time segment.

Rapid adoption refers to adoption within one time segment of the origin segment (generally within 50-100 years). To continue our example, innovation X originated in the early Gila Butte time segment, and was then rapidly adopted by the Snaketown and southeast middle Gila potting groups in the late Gila Butte time segment. *Slow adoption* refers to adoption that occurred between one and two time segments from the origin

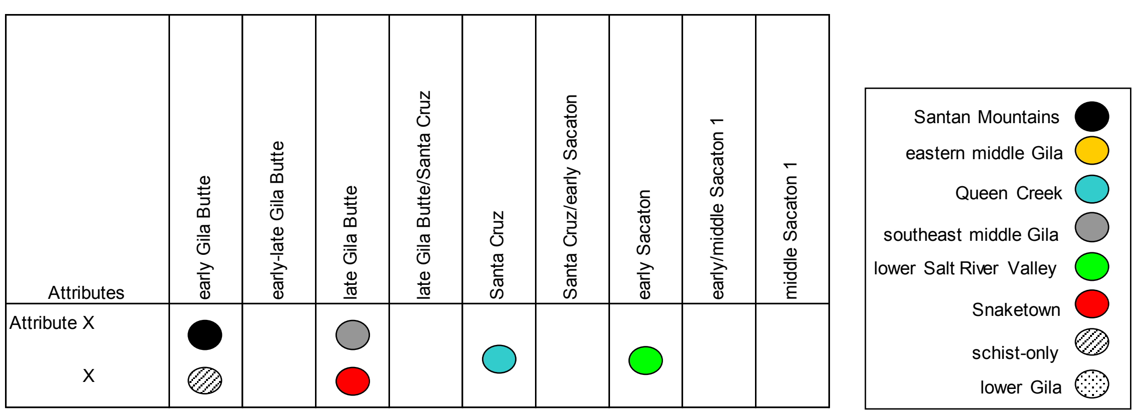


Figure 8.7. Example of measuring the rate of innovation adoption.

segment (generally within 100-150 years). Innovation X was slowly adopted by the Queen Creek potting group in the Santa Cruz time segment. *Very slow adoption* refers to adoption that occurred more than two time segments from the origin segment (generally >150 years). Innovation X was very slowly adopted by the lower Salt River Valley potting group in the early Sacaton time segment.

The rate of the adoption of stylistic innovations differed across the three reorganization episodes, measured by the percentages of innovations adopted very rapidly, rapidly, slowly, or very slowly. Although variation existed within each reorganization episode, innovations were usually adopted either very rapidly or rapidly in all three reorganizations.

Episode 1

The first episode of reorganization, occurring in the middle of the Gila Butte phase, was characterized primarily by an ideological shift. Nearly all innovations associated with this reorganization were adopted either very rapidly or rapidly on both bowls and jars by at least one potting group (Table 8.5). In fact, most innovations were adopted very rapidly by several different potting groups, even among those groups with much smaller sample sizes. Few innovations, however, were adopted rapidly by all groups. For the most part, those groups with much smaller sample sizes adopted innovations slower than other groups. For this reason, most of the slow adoption shown in Table 8.5 should not be given much weight. The overall picture of the Episode 1

Table 8.5. Rate of innovation adoption for the Episode 1 reorganization.

Santan Mountains (black)	Queen Creek (cyan)	lower Salt River Valley (green)	Snaketown (red)
eastern middle Gila (yellow)	southeast middle Gila (gray)	lower Gila (dotted)	schist-only (hatched)

Innovation	early Gila Butte	early-late Gila Butte	late Gila Butte	late Gila Butte/Santa Cru	Santa Cruz	Santa Cruz/early Sacaton	early Sacaton	early/middle Sacaton 1	middle Sacaton 1	middle Sacaton 1/2	middle Sacaton 1-2
Attribute 51 slanted railroad tie hachure	Santan Mountains southeast middle Gila schist-only Snaketown Queen Creek	lower Salt River Valley		lower Gila							
Attribute 52 organizational banding layout	Santan Mountains lower Salt River Valley schist-only	Snaketown		southeast middle Gila				Queen Creek			
Attribute 54 life forms (except birds and lizards)	Santan Mountains southeast middle Gila Snaketown schist-only		lower Salt River Valley		lower Gila		eastern middle Gila Queen Creek				
Attribute 55 quail							Snaketown	Queen Creek			
Attribute 56 free-floating fringe	Santan Mountains eastern middle Gila lower Salt River Valley schist-only Snaketown			lower Gila				Queen Creek			
190 small, geometric element groupd D			schist-only								
Attribute 195 small element group A		schist-only	Snaketown					Queen Creek			Santan Mountains
Attribute 200 crenulated line	schist-only		Snaketown lower Salt River Valley					Queen Creek	Santan Mountains		eastern middle Gila
Attribute 203 fringed curvilinear scroll	eastern middle Gila Queen Creek lower Salt River Valley Snaketown schist-only	Santan Mountains					southeast middle Gila				

reorganization, therefore, was one of very rapid adoption for most innovations by most potting groups.

Episode 2

The second episode of reorganization occurred in the middle of the Sacaton Phase, and revolved primarily around economic restructuring (Table 8.6). At this time, the rate of innovation adoption was noticeably slower than in the Episode 1 reorganization. In part, this slower rate was due to the fact that several inventions were never adopted by other potting groups. In addition, while many innovations were adopted rapidly, few were adopted very rapidly within the same time segment.

Regression analyses showed that the lack of evidence for very rapid adoption among some potting groups could actually be a result of sample size. For example, adoption in the middle Sacaton 1 time segment would have been classified as very rapid for many innovations. During this time segment, however, the sample sizes of bowl sherds from the Queen Creek and eastern middle Gila potting groups was very small, with only three and four sherds represented, respectively. The fact that there were no adopted innovations identified by these groups at this time was in line with what would be expected for their sample sizes (Figure 8.8).

Sample size was not a factor, however, with the Santan Mountains, Snaketown, and schist-only groups. These groups did not exhibit very rapid adoption consistently during this reorganization episode. The results, therefore, indicate that a considerable amount of variation existed in the rate of innovation adoption among potting groups. The possible reasons for this variation are discussed in the following chapter.

Table 8.6. Rate of innovation adoption for the Episode 2 reorganization.

Santan Mountains (black)	Queen Creek (blue-green)	lower Salt River Valley (green)	Snaketown (red)
eastern middle Gila (yellow)	southeast middle Gila (grey)	lower Gila (dotted)	schist-only (hatched)

Attributes	early Gila Butte	early-late Gila Butte	late Gila Butte	late Gila Butte/Santa Cruz	Santa Cruz	Santa Cruz/early Sacaton	early Sacaton	early/middle Sacaton 1	middle Sacaton 1	middle Sacaton 1/2	middle Sacaton 1-2	middle Sacaton 2	middle Sacaton 2/late Sacaton	late Sacaton	late Sacaton/Soho
Attribute 80 wavy-capped fringed (single- or double-capped)							eastern middle Gila	southeast middle Gila Snaketown schist-only	Queen Creek				Santan Mountains		
Attribute 91 crenulated line in a panel									Santan Mountains southeast middle Gila Snaketown schist-only				Queen Creek		
Attribute 92 Gila Shoulder <120 degrees							schist-only		Santan Mountains Queen Creek southeast middle Gila Snaketown				eastern middle Gila		
Attribute 93 Gila Shoulder, knife-edged									Snaketown schist-only						
Attribute 96 rectilinear scroll	Santan Mountains				eastern middle Gila		southeast middle Gila schist-only	Snaketown						Queen Creek	
Attribute 233 panel, at least partly line demarcated, >1 centerline motif									schist-only						
Attribute 235 panel, at least partly line demarcated, zipper, curv. Scroll, or other border elaboration (except fringing, ticking, or sawteeth)									Snaketown						
Attribute 238 panel, at least partly line demarcated, multiple duplicate element used as panel centerline							Santan Mountains Queen Creek	Snaketown		southeast middle Gila schist-only					
Attribute 250 small, geometric element group E								schist-only			Snaketown				
Attribute 255 panel, isolated (completely line demarcated)									schist-only						
Attribute 260 banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width >5mm)															Santan Mountains
Attribute 284 small, geometric element group C								Snaketown schist-only	Santan Mountains Queen Creek					southeast middle Gila	

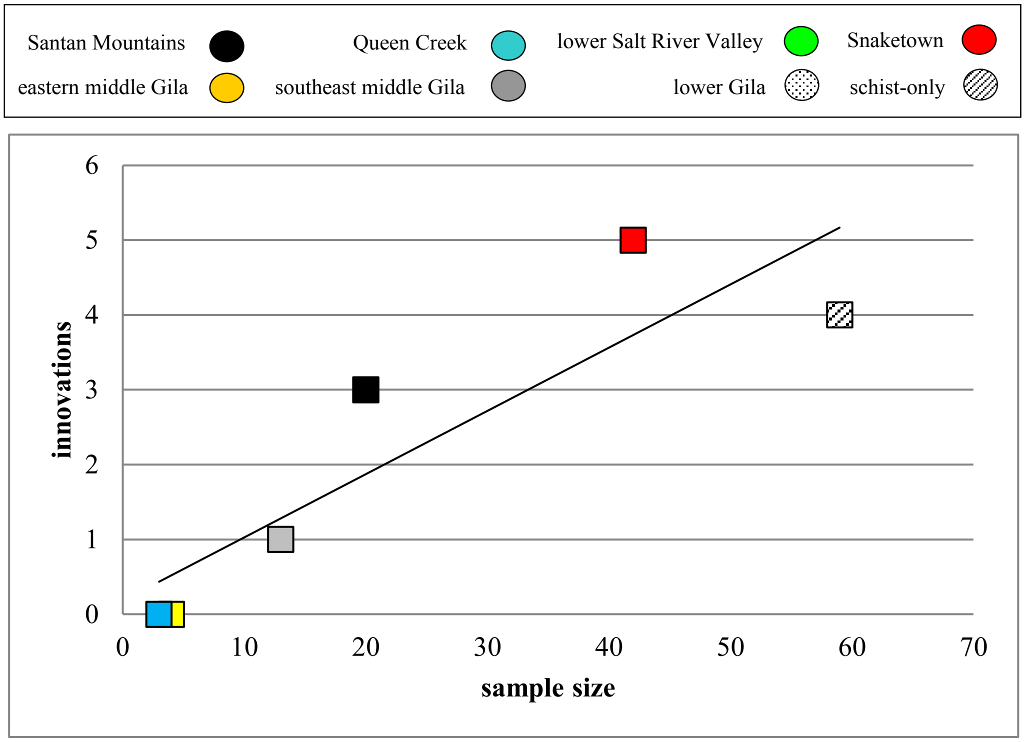


Figure 8.8. Number of innovations by sample size for each potting group in the middle Sacaton 1 time segment (bowl sherds).

Episode 3

The third episode of reorganization occurred at the end of the Sacaton phase, and was marked by shifts in politics, ideology, and economics. This reorganization was characterized by more rapid innovation adoption than in the Episode 2 reorganization (Table 8.7). All but one innovation (tapered lines) was adopted either very rapidly or rapidly by at least one other potting group. That being said, not all groups adopted all innovations rapidly, as three innovations (50%) were adopted slowly by some potting groups. No innovations were adopted very slowly; a result due, in part, to the fact that buff ware production ceased in the Soho time segment. Sample size was not a factor in this pattern.

Table 8.7. Rate of innovation adoption for the Episode 3 reorganization.

Santan Mountains ● (black)	Queen Creek ● (turquoise)	lower Salt River Valley ● (green)	Snaketown ● (red)
eastern middle Gila ● (yellow)	southeast middle Gila ● (grey)	lower Gila (stippled)	schist-only (hatched)

Attributes	middle Sacaton 1	middle Sacaton 1/2	middle Sacaton 1-2	middle Sacaton 2	middle Sacaton 2/late Sacaton	late Sacaton	late Sacaton/Soho	Soho	late Sacaton-Civano	Soho-Civano
Attribute 95 outline line and stagger	Santan Mountains Snaketown schist-only		southeast middle Gila							
Attribute 111 tapered lines	schist-only					Santan Mountains eastern middle Gila Queen Creek Snaketown		southeast middle Gila		
Attribute 112 upper freeline (jars only)	Snaketown schist-only					Santan Mountains Queen Creek southeast middle Gila				
Attribute 121 open panel						Santan Mountains Queen Creek schist-only	Snaketown	eastern middle Gila southeast middle Gila		
Attribute 122 decorated neck					Snaketown	Santan Mountains Queen Creek schist-only		eastern middle Gila southeast middle Gila		
Attribute 124 tall neck					Snaketown	Santan Mountains Queen Creek schist-only		eastern middle Gila southeast middle Gila		

A comparative picture of the rate of innovation adoption

The rate of innovation adoption varied among the three episodes of reorganization in significant ways. Figure 8.9 presents the percentage of innovations adopted very rapidly, rapidly, slowly, very slowly, and never adopted. The most rapid adoption of innovations occurred in the Episode 1 reorganization. Of those innovations not adopted very rapidly, almost all were adopted by at least one potting group rapidly. The rate of adoption slowed down during the subsequent Episode 2 reorganization, when several innovations recorded in this study were never adopted by other groups after their initial

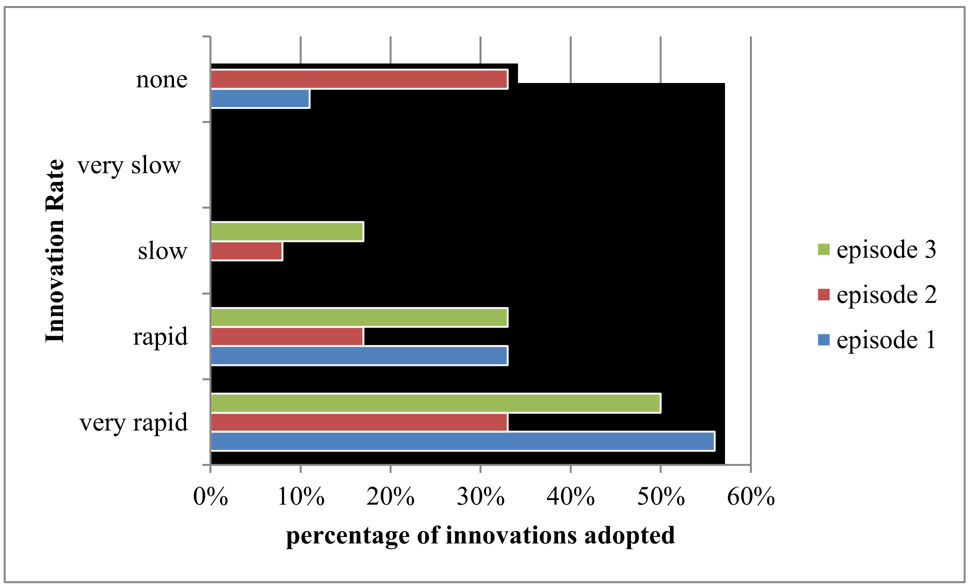


Figure 8.9. Rate of innovation adoption by at least one potting group.

appearance, and of those that were, a smaller percentage was adopted very rapidly. Therate of adoption sped up again in the final episode of reorganization (Episode 3), when 50 percent of innovations on jars were adopted very rapidly by at least one potting group, a pace above that of the Episode 2 reorganization, but below the Episode 1 reorganization.

These results demonstrate that the rate of innovation adoption was similarly rapid in the Episode 1 and 3 reorganizations, but slower in the Episode 2 reorganization. At the beginning of this chapter, it was hypothesized that the rate of innovation adoption should correspond with the relative degree of integration and sense of interconnection. It is interesting that the second episode of reorganization, generally considered to be the time of highest socio-economic integration, exhibited the slowest rates of innovation adoption; while the third reorganization episode, generally considered to be a time of social fragmentation, exhibited very rapid rates of adoption. As will be discussed in the following chapter, other social factors, particularly economic competition, needs to be taken into consideration to account for this unexpected patterning.

Pattern of Adoption

The same basic information used to assess the rate of innovation adoption was also used to determine the pattern of adoption (i.e., which specific potting groups were early adopters and which were late adopters). As will be shown, the patterns were relatively similar across the three episodes of reorganization. The path from origin to earliest adopters was also similar across the three reorganization episodes, with most innovations adopted first by near neighbors.

Episode 1

During the first reorganization episode, most potting groups adopted some stylistic innovations very rapidly (see Table 8.5). A regression analysis of the time segment in which most Episode 1 reorganization episode innovations originated (the early Gila Butte segment) showed that each potting group adopted a similar number of innovations within that same time segment as would be expected given their sample size (Figure 8.10).[3] The only group to invent or very rapidly adopt every Episode 1 innovation was the schist-only group.

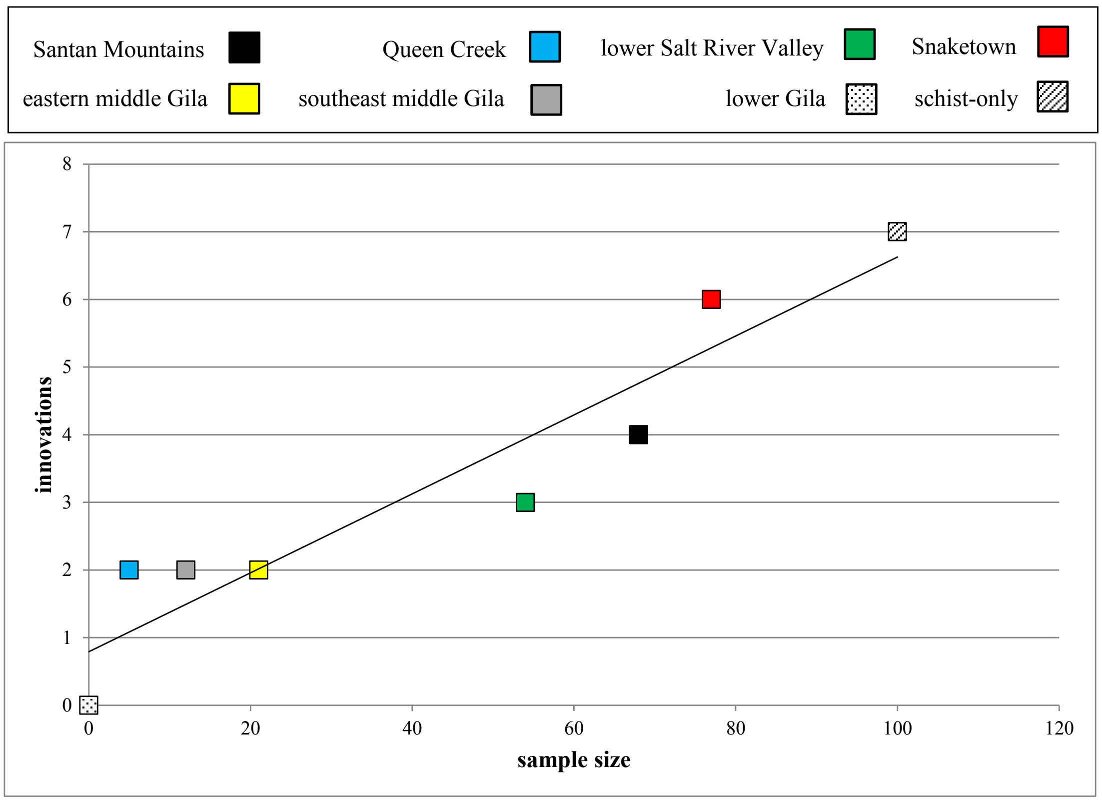


Figure 8.10. Number of innovations by sample size for each potting group in the early Gila Butte time segment; bowls and jars combined.

The pattern of adoption, as seen in the distance between an innovation's origin and its earliest adopters (Table 8.8) was essentially a pattern of nearest neighbor adoption of bowl designs (Table 8.9). The pattern appeared to be somewhat different for jars, as

Table 8.8. Distance between buff ware potting groups.

N = near M = medium D = distant mD = most distant

	Santan	eastern middle Gila	Queen Creek	southeast middle Gila	lower Salt River Valley	Snaketown	schist-only	lower Gila
Santan	-							
eastern middle Gila	N	-						
Queen Creek	M	M	-					
southeast middle Gila	M	N	D	-				
lower Salt River Valley	D	D	D	D	-			
Snaketown	N	N/M	M	M	D	-		
schist-only	N	N	N	N	D	N	-	
lower Gila	mD	mD	mD	mD	mD	mD	mD	-

early adoption occurred frequently with medium and distant groups. This difference between bowls and jars can largely be explained by the larger sample of jar sherds in the group responsible for most of the distant early adoptions, the lower Salt River Valley potting group. The early adoption pattern by near, medium, and distant potting groups should, therefore be viewed as the basic pattern for the first reorganization episode.

Episode 2

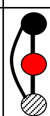
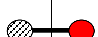
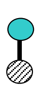
The second episode of reorganization appeared to be characterized by consistent invention or early adoption from the Snaketown and schist-only groups on both bowls and jars (see Table 8.6). Conversely, several potting groups appeared to adopt only very few innovations very rapidly. A regression analysis combining bowls and jars, however, demonstrates that these results fall in line with what was expected based on the respective sample sizes (Figure 8.11). Taken sample size into account, therefore, no consistent pattern was evident concerning the order of earliest adopters.

Table 8.9. Distance from origin to early adopters for the Episode 1 reorganization.

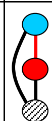
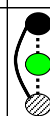
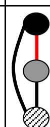
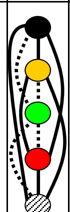
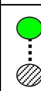
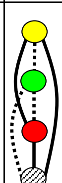
Santan Mountains	Queen Creek	lower Salt River Valley	Snaketown
eastern middle Gila	southeast middle Gila	lower Gila	schist-only

near	
medium	
distant	
most distant	

Bowls

Innovation	early Gila Butte	early-late Gila Butte	late Gila Butte	late Gila Butte/Santa Cruz	Santa Cruz
Attribute 51 slanted railroad tie hachure					
Attribute 52 organizational banding layout					
Attribute 54 life forms (except birds and lizards)					
Attribute 55 quail	no adoption				
Attribute 56 free-floating fringe					
Attribute 190 small, geometric element group D	no adoption				
Attribute 195 small element group A					
Attribute 200 crenulated line					
Attribute 203 fringed curvilinear scroll					

Jars

Innovation	early Gila Butte	early-late Gila Butte	late Gila Butte	late Gila Butte/Santa Cruz	Santa Cruz
Attribute 51 slanted railroad tie hachure					
Attribute 52 organizational banding layout					
Attribute 54 life forms (except birds and lizards)					
Attribute 55 quail	no adoption				
Attribute 56 free-floating fringe					
Attribute 195 small element group A					
Attribute 200 crenulated line					
Attribute 203 fringed curvilinear scroll					

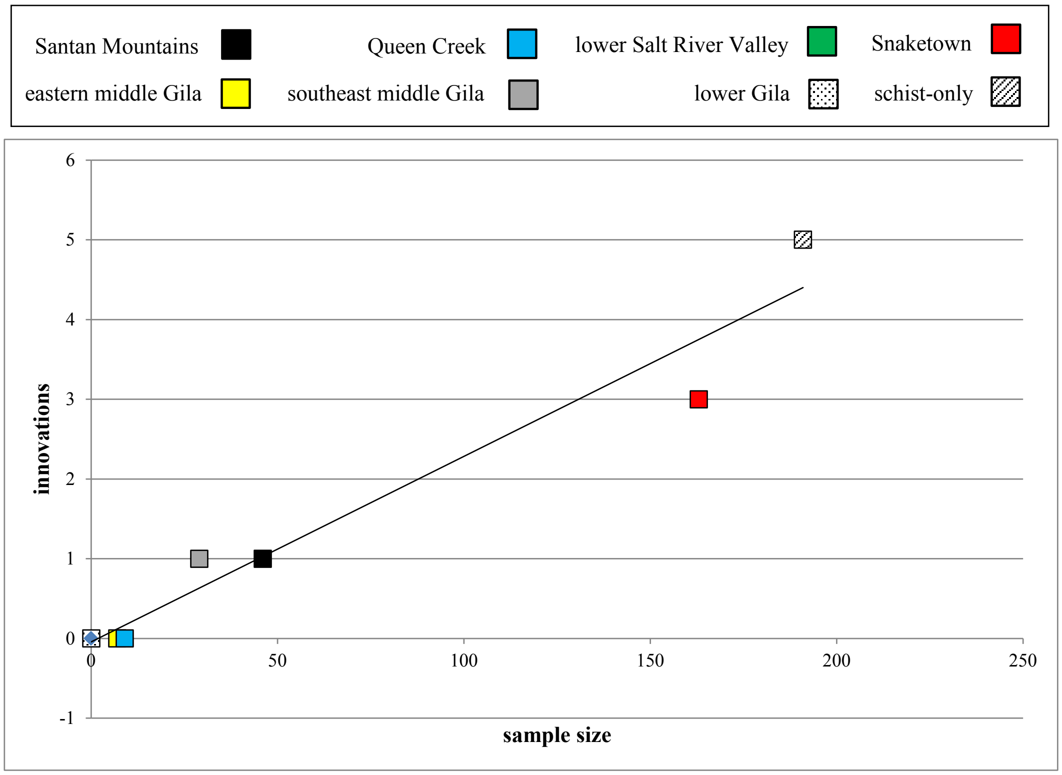


Figure 8.11. Number of innovations by sample size for each potting group in the middle Sacaton 1 time segment; bowls and jars combined.

The relative distance between innovation origins and earliest adopters was dominated by a nearest-neighbor path (Table 8.10). This was due, in part, to the fact the lower Salt River Valley was no longer a significant production area for decorated vessels, thus eliminating this distant group from the possibility of early adoption. Nevertheless, medium distance groups were also rare as earliest adopters. The primary path from invention to earliest adoption, therefore, was between nearest neighbors.

Episode 3

In the third episode of reorganization, early adoption was, again, associated with the most well-represented potting groups. Taking sample size into account, however,

Table 8.10. Distance from origin to early adopters in the Episode 2 reorganization.

Santan Mountains	Queen Creek	lower Salt River Valley	Snaketown
eastern middle Gila	southeast middle Gila	lower Gila	schist-only

near
medium
distant
most distant

Bowls

Attributes	early Sacaton	early/middle Sacaton 1	middle Sacaton 1	middle Sacaton 1/2	middle Sacaton 1-2
Attribute 80 wavy-capped fringed (single- or double-capped)					
Attribute 91 crenulated line in a panel					
Attribute 96 rectilinear scroll					
Attribute 235 panel, at least partly line demarcated, zipper, curv. Scroll, or other border elaboration	not adopted				
Attribute 238 panel, at least partly line demarcated, multiple duplicate element used as panel centerline					
Attribute 250 small, geometric element group E					
Attribute 255 panel, isolated (completely line demarcated)	not adopted				
Attribute 284 small, geometric element group C					

Jars

Attributes	Santa Cruz	Santa Cruz/early Sacaton	early Sacaton	early/middle Sacaton 1	middle Sacaton 1
Attribute 80 wavy-capped fringed (single- or double-capped)					
Attribute 91 crenulated line in a panel					
Attribute 92 Gila Shoulder <120 degrees					
Attribute 93 Gila Shoulder, knife-edged					
Attribute 96 rectilinear scroll					
Attribute 233 panel, at least partly line demarcated, >1 centerline motif	not adopted				
Attribute 238 panel, at least partly line demarcated, multiple duplicate elements used as panel centerline					
Attribute 260 banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line	not adopted				
Attribute 284 small, geometric element group C					

[1] Attribute 96 (rectilinear scrolls) was recorded in one instance in th early Gila Butte time segment in the Santan Mountains temper group.

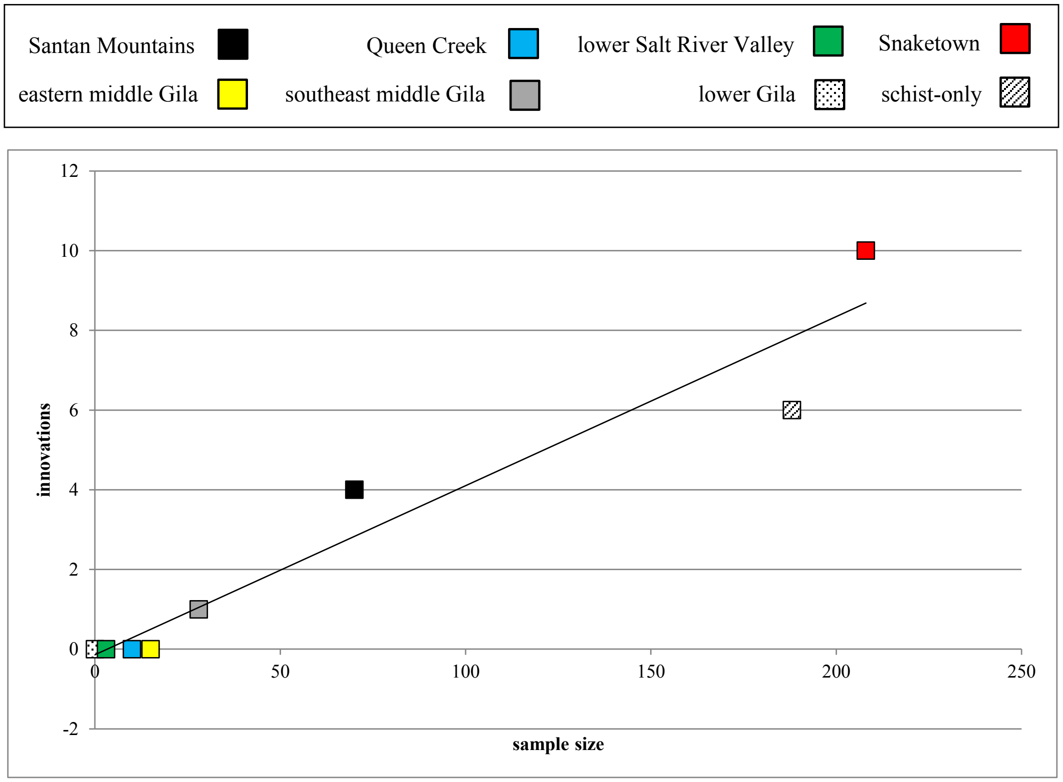


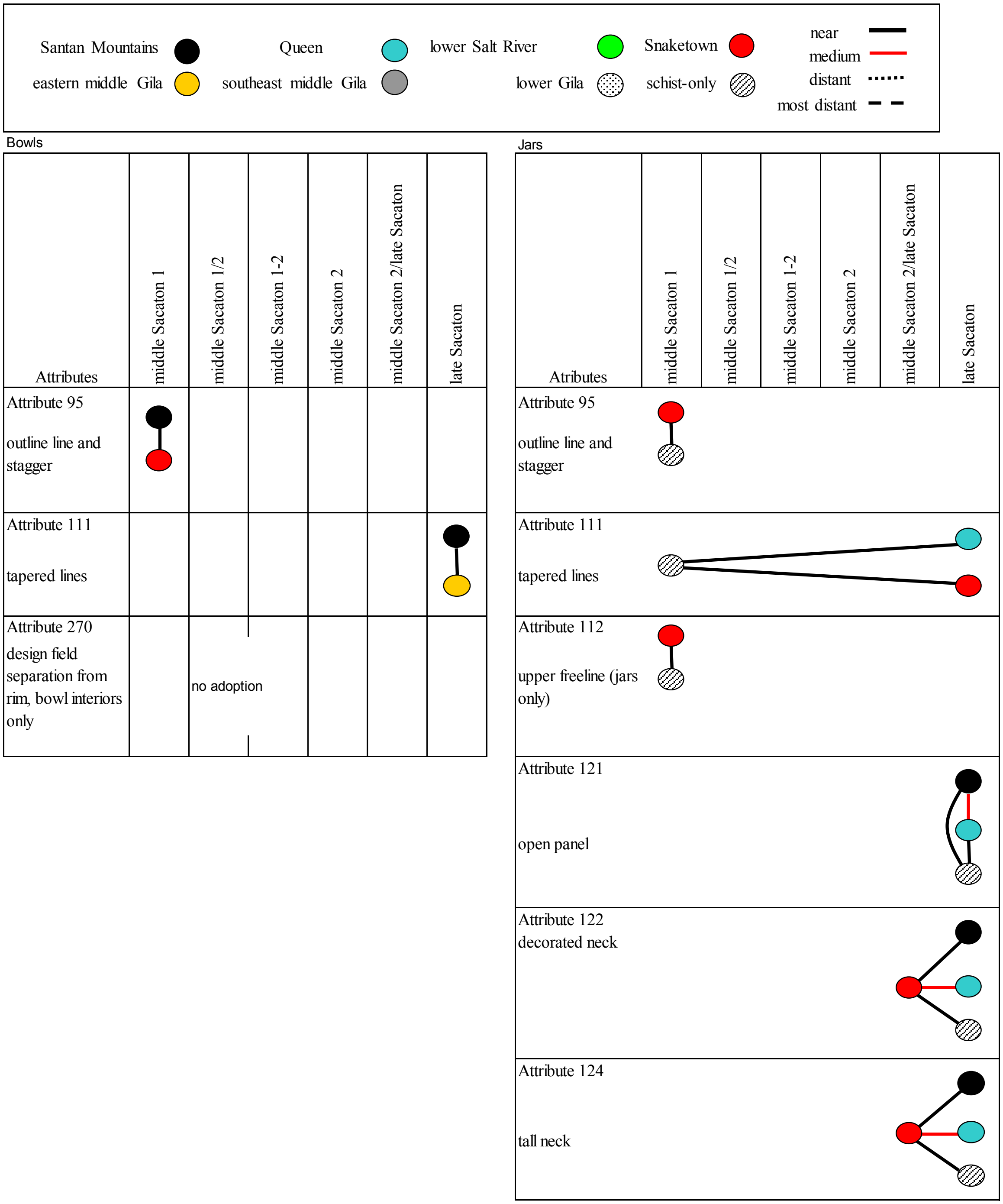
Figure 8.12. Number of innovations by sample size for each potting group combining sherds from the middle Sacaton 1, middle Sacaton 1-2, and middle Sacaton 2-late Sacaton time segments; bowls and jars combined.

revealed that the poorly represented groups very rapidly adopted as many innovations as expected given their small sample size (Figure 8.12). The main difference between this reorganization episode and the previous was that more groups adopted innovations rapidly in the Episode 3 reorganization (see Table 8.7).

The relative distance between the origins of stylistic innovations and the earliest adopters was again dominated by a nearest neighbor path (Table 8.11).

Those instances of early adoption by medium distance groups represented the early adoption by the Queen Creek potting group.

Table 8.11. Distance from origin groups to earliest adopters for the Episode 3 reorganization.



A comparative picture of the pattern of innovation adoption

For the most part, then, clear adoption patterns were not evident from innovation origin to earliest adopter. During the Episode 2 and 3 reorganizations, adopted innovations generally appeared in the number they were expected. In the Episode 1 reorganization, however, it was clear that the schist-only potting group was the most consistent in adopting early compared to other well-represented groups (i.e. Snaketown, Santan Mountains, and lower Salt River Valley).

As is discussed in more detail in the next chapter, the lack of a clear pattern in innovation adoption suggests that buff ware potting groups may have maintained more autonomy than expected. The groups with the highest output were not necessarily the first to invent or adopt an innovation, as shown below.

The pattern of innovation adoption, as observed in their paths from origin to earliest adopters among the potting groups, was similar for each reorganization episode, as well as between vessel forms. For the most part, stylistic innovations followed a nearest neighbor path from their origin to their earliest adopters. In each episode, a minority of adoption paths were classified as occurring between potting groups a medium distance apart from one another. The most significant deviation from this pattern was for jars in the Episode 1 reorganization, when several innovations were very rapidly adopted by the more distant lower Salt River Valley group.

The relationship between innovation origin groups and earliest adopters was expected to be a product of the relative social closeness between groups at any point in time. The social closeness, in turn, was expected to potentially correspond with the sense of interconnection and relative degree of integration in the society, as a whole. A more interconnected society should be characterized by more socially close relationships with distant potting groups. The lack of significant variation in the pattern of innovation adoption among the three episodes of reorganizations was, therefore, unexpected. In the following chapter, I explore why the relationships among buff ware potting groups were relatively stable over the reorganization episodes.

Uniformity of Adoption

The uniformity of innovation adoption was a measurement of 1) how many potting groups adopted an innovation associated with each reorganization episode regardless of timing, and 2) the brevity in which potting groups adopted an innovation suite. By considering the uniformity of adoption in these two ways, similarities and differences clearly emerged among the different episodes of reorganization. The results show that the same potting groups consistently adopted the same suite of innovations in all three reorganization episodes, but the timing, or brevity, of that adoption varied between the episodes.

Episode 1

Overall, the number of potting groups that eventually adopted an innovation in the first episode of reorganization was variable, ranging from one to seven groups for the different innovations (Table 8.12). The schist-only, Snaketown, lower Salt River Valley, Queen Creek, and Santan Mountains potting groups adopted a similar set of attributes. The other potting groups adopted an expected number of innovations derived from their sample sizes. In general terms, most innovations in this reorganization episode were

Table 8.12. The total number of potting groups that adopted a particular innovation for the Episode 1 reorganization.

Santan Mountains (black) · Queen Creek (turquoise) · lower Salt River Valley (green) · Snaketown (red)
eastern middle Gila (yellow) · southeast middle Gila (gray) · lower Gila (dotted) · schist-only (hatched)

Episode 1 innovation suite - bowls and jars combined

	Santan Mountains	eastern middle Gila	Queen Creek	southeast middle Gila	lower Salt River Valley	Snaketown	schist-only	lower Gila
Attribute 51 - slanted railroad tie hachure	●		●	●	●	●	●	●
Attribute 52 - organizational banding layout	●		●	●	●	●	●	
Attribute 54 - life forms (except birds and lizards)	●	●	●		●	●	●	●
Attribute 55 - quail			●			●		
Attribute 56 - free-floating fringe	●	●	●		●	●	●	●
Attribute 190 - small, geometric element groupd D							●	
Attribute 195 - small element group A	●		●			●	●	
Attribute 200 - crenulated line	●	●	●	●	●	●	●	
Attribute 203 - fringed curvilinear scroll	●	●	●	●	●	●	●	

eventually adopted by nearly all potting groups. In other words, innovation adoption in the Episode 1 reorganization was highly uniform.

Episode 2

Of all reorganization episodes considered in this study, innovation adoption appeared to be the least uniform in the Episode 2 reorganization (Table 8.13). Most innovations were adopted at some point by the schist-only group, as well as by the Snaketown, and Santan Mountains potting groups. The remaining groups, however, failed to adopt many innovations associated with this time segment. A regression analysis revealed, however, that all of the groups that appeared to fail to adopt several innovations

Table 8.13. The total number of potting groups that adopted a particular innovation for the Episode 2 reorganization.

Santan Mountains (black)	Queen Creek (turquoise)	lower Salt River Valley (green)	Snaketown (red)
eastern middle Gila (yellow)	southeast middle Gila (gray)	lower Gila (dotted)	schist-only (hatched)

Episode 2 innovation suite - bowls and jars combined

Attribute	Santan Mountains	eastern middle Gila	Queen Creek	southeast middle Gila	lower Salt River Valley	lower Gila	Snaketown	schist-only
Attribute 80 - wavy-capped fringed (single- or double-capped)	●	●	●	●			●	●
Attribute 91 - crenulated line in a panel	●		●	●			●	●
Attribute 92 - Gila Shoulder <120 degrees	●	●	●	●			●	●
Attribute 93 - Gila Shoulder, knife-edged							●	●
Attribute 96 - rectilinear scroll	●	●	●	●			●	●
Attribute 233 - panel, at least partly line demarcated, >1 centerline motif								●
Attribute 235 - panel, at least partly line demarcated, zipper, curv. Scroll, or other border elaboration (except fringing, ticking, or sawteeth)							●	
Attribute 238 - panel, at least partly line demarcated, multiple duplicate element used as panel centerline	●		●	●			●	●
Attribute 245 - cauldron (concave or vertical wall)	●						●	●
Attribute 250 - small, geometric element group E							●	●
Attribute 255 - panel, isolated (completely line demarcated)								●
Attribute 260 - banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width >5mm)	●							
Attribute 284 - small, geometric element group C	●		●	●			●	●

actually adopted more than the number that was expected given their sample size (Figure 8.13).

The Snaketown and schist-only potting groups were expected to contain many more innovations, including the rare innovations, than the other groups due to their

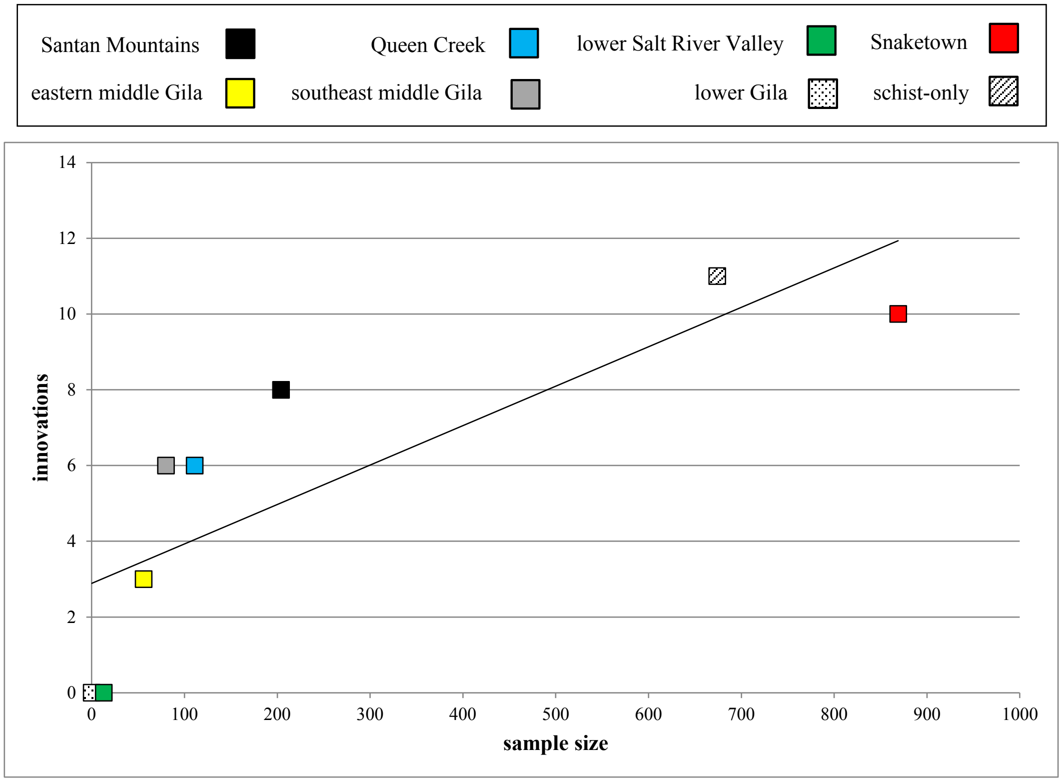


Figure 8.13. Number of innovations by sample size for each potting group combining sherds from the early Sacaton – late Sacaton/Soho time segments; bowls and jars combined.

production dominance. While this expectation was met in regards to the schist-only potting group, the Snaketown group actually contained fewer innovations than expected. If the schist-only group was more geographically dispersed and/or less unified than the other potting groups, it is not surprising that rare innovations might be more frequent. Taking these sample size issues into account, therefore, revealed that innovation adoption in the Episode 2 reorganization was semi-uniform.

Episode 3

The third episode of reorganization was the most uniform of all three reorganization episodes. Nearly all stylistic innovations associated with the Episode 3 reorganization were adopted by all potting groups that existed at the time (Table 8.14). The single exception to this pattern, Attribute 270, occurred only once.

A comparative picture of the uniformity of adoption

A comparison of innovation adoption among the three episodes of reorganization revealed that the uniformity of innovation adoption was high in the first and third reorganization episodes, but only semi-uniform in the second. It would be a mistake, however, to conclude from the uniformity of innovation adoption that these potting groups with similar stylistic repertoires eventually came to nearly identical stylistic repertoires in each reorganization episode. The uniformity simply shows which potting groups adopted a particular innovation at any point in time; it says nothing of how long that innovation remained in the stylistic repertoire of any potting group or how consistently it was employed by that group.

A close examination of an innovation's presence at any given point in time revealed that many innovations were not consistently employed over time by a potting group after their initial adoption by that group (Figure 8.14). For example, although the Santan Mountains, Snaketown, and schist-only potting groups had each adopted most Episode 1 innovations by the early Sacaton time segment, they were not all regularly employing the same innovations during each time segment.

Table 8.14. The total number of potting groups that adopted a particular innovation for the Episode 3 reorganization.

Santan Mountains	● (black)	Queen Creek	● (turquoise)	lower Salt River Valley	● (green)	Snaketown	● (red)
eastern middle Gila	● (yellow)	southeast middle Gila	● (grey)	lower Gila	● (dotted)	schist-only	● (hatched)

Episode 3 innovation suite - bowls and jars combined

Attribute	Santan Mountains	eastern middle Gila	Queen Creek	southeast middle Gila	Snaketown	schist-only
Attribute 95 - outline line and stagger	●			●	●	●
Attribute 111 - tapered lines	●	●	●	●	●	●
Attribute 112 - upper freeline (jars only)	●		●	●	●	●
Attribute 121 - open panel	●	●	●	●	●	●
Attribute 122 - decorated neck	●	●	●	●	●	●
Attribute 124 - tall neck	●	●	●	●	●	●
Attribute 270 - design field separation from rim (bowl interiors only)						●

after that they were initially adopted. These data suggest that a common repository of stylistic attributes related to the reorganization existed from which potters from different potting groups could freely choose to apply to their vessels.

Overall, the innovations associated with the Episode 1 reorganization appeared to be the least uniformly adopted, not in terms of the number of adopted innovations by different potting groups, but in terms of the variability in the timing of that adoption. Whereas many innovations in the Episode 1 suite were adopted ~150 years apart from one another by different groups, most innovations in Episodes 2 and 3 were adopted within 30-100 years of one another.

These results were, in some respects, the opposite of what was expected. The sense of interconnection that was supposed to have accompanied the first episode of

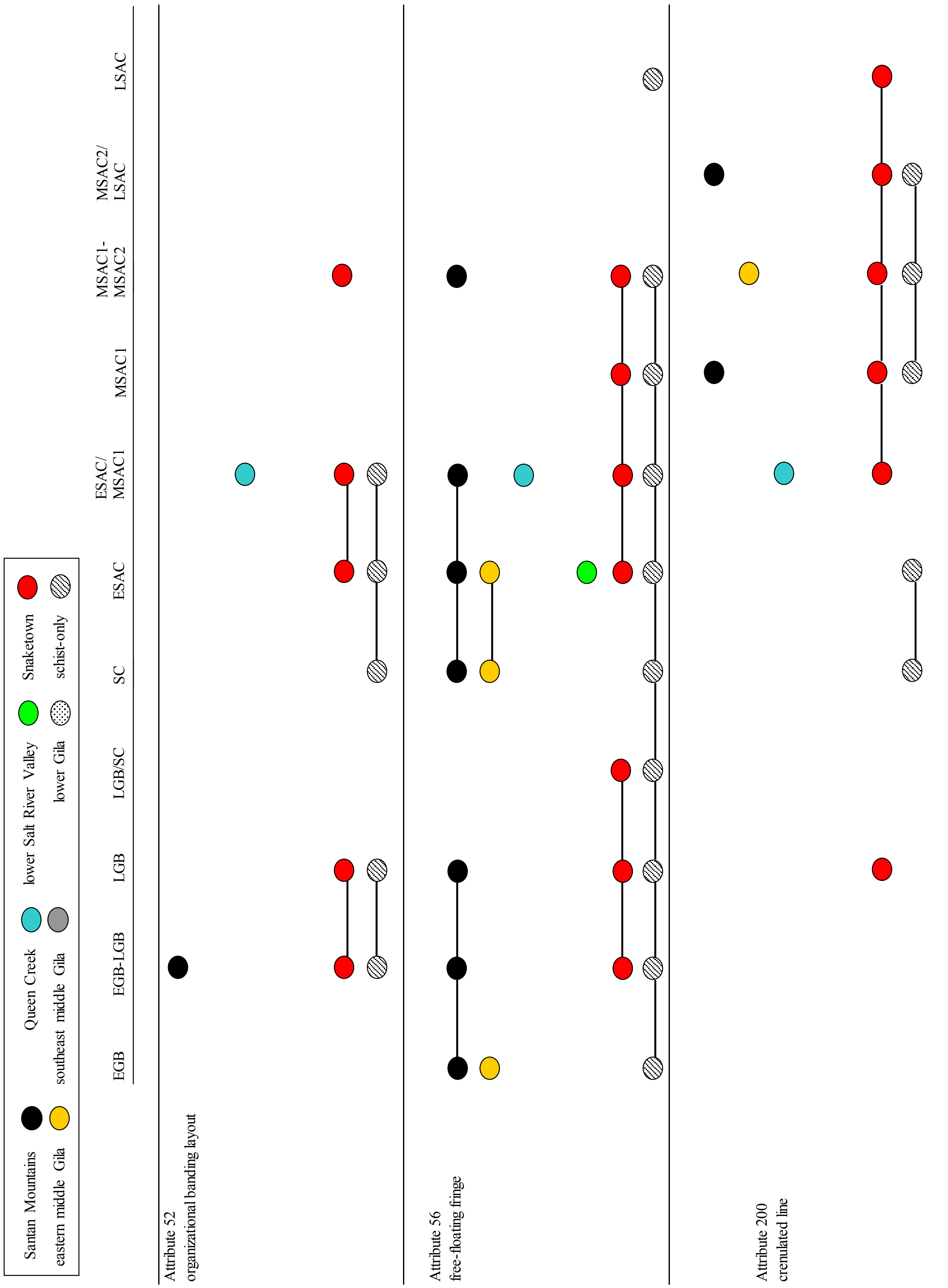


Figure 8.14. Presence of Episode 1 individual stylistic innovations on bowls over time by potting group.

reorganization was expected to have resulted in the most uniform adoption of innovations, while the social fragmentation that characterized the third episode of reorganization should have exhibited the least uniformity in adoption. The reasons why these expectations were not met are discussed in the following chapter.

Wallace's Style Horizons

The results presented above need to be considered in light of Wallace's 'horizon styles' (1994, 1995, 2001; see also Wallace et al. 1995) for southern and central Arizona, because these style have been employed as a framework in which to understand stylistic shifts not only in pottery, but also in other media. In these studies, Wallace and colleagues argued that, prior to A.D. 1300 and the Salado phenomenon, the Hohokam stylistic sequence could be broken up into three styles, each with distinctive attributes, motifs, and layouts that tended to occur on multiple types of media. The second and third of these style horizons correspond generally to my Episode 1 and Episode 2 reorganizations.[4] That is, the horizon styles are characterized not only by innovations in attributes or motifs or layouts, but by a new prominence of attributes, motifs, or layouts that may have been in existence for hundreds of years. Furthermore, horizon styles were described generally, and take the whole vessel into account. For example, Style 2 is characterized by the prominence of rectilinear motifs, non-figurative designs, and basketweave layouts (Wallace 1994, 1995; Wallace et al. 1995). In contrast, my Episode 2 reorganization includes specific individual attributes, measured quantitatively, and all of which were either absent or very rare prior to the reorganization.

These difficulties stated, it was still possible to convert my attribute data into more general characteristics, and then examine those in regard to the origin, rate, pattern, and uniformity of innovation and adoption. This conversion was done by simply combining several of my specific attributes into more generic motifs that corresponded well with stylistic distinctions of Styles 1 and 2 (Table 8.15). The two stylistic distinctions chosen from Wallace's horizon styles were repeated small elements from Style 2, and basketweave layout for Style 3. Bowls and jars were combined in this part of the analysis because the distinctive traits that Wallace and colleagues have described for the horizon styles were not delimited by vessel form (or even different media).

Origin

The earliest appearances of the repeated small elements in Wallace's Horizon Style 2 in this study occurred in the early Gila Butte time segment, and were associated with three different potting groups: the Santan Mountains group, the lower Salt River Valley group, and the schist-only group (Table 8.16). It is interesting that none of the earliest appearances of repeated small elements were associated with the Snaketown potting group given the fact that 23 percent of the early Gila Butte sherds belonged to this potting group.

The earliest appearances of basketweave layouts occurred in the early Sacaton time segment on sherds from the Santan Mountains and Queen Creek potting groups. In other words, potters in a quarter of all of the potting groups identified were decorating vessels with a basketweave technique, at least in part, by the early Sacaton time segment.

Table 8.15. Conversion of my specific attributes to two of Wallace's distinctive traits for Styles 1 and 2.

Reorganization episode 1	**Wallace's Horizon Style 2**
190 - small, geometric element group D	Repeated small elements
195 - small element group A	
52 - organizational banding layout	
Reorganizaiton episode 2	**Wallace's Horizon Style 3**
91 - crenulated line in a panel	basketweave layout
233 - panel, at least partly line demarcated, >1 centerline motif	
235 - panel, at least partly line demarcated, zipper, curv. Scroll, or other border elaboration (except fringing, ticking, or sawteeth)	
238 - panel, at least partly line demarcated, multiple duplicate elements used as panel centerline	
255 - panel, isolated (completely line demarcated)	

Table 8.16. The earliest appearances in this study of distinctive traits for Wallace's Styles 1 and 2, combining bowls and jars.

Santan Mountains	Queen Creek	lower Salt River	Snaketown
eastern middle Gila	SE middle Gila	lower Gila	schist-only

Episode 1 reorganization

Attribute*	Production group associated with origin	Earliest occurrence
repeated small elements		early Gila Butte
Episode 2 reorganization		
basketweave		early Sacaton

To explore this result further, basketweave (or paneling) designs were tabulated quantitatively across all time segments. In order to compare potting groups using the highest possible sample sizes, I combined sherds from six of the potting groups to compare against the dominant Snaketown and schist-only groups (Table 8.17). Only one case of paneling was recorded that pre-dated the early Sacaton time segment, that being in the early Gila Butte segment and associated with the schist-only potting group. Basketweave designs appear in earnest in the early Sacaton time segment, and steadily increase throughout the rest of the buff ware sequence.

The first conspicuous result is that during the initial period of basketweave popularity the highest percentages occurred with the non-Snaketown and non-schist-only potting groups. In the subsequent transition from the early Sacaton to the middle Sacaton1 time segment, up until the transition from the middle Sacaton 2 to the late Sacaton time segment, the Snaketown and schist-only potting groups utilized

Table 8.17. Presence of basketweave layout (indicative of basketweave or plaited designs) over time comparing the Snaketown and schist-only with all other potting groups.

Time		other	Snaketown	schist-only
early Gila Butte	basketweave present	-	-	1
	total sherds	107	77	100
		0.0%	0.0%	1.0%
early Sacaton	basketweave present	4	2	2
	total sherds	80	228	111
		5.0%	0.9%	1.8%
early Sacaton/middle Sacaton 1	basketweave present	2	8	1
	total sherds	55	143	106
		3.6%	5.6%	0.9%
middle Sacaton 1	basketweave present	14	21	24
	total sherds	97	163	192
		14.4%	12.9%	12.5%
middle Sacaton 1 - middle Sacaton 2	basketweave present	10	19	17
	total sherds	82	224	141
		12.2%	8.5%	12.1%
middle Sacaton 2 - late Sacaton	basketweave present	1	1	3
	total sherds	43	22	52
		2.3%	4.5%	5.8%
late Sacaton	basketweave present	8	2	2
	total sherds	61	55	37
		13.1%	3.6%	5.4%
late Sacaton/Soho	basketweave present	6	5	10
	total sherds	36	44	37
		16.7%	11.4%	27.0%
late Sacaton - Civano	basketweave present	4	7	3
	total sherds	8	15	15
		50.0%	46.7%	20.0%
Soho - Civano	basketweave present	15	6	11
	total sherds	69	18	49
		21.7%	33.3%	22.4%

basketweave layouts on a comparable level with the other potting groups. During the late Sacaton segment, however, the non-Snaketown and non-schist-only groups again demonstrated a tendency toward more frequent use of basketweave layout. After the late Sacaton time segment, basketweave layouts became more popular for all potting groups.

Rate of Adoption

The repeated small elements showed more variation in the timing of adoption than did the basketweave designs. On the one hand, repeated small elements were adopted very rapidly by more potting groups than basketweave designs (Table 8.18). On the other hand, repeated small elements were adopted slowly and even very slowly by some potting groups, while basketweave designs were adopted very rapidly or rapidly by nearly all groups.

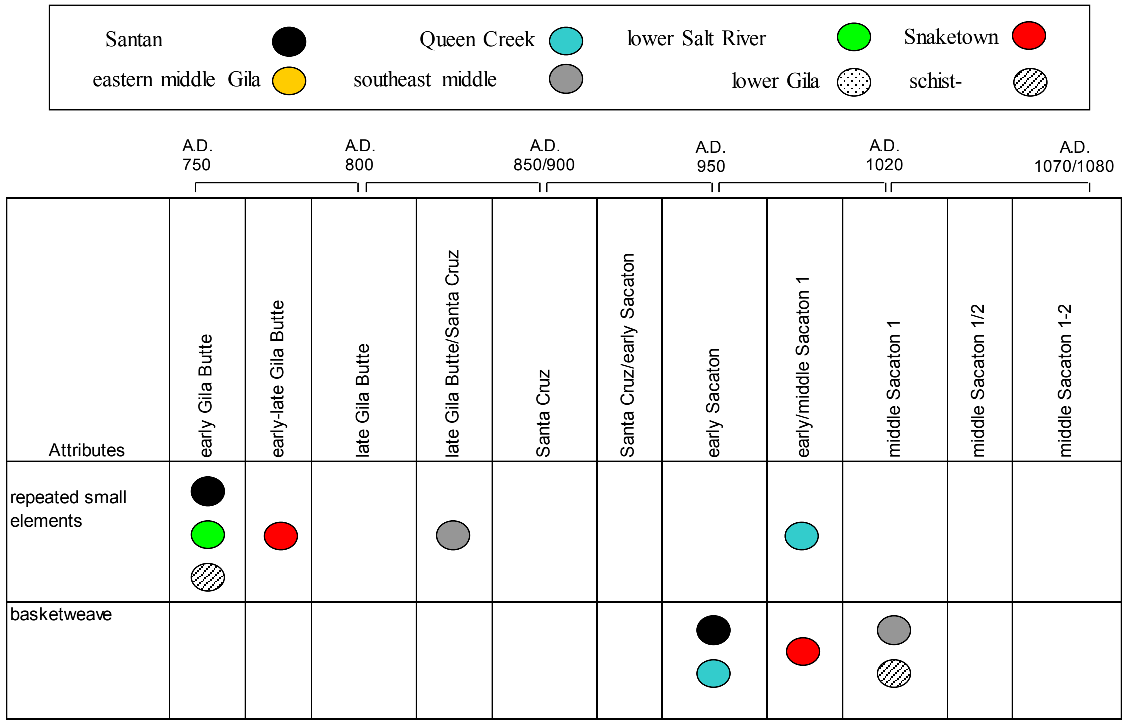
Pattern of Adoption

The distance between the innovation's origin and its earliest adopters for the two stylistic distinctions under investigation did not follow a nearest-neighbor path (Table 8.19). Instead, basketweave designs were adopted most quickly by those potting groups located a medium distance from one another. Repeated small elements were adopted just as quickly by groups that were as distant as those that were near to one another.

Uniformity of Adoption

The total number and distribution of potting groups that adopted the particular design attributes under investigation were almost identical between the repeated small elements and the basketweave design (Table 8.20). The only difference between the two was that the lower Salt River Valley group did not adopt the basketweave designs, as they had the repeated small elements. Again, this slight discrepancy is likely due to the fact that the lower Salt River Valley was essentially a non-factor in terms of the production of painted ceramics in the Sacaton phase.

Table 8.18. The rate of adoption of distinctive traits for Wallace's Styles 1 and 2, combining bowls and jars.

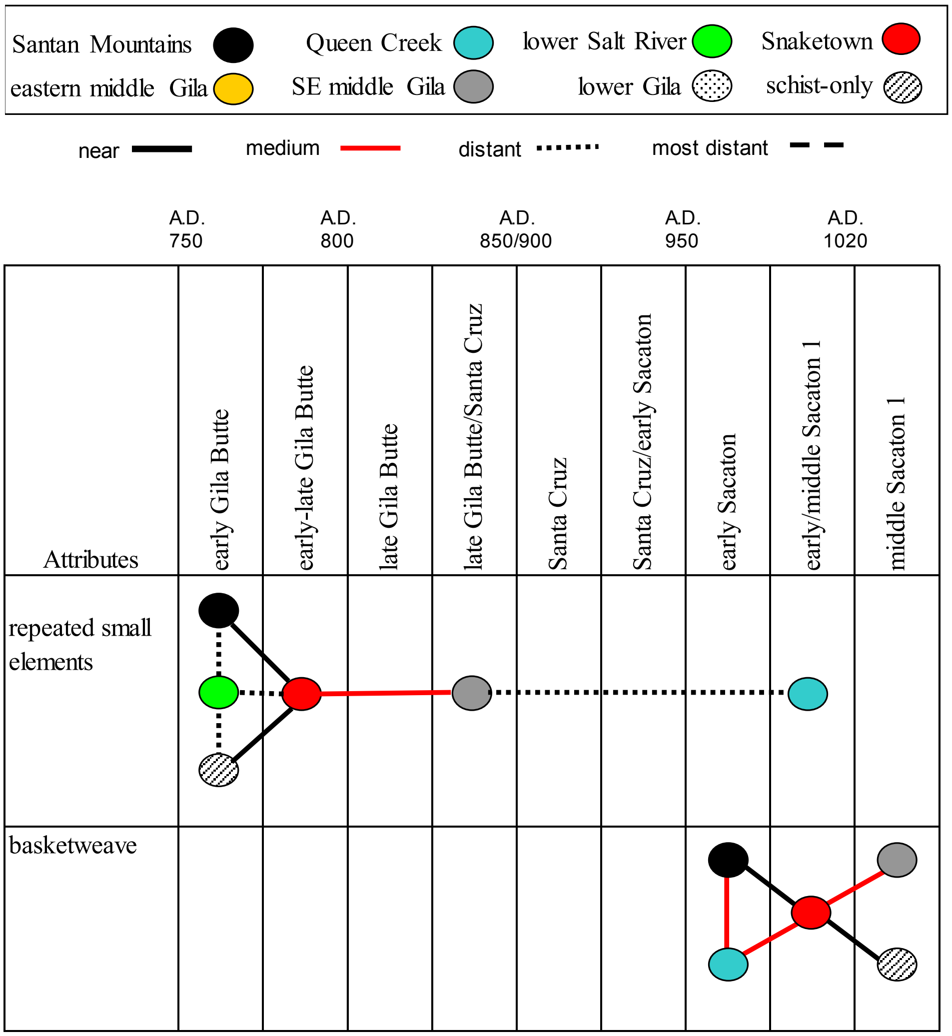


Summary

Wallace's (1995, 2001) horizon styles 1 and 2 were investigated using the data collected in this study to understand the process involved in those general styles moving from invention to adoption. My data were converted into two general categories in order to compare with Wallace, as well as to examine the largest possible sample. Repeated small elements were the representatives of Wallace's Style 2 (my Episode 1 Reorganization), and basketweave designs were the representatives of Wallace's Style 3 (my Episode 2 Reorganization).

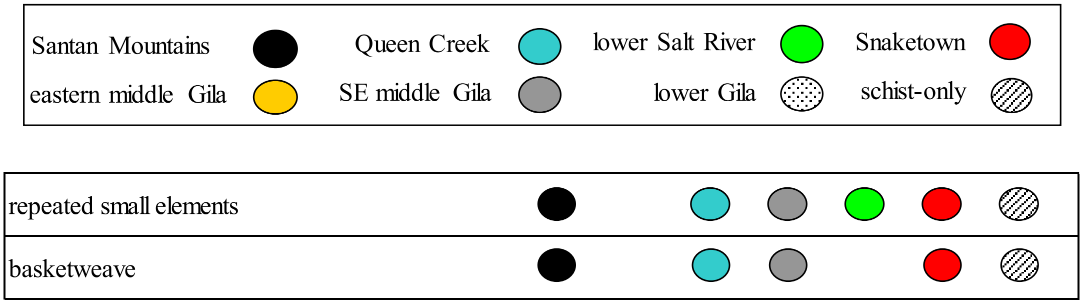
The results of these general categories conformed, for the most part, to those recorded for the individual innovations reported above for the variables describing the

Table 8.19. The pattern of adoption of distinctive traits for Wallace's Styles 1 and 2, combining bowls and jars.



process of innovation. The one exception was the pattern of innovation adoption. The pattern of adoption recorded in the individual innovations was typically between nearest neighbors, whereas the pattern recorded for the general innovation categories was a mixture of near, medium distance, and distant neighbors.

Table 8.20. The total number and distribution of potting groups that adopted distinctive traits for Wallace's Styles 1 and 2.



Overall, Wallace's horizon styles well describe important stylistic changes that occurred at significant points in Hohokam history. For Wallace (2001:258), these horizon styles begin with the introduction of a style, followed by a period of experimentation with new designs and layouts that eventually gives way to replication and simplification. Underlying this general pattern, however, this study has revealed a rather complicated process of invention and adoption among potting groups. The data concerning horizon styles can, perhaps, best be interpreted as a general idea spreading quickly (e.g., repeated small elements, basketweave layout) vs. innovations that take those ideas in new directions (e.g., specific geometric small elements, panel border elaborations, experimentation with panel borders, etc.).

Stylistic Innovation: A Summary of the Results

The measurements of four variables to describe the process of stylistic innovation over three episodes of reorganization were reported in this chapter (Table 8.21). Certain expectations had been generated for each of these variables based on what is known about the social, economic, ideological, and political environments for each episode. While some of these expectations were met, many were not. In some cases, the result was the very opposite of what was expected. In the following chapter I endeavor to interpret these results that, taken together, suggest that 1) a greater degree of autonomy existed among buff ware potting groups than was supposed, and 2) some of the assumptions that have been made about the social, economic, ideological, and political environments need to reconsidered.

Table 8.21. Summary of results for measuring the process of stylistic innovation.

Variables relating to the process of stylistic innovation	A.D. 800 mid/late Gila Butte transition	A.D. 1000-1020 early/mid Sacaton transition	A.D. 1100-1125 late Sacaton/early Soho phase
origin	ambiguous	multiple origins	few origin locations
relative timing of adoption	adoption over short period of time	adoption over longest time period	adoption over short period of time
pattern of adoption	primarily linear (nearest neighbor) adoption	primarily linear (nearest neighbor) adoption	primarily linear (nearest neighbor) adoption
uniformity of adoption	highly uniform adoption	semi-uniform adoption	highly uniform adoption

Chapter 8 Notes

[1] Three quails (attribute #55) were also recorded, but they occurred in Sacaton phase contexts - much later than it is known to have originated (Wallace 2004)

[2] Although crenulated lines originated in the Gila Butte phase, they did not become popular until later in the Sacaton phase.

[3] This figure is different from Figure 8.4 in that it only displays the sample from the earliest time segment, the early Gila Butte segment. The regression was limited to this time segment because the issue at hand in the pattern of adoption was which groups adopted very rapidly; that is, within the same time segment of the innovation's origin. Figure 8.4 combined the early Gila Butte, early/late Gila Butte, and late Gila Butte time segments to include those groups which adopted at a slower rate.

[4] I have argued here for another significant stylistic break in the late Sacaton/Soho time segments that Wallace considers to be only a development of his Style 2.

Chapter 9:

PUTTING STYLISTIC INNOVATION IN ITS CONTEXT

In this chapter, I consider the implications of the stylistic analysis results in view of the larger social context in which innovation occurred. In so doing, I place the data beside the theoretical expectations set out in the beginning of this dissertation in an attempt to explain the variability observed among reorganization episodes in the Hohokam world (Table 9.1). I conclude in Chapter 10 by drawing out broad principles that can be applied to other archaeological and anthropological cases.

Stylistic Innovation in the Hohokam World

The results of the analysis conducted for this project revealed that stylistic innovation among Hohokam buff ware potters was a complicated process that varied in significant ways for each episode of reorganization. The ideas concerning layouts and motifs were introduced and accepted quickly by some, slowly by others, and not at all, by yet other groups. Sometimes, innovations were adopted by nearest-neighbors, and sometimes, they were more quickly adopted by those more distant. Some groups appeared to adopt an innovation at one point, only to quickly abandon it in the next generation or two.

Innovation and the Episode 1 Reorganization

How then do the results for each measured variable conform to the expectations for the Episode 1 reorganization set out in Chapter 3? In general, the results were ambiguous regarding the origins of innovations. Expectations were largely met regarding the rate and uniformity of innovation adoption, but were not met in regards to the pattern.

Table 9.1. Results of innovation analysis compared to expectations.

Variables relating to the process of stylistic innovation		Episode 1:A.D. 800 mid/late Gila Butte transition	Episode 2: A.D. 1000-1020 early/mid Sacaton transition	Episode 3: A.D. 1100-1125 late Sacaton/early Soho phase
origin	*expected*	*few (even 1) origin locations*	*few origin locations initially; multiple origins soon follow*	*multiple origins from the beginning*
	observed	ambiguous	multiple origins	few origin locations
rate of adoption	*expected*	*adoption over short period of time (perhaps within one time segment) due to strong interconnection and integration*	*adoption over a relatively longer time period due to economic competition*	*adoption over longest time period due to weak interconnection among loosely integrated populations*
	observed	adoption over short period of time	adoption over longest time period	adoption over short period of time
pattern of adoption	*expected*	*non-linear adoption pattern*	*non-linear adoption pattern*	*nearest neighbor (linear) adoption pattern due to the lack of social integration*
	observed	primarily linear (nearest neighbor) adoption	primarily linear (nearest neighbor) adoption	primarily linear (nearest neighbor) adoption
uniformity of adoption	*expected*	*highly uniform adoption*	*heterogeneous adoption*	*heterogeneous adoption*
	observed	highly uniform adoption	semi-uniform adoption	highly uniform adoption

The first episode of reorganization investigated in this study occurred at the transition between the early and late Gila Butte time segments (~A.D. 800). As discussed in chapter 3, this reorganization revolved around the rapid spread of a new ideology with Mesoamerican roots (Wallace 2001; Wallace et al. 1995; Wilcox 1991a; Wilcox and Sternberg 1983; Wilcox et al. 1981). This new ideology is manifested most clearly to archaeologists in the simultaneous development and spread of new ritually important architecture (i.e., ballcourts), a new mortuary complex, and new stylistic motifs and emphases in rock art, groundstone, textiles, and buff ware pottery. I argued that the rapid acceptance and implementation of these changes over a large territory pointed towards a high level of social interconnection and concern for social integration at a wide level. Whatever the new ideology was, it seems to have succeeded in cutting across social boundaries and connecting persons who were geographically, and possibly socially, distant from one another.

These changes qualify this reorganization as a time of social stress, disruption, or change that would have provided an opportunity for agents (i.e., buff ware potters) to intentionally or unintentionally affect the larger social structure (Aldenderfer 1993; Hegmon and Kulow 2005; Schachner 2001). Because of the role that red-on-buff pottery played in the display and promotion of Hohokam ideology (Wallace 1994; Wallace et al. 1995; Wilcox 1991a), buff ware potters would have been in a position to either actively promote or reject the new ideology. Considering all of the different media and social arenas that were affected by the rapid embrace of this new ideology, it is likely that there was a considerable social (and potentially economic) incentive for buff ware potters (and everyone else, for that matter) to do the same.

During this first reorganization episode, it was expected that most innovations would have originated at a small number of locations that possessed the ritual and/or political influence to disseminate the rules of expression of the new ideology that was adopted from Mesoamerica. Research has shown that ideological changes to a system are usually disseminated from people or places of ritual importance and authority (Bargatzky 1989; Spielmann 2002). These people or places would also have to have a considerable influence on a wide network of potential consumers.

This idea was first proposed by Wallace (1994) to account for the clear changes in ideological structures, the grand scale at which the new style was exported, and the particular emphasis this ideology placed on death rituals. He sees this new style implemented by a few groups of potters potentially seizing the economic opportunity of affiliating themselves with the new religious ideology (1994:5). While this hypothesis is possible, it is equally plausible that buff ware potters were less motivated by economics, and more by self-identification with a new religious movement. In the latter case, competition between producers is likely to have been less intense than if the former had been true.

Decorated red-on-buff bowls and jars would have been an especially effective way of quickly transmitting new religious, social, and political ideas to a wide audience due to their wide circulation and transportability (especially bowls, which could be stacked). It is conceivable that certain potting communities took advantage of the ideological climate of the day by decorating their pots with new motifs and layouts that would have been linked to the new ideology. At the same time, other potting communities might have been slow to accept the new ideology, or at least to promote it in their particular medium. The rapid acceptance of this new ideology by the Hohokam throughout the Phoenix Basin would have increased the demand from those groups promoting the ideology on their pottery, and lessened the demand for the old style pots that were becoming increasingly irrelevant to most buff ware consumers.

The results of the innovation analysis presented in Chapter 8 were somewhat ambiguous in regards to the number of potting groups that engaged in innovative behavior during this first reorganization episode. On the one hand, more potting groups were potentially involved in innovative behavior than in either of the two later reorganization episodes. On the other hand, it was often impossible to distinguish between those groups that invented a particular stylistic attribute and those that adopted that innovation very rapidly. In other words, few innovations were associated with a single potting group within a single time segment. If only one or a few potting groups were responsible for most innovations, those innovations were adopted quite quickly by other groups.

While it was not possible to definitively determine whether or not the origins of innovations in the Episode 1 reorganization conformed to the expectations laid out in Chapter 3, the very rapid adoption of those innovations during this episode did meet expectations regarding the rate of adoption. Regardless of whether or not the innovations originated at a few centers of ritual importance, the nature of the reorganization seems to have provided the impetus for buff ware potters to quickly embrace a particular style affiliated with this ideology. The fact that all groups embraced this style and these innovations so quickly highlights the high level of interconnection and social integration that facilitated such rapid adoption. Economic competition does not appear to have played a major role in the adoption process of stylistic innovations at this time.

The pattern of innovation adoption was not expected to necessarily follow a linear, nearest-neighbor path during this reorganization episode based on the assumption that the high level of social interconnection and integration would have allowed and encouraged rapid adoption from distant and near potting groups in a similar way. While it is not more likely that distant groups would have adopted innovations earlier than less distant groups, potting groups would have had just as much information about stylistic innovations, as well as the opportunity to adopt those innovations, from distant groups as they had from their nearest neighbors. The analysis revealed, however, that most innovations were, in fact, first adopted by nearest neighbors, suggesting that, despite the interconnected social landscape of the period, potting communities maintained the closest connections with their closest neighbors.

The uniformity of innovation adoption among buff ware potting groups was expected to be high for the Episode 1 reorganization due to the rapidity with which this new ideology seems to have taken hold in the Phoenix Basin Hohokam (Wallace 1994). Because buff ware potters would have been in an obvious position to promote this popular new ideology, it was expected that all groups would have adopted the full suite of attributes with which it was associated.

When sample size was taken into account, all potting groups adopted an expected number of innovations. At least two of the four variables (rate and uniformity of adoption) measured to describe the innovation process in the Episode 1 reorganization met expectations. The pattern of innovation adoption, however, did not meet expectation. The origins or stylistic innovations were impossible to determine with confidence. Together, the measurements of these variables provide a picture of a new set of stylistic motifs and layouts of unknown origins that were quickly adopted in a generally linear pattern by all buff ware potting groups. Variation among groups was limited to slight preferences over time for certain innovations. Overall, buff ware potters seem to have uniformly embraced this new ideology with little sense of competition among groups.

It is difficult to determine whether the popularity of this ideology preceded the potters' promotion of it; or if its popularity increased to a significant degree because of its promotion by artisans, like buff ware potters. It would be safe to assume, perhaps, that however popular this ideology had already become, buff ware potters significantly contributed to its entrenchment in the Hohokam worldview as their pots were required components of every Hohokam household. Every display and/or use of a decorated vessel would go further in solidifying the idea contained therein as part of the overall stylistic structure.

An issue needing further consideration at this point, however, is why domestic ceramic vessels (i.e., buff ware) were appropriate means of materializing this new ideology. In order for buff ware potters to promote an ideology, consumers must accept the display of that ideology on domestic ceramics. What conditions, then, made it possible for buff ware potters to take advantage of the new ideology by quickly incorporating themes of this ideology into their work?

Ideology is always materialized in some way; it must be or it will fail to move beyond a small group or to be sustained for any length of time. It is only through the materialization process that ideology can be controlled, manipulated, and extended (DeMarrais et al. 1996:15; Earle 1997:143-192). The specific medium(s) in which the ideology is materialized varies, taking the form of monuments, symbolic objects, monuments, and writing systems (Cohen 2005; DeMarrais et al. 1996:16; Fogelin 2007; Kahn and Kirch 2011). Portable objects imbued with ideological content, in particular, are effective at linking geographically distant individuals and groups through symbolic communication (Grove and Gillespie 1992; Hodder 1982; Wobst 1977)

It is not unusual for ceramics to be used to materialize ideology (e.g.,, Cook 1994; Curet 1996; Elson and Sherman 2007; Pauketat and Emerson 1991; Reents-Budet 1998; Shanks 1999; Whitten and Whitten 1988), but neither is it necessary that they do so. It is important, therefore, to understand the use-context of ceramics that materialized ideology if we are to understand why they were an appropriate medium for that materialization. In some non-Hohokam instances, ceramics were manufactured specifically as important instruments in particular rituals, and therefore, displayed and communicated certain ideological themes (Day et al. 2006; Donnan 1976). In other instances, ceramics were made to legitimize status roles by presenting ideological concepts related to social hierarchies, and were often limited in their distribution to people of a certain rank (Reents-Budet 1994, 1998; Vaughn 2004a).

Neither of these motivations for materializing ideology seems to apply to Hohokam red-on-buff. Buff ware was not restricted to certain classes of people, but was widely distributed to nearly every household in the Phoenix Basin (at least prior to the Classic period). It was deposited in every context, from middens, to house floor assemblages, to burials. All indications are that buff ware was a regular component of every household's requisite domesticate pottery inventory (Abbott, Watts, and Lack 2007).

To better understand the conditions that foster the materialization of ideology on domestic pottery, I turn to analogous examples from the prehistoric Southwest U.S. and Mesoamerica. The first example comes from the Rio Grande area of central New Mexico. Red and yellow-slipped glaze ware vessels began to be produced in that area in the early 1300s after centuries of using black-on-white decorated pottery (Spielmann 1998). These motifs painted on these glaze-decorated vessels expressed religious ideologies that served, in part, to distinguish their users from those affiliated with other religious sects (Graves and Eckert 1998). Information on vessel size and use contexts suggests that the early glaze-decorated vessels were important in communal feasting contexts; contexts in which the vessels were prominently displayed (Spielmann 1998, 2002; see also Carr 1995; Mills 2007; Schiffer and Skibo 1997; Vaugh 2004b). The communal aspect of these events in large, open plazas served to emphasize inclusiveness. It is this context of inclusive communal display that made the vessels effective mediums for affiliating oneself, or one's group, with a particular religious ideology.

Another example of domestic pottery serving as a medium for ideological display is Salado polychrome pottery, which was ubiquitous across the southern Southwest and northern Mexico from the late 13th through mid-15th centuries. Based on the redundant use of certain identifiable iconographic motifs on the pottery across a wide territory, Crown (1994:173) argues that Salado polychrome vessels were used to display and advertise a new shared ideology. Although some items may have been restricted to particular ritual usage in association with this new ideology, Salado polychromes were not. Like Hohokam buff wares, Salado polychromes were important containers of ideological information, but were not restricted in their use or their distribution, and seemed to have been part of the domestic ceramic inventory of households (Crown 1994).

How then did these Salado polychromes become an appropriate medium for the materialization of ideology? Grove and Gillespie (1992) provide a simple explanation from a similar situation in the Early Formative Period (1500-900 B.C.) of Mesoamerica. In their evaluation, ceramics were used to ideologically connect widely separated populations through a redundant and shared set of motifs. The ceramics were common in both burials and ordinary household refuse. They argue that ceramics were an effective means of this ideological connection because they were the most common and accessible portable artifacts (1992:25). Pottery was a carrier of ideas and beliefs and signals pertaining to group membership. In the same way, by virtue of its commonality, accessibility, and transportability, Salado polychrome pottery was an ideal medium for ideologically connecting disparate groups across a wide geographic range.

Another reason domestic ceramics were well-suited to materialize ideology was related to the nature of that ideology. As Crown (1994:223) notes, the fact that the ideology associated with the imagery on the pottery was not restricted in its distribution indicates that this ideology was for all peoples, regardless of class, gender, age, etc. Domestic pottery was something that all peoples possessed and used regularly, both privately and publicly. The pottery was, therefore, a ubiquitous and mundane object that could be used to signal affiliation with a particular belief system. Crown argues that such charged icons on mundane objects "reinforces the convictions of the individual, testifies to the membership of that individual in a community of believers, and advertises access to supernatural power" (1994:6). Crown's argument that this ideology came about from the need to integrate groups in the wake of large-scale population movements in the 13th and 14th centuries also highlights the inclusive nature of the ideology.

VanPool and Savage (2010) even argue that the Salado phenomenon was the result specifically of thousands of women refugees from the north who intentionally promoted a new ideology that served to reduce conflict and promote unity and inclusiveness as they were forced into interactions and co-habitation with new groups. If accurate, the use of domestic pottery to promote this new ideology is especially appropriate, as it was a common material made and used primarily by women (VanPool and Savage 2010:253).

In the example from the Formative Period in Mesoamerica, it is interesting that the symbols associated with the ideology in the early part of that period (1500-900 B.C.) were most prevalent on ceramics, and available to all. In the transition to the middle

Formative Period (900-500 B.C.), however, there was a "nearly complete transfer in the display of the shared symbol system from one medium, ceramics, available to all, to another, greenstone, available to a few" (Grove and Gillespie 1992:30). Grove and Gillespie interpret this transfer as indicative of an elite class taking over the control of ritual and cosmological symbols (1992:30). In other words, the ubiquitous, accessible, and easily transportable domestic pottery possessed by all classes, was no longer an appropriate medium for the display and promotion of ideology because the ideology was shifting towards a more esoteric and exclusivist bent.

These examples from the Southwest U.S. and Mesoamerica help to elucidate the materialization of ideology on Hohokam red-on-buff ceramics. In each of the examples, domestic ceramics were among the most common, accessible, and portable of objects. They were commonly exchanged and possessed by households without restriction based on status, age, gender, etc. These factors alone do not necessarily make domestic ceramics appropriate vehicles for the materialization of ideology, however, as it seems also necessary to have an ideology that emphasizes integration and inclusivity of all persons as participants and beneficiaries of the ideology. An ideology having precisely that emphasis is what I have argued for in this study among the Hohokam in the Episode 1 reorganization. These factors both enabled buff ware potters to effectively materialize this new ideology, and motivated consumers to accept that materialization on their domestic pottery.

Innovation and the Episode 2 Reorganization

The expectations for the four variables describing the process of stylistic innovation that accompanied the second episode of reorganization were rarely met. The expectation regarding the origins of innovations was only partially met, while the rate, pattern, and uniformity of adoption were, for the most part, contrary to expectations.

The Episode 2 Reorganization occurred at the transition between the early and middle Sacaton 1 time segments (~A.D. 1000-1020). This reorganization came about at the time of the greatest extent of the Hohokam regional system (Crown 1991; Doyel 1991c; Wilcox 1979, 1991c). Whereas the first reorganization episode is thought to be primarily connected to an ideological shift, this second reorganization is bound up more with economic changes. It was a time when new plain ware pottery production centers arose to challenge the centuries-long dominance of other production areas. The economic shifts that occurred at this time have led some to argue for the existence of markets for exchange that had not previously existed (Abbott 2006; Abbott, Watts, and Lack 2007; Abbott, Smith, and Gallaga 2007).

Because the social context for this reorganization was so different from the previous reorganization (Episode 1), the expectations for this reorganization were also different. Social pressures to invent or adopt new stylistic innovations would not have been as great as in the first reorganization episode. Instead, I presumed that the major incentives for buff ware potters during this reorganization episode would have been economic rewards. Buff ware potters would have perceived the new economic environment taking shape in the Phoenix Basin as a new opportunity for economic gain by drawing in more exchange partners.

I hypothesized that the means for taking advantage of this perceived opportunity was to engage in stylistic invention (innovative behavior) in order to gain an edge over other production groups. For this reason, I expected stylistic innovation to originate, initially, with a small number of producers or production groups. Following the model of the product life cycle (see Chapter 2), it was expected that after the introduction stage, other production groups would also seek to innovate to differentiate themselves (the early growth stage). Next, a late growth stage was expected, characterized by intense competition from many different production groups. According Chibnik (2002), this competition would often lead to others copying the innovators; a practice which would then spur on further innovation from the more accomplished potters. The rate of adoption, therefore, was expected to occur more slowly than in the preceding Episode 1 reorganization, but still relatively rapidly due to the integrated nature of the economy and society. Again, because social integration was presumed to have been at a maximum at this point, it was expected that the pattern of innovation would have been from the origin group to those most with whom they shared the closest social connection, not necessarily their nearest neighbors. Again, this expectation is not that more distant groups would be more likely to adopt innovations early, but only that there is a possibility they could do so. Finally, innovation adoption was expected to be less uniform than the previous reorganization because of the competition expected among producers in a market economy.

In trying to make sense of the stylistic innovation data, it is helpful to remember that major changes in the organization of buff ware production did not occur in the Episode 2 Reorganization (see Chapter 3). The shifts in production had occurred in the early Sacaton time segment when the Snaketown temper group rose to dominance. The organization of production seems to have stabilized by the early/middle Sacaton 1 and middle Sacaton 1 time segments (Table 9.2). The one exception to this seems to have been the Queen Creek group, which became a slightly more important producer in the early/middle Sacaton 1 transition. The results concerning the origins of innovations, however, do not reveal that the Queen Creek group attempted to compete through stylistic inventions.

I had expected that only one or two potting groups would initially perceive the economic opportunity of this reorganization, with other groups soon to follow their lead. The results, however, did not reveal an early period of innovative activity by one or two groups. Multiple potting groups did, in fact, engage in inventive behavior, despite the fact that only the Snaketown and schist-only group (or amalgam of groups) dominated the production output. At least two other groups (Santan Mountains and eastern middle Gila) were found to be the sole potting groups associated with the earliest appearances of some innovations.

I interpret these data as indicative of the economic nature of the Episode 2 reorganization. If a shift towards a marketplace economy occurred at this time, it would have likely provided an incentive for multiple potting groups, small or large-scale, to innovate in an effort to compete against other groups for larger segments of that market.

Table 9.2. Production distribution by potting group for the Episode 2 reorganization.

Time Segment	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snaketown	schist-only
Santa Cruz	7.9%	10.2%	0.7%	0.3%	0.3%	5.9%	23.7%	51.0%
early Sacaton	8.6%	5.6%	2.3%	2.1%	0.0%	2.1%	53.3%	25.9%
early/middle Sacaton 1	4.6%	0.3%	9.8%	3.3%	0.0%	0.3%	46.9%	34.8%
middle Sacaton 1	10.2%	2.9%	2.0%	6.4%	0.0%	0.0%	36.1%	42.5%
middle Sacaton 1-2	11.8%	2.4%	0.9%	3.1%	0.0%	0.7%	49.8%	31.3%

That multiple potting groups appear to have perceived this opportunity early may suggest that the opportunity was more obvious than I supposed.

The rate of innovation adoption generally met expectations. It was expected that stylistic innovations would be adopted more slowly in the Episode 2 reorganization than in the Episode 1 reorganization due to the economic competition among producers that would cause some to be more inclined to differentiate themselves (Causey 1999; Chibnik 2002). The results from the last chapter demonstrated that stylistic innovations were, indeed, adopted less rapidly than in the Episode 1 reorganization, as seen in the fact that fewer innovations were adopted very rapidly by at least one temper group (see Table 9.6).

The heightened competition among producers during the second reorganization episode may have served to slow down innovation adoption to some extent. In the previous reorganization episode, for example, very rapid innovation adoption made sense to those groups sharing a common goal of promoting, or associating themselves with, a new religious/ideological movement that was recognizable by a set of specific motifs or layouts. In the Episode 2 reorganization, however, it seems to have been less important for buff ware potters to share a common goal with the stylistic attributes of their vessels. A marketplace economy would instead have created an atmosphere of competition (Causey 1999; Chibnik 2002, 2004; Schultz 1964), in which innovation served as a potentially useful, though risky, tool to garner a larger consumer base.

Although economic competition may have served to slow the rate of innovation adoption, the high level of interconnection and integration that existed at the time still allowed for the transfer of ideas and innovations among buff ware producers. The interconnection and integration allowed for all potting groups functioning during this reorganization to gain information about innovations quickly, even if the social incentive to adopt those innovations was not as strong as in the first reorganization episode.

The pattern of innovation adoption did not, for the most part, meet expectations. It was expected that, due to the high sense of interconnection and social integration that existed during the early-middle Sacaton time segments, innovations would be adopted first among groups with whom the origin group shared the closest connection, and not necessarily with nearest-neighbors. Although some innovations were adopted first by potting groups that were more distant, the vast majority were adopted most quickly by nearest neighbors. As with the first reorganization episode, the simplest explanation for this pattern is that, despite the integrative society and economy that could and did unite geographically distant groups, the closest social connections were, in fact, with nearest neighbors.

The uniformity of innovation adoption was expected to appear in one of two ways: 1) the heavy domination of a small number of groups as they effectively forced out the smaller production groups altogether, or 2) heterogeneous adoption, as groups were not under a great deal of social pressure to conform (compared to the Episode 1 ideological reorganization) and were, thereby, free to pick and choose which innovations they would adopt. Both scenarios assumed a heightened sense of competition among buff ware production groups at this time.

In regards to the first scenario (see Table 9.2), the production data clearly indicated that buff ware manufacture was dominated at this time by the Snaketown group and the group or groups using only schist to temper their vessels. The lower Salt River and lower Gila River valleys appear to have shut down production almost entirely.[1] It would be a mistake, however, to conclude that the Snaketown group and schist-only potters forced out all other competitors, as several other groups (Santan Mountains, southeast middle Gila, and the Queen Creek temper groups) were able to coexist at the same scale as they had in the previous two time segments. I conclude, therefore, that the expectation for uniformity in innovation adoption according to the first scenario was not supported by the data.

While the production data failed to support the expectation that a few groups would so dominate buff ware production and that all other producers would be forced out of production, the stylistic data failed to support my expectations regarding heterogeneous adoption among potting groups. Although several buff ware potting groups were functioning at this time, there was little evidence to indicate that significant differences existed in how many innovations were adopted by each group. The uniformity of innovation adoption, therefore, was similar in this reorganization episode to the uniformity of the first reorganization episode.

The high degree of uniformity in innovation adoption during this reorganization episode needs to be reconciled with the fact that several different groups engaged in innovative behavior. The data gathered concerning the origins of innovation suggested that buff ware potting groups were seeking to distinguish themselves, to some degree, from other groups through style (presumably in an effort to take advantage of economic opportunities). The data concerning the uniformity of adoption, however, suggested that conformity, not distinction, was important at this time.

The apparent discrepancy between the origins of innovation and the uniformity of adoption need not be a real discrepancy, however, when the data are left to stand on their own. In other words, it can be true that buff ware potters sought both distinction and conformity in quick succession. If a marketplace economy existed for the first time during this period, then it would have provided a venue where potters from different communities would have set up shop, side by side, in some cases to display new motifs or layouts. In such a venue, new stylistic ideas from one group or individual would have been quickly noted by all potters (Causey 1999). Some may have quickly moved to adopt such ideas, while others may have waited to see how successful those new ideas proved to be (Bolton 1993; Onkvisit and Shaw 1989).

The above scenario is supported by the rate of innovation adoption, which was generally slower during this reorganization. The high degree of uniformity was the result of the *eventual* integration of all of these innovations into a stylistic suite that was accepted and expected by the populace at large. From this perspective, economic changes still served as the primary incentive for innovation, and competition among potting groups was a factor that contributed to the overall process of innovation.

Innovation and the Episode 3 Reorganization

The variegated nature of the third episode of reorganization made it especially difficult to set specific expectations regarding the process of stylistic innovation. Nevertheless, the general characteristics of this reorganization as a time of major social disruption and change leading to social fragmentation allowed me to set general expectations. Few of the expectations set, however, were met by the results of the analysis. The pattern of innovation adoption was the only variable of the four to conform well to the expectations. The data pertaining to the origins of innovations, rate of adoption, and uniformity of adoption all yielded surprising results.

The Episode 3 reorganization was different from the first two reorganizations in that it was clearly characterized by large-scale shifts in multiple social arenas, including politics, ideology, demographics, and economics (Abbott 2000a, 2003a; Cordell et al. 1994; Doyel 2000). Long established villages and areas were abandoned and new populations moved into the lower Salt River Valley in large numbers. The ballcourt system was abandoned as platform mounds became the focal points of communities. Major shifts in ideology and ritual were evidenced not only by the end of the ballcourt system, but also in the sweeping changes in the mortuary complex and ritual paraphernalia. Political and economic systems were apparently overhauled as the Phoenix Basin became socially fragmented. Plain ware pottery production and distribution became localized, while red ware specialization emerged. Buff ware production continued, but at a much smaller scale as demand for vessels made in the 500 year old tradition waned. The first thing that needs to be considered when thinking about incentives for innovation is this dramatic decrease in buff ware production.

In the first episode of reorganization, I argued that the buff ware was heavily associated with the adoption and promotion of a new ideology. This new ideology was manifested not only in buff ware, but also in the ballcourt system and a new mortuary complex. In the late Sacaton time segment, this entire ideological system seems to have been intentionally and rapidly abandoned by the Hohokam populace at large as ballcourts ceased to be constructed and mortuary complexes changed. If buff ware was as tied to the ideological system as I propose, why did some demand for buff ware still exist?

One possibility is that a new ideological system did become popular, but there was still an important role for buff ware; albeit in a much more limited way (e.g., a few specific rituals). To address this question, I investigated whether or not buff wares dating to the Episode 3 reorganization occurred in a more limited range of contexts than in the preceding time segments. If buff ware was discarded in different types of contexts in the Episode 3 reorganization, then it may suggest a more restricted or specialized use compared to previous time segments.

Utilizing the data from this study alone, buff ware was more commonly associated with residential structures in the Episode 3 reorganization compared to the earlier time segments, when buff ware was more associated with trash pits (Table 9.3). Of course, it is possible this result is due to sampling or excavation bias than to a real difference in in use or discard contexts for buff ware.

For this reason, I examined the discard contexts for the buff ware assemblage from the site of Casa Buena, a primarily Classic-period site located in the lower Salt River Valley. Of all features containing ceramics in Locus 1 (late Sacaton – Civano time segments), 93 percent were collected from residential structures (pit houses and surface structures), while a mere 7 percent was collected from all other contexts. (Cable and Gould 1988:Appendix A).

The data from this study combined with that from Casa Buena, therefore, support the notion that buff ware may have been utilized in a more narrow range of contexts beginning in the late Sacaton time segment (the Episode 3 reorganization) than it was in prior time segments. Interestingly, the specific use contexts may have been more residentially-focused than before, with buff ware no longer necessary to most public rituals.

I suggest that these results point to an existing demand for small amounts of buff ware in the Episode 3 reorganization by a small number of adherents to the old ideological/religious system, who did not conform to the majority ideological viewpoint. If this was case, one would expect that buff ware would be distributed less uniformly among households than in previous time segments. Prior to the Episode 3 reorganization, essentially every Hohokam household not only had access to buff ware pottery; and in fact, every household needed buff ware pottery to possess the full complement of vessel forms (Abbott, Smith, and Gallaga 2007; Abbott, Watts, and Lack 2007). During the

Table 9.3. Comparison of buff ware discard contexts from multiple sites.

spelled date	trash pits	residential structure	roasting pit	Total
pre-Episode 3 reorganization	710 30.8%	1425 61.9%	167 7.3%	2302
Episode 3 reorganization	33 9.8%	276 81.9%	28 8.3%	337

Episode 3 reorganization, however, buff ware vessel forms (bowls and small jars) were replaced in the lower Salt River Valley by locally manufactured plain ware forms (Abbott 1988:113; Abbott, Watts, and Lack 2007:347). Buff ware vessels were no longer necessary, therefore, for every household from a functional perspective. The results from Casa Buena mentioned above also support this notion, where only 56 percent of all households in Locus 1 contained any buff ware, and only 30 percent contained any temporally diagnostic buff ware dating to the Episode 3 reorganization (Cable and Gould 1988: Appendix A). Admittedly, this interpretation cannot be substantiated until a more systematic assessment of buff ware discard contexts over time is conducted.

Another potential incentive to innovate, or adopt innovations, among some potters may have been the signaling of political affiliations. As mentioned, the political climate was in a state of flux at this time, along with the ideological and economic spheres. As populations moved in and out of areas in large numbers and new social groups came into close residential contact with one another, new social tensions would have inevitably developed. The well-documented fragmentation of the social landscape surely reflects shifting political strategies and agendas to cope with, or take advantage of, the changing social environment (Abbott 2003a). Bowser (2000:243) suggests that the use of style to signal political affiliation should be especially important in "small-scale, segmental societies, where alliances may be questioned and where fissioning, conflict avoidance, and recruitment result in frequent defections and realignments". The extent to which these specific requirements existed among the Hohokam in the Episode 3 reorganization is largely unknown, but can be easily envisaged from what is generally known about the social fluctuations of the period.[2]

The difficulty with adopting this view as a major incentive for stylistic innovation on buff ware pottery is that buff ware continued to be made by specialists at only a few locations and exported out to most of the Phoenix Basin, albeit in greatly diminished quantities. I have argued here (following Abbott 2000a, 2003a) that the general tenor of the political shift at this time was a movement toward more localized factions. Would buff ware producers on the middle Gila River really be interested in signaling political allegiance with localized groups in the lower Salt River Valley, or vice versa? It seems more likely that this type of signaling would occur if buff ware production and distribution (or another decorated ware/type) had also become localized.

A final potential incentive for innovation that ought to be explored is economic survival. Early in, or just prior to, this reorganization, the demand for buff ware vessels plummeted (Abbott 2006, 2009). For unknown reasons, decorated red-on-buff vessels no longer carried the importance for the general Hohokam populace as they once did. It may be that the preference for buff ware jars over bowls at this stage may have been related to changes in the contexts of use.[3] Likewise, the shift toward plain ware bowls from buff ware bowls, and then to red ware vessels (Abbott 1994a), may indicate that traditional contexts for buff ware use or display were not as important (or even existent) as before. Another possibility is that the breakdown in social integration precluded buff ware specialists from maintaining as wide a consumer base.

For those buff ware production groups who had specialized in the trade for generations (even centuries), innovation could have been one response to survive economically as potters (Bolton 1993; Cyert and March 1963; Downs and Mohr 1976). Those who have studied this particular phenomenon, however, note that the decision to innovate is not always predictable, as some are less hesitant to innovate or adopt innovations in times of necessity. Much depends on the history of the group and the success of innovation in the past (see especially Bolton 1993). The decision by buff ware potters of whether or not to innovate or adopt an innovation, therefore, would have depended, in part, upon their perception of the situation.

Although we cannot be certain of the exact motivation(s) for innovation, we can be certain that during the Episode 3 reorganization, buff ware potters made significant stylistic changes to their pottery. Under the variegated social, political, ideological, and economic circumstances that were associated with this reorganization, I expected the process of innovation to vary considerably from that seen in the first two reorganization episodes. It was expected that the breakdown of social integration and information networks, the loosening of a sense of interconnection, the establishment of localized political and economic structures, and overall social fragmentation that characterized this reorganization episode would have led to more localized and independent inventive behavior among buff ware producers. I expected innovations, therefore, to originate at many different locations. For these same reasons, the rate of innovation adoption was expected to be the slowest, and the uniformity of adoption was expected to be least, of the three reorganization episodes. The pattern of innovation adoption was expected to follow a nearest neighbor model because of the lack of integration that would not have allowed for more geographically distant groups to be socially closer than geographically proximate groups. The data did not meet this expectation. In fact, it could be argued that the third episode of reorganization showed the least amount of diversity in innovation origins.

I have already briefly discussed the changes that occurred in the organization of buff ware production in the Episode 3 reorganization (see also Chapter 7). It is worth summarizing these data again, as these changes directly affected the process of innovation. From the early Sacaton through middle Sacaton 2 time segments of the Sacaton phase, the average production output of the Snaketown and schist-only groups together comprised 80 percent of the total buff ware manufactured in the entire Phoenix Basin. Beginning in the middle Sacaton 2 – late Sacaton and into the late Sacaton, these dominant groups comprised only 62 percent (Table 9.4). At the same time, the Santan Mountain and Queen Creek groups increased from 13 percent to approximately 27 percent of the total.

Among jars, only one stylistic innovation, open panels (attribute 121), was potentially associated with a group other than the Snaketown or schist-only group in its

Table 9.4. Production distribution by temper group for the Episode 3 reorganization.

Time Segment	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snaketown	schist-only
early Sacaton	8.6%	5.6%	2.3%	2.1%	0.0%	2.1%	53.3%	25.9%
early/middle Sacaton 1	4.6%	0.3%	9.8%	3.3%	0.0%	0.3%	46.9%	34.8%
middle Sacaton 1	10.2%	2.9%	2.0%	6.4%	0.0%	0.0%	36.1%	42.5%
middle Sacaton 1-2	11.8%	2.4%	0.9%	3.1%	0.0%	0.7%	49.8%	31.3%
middle Sacaton 2 - late	17.1%	4.3%	8.5%	6.8%	0.0%	0.0%	18.8%	44.4%
late Sacaton	11.1%	1.3%	23.5%	3.9%	0.0%	0.0%	35.9%	24.2%
late Sacaton/Soho	16.2%	0.0%	11.1%	3.4%	0.0%	0.0%	37.6%	31.6%
late Sacaton - Civano	0.0%	0.0%	21.1%	0.0%	0.0%	0.0%	39.5%	39.5%
Soho - Civano	6.6%	2.9%	9.6%	31.6%	0.0%	0.0%	13.2%	36.0%

origin. The earliest appearances of all other innovations at this time were associated with one of these two groups.

Taken together with the production data, these results are even more interesting. Despite the increase in buff ware production in the Queen Creek and Santan Mountains potting groups during this reorganization, there was not an associated increase in innovative behavior in these groups. It was equally unexpected that innovative activity seems to have been high among the schist-only and Snaketown potting groups as their production output decreased.

It is difficult to know which happened first in the Snaketown and schist-only groups, a decrease in the control of the buff ware market or stylistic innovation. If the former, then the Snaketown and schist-only groups may have innovated in response to increased competition from other sources. If the latter, then stylistic innovation, itself, may have had a detrimental effect on those groups who took the risk of innovating in a changing social environment. An analysis of the three other variables used to measure the process of innovation brings some illumination to the problem.

First, the rate of innovation adoption should help to determine whether or not other groups perceived the Snaketown and schist-only groups to be successful with their innovations. Research has shown that some of the most successful production groups over the long term are groups that are more prone to watch and see before adopting innovations; thus minimizing the risk that accompanies invention or very early adoption (Bolton 1993; DiMaggio and Powell 1983; Stinchcombe 1965; Zucker 1983). If innovation was detrimental to the Snaketown and schist-only groups in some way, then we would not expect other groups to quickly adopt those innovations. A look at the results (see Table 9.7), however, revealed that the Santan Mountains and Queen Creek groups adopted most of the innovations rapidly. Likewise, the uniformity of innovation adoption shows that not only were innovations adopted rapidly, but most groups adopted all of the innovations rapidly.

It is unlikely, therefore, that stylistic innovation, itself, was responsible for the decreased demand from certain production groups. It is more probable that the Santan Mountains and Queen Creek production groups began to benefit from the changing economic landscape and breakdown in social integration in a way that the Snaketown and schist-only groups did not. It is possible, then, that increased competition pushed the Snaketown and schist-only groups to innovate (see Capron 1978; Chibnick 2002; Karlsson 1988; Onkvist and Shaw 1989).

It follows that the rate of innovation adoption, itself, did not meet expectations for the third episode of reorganization. It was expected the social fragmentation and lack of integration known from this period would have led to slow innovation adoption. Instead of exhibiting the slowest rate of innovation adoption, however, it actually showed consistently rapid adoption, as nearly all innovations were adopted by the late Sacaton time segment.

The pattern of innovation adoption met expectations, as innovation adoption essentially followed a nearest neighbor model. Although this pattern met expectations, the fact that this same pattern characterized each reorganization indicates that it did not serve to distinguish this episode.

Innovation adoption was expected to have been the least uniform in the Episode 3 reorganization, again owing to the breakdown in social integration and establishment of new social boundaries known to have characterized this period. Once again, this expectation was not met; instead, innovation adoption appears to have been highly uniform.

Why were so many expectations for this episode of reorganization not met? One possible explanation for the uniformity and rapidity of innovation adoption in this reorganization was due to a shift towards more overt leadership strategies. In this scenario, a higher level of integration and stylistic conformity could have been achieved through more direct control of craft production and exchange by elites. Knowing the powerful ideological influence that buff ware vessels had on the majority population, leaders could have used them to convey their own ideological agenda. Such a view would challenge my assumption of social and political fragmentation across the Phoenix Basin in the Episode 3 reorganization.

The difficulty with this interpretation, however, is that no convincing evidence exists that indicates that neither buff ware, nor other high value goods, were directly controlled by elites (Bayman 1995, 1996, 2002; Harry and Bayman 2000). Evidence is also lacking for an elite utilizing symbols such as those painted on buff ware pottery to convey social or political status (Bayman 1999, 2002; Crown 1991). Bayman (2002) even suggests that leadership was more individualized in the Preclassic, with elites distinguished in burials by certain socially valuable goods (though not including buff ware). He argues that leadership shifted to a more corporate form in the Classic.

I suggest that the most parsimonious explanation for the failure of the results to meet expectations is, in fact, that the landscape of this reorganization was much less socially fragmented in the southern part of the Phoenix Basin than I originally supposed. The overwhelming amount of data that exists to support the idea of social fragmentation comes almost entirely from the lower Salt River Valley (Abbott 2000a, 2003a, 2009; Doyel 2000). A closer look needs to be taken at the same types of data from the middle Gila River Valley and Queen Creek areas.

Gregory and Nials (1985) suggested that each Hohokam canal system possessed a distinctive history, and should be approached by archaeologists with this in mind. Abbott (2003b) concurred as his research demonstrated that certain canal systems implemented different strategies to cope with the changing sociopolitical environment of the Sedentary to Classic transition. According to Abbott, major factors that affected the historical trajectories of individual canal systems were migration and population pressure. This pressure led to farming in areas previously used for wild resources, which resulted in a narrowing of the diet. He hypothesized that at different times, populations of individual canal systems reached a threshold after which there were not sufficient natural resources available. When this threshold was reached, tighter restrictions were placed on group membership, resulting in an exclusionist social, political, and economic strategy.

Although the buff ware production areas were at this time located in several different canal systems along the middle Gila River and Queen Creek, all of those canal systems contained considerably lower population levels than the systems on the lower Salt River. It thus stands to reason that their population thresholds may not have been reached. In consequence, social interconnection and integration may have remained relatively intact in the southern part of the Phoenix Basin compared to the northern part. This interconnection may have remained especially strong if all groups were attempting to maintain an old ideological system or promote new ideological/religious concepts in the same way as they had in the Episode 1 (and possibly Episode 2) reorganization.

Summary of Stylistic Innovation among the Hohokam

For many years, researchers regarded the history of the Phoenix Basin as one of considerable socio-economic and political stability compared to other parts of the Southwest U.S. From certain perspectives (e.g., long-term sedentism, village location and high-density occupation, agricultural techniques) this characterization has proved correct. From another perspective, however, it is clear that we are just beginning to glimpse the complexity of the ever-changing social, ideological, demographic, economic, and political systems of the Hohokam of south-central Arizona. In this study, I have explicitly focused attention on three episodes of change, dubbed reorganizations, and how one set of artisans, buff ware potters, responded and/or contributed to these changes.

The process of innovation was found to vary across each reorganization episode, but in different ways than expected. The first episode of reorganization began in the middle of the Gila Butte phase (~A.D. 800), and was bound up with ideological/religious changes. Buff ware potters saw the opportunity to affiliate themselves with, and promote, this new ideology by inventing new stylistic motifs and layouts on buff ware vessels. Expressions (stylistic attributes) of this new ideology were adopted very early by other production groups, who likely felt both social and economic pressure to affiliate themselves with, and promote the ideology. Usually, the earliest adopters were the most geographically close groups, although very early adoption was, at times, found to occur even among those groups located outside of the buff ware heartland of the middle Gila River Valley (e.g., those producing brown-paste variants in the lower Salt River Valley). Most potting groups adopted a similar suite of innovations, testifying to the widespread acceptance of this new ideology and the shared sense of interconnection that existed among groups.

The second episode of reorganization began near the middle of the Sacaton phase (~A.D. 1000-1020), and was thought to have been connected primarily to the economic realm. New exchange opportunities were opened up to buff ware potters at this time, providing an incentive for dominant potting groups (Snaketown and schist-only), as well as relatively minor potting groups (e.g., Santan Mountains and eastern middle Gila) to take advantage of the situation by engaging in stylistically inventive behavior.

The existence of innovative activity among multiple potting groups suggests that competition may have intensified in this reorganization episode. Such a result is not surprising if, in fact, a marketplace economy did come into existence, as it would have provided a venue for buff ware consumers to choose between pots from different producers more readily. The need to distinguish oneself through stylistic innovation, therefore, could have been more pronounced at this time than at any other. This environment resulted in a slower rate of adoption than in the first and third reorganization episodes. Eventually, and somewhat gradually, most potting groups adopted a new suite of innovations that came to define the appropriate structure for buff ware design.

The third episode of reorganization began in the late Sacaton – early Soho phases (~A.D. 1100-1125). This reorganization touched on nearly all aspects of Hohokam life, including ideology, economics, politics, and demographics. Buff ware artisans may have chosen to innovate, or adopt innovations, from a more desperate position than before as red-on-buff ceramics, as an integral components and promoters of the old ideological system, were already going out of favor. It was thought that the socially fragmented landscape of localized, independent sociopolitical entities would have lent itself to localized, independent stylistic invention and innovation by buff ware potters. This expectation, however, was proved to be wrong. The origins of stylistic innovations seem to have been more or less confined to the Snaketown and schist-only groups. In most cases, the stylistic inventions spread very rapidly from these groups first to their nearest neighbors.

The data pertaining to the process of innovation, therefore, point toward a more significant sense of interconnection and a higher degree of social integration and interaction among buff ware production groups in the southern part of the Phoenix Basin compared to the lower Salt River Valley during the Episode 3 reorganization. As in the first episode of reorganization, the ideological change associated with this reorganization may have been the primary catalyst for the specific changes on buff ware pottery, as the Snaketown and schist-only groups led the way in innovation, while smaller potting groups followed. The fact that buff ware production decreased so dramatically at this time, and became restricted in use, may be indicative of a new role for buff ware within a new ideological system; a more private, household role. Alternatively, buff ware may have become irrelevant to a new ideological system, and stylistic innovation may have been a way of resisting the new ideological system for a smaller segment of the population.

This study has demonstrated the complex process of stylistic innovation among the Hohokam. In association with the various reorganizations that occurred in Hohokam society, it was found that some buff ware production groups chose to invent new stylistic motifs and layouts, while others did not. Some of groups chose to adopt innovations early, while others waited over the course of several generations. In the end, most innovations were adopted by most potting groups, but with no discernible pattern across multiple stylistic attributes. In the first and third reorganization episodes, stylistic innovation appears to have been closely linked with ideological changes, and therefore, was not necessarily subject to the same levels of economic competition that characterize other products or societies. In the second episode of reorganization, a greater diversity of potting groups risked innovation, though eventually, all conformed to a shared stylistic ideal.

In the first two episodes of reorganization, stylistic innovation was successful in gaining full acceptance by the consumer base throughout the Phoenix Basin, and beyond. It was a different story, however, in the third episode of reorganization. Increased numbers of immigrants from ancestral Puebloan and Mogollon areas came into the Phoenix Basin, bringing with them new ideological systems. Population thresholds seems to have been reached which caused new economic and political strategies to emerge that were focused on individual canal systems and more localized social identities. Despite their best attempts to maintain the relevance for their product through stylistic innovation, buff ware artisans could only stall the inevitable as new ideas about religion, politics, and social identity began to render the centuries-old pottery tradition obsolete.

Chapter 9 Notes

[1] This statement pertains primarily to the lower Salt River Valley. Because such a small sample was analyzed from the lower Gila River Valley, itself, it is more proper to speak of the absence of buff wares being imported into the lower Salt River Valley, middle Gila River Valley, and Queen Creek areas in the Episode 2 reorganization.

[2] A good example of research along these lines for Hohokam populations outside of the Phoenix Basin can be found in that conducted in the Tonto Basin (see Clark 2001; Elson 1998; Rice 2000; Stark et al. 1995).

[3] Because vessel form and function are related to their context of use (Carr 1995), it is plausible that a shift in preference from one vessel form to another resulted from a shift in the arena in which they were used. In other areas of the Southwest, large decorated bowls were important in communal feasting contexts (Graves and Spielmann 2000; Potter 2000; Wills 2001). Feasting has not been invoked in Hohokam archaeology to the same extent, but it should not be dismissed outright. If large red-on-buff bowls were important in communal feasting contexts, then a shift to jars may suggest a decline in such feasting events, or at least a significant change in their structure.

Chapter 10:

STYLISTIC INNOVATION BEYOND THE HOHOKAM WORLD

Small-scale and complex societies around the world are characterized by periods of either low or high levels of innovation. For the most part, innovation has been viewed by archaeologists as an event that occurred for some reason at a particular point in time and in a particular place, rather than as a process (Schiffer 2010; Torrence and van der Leeuw 1989). More thought needs to be given to how the social context shaped the way innovation happened in the past. From the incentive for an innovation to its widespread adoption, the social context is what makes innovation possible. More and more studies are demonstrating that innovation should be viewed as a product of the opportunities artisans perceive in their particular social environments. Studies across the Southwest U.S., and the world, have shown that social environments existed in which innovation was either discouraged (Kohler et al. 2004; Sørenson 1989) or encouraged (DeBoer 1990; Hegmon and Kulow 2005; Parkinson 2006). In the same way, the social environment contributes to how quickly and uniformly innovations are adopted, as well as to the specific path an innovation follows from origin to adoption.

In this study, I have shown how stylistic development can be fruitfully assessed by investigating the process, rather than simply the presence, of innovation. My goal in so doing is to bring a more nuanced understanding to archaeologists of the relationship between innovation and social organization. In particular, my objective is to correlate different patterns of the innovation process with social reorganizations in the ideological, economic, and political realms in one middle-range society, the Hohokam of the Phoenix Basin, Arizona.

At this point, it must be acknowledged that, although I have examined stylistic innovation among the Hohokam beginning in the middle of the 9th century A.D., many of the individual elements and motifs were likely the culmination of a pattern of innovation that had begun centuries earlier in Mesoamerica. Braniff (1972, 1975) for example, see foreshadowings of this stylistic pattern as early as 1000 B.C. at the central Mexican site of Tlatilco. Several archaeologists agree that, at least by the early part of the late Formative (ca. 400-300 B.C.), the Chupícuaro tradition in Michoacán and southern Guanajuato exhibited some of the elemental characteristics of a pattern that would become widespread across northwestern Mexico and the Southwest U.S. over the next millennium (Braniff 1975; Carot 2001; Kelly 1966).

Carot (2001) has tracked this pattern across time and space, beginning with the sporadic occurrence of certain attributes identified on ceramics at the site of Chupícuaro ca. 400-200 B.C. in Guanajuato, followed by the diversification of these attributes at the nearby site of Morales ca. 300-100 B.C. The style then spread to places like Cerro Encantado to the north (Jalisco) and Querendaro to the southwest (Michoacan). The next manifestation of this style is best represented on ceramics dating from 100 B.C. to A.D. 250 at the site of Loma Alta, also in Michoacan (Carot 2001). At that site, familiar Hohokam motifs described here for the Episode 1 reorganization, such as single-capped fringe, fringed curvilinear scrolls, and various zoomorphic and anthropomorphic motifs seem to have clear antecedents. Geometric and figurative elements of this style then reach into Zacatecas with the Chalchihuites culture before finally reaching the Hohokam area ca. A.D. 800.

The point of this brief excursus into Mesoamerica is to stress that innovation among the Hohokam cannot be divorced from its larger context. The prehistoric inhabitants of the Phoenix Basin did not exist in a vacuum. Although real stylistic invention and innovations were developed, they were built upon pre-existing ideas and innovations that undergirded a larger and more broadly shared ideology. The specific mechanisms and historical circumstances that led to the spread of this ideology to the Hohokam some 1,300 kilometers away is beyond the scope of this study; however, the methodology and results generated here have provided a framework for understanding how this ideology was adopted and reinterpreted in local terms, in part through the intentional actions of Hohokam potters.

Among the Hohokam of the Phoenix Basin, Arizona, I found that innovation adoption was most rapid and uniform in those reorganizations that revolved around shifts in ideology and politics. The reorganization characterized by economic changes, in contrast, exhibited more groups risking innovation, but more hesitant to adopt innovations from other groups quickly.

The surprising part of the study was that, although the relative sense of interconnection and degree of social integration thought to exist in each reorganization did sometimes play significant roles in the innovation process, they did not reliably predict many parts of that process. For example, despite the interconnection and integration that characterized the Episode 1 and 2 reorganizations, the pattern of innovation adoption was just as linear in these reorganizations as in the socially fragmented Episode 3 reorganization, suggesting that interconnection always had a spatial component for the Hohokam. Another example is the unexpected results of innovation and adoption in the Episode 3 reorganization. As mentioned, this reorganization was supposed to be a time of fractured social relationships and an emphasis on more localized social identities. Stylistic innovation, however, was found to be more concentrated at a few places, rather than spread out among multiple groups; innovation adoption was more rapid than in the previous reorganization, rather than slowed by less integration; and adoption remained highly uniform among all groups, rather than more variable as a result of less interconnection as social identities were re-focused.

In the end, it was the character of each reorganization episode, rather than the relative degree of integration or sense of interconnection, that best predicted the process of innovation. In both cases in which ideological change was a significant part of the reorganization (Reorganization Episodes 1 and 3), innovation adoption was very rapid and uniform, moving first to nearest neighbors, and then quickly out to all other potting groups. In the economically-focused Episode 2 reorganization, innovation originated at more places, and was adopted more slowly by all groups.

It follows that, in describing the process of stylistic innovation, special attention must be given to what the artisan intended to convey. Major ideological changes, perhaps coupled with political changes, brought the sense of interconnection among buff ware potting groups to the fore in the first and third reorganization episodes. Buff ware potters were in a position to affiliate themselves with and promote those changes, and they seem to have done so quickly and uniformly. Major economic changes led buff ware potters to de-emphasize the sense of interconnection and emphasize distinction.

The applications of the approach to the innovation process taken in this study need not be limited to stylistic inquiries, nor to middle-range societies. It is my hope that the parameters I used to measure the process of innovation, as derived from contemporary innovation theory in anthropology and economics, can be accommodated to other cultural settings and levels of societal complexities in order to explore the process of innovation in different social contexts.

The ultimate goal of this project is, therefore, to contribute to the theoretical and methodological study of innovation in archaeological research, in general. The primary methodological contribution of this study is the identification of archaeologically measurable variables to describe the process of innovation. These variables were the origin of innovations, the rate of innovation adoption, the pattern of adoption, and the uniformity of adoption. These particular variables proved useful in their ability to provide a composite picture of the process, and from that picture, to generate explanations for stylistic variation by assessing the relationships among production groups over time.

Archaeologists working in other parts of the world can use these variables as a starting point for describing the innovation process in style, technology, ritual, etc., but would undoubtedly be able to identify other variables that pertain to their particular setting and dataset. In some areas, for example, control over production is better than in the Hohokam case; in others, it will be worse. The same applies to control over time. In some areas, innovation will be a constant theme; in others, it will be rarer. Additional variables might be found useful for different situations, but the point is to utilize variables that enable one to understand the whole process of innovation, so that the artisans/producers are given an active role in decision making within a social context.

The theoretical contribution of this study is the amalgamation of contemporary economic, ethnographic, and archaeological theories on innovation to generate a framework for the study of the relationship between innovation and the social environment in prehistoric middle-range societies. Archaeology stands in a unique place to examine such relationships over the long term. In this case, the decision-making of the same groups of craft specialists was examined over the course of 300 years. At specific episodes of social stress or change, which I have labeled as reorganizations, each group decided how they would respond, and in the process, contributed to the complexity and 'look' of that reorganization. In many cases, the data collected on the process of innovation have given valid reasons to question some of the assumptions that led to my expectations.

Expectations for innovation and adoption were set up in this study, based on general observations in economics and ethnography; however, more often than not, the expectations were not met. Although care was taken to draw general principles from the literature, it is still quite possible that some of the expectations were not met because they were generated, in large part, from research in contemporary capitalist economies. Even within that literature, however, economists are rarely confident in predicting the process and result of innovation. This study has helped to confirm, then, that from an economic and anthropological perspective, innovation is an extremely complicated social phenomenon in any society. The results of this study demonstrate that an understanding of innovation requires a highly nuanced understanding of the historical processes that characterize each case study. It has been noted that innovation is difficult, if not impossible, to predict in contemporary societies (Bolton 1993:58). Should we expect any less when we turn our attention to prehistory?

To be sure, one can predict that innovation is more likely in certain situations, but the archaeologist, anthropologist, or economist is always at the mercy of the human agent, who alone makes a decision of whether or not a new thing or idea is worthwhile, and whether or not that new thing or idea will be part of their own repertoire. In the end, the value of this study has proven not to be in providing a predictive model for innovation, but a descriptive one that highlights the complexity of human decision making in the face of social and economic challenges and opportunities.

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APPENDIX A

STYLISTIC ATTRIBUTES AND THEIR TEMPORAL RANGES

Table A.1. Stylistic attributes and their temporal ranges (based on Wallace 2001, 2004) for the 24 depositional contexts chosen for detailed anlaysis. Percents should be read as "attribute A occurs on B percent of the total number of temporally diagnostic sherds from Feature Y".

Feature 141 (N=63)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	3	4.8%												
free-floating fringe	1	1.6%												
single-capped fringe	1	1.6%												
indet. free-dloating or aingle-capped fringe	1	1.6%												
wavy-capped fringe	2	3.3%												
rect. scroll	2	3.2%												
solid void motif	3	4.8%												
tapered line	2	3.2%												
Upper Freeline (pct. calculated for jars with necks only)	5	83.3%												
open panel	4	6.3%												
Decorated Neck (pct. calculated for jars with necks only)	4	66.7%												
Tall Neck (pct. calculated for jars with necks only	2	33.3%												
crenulated line***	2	3.2%												
Jar with sectioned design¹ (pct. calculated for jars only)	3	7.3%												
Total # of attributes	35		mixed =	0.0%										

Feature 152 (N=26)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	2	7.7%												
banded layout	1	3.8%												
slanted railroad tie hachure	1	3.8%												
large solids (>5cm2)	4	15.4%												
indet. free-floating or single-capped fringe	1	3.8%												
panel with a serrated margin	1	3.8%												
crenulated line in a panel	1	3.8%												
crenulated line***	2	7.7%												
fringed curvilinear scroll	1	3.8%												
Jar with sectioned design¹ (pct. calculated for jars only)	2	11.8%												
Total # of attributes	16		mixed =	6.30%										

Feature 161 (N=58)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. Scroll	6	10.3%												
Trailing Lines (pct. calculated for bowls only)	11	30.0%												
Organizational Banding Layout¹	1	1.7%												
life forms (except birds and lizards)	1	1.7%												
free-floating fringe	4	6.9%												
large solids (>5cm2)	3	5.2%												
indet. free-dloating or aingle-capped fringe	2	3.4%												
wavy-capped fringe	2	3.4%												
solid void motif	1	1.7%												
Wipe-marked jar interior (pct. calculated for jars only)	1	4.5%												
Jar with sectioned design¹ (pct. calculated for jars only)	1	4.5%												
Total # of attributes	33		mixed =	3.0%										

Feature 166 (N=510)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
scoop	8	1.6%												
curv. scroll	43	8.4%												
Trailing Lines (pct. calculated for bowls only)	74	28.4%												
banded layout¹	12	53.0%												
flying bird, positive	19	3.7%												
life forms (except birds and lizards)	7	1.4%												
quail	1	0.2%												
free-floating fringe	28	5.5%												
single-capped fringe	59	11.6%												
large solids (> 5 cm2)	9	1.8%												
indet. free-floating or single-capped fringe	12	2.4%												
cuneiform hatch	1	0.2%												
life forms	2	0.4%												
panel with a centerline motif	5	1.0%												
wavy-capped fringe	3	0.6%												
solid void motif	1	0.2%												
small element group A	6	1.2%												
crenulated line	2	0.4%												
fringed curv. Scroll	11	2.2%												
Wipe-marked jar interior (pct. calculated for jars only)	2	0.8%												
Jar with sectioned design¹ (pct. calculated for jars only)	7	2.9%												
design element diversity>4	1	0.2%												
Panel, partly line demarcated, multiple duplicate elements used as panel centerline	1	0.2%												
Total # of attributes	314		mixed =	1.00%										

Feature 188 (N=31)

Atribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	3	9.7%												
single-capped fringe	1	3.2%												
life forms	1	3.2%												
Everted Jar Rim (pct. calculated for jar rims only)	1	25.0%												
wavy-capped fringe	4	12.9%												
Gila shoulder, <120°	1	3.2%												
rect. scroll	1	3.2%												
crenulated line	1	3.2%												
Line-demarcated panels (>50% line demarcated)	1	3.2%												
Jar with sectioned design¹ (pct. calculated for jars only)	4	18.2%												
Total # of attributes	18		mixed =	0.00%										

Feature 262 (N=75)

Atribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. Scroll	7	9.3%												
single-capped fringe	6	8.0%												
indet. free-floating or single-capped fringe	1	1.3%												
everted jar rim	2	28.6%												
wavy-capped fringe	8	10.7%												
Gila shoulder, <120°	4	8.7%												
Gila shoulder, knife-edged	1	2.2%												
rect. Scroll	2	2.7%												
solid void motif	1	1.3%												
crenulated line	3	4.0%												
Line-demarcated panels (>50% line demarcated)	1	1.3%												
Jar with sectioned design¹ (pct. calculated for jars only)	1	2.0%												
Total # of attributes	37		mixed =	0.00%										

Feature 320 (N=41)													
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. Scroll	3	7.3%												
free-floating fringe	3	7.3%												
single-capped fringe	5	12.2%												
large solids (>5cm2)	2	4.9%												
Everted Jar Rim (pct. calculated for jar rims only)	1	50.0%												
wavy-capped fringe	1	2.4%												
Gila Shoulder <120 degrees²	2	4.9%												
open panel	1	2.4%												
crenulated line	2	4.9%												
Jar with sectioned design¹ (pct. calculated for jars only)	1	2.7%												
small, geometric element group C	1	2.4%												
Total # of attributes	22		mixed =	4.50%										

Feature 383 (N=46)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Single-Capped Fringe	3	6.5%												
Large Solids (> 5 cm^2)	3	6.5%												
Rectilinear Scroll	5	10.9%												
Open Panel	6	13.0%												
Line-demarcated panels (>50% line demarcated)	1	2.2%												
Jar with sectioned design¹ (pct. calculated for jars only)	3	9.4%												
Total # of attributes	21		mixed =	0.0%										

Feature 384 (N=19)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Free-Floating Fringe	1	5.3%												
Rectilinear Scroll	4	21.1%												
Upper Freeline (pct. calculated for jars with necks only)	1	100%												
Open Panel	3	15.8%												
Decorated Neck (pct. calculated for jars with necks only)	1	100%												
Tall Neck (pct. calculated for jars with necks only	1	100%												
Jar with sectioned design¹ (pct. calculated for jars only)	3	18.8%												
Total # of attributes	14		mixed =	0.00%										

Feature 635 (N=28)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Curvilinear Scroll	1	3.6%												
Trailing Lines (pct. calculated for bowls only)	2	28.6%												
Life Forms (except birds and lizards)	1	3.6%												
Free-Floating Fringe	1	3.6%												
Everted Jar Rim (pct. calculated for jar rims only)	1	14.3%												
rect. scroll	1	3.6%												
Upper Freeline (pct. calculated for jars with necks only)	2	25.0%												
Open Panel	4	14.3%												
Decorated Neck (pct. calculated for jars with necks only)	5	62.5%												
Tall Neck (pct. calculated for jars with necks only	5	62.5%												
Jar with sectioned design¹ (pct. calculated for jars only)	4	19.0%												
Total # of attributes	27		mixed =	#####										

Feature 669 (N=46)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Curvilinear Scroll	5	10.9%												
Trailing Lines (pct. calculated for bowls only)	2	8.3%												
Organizational Banding Layout[1]	1	2.2%												
Life Forms (except birds and lizards)	1	2.2%												
Free-Floating Fringe	1	2.2%												
Single-Capped Fringe	4	8.7%												
Everted Jar Rim (pct. calculated for jar rims only)	1	50.0%												
Panel with a Centerline Motif	3	6.5%												
Wavy-capped Fringe (single- or double-capped)	2	4.3%												
Gila Shoulder <120 degrees[2]	3	6.5%												
Rectilinear Scroll	1	2.2%												
Crenulated Line	1	2.2%												
Jar with sectioned design[1] (pct. calculated for jars only)	4	18.2%												
Total # of attributes	29		mixed =	0.00%										

Feature 784 (N=33)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	3	9.1%												
Trailing Lines (pct. calculated for bowls only)	3	15.0%												
Organizational Banding Layout[1]	2	6.1%												
life forms (except birds and lizards)	1	3.0%												
free-floating fringe	3	9.1%												
single-capped fringe	5	15.2%												
wavy-capped fringe	2	6.1%												
panel with a serrated margin	1	3.0%												
solid void motif	1	3.0%												
small element group A	1	3.0%												
fringed curv. Scroll	1	3.0%												
Line-demarcated panels (>50% line demarcated)	1	3.0%												
small element group C	1	3.0%												
Total # of attributes	25		mixed =	4.00%										

Feature 785 (N=45)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Trailing Lines (pct. calculated for bowls only)	2	15.4%												
Life Forms (except birds and lizards)	1	2.2%												
Single-Capped Fringe	1	2.2%												
Everted Jar Rim (pct. calculated for jar rims only)	1	20.0%												
Rectilinear Scroll	2	4.4%												
Solid Void Motif	1	2.2%												
Tapered Lines	1	2.2%												
Upper Freeline (pct. calculated for jars with necks only)	1	16.7%												
Open Panel	2	4.4%												
Decorated Neck (pct. calculated for jars with necks only)	1	16.7%												
Crenulated Line	2	4.4%												
Total # of attributes	15		mixed =	#####										

Feature 867 (N=46)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Curvilinear Scroll	3	6.5%												
Free-Floating Fringe	1	2.2%												
Single-Capped Fringe	6	13.0%												
Everted Jar Rim (pct. calculated for jar rims only)	1	2.2%												
Panel with a Centerline Motif	1	2.2%												
Wavy-capped Fringe (single- or double-capped)	3	6.5%												
Gila Shoulder <120 degrees[2]	2	4.3%												
Rectilinear Scroll	1	2.2%												
Total # of attributes	18		mixed =	0.00%										

Feature 868 (N=26)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Single-Capped Fringe	2	7.7%												
Wavy-capped Fringe (single- or double-capped)	1	3.8%												
Rectilinear Scroll	3	11.5%												
Solid Void Motif	2	7.7%												
Upper Freeline (pct. calculated for jars with necks only)	4	50.0%												
Decorated Neck (pct. calculated for jars with necks only)	1	12.5%												
Tall Neck (pct. calculated for jars with necks only	1	12.5%												
Total # of attributes	14		mixed =	0.00%										

Feature 874 (N=160)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	18	11.3%												
allover layout	1	0.6%												
life forms (except birds and lizards)	1	0.6%												
free-floating fringe	1	0.6%												
single-capped fringe	15	9.4%												
large solids (>5cm2)	1	0.6%												
Everted Jar Rim (pct. calculated for jar rims only)	9	75.0%												
panel with centerline motif	8	4.4%												
wavy-capped fringe	3	1.9%												
crenulated line in a panel	3	3.8%												
Gila Shoulder <120 degrees²	6	3.8%												
rect. scroll	5	3.8%												
solid void motif	1	0.6%												
crenulated line	6	3.8%												
Line-demarcated panels (>50% line demarcated)	2	1.3%												
Jar with sectioned design¹ (pct. calculated for jars only)	2	2.4%												
Panel, partly line demarcated, multiple duplicate elements used as panel centerline	7	4.4%												
Panel, isolated (completely line demarcated)	1	0.6%												
Total # of attributes	90		mixed =	0.00%										

Feature 979 (N=48)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
single-capped fringe	4	8.3%												
wavy-capped fringe	10	20.8%												
Gila Shoulder <120 degrees²	3	6.3%												
Gila Shoulder, knife-edged²	1	2.1%												
rect. scroll	8	16.7%												
solid void motif	7	14.6%												
Upper Freeline (pct. calculated for jars with necks only)	8	88.9%												
Decorated Neck (pct. calculated for jars with necks only)	3	37.5%												
Tall Neck (pct. calculated for jars with necks only	2	25.0%												
crenulated line	1	2.1%												
Jar with sectioned design¹ (pct. calculated for jars only)	2	4.5%												
small element group C	1	2.1%												
Total # of attributes	50		mixed =	8.00%										

Feature 1062 (N=129)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	6	4.7%												
Organizational Banding Layout[1]	1	0.8%												
single-capped fringe	7	5.4%												
large solids (>5cm2)	3	2.3%												
wavy-capped fringe	1	0.8%												
Gila Shoulder <120 degrees[2]	1	0.8%												
rect. scroll	3	2.3%												
crenulated line	1	0.8%												
Jar with sectioned design[1] (pct. calculated for jars only)	3	6.3%												
small element group E	1	0.8%												
Total # of attributes	27		mixed =	0.00%										

Feature 1089 (N=30)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Curvilinear Scroll	3	10.0%												
Single-Capped Fringe	3	10.0%												
Everted Jar Rim (pct. calculated for jar rims only)	3	50.0%												
Wavy-capped Fringe (single- or double-capped)	4	13.3%												
Gila Shoulder <120 degrees[2]	2	6.7%												
Rectilinear Scroll	2	6.7%												
Jar with sectioned design[1] (pct. calculated for jars only)	1	4.2%												
Banded layout, a-b-a or aa-b-aa with b bands composed of a single thick line (width >5mm)	1	3.3%												
Total # of attributes	19		mixed =	0.00%										

Feature 1093 (N=85)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	2	2.4%												
Everted Jar Rim (pct. calculated for jar rims only)	1	2.1%												
wavy-capped fringe	9	10.6%												
Gila Shoulder <120 degrees[2]	1	1.2%												
rect. scroll	1	1.2%												
solid void motif	1	1.2%												
tapered line	1	1.2%												
Upper Freeline (pct. calculated for jars with necks only)	5	45.5%												
crenulated line	3	3.5%												
Jar with sectioned design[1] (pct. calculated for jars only)	1	2.1%												
Total # of attributes	25		mixed =	0.00%										

Feature 1136 (N=51)

Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	1	2.0%												
single-capped fringe	1	2.0%												
Everted Jar Rim (pct. calculated for jar rims only)	1	2.0%												
wavy-capped fringe	7	13.7%												
rect. scroll	3	5.9%												
solid void motif	4	7.8%												
Upper Freeline (pct. calculated for jars with necks only)	9	90.0%												
Decorated Neck (pct. calculated for jars with necks only)	1	10.0%												
Tall Neck (pct. calculated for jars with necks only	1	10.0%												
Jar with sectioned design[1] (pct. calculated for jars only)	3	7.5%												
Design field separation from rim, bowl interiors only	1	9.1%												
small element group C	3	5.9%												
Total # of attributes	35		mixed =	0.00%										

Feat. 1181														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Curvilinear Scroll	5	14.3%												
Single-Capped Fringe	5	14.3%												
Everted Jar Rim (pct. calculated for jar rims only)	2	100.0%												
Panel with a Centerline Motif	2	5.7%												
Wavy-capped Fringe (single- or double-capped)	1	2.9%												
Crenulated Line in a Panel	1	2.9%												
Gila Shoulder <120 degrees²	3	8.6%												
Rectilinear Scroll	3	8.6%												
Small element group A, nos.: 30, 34, 35, 58, 63, 70, 1, 2, 73, 80, 81, 83, 84, 85, 86, 95, 96, 99, 103, 113, 114	1	2.9%												
Crenulated Line	1	2.9%												
Fringed curvilinear scroll	1	2.9%												
Jar with sectioned design¹ (pct. calculated for jars only)	1	4.0%												
Panel, at least partly line demarcated, multiple duplicate elements used as panel centerline	1	2.9%												
Total # of attributes	27		mixed =	0.00%										

Feat. 1296 (N=116)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
curv. scroll	3	2.6%												
Trailing Lines (pct. calculated for bowls only)	1	11.1%												
rect. scroll	7	6.0%												
tapered line	1	0.9%												
Upper Freeline (pct. calculated for jars with necks only)	10	41.7%												
pitcher	1	0.9%												
open panel	13	11.2%												
Decorated Neck (pct. calculated for jars with necks only)	8	33.3%												
Tall Neck (pct. calculated for jars with necks only	4	16.7%												
crenulated line	2	1.7%												
Total # of attributes	50		mixed =	2.00%										

Classic Features (374 and 376) (N=23)														
Attribute	count	pct.	ES	SW	ESN	LSN	EGB	LGB	SC	ESAC	MSAC1	MSAC2	LSAC	SOHO
Open Panel	2	8.7%												
Decorated Neck (pct. calculated for jars with necks only)	2	50.0%												
Tall Neck (pct. calculated for jars with necks only)	1	25.0%												
Small element group A, nos.: 30, 34, 35, 58, 63, 70, 1, 2, 73, 80, 81, 83, 84, 85, 86, 95, 96, 99, 103, 113, 114	1	4.3%												
Crenulated Line	1	4.3%												
Jar with sectioned design¹ (pct. calculated for jars only)	4	18.2%												
Total # of attributes	11		mixed =	9.10%										

APPENDIX B

THE BUFF WARE SAMPLE BY SITE, FEATURE, AND DATE

Table B.1. The buff ware sample by site, feature, and date**.**

Site	Feature	early Gila Butte	early Gila Butte/late Gila Butte	late Gila Butte	late Gila Butte/Santa Cruz	Santa Cruz	early Sacaton	early Sacaton/middle Sacaton 1	middle Sacaton 1	middle Sacaton 1 - middle Sacaton 2	middle Sacaton 2 - late Sacaton	late Sacaton	late Sacaton/Soho	late Sacaton - Civano	early Sacaton - late Sacaton	Soho	Soho - Civano	Total
El Caserio	21						23											23
El Caserio	28						4											4
El Caserio	45					3												3
El Caserio	46					1	22											23
El Caserio	50						4											4
El Caserio	59					3												3
El Caserio	60						20											20
El Caserio	62					8												8
El Caserio	65						14											14
El Caserio	88						9											9
AZ T:13:18	-		1												27			28
AZ T:13:18	35														1			1
Grewe	165								1									1
Grewe	204								1									1
Grewe	350			50														50
Grewe	440						66											66
Grewe	97						83											83
La Ciudad	1196	40																40
La Ciudad	293					18												18
La Ciudad	373			35														35
La Ciudad	374			140														140
La Ciudad	44	4																4
La Ciudad	598					26												26
La Ciudad	762		28	2														30
La Ciudad	766			71														71
La Ciudad	841					10												10
La Lomita	14									28								28
La Lomita	26						18											18
La Lomita	27									5								5
La Lomita	37						28											28
La Lomita	38									24								24
La Lomita	40									3								3
La Lomita	41									2								2
La Lomita	44									2								2
La Lomita	54					52												52
La Lomita	60						20											20
La Villa	10				3													3
La Villa	109	3																3
La Villa	114				4													4
La Villa	116	68																68
La Villa	117	44																44
La Villa	128	1																1
La Villa	76	5																5
La Villa	80					38												38
La Villa	81					1												1
La Villa	84					5												5
Las Colinas	1004					13												13
Las Colinas	1012					23												23
Las Colinas	1015					64						1						65
Las Colinas	4000									8								8
Las Colinas	4019					2						8						10
Las Colinas	4025										4							4
Las Colinas	4150										9							9
Las Colinas	4178									6								6
Las Colinas	4250								1		2	15						18
Las Colinas	4254							18	2									20
Las Colinas	4262								35		1							36
Las Colinas	5034										41							41
Las Colinas	5038											21						21
Las Colinas	5066								34		6							40
Las Colinas	5126										55							55
Las Ruinitas	1									23								23
Las Ruinitas	11									9								9
Las Ruinitas	12						21											21

Site	Feature	early Gila Butte	early Gila Butte/late Gila Butte	late Gila Butte	late Gila Butte/Santa Cruz	Santa Cruz	early Sacaton	early Sacaton/middle Sacaton 1	middle Sacaton 1	middle Sacaton 1 - middle Sacaton 2	middle Sacaton 2 - late Sacaton	late Sacaton	late Sacaton/Soho	late Sacaton - Civano	early Sacaton - late Sacaton	Soho	Soho - Civano	Total
Las Ruinitas	2									90								90
Las Ruinitas	23									5								5
Las Ruinitas	30									4								4
Las Ruinitas	4									10								10
Los Guanacos	126								11									11
Los Guanacos	59								33									33
Los Guanacos	95								43									43
Los Hornos	10									19								19
Los Hornos	112		1							37								38
Los Hornos	12									35								35
Los Hornos	132									10								10
Los Hornos	15									7								7
Los Hornos	153	1			12													13
Los Hornos	16									20								20
Los Hornos	176									1								1
Los Hornos	199				29													29
Los Hornos	21	33								1								34
Los Hornos	38						22											22
Los Hornos	60				21													21
Los Hornos	76						11											11
Los Hornos	79				7		1											8
Los Hornos	85	109																109
Los Hornos	99	31																31
Lower Santan	1089									11								11
Lower Santan	1093											21						21
Lower Santan	1136											27						27
Lower Santan	1181								20									20
Lower Santan	1296												31					31
Lower Santan	141												21					21
Lower Santan	157												13					13
Lower Santan	161							32										32
Lower Santan	166							202										202
Lower Santan	188								16									16
Lower Santan	262									29								29
Lower Santan	330																2	2
Lower Santan	373																2	2
Lower Santan	374																4	4
Lower Santan	376																3	3
Lower Santan	379																2	2
Lower Santan	380																1	1
Lower Santan	382																1	1
Lower Santan	383													12				12
Lower Santan	384													11				11
Lower Santan	401																4	4
Lower Santan	482													15				15
Lower Santan	518																1	1
Lower Santan	548											7						7
Lower Santan	669								28									28
Lower Santan	773												11					11
Lower Santan	784							22										22
Lower Santan	868												22					22
Palo Verde	339								25									25
Palo Verde	341							18										18
Palo Verde	473							13										13
Palo Verde	475							1	21									22
Pueblo del Rio	110			9														9
Pueblo del Rio	133			7														7
Pueblo del Rio	143			2														2
Pueblo del Rio	263			8														8
Pueblo del Rio	267			5														5
Pueblo del Rio	295		4															4
Pueblo del Rio	475			1														1
Pueblo del Rio	548		4															4
Pueblo Grande	144												19					19
Pueblo Grande	1622															2		2
Pueblo Grande	2027											11						11

Site	Feature	early Gila Butte	early Gila Butte/late Gila Butte	late Gila Butte	late Gila Butte/Santa Cruz	Santa Cruz	early Sacaton	early Sacaton/middle Sacaton 1	middle Sacaton 1	middle Sacaton 1 - middle Sacaton 2	middle Sacaton 2 - late Sacaton	late Sacaton	late Sacaton/Soho	late Sacaton - Civano	early Sacaton - late Sacaton	Soho	Soho - Civano	Total
Pueblo Grande	2032											7						7
Pueblo Grande	2099											12						12
Pueblo Grande	2105															2		2
Pueblo Grande	2206															3		3
Pueblo Grande	3109															6		6
Pueblo Grande	3517															1		1
Pueblo Grande	520															17		17
Pueblo Grande	591											1						1
Pueblo Grande	614											1						1
Pueblo Grande	687											8						8
Pueblo Grande	710											10						10
Pueblo Grande	780											1						1
Pueblo Grande	786											2						2
AZ N:12:105	-														10			10
AZ AA:1:124	12														18			18
AZ AA:1:124	13														30			30
AZ AA:1:124	14														14			14
AZ AA:1:124	17														7			7
AZ AA:1:124	19														4			4
AZ T:3:19	-														11			11
AZ T:3:323	14		4															4
AZ T:3:323	40		4															4
AZ T:3:323	54		6															6
AZ T:3:323	58		11															11
AZ T:3:323	6		4															4
AZ T:3:323	60		4															4
AZ T:3:323	62		3															3
AZ T:3:323	77		8															8
AZ T:3:323	79		15															15
Snaketown	10E					37												37
Snaketown	10J									65								65
Snaketown	11F						19											19
Snaketown	5F, house 1								38									38
Snaketown	5F, house 7								61									61
Snaketown	5G, house								25									25
Snaketown	5G, house								11									11
Snaketown	5G, house 6								18									18
Snaketown	6G								33									33
Snaketown	8D		79															79
Snaketown	9E		165															165
SW Germann	136														31			31
SW Germann	139						23											23
SW Germann	145						7											7
SW Germann	146						10											10
SW Germann	152															5		5
SW Germann	204															9		9
SW Germann	251															3		3
SW Germann	324						4											4
SW Germann	569															14		14
SW Germann	595															27		27
SW Germann	69															18		18
SW Germann	78															9		9
Total		339	341	330	76	304	429	306	457	454	118	153	117	38	153	116	20	3751

APPENDIX C

PROPORTIONS TEST: OBSERVED AND EXPECTED

Table C.1. Significance of proportions test comparing the observed percentage with the expected percentage derived from Wallace (2004:Table 3.6).

Feature	N	observed %	expected %	z	p	significant (0.05)
Feat. 141 late Sacaton/Soho						
Trailing Lines (pct. calculated for bowls only)	22	0.0%	0.0%	matches observed*		no
Motif Serration (not Snaketown Style)	63	0.0%	0% - 5.2%	within range		no
Flying Bird, Positive	63	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	63	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	63	1.6%	1.3% - 3.5%	within range		no
Single-Capped Fringe	63	1.6%	0% - 22.8%	within range		no
Wavy-capped Fringe (single- or double-capped)	63	3.3%	0% - 3.5%	within range		no
Crenulated Line in a Panel	63	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	63	0.0%	0% - 6.9%	within range		no
Lines Motif	63	0.0%	3.5% - 5.2%	-1.512	0.107	no
Tapered Lines	63	3.2%	1.7% - 2.6%	0.299	0.764	no
Crenulated Line*	63	3.2%	0.0%	not determined**		no
Feat. 152 early Sacaton - middle Sacaton 2						
Trailing Lines (pct. calculated for bowls only)	9	0.0%	2.4% - 20.2%	-0.470	-0.638	no
Motif Serration (not Snaketown Style)	26	0.0%	0% - 0.9%	within range		no
Flying Bird, Positive	26	0.0%	0.2% - 1.2%	-0.228	0.818	no
Life Forms (except birds and lizards)	26	0.0%	0.2% - 0.6%	-0.396	0.734	no
Free-Floating Fringe	26	0.0%	1.0% - 6.8%	-1.377	0.168	no
Single-Capped Fringe	26	0.0%	4.3% - 22.1%	-1.081	-0.280	no
Wavy-capped Fringe (single- or double-capped)	26	0.0%	0% - 1.4%	-0.608	0.542	no
Crenulated Line in a Panel	26	3.8%	0% - 2.3%	0.510	0.610	no
Outline Line and Stagger	26	0.0%	0%	matches observed*		no
Lines Motif	26	0.0%	0%	matches observed*		no
Tapered Lines	26	0.0%	0%	matches observed*		no
Crenulated Line*	26	7.7%	0.6% - 5.2%	0.574	0.569	no
Feat. 161 early Sacaton/middle Sacaton 1						
Trailing Lines (pct. calculated for bowls only)	36	30.0%	2.4%	10.820	0.000	yes
Motif Serration (not Snaketown Style)	58	0.0%	0.90%	-0.726	0.465	no
Flying Bird, Positive	58	0.0%	0.20%	-0.341	0.734	no
Life Forms (except birds and lizards)	58	1.7%	0.2%	2.557	0.010	yes
Free-Floating Fringe	58	6.9%	1.0%	4.516	0.000	yes
Single-Capped Fringe	58	0.0%	22.10%	-4.056	0.000	yes
Wavy-capped Fringe (single- or double-capped)	58	3.4%	1.4%	1.296	0.194	no
Crenulated Line in a Panel	58	0.0%	2.30%	-1.169	0.242	no
Outline Line and Stagger	58	0.0%	0%	matches observed*		no
Lines Motif	58	0.0%	0%	matches observed*		no
Tapered Lines	58	0.0%	0%	matches observed*		no
Crenulated Line*	58	0.0%	5.20%	-1.784	0.075	no
Feat. 166 early Sacaton/middle Sacaton 1						
Trailing Lines (pct. calculated for bowls only)	261	28.4%	2.4% - 20.2%	3.300	0.001	yes
Motif Serration (not Snaketown Style)	510	0.0%	0% - 0.9%	within range		no
Flying Bird, Positive	510	3.7%	0.2% - 1.2%	5.185	0.000	yes
Life Forms (except birds and lizards)	510	1.4%	0.2% - 0.6%	2.339	0.019	yes
Free-Floating Fringe	510	5.5%	1.0% - 6.8%	within range		no
Single-Capped Fringe	510	11.6%	4.3% - 22.1%	within range		no
Wavy-capped Fringe (single- or double-capped)	510	0.6%	0% - 1.4%	within range		no
Crenulated Line in a Panel	510	0.0%	0% - 2.3%	within range		no
Outline Line and Stagger	510	0.0%	0%	matches observed*		no
Lines Motif	510	0.0%	0%	matches observed*		no
Tapered Lines	510	0.0%	0%	matches observed*		no
Crenulated Line*	510	0.4%	0.6% - 5.2%	-0.585	0.555	no

Table C.1. Continued

Feat. 188 middle Sacaton 1 - late Sacaton

Trailing Lines (pct. calculated for bowls only)	9	9.7%	2.4%	1.431	0.153	no
Motif Serration (not Snaketown Style)	31	0.0%	0.9%	-0.531	0.596	no
Flying Bird, Positive	31	0.0%	0% - 20%	within range		no
Life Forms (except birds and lizards)	31	0.0%	0% - 2%	within range		no
Free-Floating Fringe	31	3.2%	1% - 3.5%	within range		no
Single-Capped Fringe	31	3.2%	22.1%	-2.536	0.011	yes
Wavy-capped Fringe (single- or double-capped)	31	12.9%	3.5%	2.848	0.004	yes
Crenulated Line in a Panel	31	0.0%	0% - 2.3%	within range		no
Outline Line and Stagger	31	0.0%	0% - 6.9%	within range		no
Lines Motif	31	0.0%	0% - 3.5%	within range		no
Tapered Lines	31	0.0%	0% - 1.7%	within range		no
Crenulated Line*	31	3.2%	0% - 5.2%	within range		no

Feat. 262 middle Sacaton 1 - middle Sacaton 2

Trailing Lines (pct. calculated for bowls only)	26	0.0%	2.4%	-0.800	0.424	no
Motif Serration (not Snaketown Style)	75	0.0%	0.9%	-0.825	0.407	no
Flying Bird, Positive	75	0.0%	0.2%	-0.388	0.697	no
Life Forms (except birds and lizards)	75	0.0%	0.2%	-0.388	0.697	no
Free-Floating Fringe	75	0.0%	1.0%	-0.870	0.384	no
Single-Capped Fringe	75	8.0%	22.1%	-2.943	0.003	yes
Wavy-capped Fringe (single- or double-capped)	75	10.7%	1.4%	6.855	0.000	yes
Crenulated Line in a Panel	75	0.0%	2.3%	-1.329	0.184	no
Outline Line and Stagger	75	0.0%	0.0%	matches observed*		no
Lines Motif	75	0.0%	0.0%	matches observed*		no
Tapered Lines	75	0.0%	0.0%	matches observed*		no
Crenulated Line*	75	4.0%	5.2%	-0.468	0.638	no

Feat. 320 middle Sacaton 1 - late Sacaton

Trailing Lines (pct. calculated for bowls only)	4	0.0%	2.4%	-0.314	0.757	no
Motif Serration (not Snaketown Style)	41	0.0%	0.9%	-0.610	0.542	no
Flying Bird, Positive	41	0.0%	0.2%	-0.287	0.779	no
Life Forms (except birds and lizards)	41	0.0%	0.2%	-0.287	0.779	no
Free-Floating Fringe	41	7.3%	1.0%	4.054	0.000	yes
Single-Capped Fringe	41	12.2%	22.1%	-1.528	0.126	no
Wavy-capped Fringe (single- or double-capped)	41	2.4%	1.4%	0.545	0.582	no
Crenulated Line in a Panel	41	0.0%	2.3%	-0.982	0.327	no
Outline Line and Stagger	41	0.0%	0.0%	matches observed*		no
Lines Motif	41	0.0%	0.0%	matches observed*		no
Tapered Lines	41	0.0%	0.0%	matches observed*		no
Crenulated Line*	41	4.9%	5.2%	-0.087	0.928	no

Feat. 383 late Sacaton - Civano

Trailing Lines (pct. calculated for bowls only)	14	0.0%	0.0%	matches observed*		no
Motif Serration (not Snaketown Style)	46	0.0%	0.0%	matches observed*		no
Flying Bird, Positive	46	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	46	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	46	0.0%	1.3%	-0.778	-2.55676	no
Single-Capped Fringe	46	6.5%	0.0%	not determined**		no
Wavy-capped Fringe (single- or double-capped)	46	0.0%	0.0%	matches observed*		no
Crenulated Line in a Panel	46	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	46	0.0%	0.0%	matches observed*		no
Lines Motif	46	0.0%	5.2%	-1.588	-4.17692	no
Tapered Lines	46	0.0%	2.6%	-1.108	-3.21624	no
Crenulated Line*	46	0.0%	0.0%	matches observed*		no

Table C.1. Continued

Feat. 384 late Sacaton - Civano						
Trailing Lines (pct. calculated for bowls only)	3	0.0%	0.0%	matches observed*		no
Motif Serration (not Snaketown Style)	19	0.0%	0.0%	matches observed*		no
Flying Bird, Positive	19	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	19	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	19	5.3%	1.3%	1.539	0.124	no
Single-Capped Fringe	19	0.0%	0.0%	matches observed*		no
Wavy-capped Fringe (single- or double-capped)	19	0.0%	0.0%	matches observed*		no
Crenulated Line in a Panel	19	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	19	0.0%	0.0%	matches observed*		no
Lines Motif	19	0.0%	5.2%	-1.021	0.308	no
Tapered Lines	19	0.0%	2.6%	-0.712	0.478	no
Crenulated Line*	19	0.0%	0.0%	matches observed*		no
Feat. 635 middle Sacaton 1 - Soho						
Trailing Lines (pct. calculated for bowls only)	7	28.6%	2.40%	4.529	0.000	yes
Motif Serration (not Snaketown Style)	28	0.0%	0% - 5.2%	within range		no
Flying Bird, Positive	28	0.0%	0% - 0.2%	within range		no
Life Forms (except birds and lizards)	28	3.6%	0.20%	4.027	0.000	yes
Free-Floating Fringe	28	3.6%	3.50%	0.029	0.976	no
Single-Capped Fringe	28	0.0%	0% - 22.8%	within range		no
Wavy-capped Fringe (single- or double-capped)	28	0.0%	0% - 3.5%	within range		no
Crenulated Line in a Panel	28	0.0%	0% -2.3%	within range		no
Outline Line and Stagger	28	0.0%	0% - 6.9%	within range		no
Lines Motif	28	0.0%	0% - 5.2%	within range		no
Tapered Lines	28	0.0%	0% - 2.6%	within range		no
Crenulated Line*	28	0.0%	0% - 5.2%	within range		no
Feat. 669 middle Sacaton 1						
Trailing Lines (pct. calculated for bowls only)	24	8.3%	2.4%	1.889	0.059	no
Motif Serration (not Snaketown Style)	46	0.0%	0.9%	0.646	0.516	no
Flying Bird, Positive	46	0.0%	0.2%	0.304	0.734	no
Life Forms (except birds and lizards)	46	2.2%	0.2%	3.036	0.002	yes
Free-Floating Fringe	46	2.2%	1.0%	0.818	0.412	no
Single-Capped Fringe	46	8.7%	22.1%	-2.190	0.029	yes
Wavy-capped Fringe (single- or double-capped)	46	4.3%	1.4%	1.674	0.095	no
Crenulated Line in a Panel	46	0.0%	2.3%	-1.041	0.298	no
Outline Line and Stagger	46	0.0%	0.0%	matches observed*		no
Lines Motif	46	0.0%	0.0%	matches observed*		no
Tapered Lines	46	0.0%	0.0%	matches observed*		no
Crenulated Line*	46	2.2%	5.2%	-0.916	0.358	no
Feat. 784 early Sacaton/middle Sacaton 1						
Trailing Lines (pct. calculated for bowls only)	20	15.0%	2.4% - 20.2%	within range		no
Motif Serration (not Snaketown Style)	33	0.0%	0% - 0.9%	within range		no
Flying Bird, Positive	33	0.0%	0.2% - 1.2%	-0.257	0.795	no
Life Forms (except birds and lizards)	33	3.0%	0.2% - 0.6%	1.785	0.073	no
Free-Floating Fringe	33	9.1%	1.0% - 6.8%	0.525	0.596	no
Single-Capped Fringe	33	15.2%	4.3% - 22.1%	within range		no
Wavy-capped Fringe (single- or double-capped)	33	6.1%	0% - 1.4%	2.298	0.021	yes
Crenulated Line in a Panel	33	0.0%	0% - 2.3%	within range		no
Outline Line and Stagger	33	0.0%	0%	matches observed*		no
Lines Motif	33	0.0%	0%	matches observed*		no
Tapered Lines	33	0.0%	0%	matches observed*		no
Crenulated Line*	33	0.0%	0.6% - 5.2%	-0.446	0.653	no

Table C.1. Continued

Feat. 785 late Sacaton/Soho						
Trailing Lines (pct. calculated for bowls only)	13	15.4%	0.0%	not determined**		yes
Motif Serration (not Snaketown Style)	45	0.0%	0% - 5.2%	within range		no
Flying Bird, Positive	45	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	45	2.2%	0.0%	not determined**		no
Free-Floating Fringe	45	0.0%	1.3%	-0.770	0.441	no
Single-Capped Fringe	45	2.2%	0% - 22.8%	within range		no
Wavy-capped Fringe (single- or double-capped)	45	0.0%	0% - 3.5%	within range		no
Crenulated Line in a Panel	45	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	45	0.0%	0% - 6.9%	within range		no
Lines Motif	45	0.0%	3.5%	-1.278	0.201	no
Tapered Lines	45	2.2%	1.7% - 2.6%	within range		no
Crenulated Line*	45	4.4%	0.0%	not determined**		no
Feat. 867 middle Sacaton 1 - middle Sacaton 2						
Trailing Lines (pct. calculated for bowls only)	4	0.0%	2.4%	-0.314	0.757	no
Motif Serration (not Snaketown Style)	46	0.0%	0.9%	-0.646	0.516	no
Flying Bird, Positive	46	0.0%	0.2%	-0.304	0.764	no
Life Forms (except birds and lizards)	46	0.0%	0.2%	-0.304	0.764	no
Free-Floating Fringe	46	2.2%	1.0%	0.818	0.412	no
Single-Capped Fringe	46	13.0%	22.1%	-1.487	0.136	no
Wavy-capped Fringe (single- or double-capped)	46	6.5%	1.4%	2.944	0.003	yes
Crenulated Line in a Panel	46	0.0%	2.3%	-1.041	0.298	no
Outline Line and Stagger	46	0.0%	0.0%	matches observed*		no
Lines Motif	46	0.0%	0.0%	matches observed*		no
Tapered Lines	46	0.0%	0.0%	matches observed*		no
Crenulated Line*	46	0.0%	5.2%	-1.588	0.112	no
Feat. 868 late Sacaton - Soho						
Trailing Lines (pct. calculated for bowls only)	14	0.0%	0.0%	matches observed*		no
Motif Serration (not Snaketown Style)	26	0.0%	0% - 5.2%	within range		no
Flying Bird, Positive	26	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	26	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	26	0.0%	1.3%	-0.585	0.555	no
Single-Capped Fringe	26	7.7%	0% - 22.8%	within range		no
Wavy-capped Fringe (single- or double-capped)	26	3.8%	3.5%	0.083	0.936	no
Crenulated Line in a Panel	26	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	26	0.0%	0% - 6.9%	within range		no
Lines Motif	26	0.0%	3.5%	-0.971	0.332	no
Tapered Lines	26	0.0%	1.7%	-0.671	0.503	no
Crenulated Line*	26	0.0%	0.0%	matches observed*		no
Feat. 874 middle Sacaton 1						
Trailing Lines (pct. calculated for bowls only)	78	0.0%	2.4%	-1.385	0.165	no
Motif Serration (not Snaketown Style)	160	0.0%	0.9%	-1.205	0.226	no
Flying Bird, Positive	160	0.0%	0.2%	-0.566	0.569	no
Life Forms (except birds and lizards)	160	0.6%	0.2%	1.133	0.258	no
Free-Floating Fringe	160	0.6%	1.0%	-0.509	0.610	no
Single-Capped Fringe	160	9.4%	22.1%	-3.872	0.000	yes
Wavy-capped Fringe (single- or double-capped)	160	1.9%	1.4%	0.538	0.589	no
Crenulated Line in a Panel	160	3.8%	2.3%	1.266	0.204	no
Outline Line and Stagger	160	0.0%	0.0%	matches observed*		no
Lines Motif	160	0.0%	0.0%	matches observed*		no
Tapered Lines	160	0.0%	0.0%	matches observed*		no
Crenulated Line*	160	3.8%	5.2%	-0.798	0.424	no

Table C.1. Continued

Feat. 979 middle Sacaton 2/late Sacaton						
Trailing Lines (pct. calculated for bowls only)	15	0.0%	0% - 2.4%	within range		no
Motif Serration (not Snaketown Style)	48	0.0%	0.9% - 5.2%	-0.660	0.509	no
Flying Bird, Positive	48	0.0%	0% - 0.2%	within range		no
Life Forms (except birds and lizards)	48	0.0%	0% - 0.2%	within range		no
Free-Floating Fringe	48	0.0%	1% - 3.5%	-0.696	0.484	no
Single-Capped Fringe	48	8.3%	22.1% - 22.8%	-2.304	0.021	yes
Wavy-capped Fringe (single- or double-capped)	48	20.8%	1.4% - 3.5%	6.522	0.000	yes
Crenulated Line in a Panel	48	0.0%	0%	matches observed*		no
Outline Line and Stagger	48	0.0%	0% - 6.9%	within range		no
Lines Motif	48	0.0%	0% - 3.5%	within range		no
Tapered Lines	48	0.0%	0% - 1.7%	within range		no
Crenulated Line*	48	2.1%	0% - 5.2%	within range		no
Feat. 1062 middle Sacaton 1						
Trailing Lines (pct. calculated for bowls only)	81	0.0%	2.4%	-1.411	0.159	no
Motif Serration (not Snaketown Style)	129	0.0%	0.9%	-1.082	0.271	no
Flying Bird, Positive	129	0.0%	0.2%	-0.508	0.610	no
Life Forms (except birds and lizards)	129	0.0%	0.2%	-0.508	0.610	no
Free-Floating Fringe	129	0.0%	1.0%	-1.142	0.254	no
Single-Capped Fringe	129	5.4%	22.1%	-4.571	0.000	yes
Wavy-capped Fringe (single- or double-capped)	129	0.8%	1.4%	-0.580	0.562	no
Crenulated Line in a Panel	129	0.0%	2.3%	-1.743	0.082	no
Outline Line and Stagger	129	0.0%	0.0%	matches observed*		no
Lines Motif	129	0.0%	0.0%	matches observed*		no
Tapered Lines	129	0.0%	0.0%	matches observed*		no
Crenulated Line*	129	0.8%	5.2%	-2.251	0.024	yes
Feat. 1089 middle Sacaton 1 - middle Sacaton 2						
Trailing Lines (pct. calculated for bowls only)	6	0.0%	2.4%	-0.384	0.704	no
Motif Serration (not Snaketown Style)	30	0.0%	0.9%	-0.522	0.603	no
Flying Bird, Positive	30	0.0%	0.2%	-0.245	0.803	no
Life Forms (except birds and lizards)	30	0.0%	0.2%	-0.245	0.803	no
Free-Floating Fringe	30	0.0%	1.0%	-0.550	0.582	no
Single-Capped Fringe	30	10.0%	22.1%	-1.597	0.110	no
Wavy-capped Fringe (single- or double-capped)	30	13.3%	1.4%	5.548	0.000	yes
Crenulated Line in a Panel	30	0.0%	2.3%	-0.840	0.401	no
Outline Line and Stagger	30	0.0%	0.0%	matches observed*		no
Lines Motif	30	0.0%	0.0%	matches observed*		no
Tapered Lines	30	0.0%	0.0%	matches observed*		no
Crenulated Line*	30	0.0%	5.2%	-1.283	0.201	no
Feat. 1093 late Sacaton						
Trailing Lines (pct. calculated for bowls only)	37	0.0%	0.0%	matches observed*		no
Motif Serration (not Snaketown Style)	85	0.0%	5.0%	-2.115	0.034	yes
Flying Bird, Positive	85	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	85	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	85	0.0%	3.5%	-1.756	0.078	no
Single-Capped Fringe	85	0.0%	22.8%	-5.010	0.000	yes
Wavy-capped Fringe (single- or double-capped)	85	10.6%	3.5%	3.562	0.000	yes
Crenulated Line in a Panel	85	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	85	0.0%	6.9%	-2.510	0.012	yes
Lines Motif	85	0.0%	3.5%	-1.756	0.078	no
Tapered Lines	85	1.2%	1.7%	-0.357	0.719	no
Crenulated Line*	85	3.5%	0.0%	not determined**		no

Table C.1. Continued

Feat. 1136 late Sacaton						
Trailing Lines (pct. calculated for bowls only)	11	0.0%	0.0%	matches observed*		no
Motif Serration (not Snaketown Style)	51	0.0%	5.0%	-1.638	0.101	no
Flying Bird, Positive	51	0.0%	0.0%	not determined**		no
Life Forms (except birds and lizards)	51	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	51	0.0%	3.5%	-1.360	0.174	no
Single-Capped Fringe	51	2.0%	22.8%	-3.541	0.000	yes
Wavy-capped Fringe (single- or double-capped)	51	13.7%	3.5%	3.964	0.000	yes
Crenulated Line in a Panel	51	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	51	0.0%	6.9%	-1.944	0.052	no
Lines Motif	51	0.0%	3.5%	-1.360	0.174	no
Tapered Lines	51	0.0%	1.7%	-0.939	0.347	no
Crenulated Line*	51	0.0%	0.0%	matches observed*		no
Feat. 1181 middle Sacaton 1 - middle Sacaton 2						
Trailing Lines (pct. calculated for bowls only)	10	0.0%	2.4%	-0.496	0.617	no
Motif Serration (not Snaketown Style)	35	0.0%	0.9%	-0.564	0.575	no
Flying Bird, Positive	35	0.0%	0.2%	-0.265	0.787	no
Life Forms (except birds and lizards)	35	0.0%	0.2%	-0.265	0.787	no
Free-Floating Fringe	35	0.0%	1.0%	-0.595	0.549	no
Single-Capped Fringe	35	14.3%	22.1%	-1.112	0.267	no
Wavy-capped Fringe (single- or double-capped)	35	2.9%	1.4%	0.755	0.447	no
Crenulated Line in a Panel	35	0.0%	2.3%	-0.908	0.363	no
Outline Line and Stagger	35	0.0%	0.0%	matches observed*		no
Lines Motif	35	0.0%	0.0%	matches observed*		no
Tapered Lines	35	0.0%	0.0%	matches observed*		no
Crenulated Line*	35	2.9%	5.2%	-0.613	0.542	no
Feat. 1296 late Sacaton/Soho						
Trailing Lines (pct. calculated for bowls only)	9	11.1%	0.0%	not determined**		yes
Motif Serration (not Snaketown Style)	116	0.0%	0% - 5.2%	within range		no
Flying Bird, Positive	116	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	116	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	116	0.0%	1.3% - 3.5%	-1.236	0.215	no
Single-Capped Fringe	116	0.0%	0% - 22.8%	within range		no
Wavy-capped Fringe (single- or double-capped)	116	0.0%	0% -3.5%	within range		no
Crenulated Line in a Panel	116	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	116	0.0%	0% - 6.9%	within range		no
Lines Motif	116	0.0%	3.5% - 5.2%	-2.051	0.040	yes
Tapered Lines	116	0.9%	1.7% - 2.6%	-0.667	0.503	no
Crenulated Line*	116	1.7%	0.0%	not determined**		no
Feat. 374 and 376 Soho						
Trailing Lines (pct. calculated for bowls only)	1	0.0%	0.0%	matches observed*		no
Motif Serration (not Snaketown Style)	28	0.0%	0.0%	matches observed*		no
Flying Bird, Positive	28	0.0%	0.0%	matches observed*		no
Life Forms (except birds and lizards)	28	0.0%	0.0%	matches observed*		no
Free-Floating Fringe	28	0.0%	1.3%	-0.607	0.542	no
Single-Capped Fringe	28	0.0%	0.0%	matches observed*		no
Wavy-capped Fringe (single- or double-capped)	28	0.0%	0.0%	matches observed*		no
Crenulated Line in a Panel	28	0.0%	0.0%	matches observed*		no
Outline Line and Stagger	28	0.0%	0.0%	matches observed*		no
Lines Motif	28	0.0%	5.2%	-1.239	0.215	no
Tapered Lines	28	0.0%	2.6%	-0.865	0.384	no
Crenulated Line*	28	3.6%	0.0%	not determined**		no

* Test of proportions could not be calculated on attributes whose expected proportions for a given time segment was 0%. However, if the observed proportion was also zero, it was considered to match the expected proportion.

** test of proportions could not be calculated on those attributes whose expected frequencies for a given time segment was 0%

APPENDIX D

TEMPER GROUP DESIGNATIONS

Table D.1. Temper group designations by site, time segment, and feature**.**

Site	Time Segment	Feature	uniden-tified	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
El Caserio	early Sacaton	21							1	17	5	23
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.3%	73.9%	21.7%	
El Caserio	early Sacaton	28								2	2	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	
El Caserio	early Sacaton	46			1				1	10	10	22
			0.0%	0.0%	4.5%	0.0%	0.0%	0.0%	4.5%	45.5%	45.5%	
El Caserio	early Sacaton	50								3	1	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	75.0%	25.0%	
El Caserio	early Sacaton	60		2					1	11	6	20
			0.0%	10.0%	0.0%	0.0%	0.0%	0.0%	5.0%	55.0%	30.0%	
El Caserio	early Sacaton	65	1	3					3	1	6	14
			7.1%	21.4%	0.0%	0.0%	0.0%	0.0%	21.4%	7.1%	42.9%	
El Caserio	early Sacaton	88		1	1				1	3	3	9
			0.0%	11.1%	11.1%	0.0%	0.0%	0.0%	11.1%	33.3%	33.3%	
El Caserio	Santa Cruz	45								1	2	3
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	66.7%	
El Caserio	Santa Cruz	46								1		1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
El Caserio	Santa Cruz	59		2							1	3
			0.0%	66.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	
El Caserio	Santa Cruz	62		1						7		8
			0.0%	12.5%	0.0%	0.0%	0.0%	0.0%	0.0%	87.5%	0.0%	
Gillespie Dam	early - late Gila Butte	-									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Gillespie Dam	early - late Sacaton	-						10			17	27
			0.0%	0.0%	0.0%	0.0%	0.0%	37.0%	0.0%	0.0%	63.0%	
Gillespie Dam	early - late Sacaton	35									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Grewe	early Sacaton	440		12	7	1	6			19	21	66
			0.0%	18.2%	10.6%	1.5%	9.1%	0.0%	0.0%	28.8%	31.8%	
Grewe	early Sacaton	97		7	12					41	23	83
			0.0%	8.4%	14.5%	0.0%	0.0%	0.0%	0.0%	49.4%	27.7%	
Grewe	late Gila Butte	350		5	12					4	29	50
			0.0%	10.0%	24.0%	0.0%	0.0%	0.0%	0.0%	8.0%	58.0%	
Grewe	middle Sacaton 1	165					1					1
			0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	
Grewe	middle Sacaton 1	204		1								1
			0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
La Ciudad	early Gila Butte	1196		8	3		3		7	7	12	40
			0.0%	20.0%	7.5%	0.0%	7.5%	0.0%	17.5%	17.5%	30.0%	
La Ciudad	early Gila Butte	44			2					1	1	4
			0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	25.0%	25.0%	
La Ciudad	early - late Gila Butte	762					1		3	3	21	28
			0.0%	0.0%	0.0%	0.0%	3.6%	0.0%	10.7%	10.7%	75.0%	
La Ciudad	late Gila Butte	373			3	1	2		4	1	24	35
			0.0%	0.0%	8.6%	2.9%	5.7%	0.0%	11.4%	2.9%	68.6%	
La Ciudad	late Gila Butte	374		1	5	2	4		21		107	140
			0.0%	0.7%	3.6%	1.4%	2.9%	0.0%	15.0%	0.0%	76.4%	
La Ciudad	late Gila Butte	762									2	2
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
La Ciudad	late Gila Butte	766					4		10	12	45	71
			0.0%	0.0%	0.0%	0.0%	5.6%	0.0%	14.1%	16.9%	63.4%	
La Ciudad	Santa Cruz	293		1					2	1	14	18
			0.0%	5.6%	0.0%	0.0%	0.0%	0.0%	11.1%	5.6%	77.8%	
La Ciudad	Santa Cruz	598					1	1	7	1	16	26
			0.0%	0.0%	0.0%	0.0%	3.8%	3.8%	26.9%	3.8%	61.5%	
La Ciudad	Santa Cruz	841		1						7	2	10
			0.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	70.0%	20.0%	

Site	Time Segment	Feature	uniden-tified	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
La Lomita	early Sacaton	26		1						14	3	18
			0.0%	5.6%	0.0%	0.0%	0.0%	0.0%	0.0%	77.8%	16.7%	
La Lomita	early Sacaton	37		4					1	19	4	28
			0.0%	14.3%	0.0%	0.0%	0.0%	0.0%	3.6%	67.9%	14.3%	
La Lomita	early Sacaton	60		1						8	11	20
			0.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	40.0%	55.0%	
La Lomita	middle Sacaton 1-2	14		1		1			1	16	9	28
			0.0%	3.6%	0.0%	3.6%	0.0%	0.0%	3.6%	57.1%	32.1%	
La Lomita	middle Sacaton 1-2	27		1						3	1	5
			0.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	60.0%	20.0%	
La Lomita	middle Sacaton 1-2	38		4						12	8	24
			0.0%	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	33.3%	
La Lomita	middle Sacaton 1-2	40			1					1	1	3
			0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	33.3%	33.3%	
La Lomita	middle Sacaton 1-2	41								1	1	2
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	
La Lomita	middle Sacaton 1-2	44								1	1	2
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	
La Lomita	Santa Cruz	54		4	8	1				11	28	52
			0.0%	7.7%	15.4%	1.9%	0.0%	0.0%	0.0%	21.2%	53.8%	
La Villa	early Gila Butte	109			1						2	3
			0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	66.7%	
La Villa	early Gila Butte	116		9	7		3		21	10	18	68
			0.0%	13.2%	10.3%	0.0%	4.4%	0.0%	30.9%	14.7%	26.5%	
La Villa	early Gila Butte	117		6	1	1	1		17	1	17	44
			0.0%	13.6%	2.3%	2.3%	2.3%	0.0%	38.6%	2.3%	38.6%	
La Villa	early Gila Butte	128									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
La Villa	early Gila Butte	76							2		3	5
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	40.0%	0.0%	60.0%	
La Villa	Gila Butte/Santa Cruz	10		1							2	3
			0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	66.7%	
La Villa	Gila Butte/Santa Cruz	114					1	1			2	4
			0.0%	0.0%	0.0%	0.0%	25.0%	25.0%	0.0%	0.0%	50.0%	
La Villa	Santa Cruz	80		1	6	1			1	18	11	38
			0.0%	2.6%	15.8%	2.6%	0.0%	0.0%	2.6%	47.4%	28.9%	
La Villa	Santa Cruz	81									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
La Villa	Santa Cruz	84		1						4		5
			0.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	80.0%	0.0%	
Las Colinas	early/middle Sacaton 1	4254		2	1	2	3			2	8	18
			0.0%	11.1%	5.6%	11.1%	16.7%	0.0%	0.0%	11.1%	44.4%	
Las Colinas	late Sacaton	1015									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Las Colinas	late Sacaton	4019		1			2			1	4	8
			0.0%	12.5%	0.0%	0.0%	25.0%	0.0%	0.0%	12.5%	50.0%	
Las Colinas	late Sacaton	4250		4		2				6	3	15
			0.0%	26.7%	0.0%	13.3%	0.0%	0.0%	0.0%	40.0%	20.0%	
Las Colinas	late Sacaton	5038		3	1	2	1			12	2	21
			0.0%	14.3%	4.8%	9.5%	4.8%	0.0%	0.0%	57.1%	9.5%	
Las Colinas	middle Sacaton 1	4250									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Las Colinas	middle Sacaton 1	4254		1							1	2
			0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	
Las Colinas	middle Sacaton 1	4262		6	1		5			9	14	35
			0.0%	17.1%	2.9%	0.0%	14.3%	0.0%	0.0%	25.7%	40.0%	
Las Colinas	middle Sacaton 1	5066		4	1	1				9	19	34
			0.0%	11.8%	2.9%	2.9%	0.0%	0.0%	0.0%	26.5%	55.9%	
Las Colinas	middle Sacaton 1- 2	4000			2					2	4	8
			0.0%	0.0%	25.0%	0.0%	0.0%	0.0%	0.0%	25.0%	50.0%	
Las Colinas	middle Sacaton 1- 2	4178		2							4	6
			0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	66.7%	
Las Colinas	middle Sacaton 2 - late Sacaton	4025		1							2	4
			0.0%	25.0%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	

Site	Time Segment	Feature	uniden-tified	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
Las Colinas	middle Sacaton 2 - late Sacaton	4150		1	1					1	6	9
			0.0%	11.1%	11.1%	0.0%	0.0%	0.0%	0.0%	11.1%	66.7%	
Las Colinas	middle Sacaton 2 - late Sacaton	4250				1					1	2
			0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	50.0%	
Las Colinas	middle Sacaton 2 - late Sacaton	4262									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Las Colinas	middle Sacaton 2 - late Sacaton	5034	1	10	1	5	2			9	13	41
			2.4%	24.4%	2.4%	12.2%	4.9%	0.0%	0.0%	22.0%	31.7%	
Las Colinas	middle Sacaton 2 - late Sacaton	5066			1		1			2	2	6
			0.0%	0.0%	16.7%	0.0%	16.7%	0.0%	0.0%	33.3%	33.3%	
Las Colinas	middle Sacaton 2 - late Sacaton	5126		8	1	4	5			10	27	55
			0.0%	14.5%	1.8%	7.3%	9.1%	0.0%	0.0%	18.2%	49.1%	
Las Colinas	Santa Cruz	1004		1	2				4		6	13
			0.0%	7.7%	15.4%	0.0%	0.0%	0.0%	30.8%	0.0%	46.2%	
Las Colinas	Santa Cruz	1012		1	4				1		17	23
			0.0%	4.3%	17.4%	0.0%	0.0%	0.0%	4.3%	0.0%	73.9%	
Las Colinas	Santa Cruz	1015		5	10				3	12	34	64
			0.0%	7.8%	15.6%	0.0%	0.0%	0.0%	4.7%	18.8%	53.1%	
Las Colinas	Santa Cruz	4019			1						1	2
			0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	
Las Ruinitas	early Sacaton	12					1			17	3	21
			0.0%	0.0%	0.0%	0.0%	4.8%	0.0%	0.0%	81.0%	14.3%	
Las Ruinitas	middle Sacaton 1- 2	1	2	2	2		1			15	1	23
			8.7%	8.7%	8.7%	0.0%	4.3%	0.0%	0.0%	65.2%	4.3%	
Las Ruinitas	middle Sacaton 1- 2	11			1					7	1	9
			0.0%	0.0%	11.1%	0.0%	0.0%	0.0%	0.0%	77.8%	11.1%	
Las Ruinitas	middle Sacaton 1- 2	2		9	4	1	4			65	7	90
			0.0%	10.0%	4.4%	1.1%	4.4%	0.0%	0.0%	72.2%	7.8%	
Las Ruinitas	middle Sacaton 1- 2	23	1							3	1	5
			20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	60.0%	20.0%	
Las Ruinitas	middle Sacaton 1- 2	30					1			2	1	4
			0.0%	0.0%	0.0%	0.0%	25.0%	0.0%	0.0%	50.0%	25.0%	
Las Ruinitas	middle Sacaton 1- 2	4								7	3	10
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	70.0%	30.0%	
Los Guanacos	middle Sacaton 1	126		2						1	8	11
			0.0%	18.2%	0.0%	0.0%	0.0%	0.0%	0.0%	9.1%	72.7%	
Los Guanacos	middle Sacaton 1	59	1	2	5	1	1			5	18	33
			3.0%	6.1%	15.2%	3.0%	3.0%	0.0%	0.0%	15.2%	54.5%	
Los Guanacos	middle Sacaton 1	95		4	3	1				14	21	43
			0.0%	9.3%	7.0%	2.3%	0.0%	0.0%	0.0%	32.6%	48.8%	
Los Hornos	early Gila Butte	153							1			1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
Los Hornos	early Gila Butte	21		6						21	6	33
			0.0%	18.2%	0.0%	0.0%	0.0%	0.0%	0.0%	63.6%	18.2%	
Los Hornos	early Gila Butte	85	1	32	1	1	3		5	37	29	109
			0.9%	29.4%	0.9%	0.9%	2.8%	0.0%	4.6%	33.9%	26.6%	
Los Hornos	early Gila Butte	99		8	6	3	2		1		11	31
			0.0%	25.8%	19.4%	9.7%	6.5%	0.0%	3.2%	0.0%	35.5%	
Los Hornos	early - late Gila Butte	112								1		1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
Los Hornos	early Sacaton	38		1	1	1				16	3	22
			0.0%	4.5%	4.5%	4.5%	0.0%	0.0%	0.0%	72.7%	13.6%	
Los Hornos	early Sacaton	76		1	1					6	3	11
			0.0%	9.1%	9.1%	0.0%	0.0%	0.0%	0.0%	54.5%	27.3%	
Los Hornos	early Sacaton	79							1			1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
Los Hornos	Gila Butte/Santa Cruz	153		4					1	1	6	12
			0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	8.3%	8.3%	50.0%	
Los Hornos	Gila Butte/Santa Cruz	199		3					3	4	19	29
			0.0%	10.3%	0.0%	0.0%	0.0%	0.0%	10.3%	13.8%	65.5%	
Los Hornos	Gila Butte/Santa Cruz	60		1			2	1	2	7	8	21
			0.0%	4.8%	0.0%	0.0%	9.5%	4.8%	9.5%	33.3%	38.1%	
Los Hornos	Gila Butte/Santa Cruz	79		2						4	1	7
			0.0%	28.6%	0.0%	0.0%	0.0%	0.0%	0.0%	57.1%	14.3%	

Site	Time Segment	Feature	uniden-tified	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
Los Hornos	middle Sacaton 1 - 2	10		2					1	13	3	19
			0.0%	10.5%	0.0%	0.0%	0.0%	0.0%	5.3%	68.4%	15.8%	
Los Hornos	middle Sacaton 1 - 2	112		7						8	22	37
			0.0%	18.9%	0.0%	0.0%	0.0%	0.0%	0.0%	21.6%	59.5%	
Los Hornos	middle Sacaton 1 - 2	12	1	1	1	2				8	22	35
			2.9%	2.9%	2.9%	5.7%	0.0%	0.0%	0.0%	22.9%	62.9%	
Los Hornos	middle Sacaton 1 - 2	132		5			1			2	2	10
			0.0%	50.0%	0.0%	0.0%	10.0%	0.0%	0.0%	20.0%	20.0%	
Los Hornos	middle Sacaton 1 - 2	15		1						2	4	7
			0.0%	14.3%	0.0%	0.0%	0.0%	0.0%	0.0%	28.6%	57.1%	
Los Hornos	middle Sacaton 1 - 2	16		4			1			5	10	20
			0.0%	20.0%	0.0%	0.0%	5.0%	0.0%	0.0%	25.0%	50.0%	
Los Hornos	middle Sacaton 1 - 2	176								1		1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
Los Hornos	middle Sacaton 1 - 2	21							1			1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	
Lower Santan	early/middle Sacaton 1	161		1						25	6	32
			0.0%	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	78.1%	18.8%	
Lower Santan	early/middle Sacaton 1	166		8		22	4			103	65	202
			0.0%	4.0%	0.0%	10.9%	2.0%	0.0%	0.0%	51.0%	32.2%	
Lower Santan	early/middle Sacaton 1	784		2		3				10	7	22
			0.0%	9.1%	0.0%	13.6%	0.0%	0.0%	0.0%	45.5%	31.8%	
Lower Santan	late Sacaton	1093		3		4				13	1	21
			0.0%	14.3%	0.0%	19.0%	0.0%	0.0%	0.0%	61.9%	4.8%	
Lower Santan	late Sacaton	1136		2		6	3			9	7	27
			0.0%	7.4%	0.0%	22.2%	11.1%	0.0%	0.0%	33.3%	25.9%	
Lower Santan	late Sacaton	548								6	1	7
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	85.7%	14.3%	
Lower Santan	late Sacaton/Soho	1296		4		3	2			7	15	31
			0.0%	12.9%	0.0%	9.7%	6.5%	0.0%	0.0%	22.6%	48.4%	
Lower Santan	late Sacaton/Soho	141		4		3	2			9	3	21
			0.0%	19.0%	0.0%	14.3%	9.5%	0.0%	0.0%	42.9%	14.3%	
Lower Santan	late Sacaton/Soho	157		2		1				9	1	13
			0.0%	15.4%	0.0%	7.7%	0.0%	0.0%	0.0%	69.2%	7.7%	
Lower Santan	late Sacaton/Soho	773		1						4	6	11
			0.0%	9.1%	0.0%	0.0%	0.0%	0.0%	0.0%	36.4%	54.5%	
Lower Santan	late Sacaton/Soho	868		5		2				14	1	22
			0.0%	22.7%	0.0%	9.1%	0.0%	0.0%	0.0%	63.6%	4.5%	
Lower Santan	late Sacaton-Civano	383				2				5	5	12
			0.0%	0.0%	0.0%	16.7%	0.0%	0.0%	0.0%	41.7%	41.7%	
Lower Santan	late Sacaton-Civano	384				2				5	4	11
			0.0%	0.0%	0.0%	18.2%	0.0%	0.0%	0.0%	45.5%	36.4%	
Lower Santan	late Sacaton-Civano	482				4				5	6	15
			0.0%	0.0%	0.0%	26.7%	0.0%	0.0%	0.0%	33.3%	40.0%	
Lower Santan	middle Sacaton 1	1181		4		2	1			9	4	20
			0.0%	20.0%	0.0%	10.0%	5.0%	0.0%	0.0%	45.0%	20.0%	
Lower Santan	middle Sacaton 1	188				2				12	2	16
			0.0%	0.0%	0.0%	12.5%	0.0%	0.0%	0.0%	75.0%	12.5%	
Lower Santan	middle Sacaton 1	669		3		2				9	14	28
			0.0%	10.7%	0.0%	7.1%	0.0%	0.0%	0.0%	32.1%	50.0%	
Lower Santan	middle Sacaton 1 - 2	1089								7	4	11
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	63.6%	36.4%	
Lower Santan	middle Sacaton 1 - 2	262		1						21	7	29
			0.0%	3.4%	0.0%	0.0%	0.0%	0.0%	0.0%	72.4%	24.1%	
Lower Santan	Soho-Civano	330					1			1		2
			0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	50.0%	0.0%	
Lower Santan	Soho-Civano	373									2	2
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Lower Santan	Soho-Civano	374		1						2	1	4
			0.0%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	25.0%	
Lower Santan	Soho-Civano	376								2	1	3
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	66.7%	33.3%	
Lower Santan	Soho-Civano	379				1				1		2
			0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	50.0%	0.0%	

Site	Time Segment	Feature	uniden-tified	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
Lower Santan	Soho-Civano	380									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Lower Santan	Soho-Civano	382									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Lower Santan	Soho-Civano	401		2		1					1	4
			0.0%	50.0%	0.0%	25.0%	0.0%	0.0%	0.0%	0.0%	25.0%	
Lower Santan	Soho-Civano	518								1		1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
Palo Verde	early/middle Sacaton 1	341	1	1			2		1	2	11	18
			5.6%	5.6%	0.0%	0.0%	11.1%	0.0%	5.6%	11.1%	61.1%	
Palo Verde	early/middle Sacaton 1	473				3	1			1	8	13
			0.0%	0.0%	0.0%	23.1%	7.7%	0.0%	0.0%	7.7%	61.5%	
Palo Verde	early/middle Sacaton 1	475									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Palo Verde	middle Sacaton 1	339	1	2	1		7				14	25
			4.0%	8.0%	4.0%	0.0%	28.0%	0.0%	0.0%	0.0%	56.0%	
Palo Verde	middle Sacaton 1	475		1						6	14	21
			0.0%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%	28.6%	66.7%	
Pueblo del Rio	early/late Gila Butte	295								1	3	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	75.0%	
Pueblo del Rio	early/late Gila Butte	548					1			1	2	4
			0.0%	0.0%	0.0%	0.0%	25.0%	0.0%	0.0%	25.0%	50.0%	
Pueblo del Rio	late Gila Butte	110					1		2	2	4	9
			0.0%	0.0%	0.0%	0.0%	11.1%	0.0%	22.2%	22.2%	44.4%	
Pueblo del Rio	late Gila Butte	133							1	3	3	7
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.3%	42.9%	42.9%	
Pueblo del Rio	late Gila Butte	143								1	1	2
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	
Pueblo del Rio	late Gila Butte	263							4	1	3	8
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	12.5%	37.5%	
Pueblo del Rio	late Gila Butte	267							1	1	3	5
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	20.0%	60.0%	
Pueblo del Rio	late Gila Butte	475								1		1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	
Pueblo Grande	late Sacaton	2027		1		1				2	7	11
			0.0%	9.1%	0.0%	9.1%	0.0%	0.0%	0.0%	18.2%	63.6%	
Pueblo Grande	late Sacaton	2032				6					1	7
			0.0%	0.0%	0.0%	85.7%	0.0%	0.0%	0.0%	0.0%	14.3%	
Pueblo Grande	late Sacaton	2099		1		9				1	1	12
			0.0%	8.3%	0.0%	75.0%	0.0%	0.0%	0.0%	8.3%	8.3%	
Pueblo Grande	late Sacaton	591				1						1
			0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Pueblo Grande	late Sacaton	614									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
Pueblo Grande	late Sacaton	687		1	1					5	1	8
			0.0%	12.5%	12.5%	0.0%	0.0%	0.0%	0.0%	62.5%	12.5%	
Pueblo Grande	late Sacaton	710		1		2					7	10
			0.0%	10.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%	70.0%	
Pueblo Grande	late Sacaton	780				1						1
			0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Pueblo Grande	late Sacaton	786				2						2
			0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Pueblo Grande	late Sacaton/Soho	144		3		4				1	11	19
			0.0%	15.8%	0.0%	21.1%	0.0%	0.0%	0.0%	5.3%	57.9%	
Pueblo Grande	Soho	1622				1	1					2
			0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	
Pueblo Grande	Soho	2105		1		1						2
			0.0%	50.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Pueblo Grande	Soho	2206				1	1				1	3
			0.0%	0.0%	0.0%	33.3%	33.3%	0.0%	0.0%	0.0%	33.3%	
Pueblo Grande	Soho	3109			1						5	6
			0.0%	0.0%	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	83.3%	
Pueblo Grande	Soho	3517									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	

Site	Time Segment	Feature	uniden-tified	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
Pueblo Grande	Soho	520		1		2	5				9	17
			0.0%	5.9%	0.0%	11.8%	29.4%	0.0%	0.0%	0.0%	52.9%	
AZ N:12:105 ASM	early - late Sacaton	-						3		2	5	10
			0.0%	0.0%	0.0%	0.0%	0.0%	30.0%	0.0%	20.0%	50.0%	
AZ AA:1:124 ASM	early - late Sacaton	12								5	13	18
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	27.8%	72.2%	
AZ AA:1:124 ASM	early - late Sacaton	13								15	15	30
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	
AZ AA:1:124 ASM	early - late Sacaton	14						1		5	8	14
			0.0%	0.0%	0.0%	0.0%	0.0%	7.1%	0.0%	35.7%	57.1%	
AZ AA:1:124 ASM	early - late Sacaton	17									7	7
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
AZ AA:1:124 ASM	early - late Sacaton	19									4	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
RSA 175	Preclassic	-									1	1
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
AZ T:3:19 ASM	early - late Sacaton	-						2		1	8	11
			0.0%	0.0%	0.0%	0.0%	0.0%	18.2%	0.0%	9.1%	72.7%	
AZ T:3:323 ASM	early - late Gila Butte	14							1	1	2	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	25.0%	50.0%	
AZ T:3:323 ASM	early - late Gila Butte	40							2		2	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	50.0%	
AZ T:3:323 ASM	early - late Gila Butte	54						2			4	6
			0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	66.7%	
AZ T:3:323 ASM	early - late Gila Butte	58							2		9	11
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18.2%	0.0%	81.8%	
AZ T:3:323 ASM	early - late Gila Butte	6								2	2	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	
AZ T:3:323 ASM	early - late Gila Butte	60									4	4
			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
AZ T:3:323 ASM	early - late Gila Butte	62						1			2	3
			0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	66.7%	
AZ T:3:323 ASM	early - late Gila Butte	77						1	1		6	8
			0.0%	0.0%	0.0%	0.0%	0.0%	12.5%	12.5%	0.0%	75.0%	
AZ T:3:323 ASM	early - late Gila Butte	79						3	4	1	7	15
			0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	26.7%	6.7%	46.7%	
Snaketown	early/late Gila Butte	8D		15		1			1	52	10	79
			0.0%	19.0%	0.0%	1.3%	0.0%	0.0%	1.3%	65.8%	12.7%	
Snaketown	early - late Gila Butte	9E	1	53			1			50	60	165
			0.6%	32.1%	0.0%	0.0%	0.6%	0.0%	0.0%	30.3%	36.4%	
Snaketown	early Sacaton	11F		4						10	5	19
			0.0%	21.1%	0.0%	0.0%	0.0%	0.0%	0.0%	52.6%	26.3%	
Snaketown	middle Sacaton 1	5F, house 1	1	1			3			25	8	38
			2.6%	2.6%	0.0%	0.0%	7.9%	0.0%	0.0%	65.8%	21.1%	
Snaketown	middle Sacaton 1	5F, house 7	1	7			1			23	29	61
			1.6%	11.5%	0.0%	0.0%	1.6%	0.0%	0.0%	37.7%	47.5%	
Snaketown	middle Sacaton 1	5G, house 10		4	2		4			10	5	25
			0.0%	16.0%	8.0%	0.0%	16.0%	0.0%	0.0%	40.0%	20.0%	
Snaketown	middle Sacaton 1	5G, house 11		1			2			3	5	11
			0.0%	9.1%	0.0%	0.0%	18.2%	0.0%	0.0%	27.3%	45.5%	
Snaketown	middle Sacaton 1	5G, house 6		2			1			14	1	18
			0.0%	11.1%	0.0%	0.0%	5.6%	0.0%	0.0%	77.8%	5.6%	
Snaketown	middle Sacaton 1	6G	1	1			3			14	14	33
			3.0%	3.0%	0.0%	0.0%	9.1%	0.0%	0.0%	42.4%	42.4%	

Site	Time Segment	Feature	uniden-tified	Santan Mts.	eastern middle Gila	Queen Creek	SE middle Gila	lower Gila	lower Salt River Valley	Snake-town	schist-only	Total
Snaketown	middle Sacaton 1- 2	10J		13			6			22	24	65
			0.0%	20.0%	0.0%	0.0%	9.2%	0.0%	0.0%	33.8%	36.9%	
Snaketown	Santa Cruz	10E		6						9	22	37
			0.0%	16.2%	0.0%	0.0%	0.0%	0.0%	0.0%	24.3%	59.5%	
SW Germann	early Sacaton	139					1			22		23
			0.0%	0.0%	0.0%	0.0%	4.3%	0.0%	0.0%	95.7%	0.0%	
SW Germann	early Sacaton	145				5				2		7
			0.0%	0.0%	0.0%	71.4%	0.0%	0.0%	0.0%	28.6%	0.0%	
SW Germann	early Sacaton	146				3				7		10
			0.0%	0.0%	0.0%	30.0%	0.0%	0.0%	0.0%	70.0%	0.0%	
SW Germann	early Sacaton	324			1		1				2	4
			0.0%	0.0%	25.0%	0.0%	25.0%	0.0%	0.0%	0.0%	50.0%	
SW Germann	early - late Sacaton	136		2	2	15	1			7	4	31
			0.0%	6.5%	6.5%	48.4%	3.2%	0.0%	0.0%	22.6%	12.9%	
SW Germann	Soho	152					2			3		5
			0.0%	0.0%	0.0%	0.0%	40.0%	0.0%	0.0%	60.0%	0.0%	
SW Germann	Soho	204					1			7	1	9
			0.0%	0.0%	0.0%	0.0%	11.1%	0.0%	0.0%	77.8%	11.1%	
SW Germann	Soho	251				1	2					3
			0.0%	0.0%	0.0%	33.3%	66.7%	0.0%	0.0%	0.0%	0.0%	
SW Germann	Soho	569		1		1	8				4	14
			0.0%	7.1%	0.0%	7.1%	57.1%	0.0%	0.0%	0.0%	28.6%	
SW Germann	Soho	595			3	3	15			1	5	27
			0.0%	0.0%	11.1%	11.1%	55.6%	0.0%	0.0%	3.7%	18.5%	
SW Germann	Soho	69		2		1	3				12	18
			0.0%	11.1%	0.0%	5.6%	16.7%	0.0%	0.0%	0.0%	66.7%	
SW Germann	Soho	78		1			4				4	9
			0.0%	11.1%	0.0%	0.0%	44.4%	0.0%	0.0%	0.0%	44.4%	
Total			14	395	134	159	154	34	151	1253	1488	3752
			0.4%	10.4%	3.5%	4.2%	4.1%	0.9%	4.0%	33.1%	39.3%	

APPENDIX E

INNOVATIONS BY POTTING GROUP

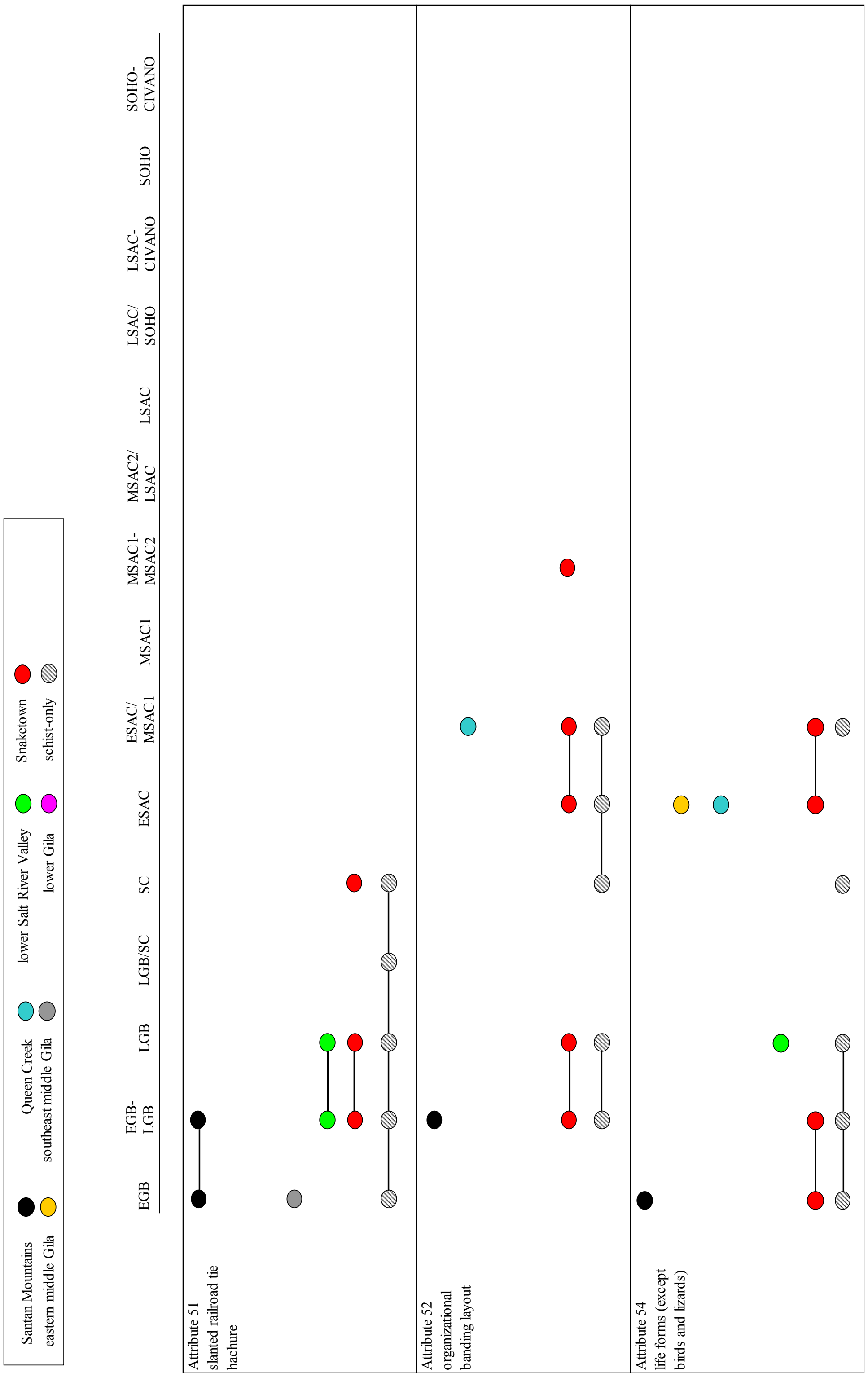

Figure E.1. Presence of Episode 1 reorganization innovations on bowl sherds for each potting group by time segment.

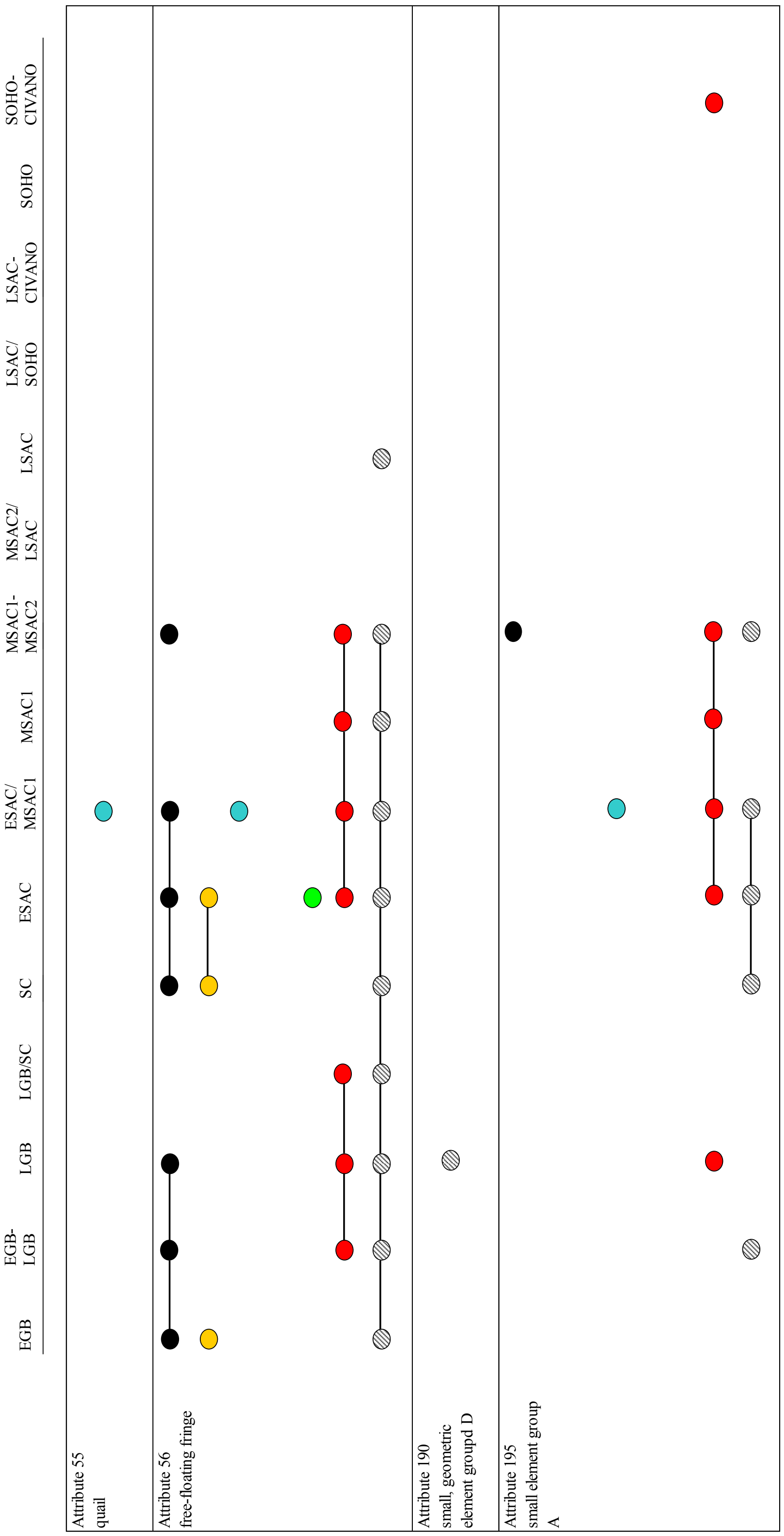

Figure E.1. Continued.

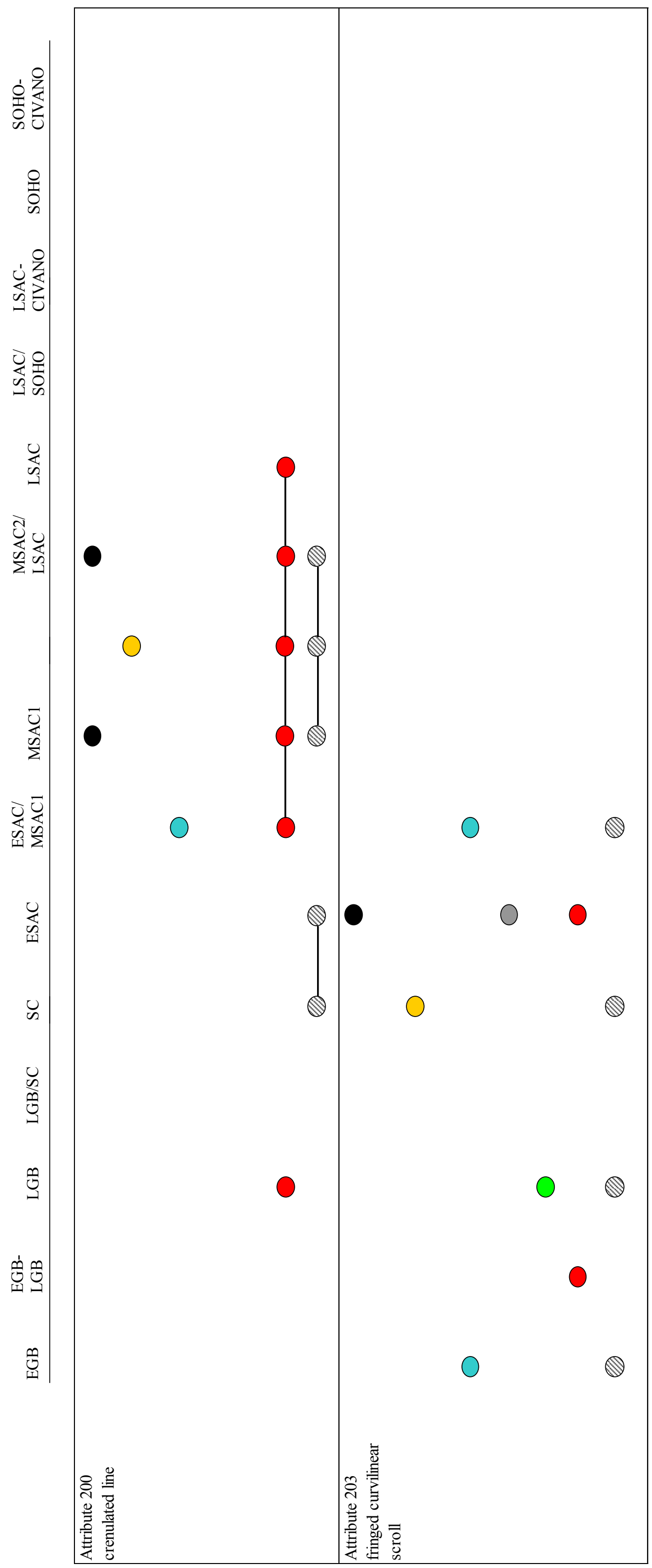

Figure E.1. Continued.

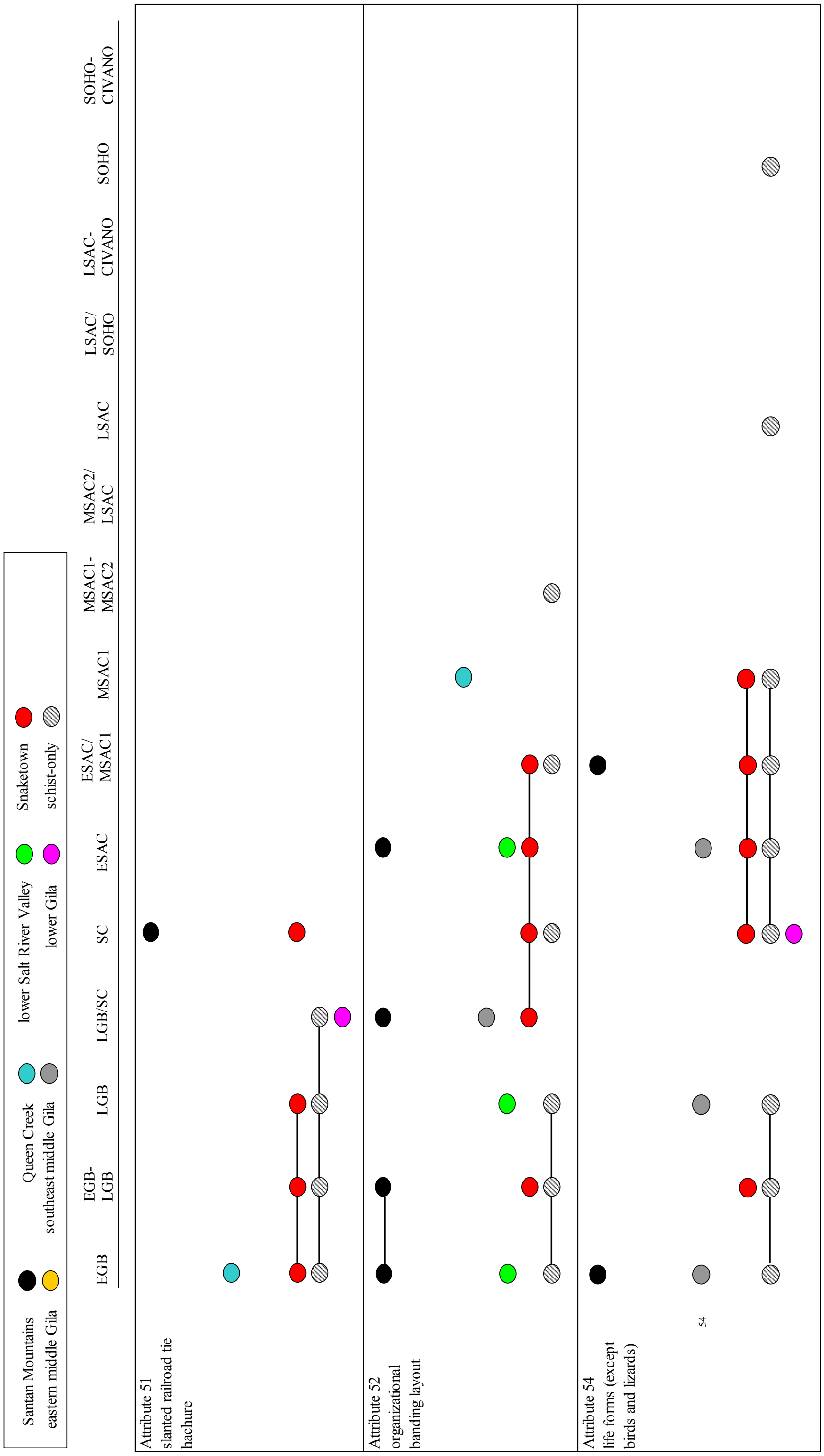

Figure E.2. Presence of Episode 1 reorganization innovations on jar sherds for each potting group by time segment.

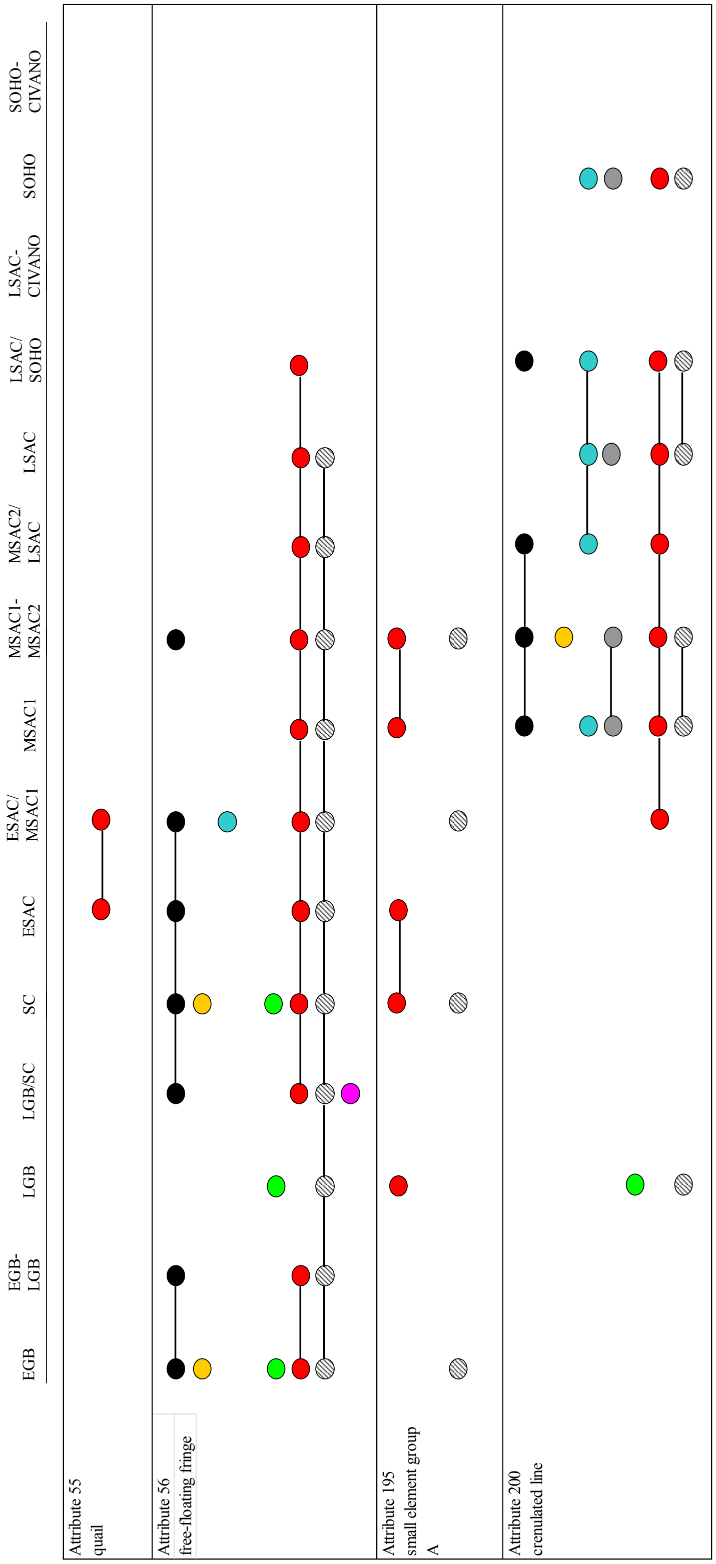

Figure E.2. Continued.

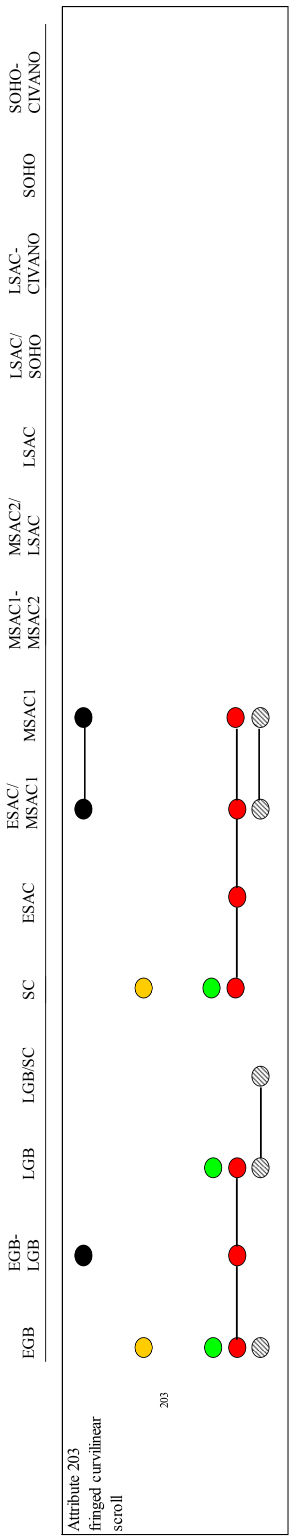

Figure E.2. Continued.

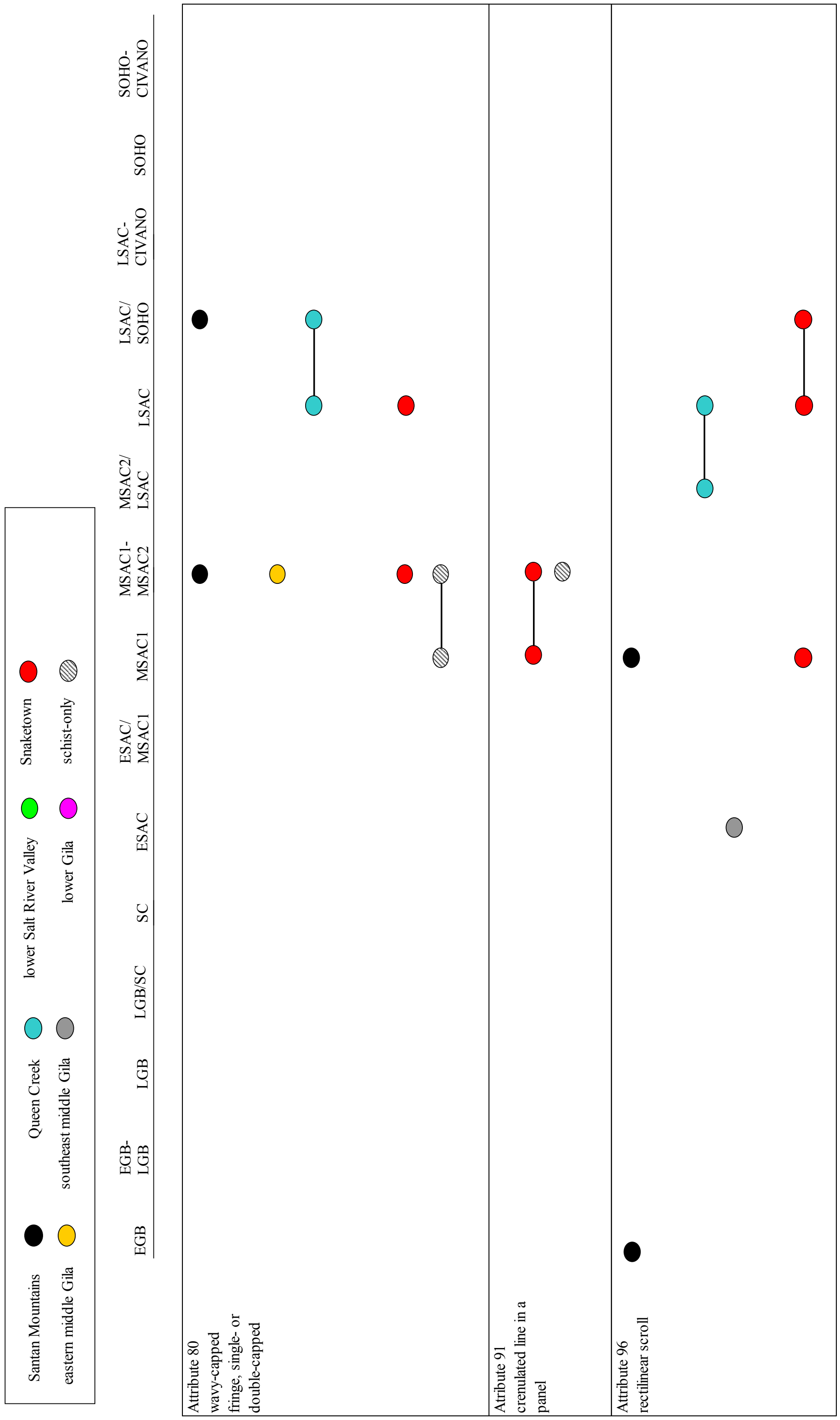

Figure E.3. Presence of Episode 2 reorganization innovations on bowl sherds for each potting group by time segment.

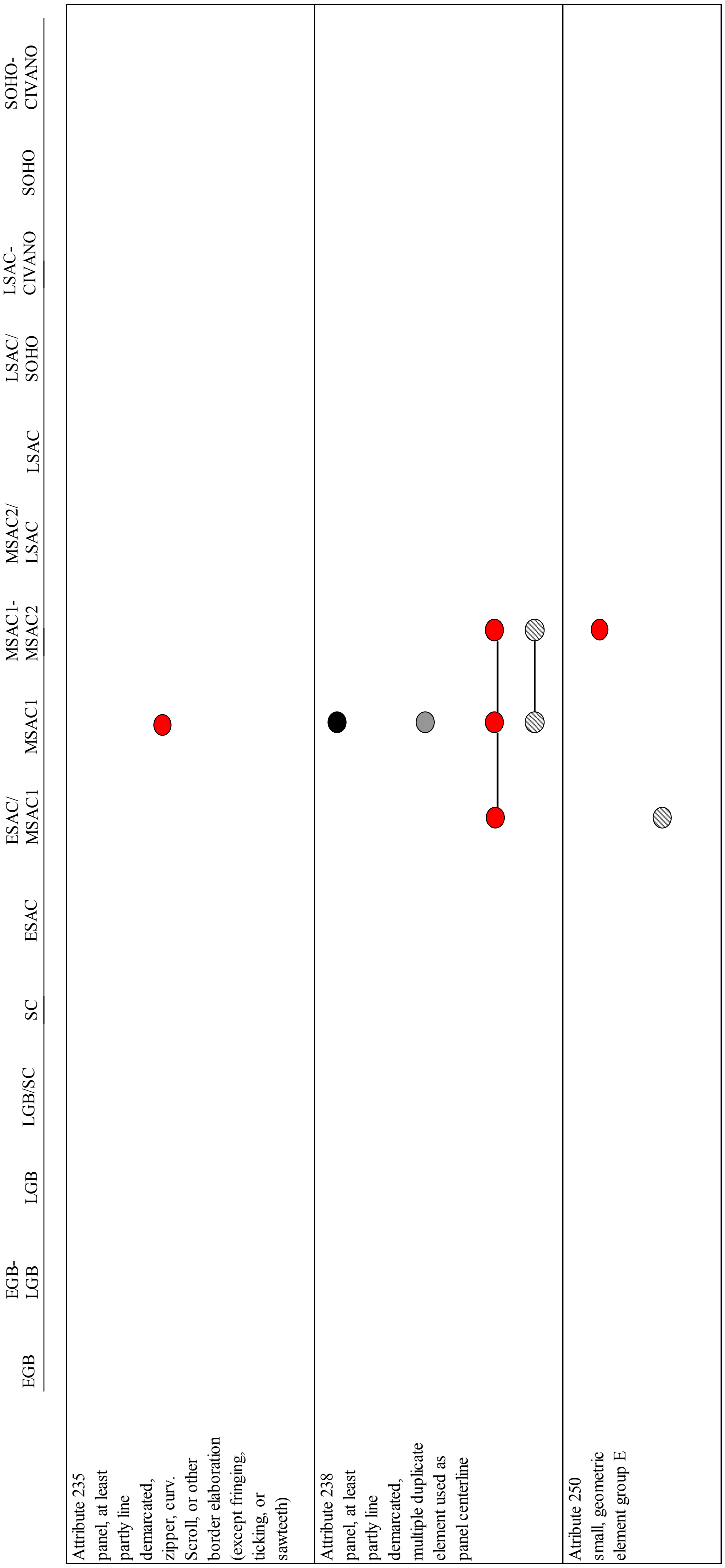

Figure E.3. Continued.

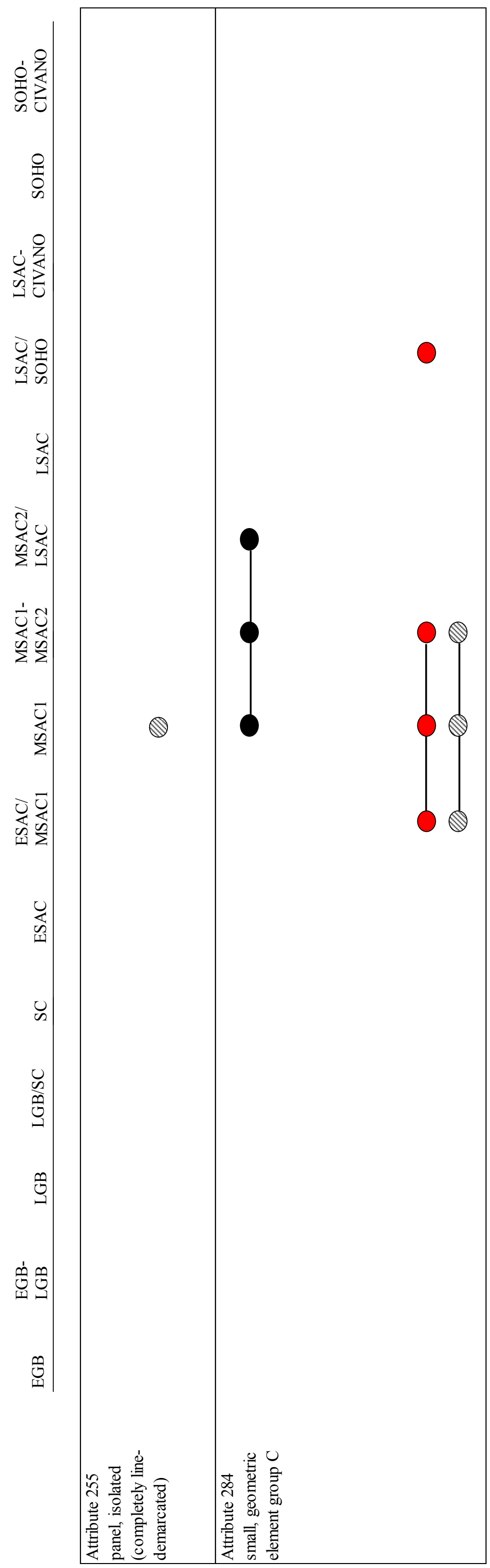

Figure E.3. Continued.

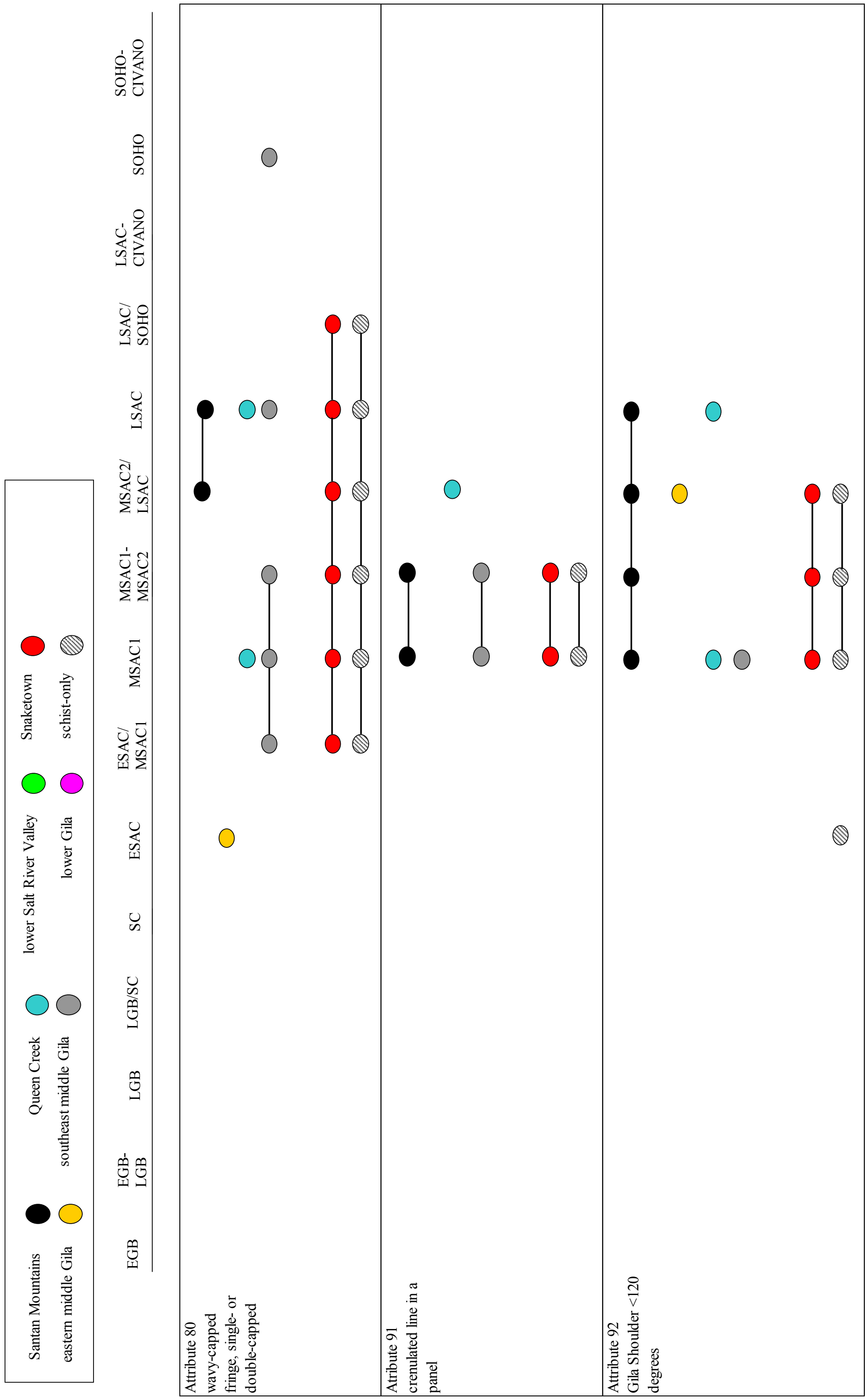

Figure E.4. Presence of Episode 2 reorganization innovations on jar sherds for each potting group by time segment.

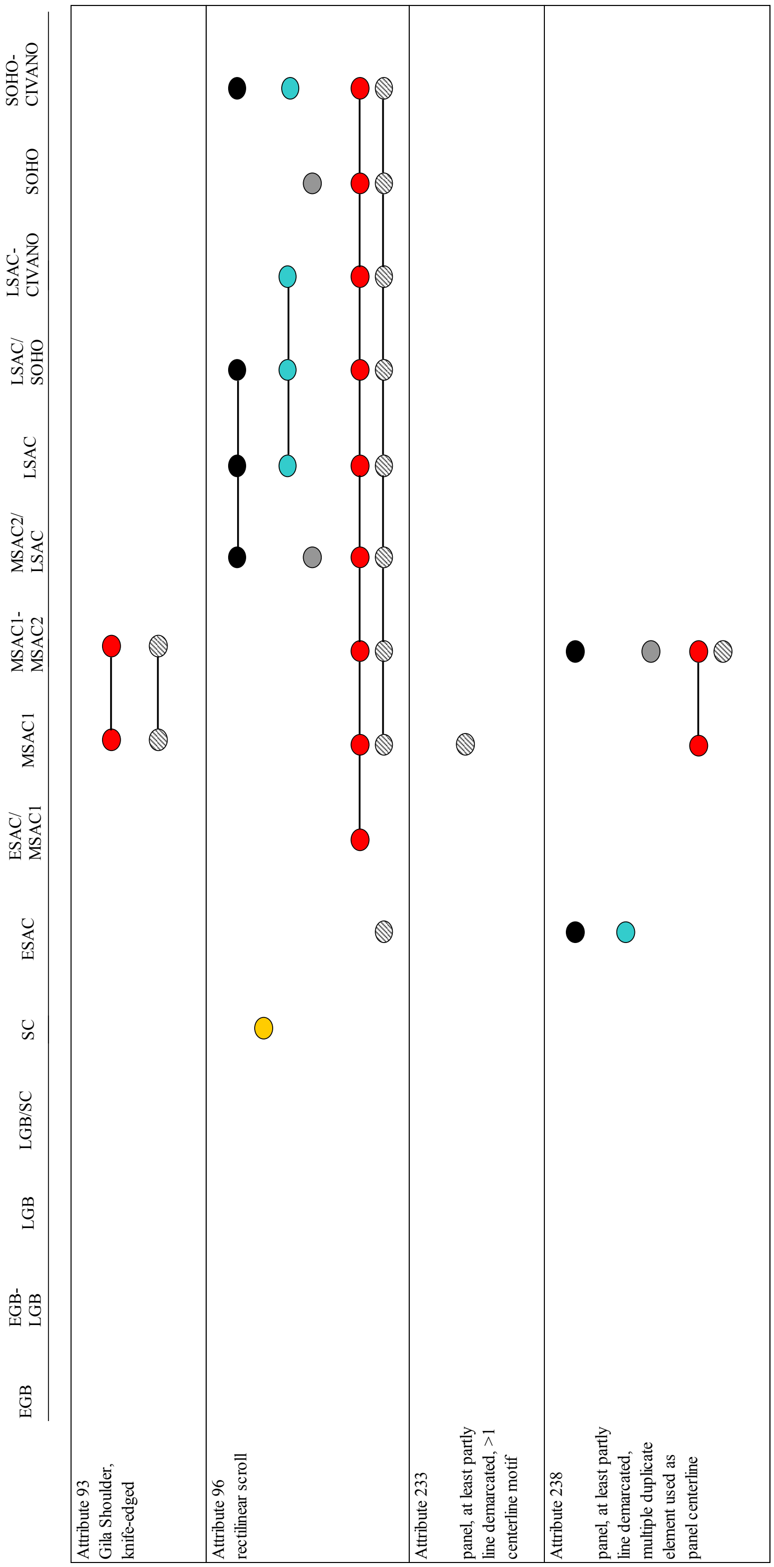

Figure E.4. Continued.

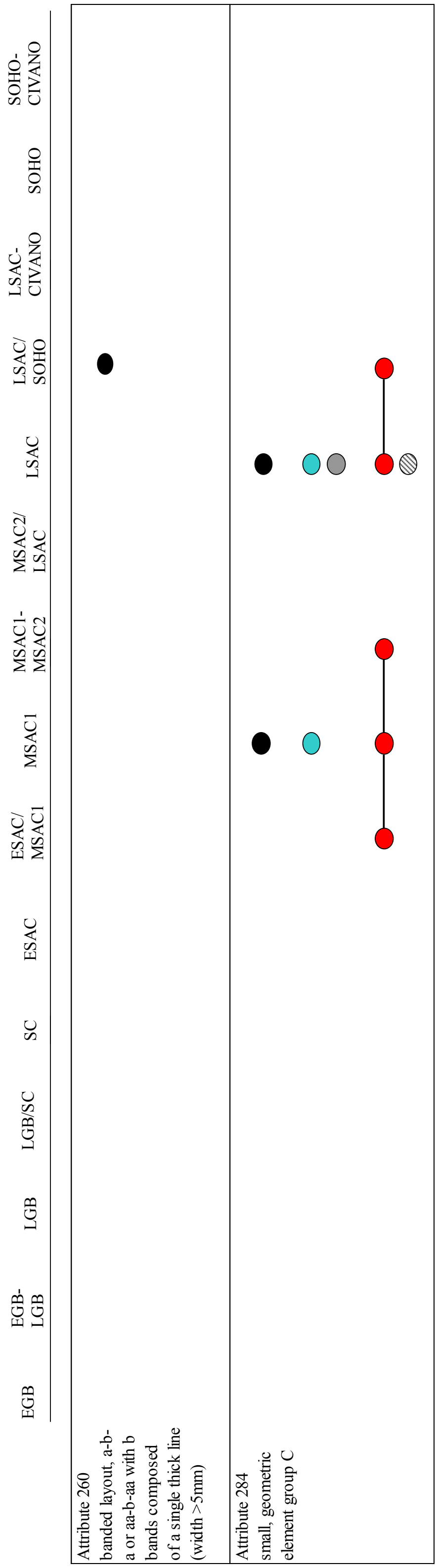

Figure E.4. Continued.

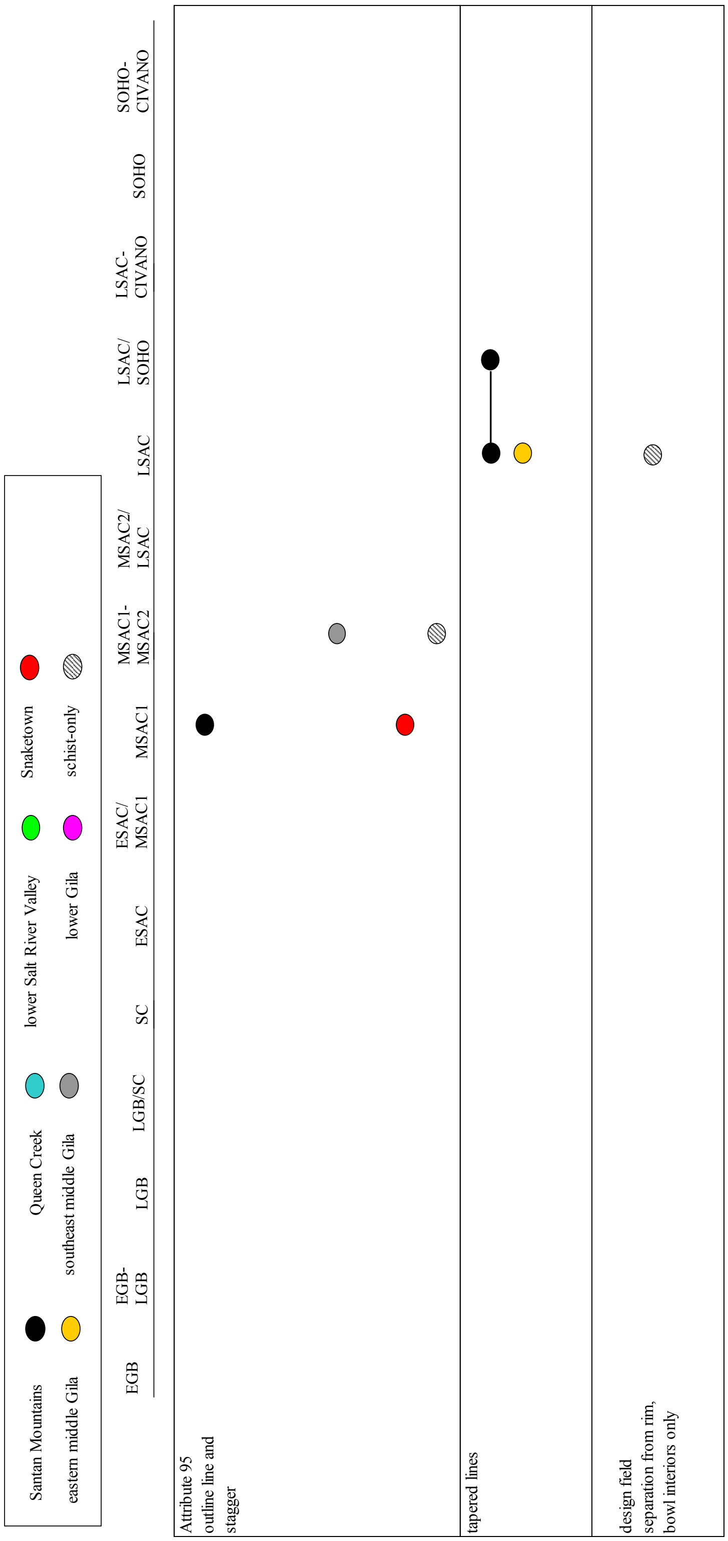

Figure E.5. Presence of Episode 3 reorganization innovations on bowl sherds for each potting group by time segment.

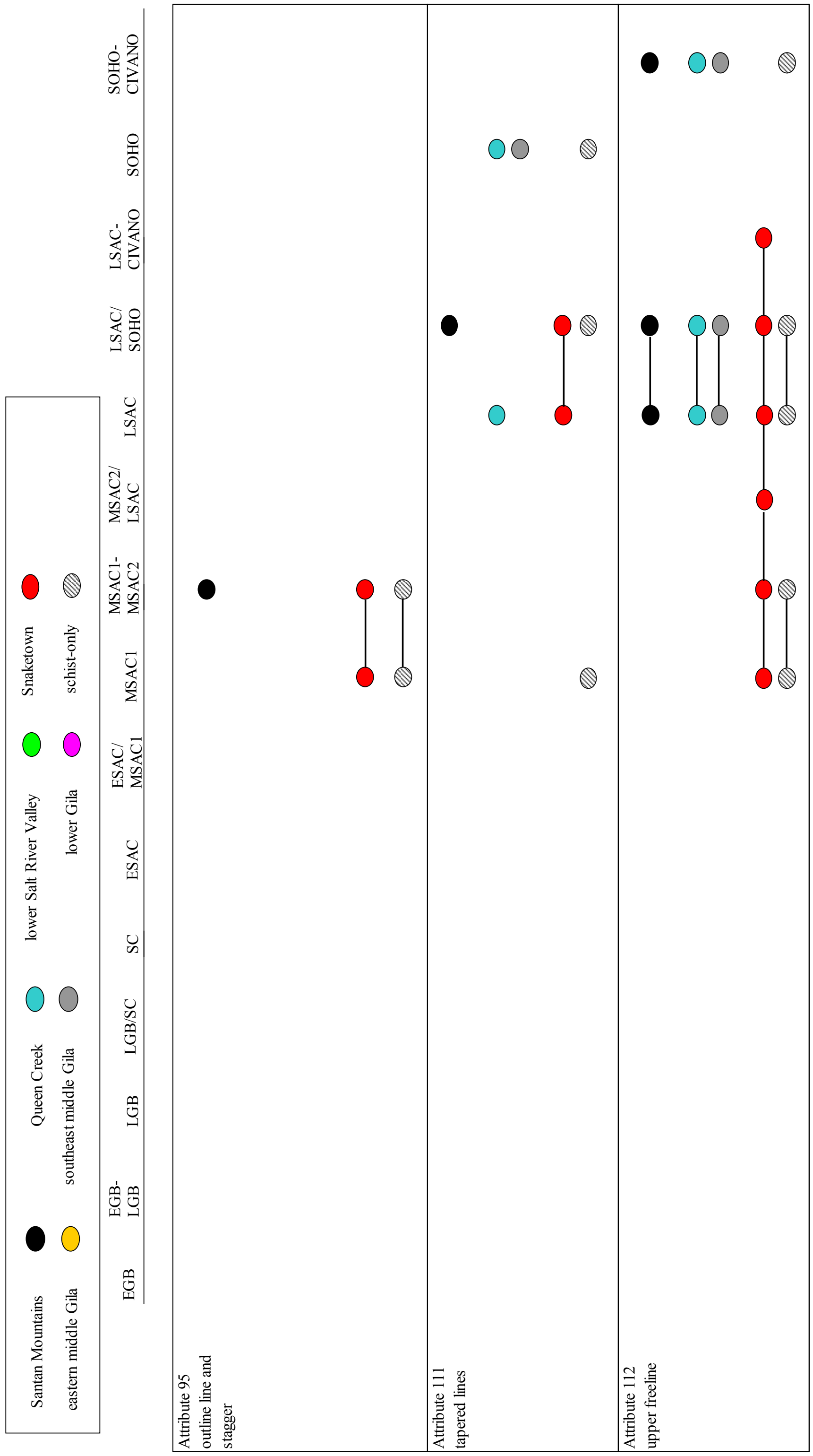

Figure E.6. Presence of Episode 3 reorganization innovations on **jar** sherds for each potting group by time segment.

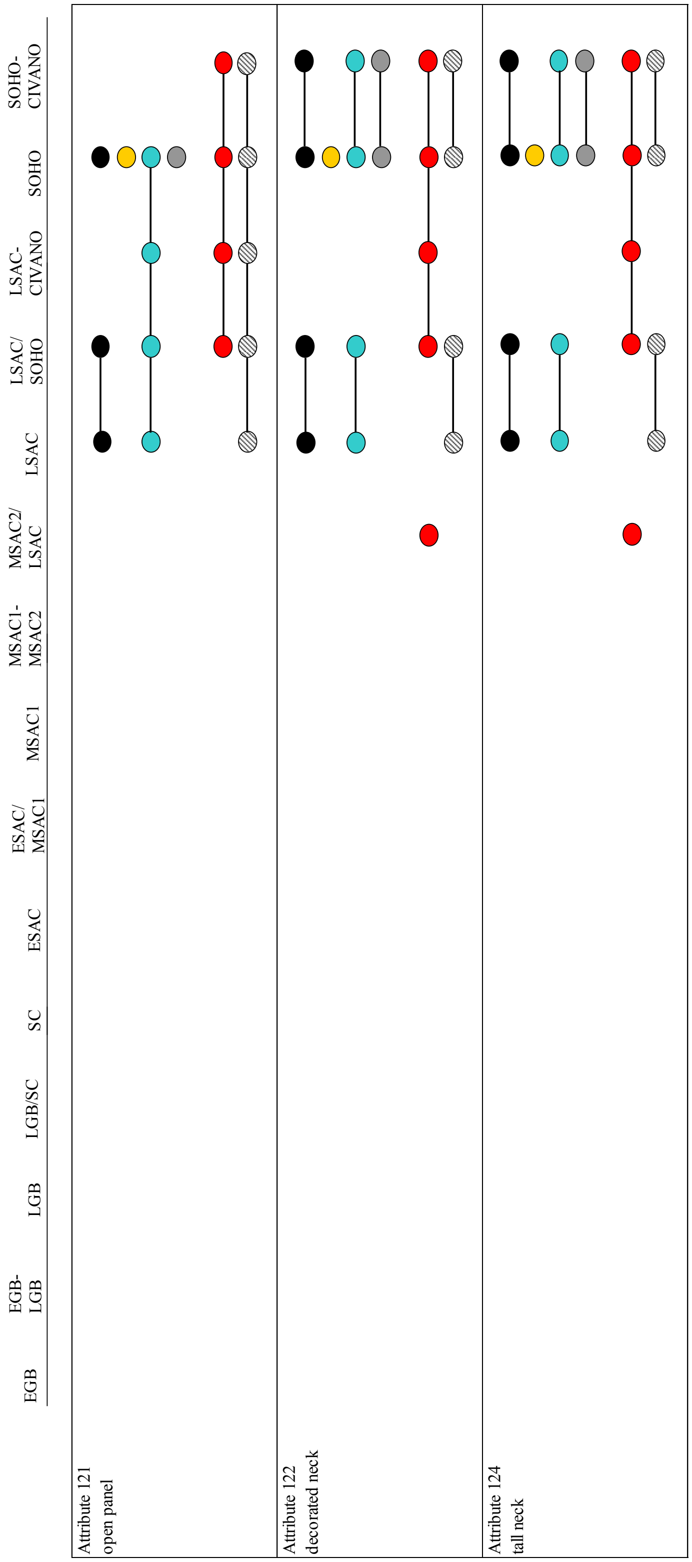

Figure E.6. Continued.