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A CASE STUDY IN THE RELATIONSHIP BETWEEN SOCIAL COMPLEXITY AND THE ORGANIZATION OF CERAMIC PRODUCTION FROM THE LAKE PÁTZCUARO BASIN, MICHOACÁN, MEXICO

VOLUME I

By

Amy Jo Hirshman

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ABSTRACT

A CASE STUDY IN THE RELATIONSHIP BETWEEN SOCIAL COMPLEXITY AND THE ORGANIZATION OF CERAMIC PRODUCTION FROM THE URICHU, MICHOACÁN, MEXICO

By

Amy Jo Hirshman

Elite ceramic fine wares associated with the Tarascan state are easily identifiable by their bold designs, vivid colors, and unique forms. Though these fine wares seem to indicate a new and different ceramic tradition, in actuality many of the formal and decorative elements are found much earlier in the ceramic sequence within the Lake Pátzcuaro Basin, the core of the Tarascan state. Two key theoretical models regarding the emergence of social complexity, the social evolutionary model and the political economy model, pose two different perspectives on the organization of craft, including ceramic, production. The Classic period to Late Postclassic period ceramic sequence from the site of Urichu, Michoacán, Mexico provides a test case for the relationship between ceramic production and the emergence of the state. Drawing upon basic ideas from the "Standardization Hypothesis" regarding the relationship between ceramic variation and the organization of ceramic production, these two theoretical models are compared along four dimensions: labor investment, assemblage homogeneity, product standardization, and concentration of production. Using multi-state character data from the sherd assemblage at Urichu and instrumental neutron activation analysis data from Urichu and the Tarascan capital of Tzintzunzan, this study assesses changes in the ceramic

assemblage reflective of larger changes in organization of ceramic production. The results of this study indicate that there were no major transformations in the organization of ceramic production from the perspective of Urichu during the Classic to Late Postclassic cultural sequence. However, smaller changes within the ceramic tradition can be aligned with some of the theoretical expectations.

For

Mom and Dad,

Faithful Cheerleaders

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The data set for this dissertation was collected as part of long-term (and on-going) research in the Lake Pátzcuaro Basin directed by Dr. Helen Pollard. As such, a number of hardworking and dedicated students and local men and women from Uricho, Michoacán, Mexico contributed to the excavation of the ceramics and the completion of the overall project. Though they are too many to name individually, I am nonetheless indebted to them for the many labors. Dr. Thomas Vogel of the Department of Geology, Michigan State University, provided advice on soil sampling. Dr. Christopher Fisher of Kent State University provided field assistance with the collection of clay samples.

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CHAPTER ONE

INTRODUCTION

Tarascan fine wares associated with the Tarascan state (c. AD 1350-1522) are easily identifiable by their bold designs, vivid colors, and unique forms. They seem to appear suddenly in the archaeological record and have become well known to archaeologists, art historians, and collectors. Though these fine wares seem to indicate a new and different ceramic and cultural tradition, in actuality many of the formal and decorative elements are found much earlier in the ceramic sequence within both the Lake Pátzcuaro Basin, the core of the prehispanic Tarascan state, and the larger cultural region.

Major theories regarding the emergence of social complexity posit craft specialization as a major component of state formation. While within Mesoamerican studies two key theories of social evolutionary theory and political economic theory drive most of the archaeological inquiry the emergence of social complexity, the generalized expectation of craft specialization remains a constant within both theories. This study is concerned with the relationship between the emergence of social complexity within the Lake Pátzcuaro Basin and craft specialization as typified by ceramic production. In particular, this study tests the expectation of production specialization in the context of the emerging Tarascan state. It also tests the particular expectations of the two theories in regards to ceramic data from the site of Urichu, found within the core of the Tarascan state.

The first major theory, social evolutionary theory, posits certain expectations regarding craft production, and ceramic production in particular, within complex societies. These expectations include full-time specialization, even to the point of spatial segregation of and investment in production loci (workshops), increased efficiency of production resulting from mass production, increased standardization of production, and at the same time, an overall increase in the variation within the assemblage due to presence of elaborated products produced to meet elite consumption demands. And, while some goods may be produced directly for elite consumption, most are produced for market exchange and according to market demands (e.g. Brumfiel and Earle 1987; Sanders and Price 1968).

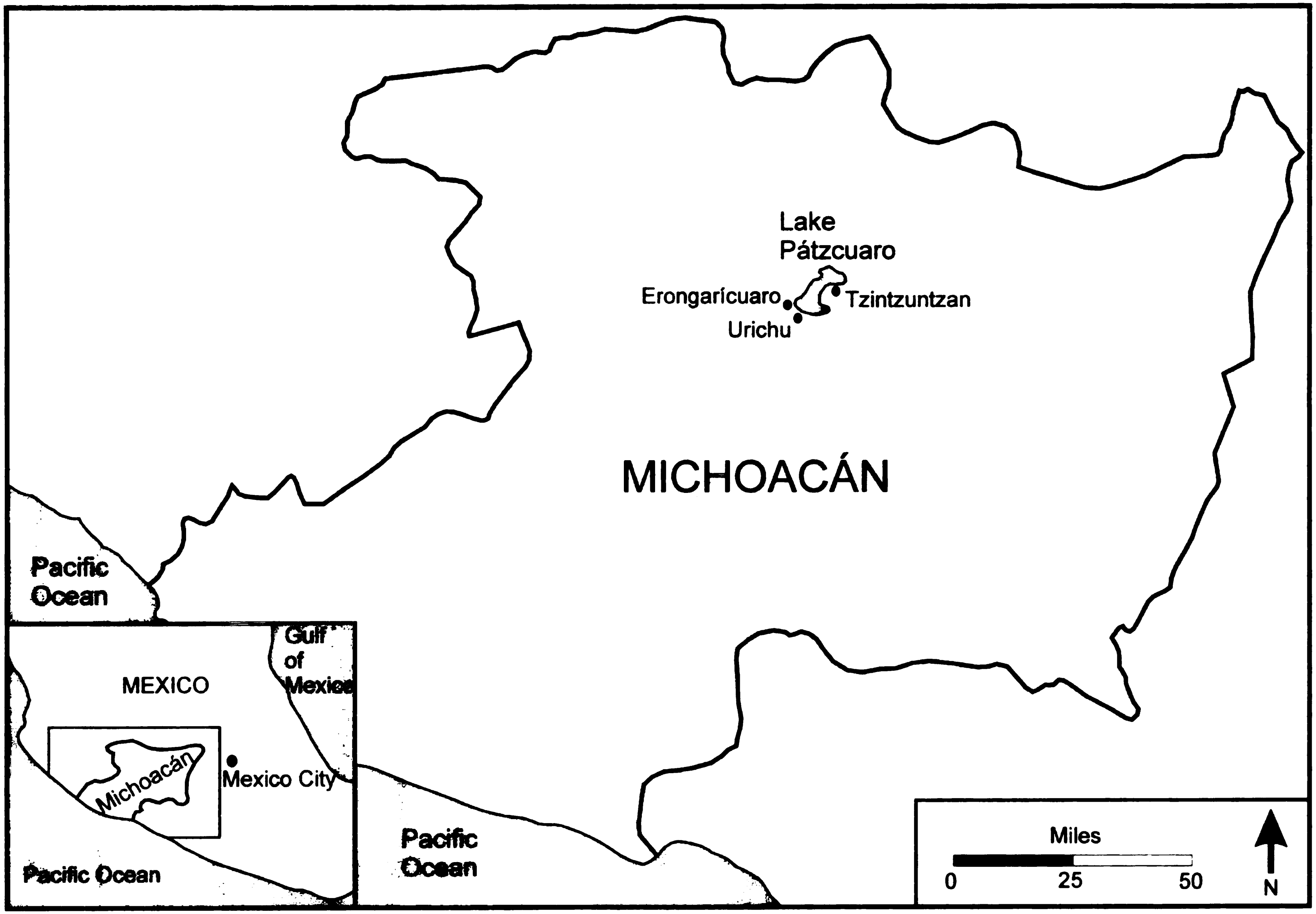
The second major theory, political economic theory, presents an alternative perspective. Within political economy, craft production, including ceramic production, will be tied less to market forces than to the direct demands of the political elites. Indeed, the entire economic system is structured less to satisfy the demands of the populace than to satisfy the demands of the elite class. The expectations for craft production, within political economic theory, stem from the dominance of the command economy over the market economy. Therefore, there is the expectation of centralization and administration of elite good production, with full-time producers; and persistence of part-time production with subsistence farming in the hinterland (Brumfiel 1987a; Brumfiel and Earle 1987).

Craft specialization is difficult to measure, as it involves issues of production scale, locale, time and energy investment and more. Often ceramic specialization in particular is used as the measure of craft specialization in general; and ceramic specialization is measured in terms of product standardization. Ceramic standardization, as outlined by the "standardization hypothesis" (cf. Blackman et al. 1993) maintains that the product of specialized producers will exhibit less variation than the products of non-specialist producers. This hypothesis is based predominantly upon ideas of efficiency and routinization of task (e.g. Balfet 1965; Costin 1991; Rice 1981).

The "standardization hypothesis" will form the backdrop to a multidimensional study of the ceramic assemblage from Urichu, Michoacán, Mexico (Figure 1.1). Four dimensions of the organization of production, labor investment, assemblage homogeneity, product standardization, and concentration of production, are appropriate to a study of a ceramic sherd assemblage (rather than a whole vessel assemblage) and to the evaluation of the larger social theories. Labor investment and assemblage homogeneity draw upon the multi-state character data coded from the assemblage sherds in order to assess temporal variation in the ceramics. Instrumental neutron activation analysis is used to evaluate sherds from both Urichu and Tzintzuntzan, the Tarascan capital, as well as clay samples from the Lake Pátzcuaro Basin. The results of the chemical characterization study are used to evaluate paste standardization throughout the cultural sequence and the provenance of ceramic production within the lake basin.

This study uses ceramics from a multi-year, multi-disciplinary project in the southwest portion of the Lake Pátzcuaro Basin. Proyecto Señoríos conducted a survey and excavations at Urichu from 1990-1996, survey and excavation at

Figure 1.1 Location of the Lake Pátzcuaro Basin, within the modern state of Michoacán



Xaracuaro in 1996, and a survey of Pareo in 1996. The excavations conducted at Urichu, which form the basis of this study, yielded deposits dated between AD 350-AD 1525, a period encompassing the emergence of the Tarascan state (ca. AD 1350).

Urichu was a lower-level administrative center of the Tarascan state, and had been autonomous prior to state formation. It is a reasonably well-preserved site, with stratified deposits. Over 130,000 ceramic artifacts were recovered at Urichu, including 70 whole vessels, with 41,076 more recovered from the survey and excavations at Jarácuaro: a sample of 37,301 sherds, and six soil samples from Urichu comprise this study. An additional 59 sherds and 18 clay samples, from Tzintzuntzan and the basin, respectively, are also part of this study.

This research on the organization of pre-state and state ceramic production is presented in several chapters. Chapter two discusses the theoretical concerns that guided this inquiry into the organization of ceramic production in the emerging Tarascan state, particularly comparing two key models of state formation and the role of craft specialization. A statement and critique of the "standardization hypothesis," including archaeological expectations for ceramics, is also part of the discussion. Chapter three contains the cultural background to the study, including the cultural chronology for recent research at the sites of Urichu and Erongarícuaro. Archaeological and ethnohistoric information regarding the pre-Tarascan and Tarascan elite activity and economy is also included. Comparative material provides a fuller backdrop for this study of the organization of ceramic production.

Chapter Four describes the data for the study and the statistical method applied to the ceramic sherd assemblage. This chapter also includes a discussion regarding the necessity of using polythetic sets as opposed to the traditional application of types derived from a Type-Variety classification system. A discussion of the utility of Cluster Analysis as a tool for discovering polythetic sets is also included in Chapter Four. Chapter Five is the study of the characteristics of the ceramics, considering the question of specialization, and change in specialization over time. The analysis assesses the change in labor investment and also tracks the polythetic sets of ceramics and the within-set and between-set variation in six temporal phases leading up to and including the Tarascan state. In so doing, changes in the organization of ceramic production are tracked and related to the competing theories of state emergence.

Chapter Six is a preliminary instrumental neutron activation analysis (INAA) of sherds from Urichu and Tzintzuntzan. From a smaller initial analysis using Urichu sherds, the study is expanded to include soils from Urichu and sherds from Tzintzuntzan. The stability of the pottery groups is evaluated. The assignment of pottery groups to probable production locations and the assessment of ceramic movement within the basin are also included in the chapter, including the hypothesis of the centralization of ceramic production during the existence of the state.

Chapter Seven is the concluding chapter, synthesizing the results of the statistical and INAA analyses. This study contributes to Tarascan studies on several levels. First, it contributes on a basic data level, with an analysis of the first stratigraphically recovered ceramics from a Tarascan site. Second, it contributes on a descriptive level, allowing us to advance in our understanding of the development and character of the Tarascan state. Third, it contributes on a theoretical level, testing the expectations of the Social Evolutionary theory and the Political Economy theory of state development. This research also contributes to our understanding of the role of the organization of ceramic production in testing our archaeological understanding of the emergence of complex societies.

CHAPTER TWO

ORGANIZATION OF CRAFT PRODUCTION AND THE EMERGENCE OF SOCIOCULTURAL COMPLEXITY

> In some definitions of cultural complexity, the essential component is the division of a community into functionally interdependent entities of such complexity that no small group of people can maintain all that community's activities.... To translate this sense of functional interdependence into archaeological terms, we must look for concentrations and distributions of artifacts indicating a certain level of activity specialization. (Wenke 1999:349)

Wenke's insistence on "functional differentiation and integration," is a *textbook* example of how archaeologists expect complex societies to exhibit certain features, particularly to exhibit differentiation of task and specialist economic production. This expectation has been expressed in different ways, however, as the role of specialization is emphasized in different ways. These differences can be seen in two key theoretical positions, that of social (cultural) evolutionary models and of political economic models. Social evolutionary models emphasize the role of elites as societal managers. One of their duties is to manage the "natural" economic growth and concomitant rise of specialist activities, including craft specialist production. On the other hand, political economic models characterize the activity of elites as the driving force of a command economy, spurring craft specialist activity in response to elite needs and not overt economic growth. While each model expects craft specialists to occur within state level societies, and each expects the products of craft specialists to be identifiable, each model has different expectations for how and when craft production is reorganized along specialist lines. This study tests the social evolutionary and political economic models to examine which one best describes the reorganization of ceramic production in the Lake Pátzcuaro Basin before, during, and after the emergence and existence of the Tarascan State, a period of approximately 1200 years (AD 350-1525).

MODELS OF SOCIAL COMPLEXITY AND PRODUCTION ORGANIZATION

Relationship Between Social Complexity and Craft Specialization

Theories and models of sociocultural change have long held that the emergence of social complexity coincides with changes in the organization of production, especially of craft production and specialization. While the occurrence of specialization has long been an expectation of social complexity (cf. Childe 1951; Flannery 1972; Johnson and Earle 1987), it was the creative work of Clark and Parry (1990) that actually tested the hypothesis of producer specialization in complex societies. Using data from the Human Relations Area Files, they tested the occurrence of craft specialists vs. "complexity," indexed by five variables: community size, density of population, level of political integration, social stratification, and agricultural dependence (Clark and Parry 1990:304). Their findings indicated a strong relationship between craft specialization and socially complex societies: "the correlation analyses indicate a general association of the intensity of craft specialization with the degree of cultural complexity, as measured by a combination of demographic, sociopolitical, and agricultural indices" (Clark and Parry 1990:309). This conclusion has become an oft-cited justification for maintaining the expectation that social complexity and craft specialization are related (cf. Blackman et al. 1993; Rice 1991; Wattenmaker 1998).

Two Theoretical Models of the Relationship Between Social Complexity and Craft Production

Two key theoretical models regarding the emergence of social complexity have traditionally guided Mesoamerican archaeology: by social evolutionary, or cultural, models, and by political economic models. Each of these two models have explicit economic expectations regarding a) the emergence, role, and importance of craft production (and specialization) and b) exchange of goods and services. However, both models generally expect craft specialist production within the context of that peculiar form of social organization we refer to as "the state."

Brumfiel and Earle (1987) discussed three general models of the relationship between social complexity and specialization in their seminal discussion of specialization. These general models are 1) the commercial development model, 2) the adaptationist model, and 3) the political model. The two former models fall within the broader expectations of the social evolutionary model, while the third falls within the political economic model. Each model considers the relationship of social complexity and the organization of production and in so doing highlights the expectations for the role, intensity, and timing of the emergence of specialization. Brumfiel and Earle (1987) is used as a baseline to streamline the discussion of these two theories in this study.

Within social evolutionary theory, craft specialization and market growth are considered normal and appropriate, and full-time specialization is expected with the development of a state-level society. The commercial development model holds specialization as a key component of social complexity, being part and parcel of the normal and expected growth of the economy. As the economy grows larger, economic tasks diversify as people specialize in order to improve efficiency and maximize economic gains. Specialists are expected to engage in their tasks at a "full-time" level, especially within urban centers. Growth is market driven, and elites are considered to be just another specialized activity group, developing as overseers maintaining the economic situation rather than as favored economic actors. Growth is normal, natural, and the existence of specialization is the indicator of social complexity.

Related to the commercial model is the adaptationist model. Again, economic growth is expected, as is also the development of diversification and specialization of task. However, elites are seen as managers, administering the economy for the general good. Brumfiel and Earle (1987) highlight four variants of the model, focusing on elites as managers of different aspects of the economy: as managers of a redistributive economy, as managers of a market economy in highly diverse resource contexts, as managers of the key means of production, or as managers of long-distance trade. The market's role changes with different varieties of the model, but in general the market is primarily an economic institution. An emphasis on full-time specialization and participation in the market economy is expected, though some "part-time" specialization is not surprising. Specialization is, again, expected to emerge just prior to and with social complexity.

While differing from one another in the role of elites, both models are applicable to and used within the general theoretical construct of social neo-evolutionary theory. The expectations of the naturalness of economic growth, of benevolent managerial elites, the co-occurrence of specialization with complexity, and the emphasis on the intensity of specialization are concomitant with other social evolutionary expectations of the state and civilization, such as urbanism and surplus agricultural production. These models have been applied to early states in various parts of the world and have been quite influential in the development of the dominant paradigms guiding Mesoamerican archaeology.

Early emphasis in social evolutionary theory included classifying societies by types, based on characteristics such as technology or political structure. Several authors were instrumental in the development of such social typologies, such as "savagery-barbarism-civilization" (e.g. Morgan 1877) or "non-rank-rank-stratified-state" (e.g. Fried 1967), and "band-tribe-chiefdom-state" (Service 1971, 1975). However, it was the work of Julian Steward (cf. 1953) that first brought these typological ideas into a dynamic, testable archaeological paradigm. Steward brought together expectations of certain so-called "levels" of complexity with ecological variables and developed a multilinear model of culture change and the "culture core" concept emphasizing subsistence activity that was adaptive in an ecological context (Steward 1953; Trigger 1989).

These neo-evolutionary ideas and the concept of the culture core stimulated archaeological research on culture change. In Mesoamerica, dominant and durable paradigms for research were formulated according to Stewardian themes. Authors such as Armillas (1948), Palerm and Wolf (1957), and Jimenez Moreno (1966) laid down what became guiding parameters for the chronology and core research areas for Mesoamerican archaeology. In turn, they prompted ecologically-oriented settlement studies, such as the early work of Sanders (1957) and Willey (1957). An important culmination of this approach can be found in the work in the Valley of Mexico (Sanders et al. 1979). That ambitious survey has served both as a model for later work, such as the survey of the Valley of Oaxaca, and as a guiding framework for cultural development within Mesoamerica, including the expectations of "internal differentiation, based on economic specialization and differential access to economic and political power" (Sanders et al. 1979:4).

From this early work, neo-evolutionary expectations of the emergence and role of specialization were articulated. For example, Sanders and Price (1968) state well the expectation of a neo-evolutionary perspective on Mesoamerican cultural complexity and craft specialization. They write:

> A result of increased population, surplus production, and competition for strategic resources is the specialization of occupation characteristic of civilization and, to a lesser degree, of the more complex chiefdoms. If surplus is channeled into population growth, this would ultimately provide the stimulus for social control, which would in turn alter the pattern of disposing of

> surplus and produce still increased demand for production of surplus. The specialization of function is in a sense self-intensifying once under way. Part of this is of course definitional: food production becomes a full-time specialty too when other occupations have become professionalized, if only by contrast. More substantive processes are, however, also operative. As the diversification of economic interest becomes greater, the greater is the need for centralized regulation to reconcile these interests. Specialists in control of men and of resources—political specialists—are increasingly required and can be supported from the increased production. As such authorities acquire more functions, they become indispensable to the society as a whole, and their position is accordingly strengthened. (Sanders and Price 1968:232-233)

Elsewhere they also discuss the "high level" of craft specialization within Central Mexico—that is, within the Aztec empire (Sanders and Price 1968). However, Aztec Tenochtitlan is not the only dominant example of high levels of social complexity and craft specialization within Mesoamerica. Teotihuacan has also served as a basis for such ideas as urbanism, public-spirited rulers [also common within Mayan archaeological reconstructions until relatively recently (cf. Sabloff 1994)] and the importance of craft specialization. Models of craft specialization posited within this theoretical framework also include those of Rathje (1975), Price (1977), and Rice (1981).

Rathje emphasized a "trajectory" "that defines resource management changes through time in the material attributes of production and distribution systems" (1975:413). In particular, he expects an increase in the number of end products produced through the lessening of investment into the product, via standardization and efficiency of production. Price emphasized that changes in sociocultural organization are accompanied by changes in technological organization and production (1977). That is, technological changes toward the increasingly efficient use of energy, particularly labor. While the arguments of the first two authors were somewhat theoretical, Rice's work (1981) operationalized these ideas with her model of craft production. Rice formulated an explicit step-wise model of increasing specialization of production that is based on increasing uniformity of product, increasing differentiation between elite and utilitarian wares, and increasing evidence of mass production.

As the above example illustrates, specialized production within managerial or adaptational models includes expectations of economies of scale, improvement of efficiency, and mass production for market distribution. While household-based production can certainly meet this demand, and may actually do so within rural contexts, workshops are expected to emerge especially within urban contexts as a means to maximize production efficiency. While sumptuary goods are also expected, the emphasis of specialist production is on workshop production of mass produced goods for market distribution and consumer consumption. These workshops—evidence of "full-time," organized, maximized production—are expected as an indicator of the emergence of "true" social complexity, that is, state-level societies.

While influential and fruitful in archaeological research, neo-evolutionary models, which emphasize the managerial or adaptational aspects of elites, have their critics, too. Brumfiel and Earle (1987:3) note archaeological evidence contrary to these models, including examples of elite intervention in economic matters for overtly political ends. Clark and Parry found that while craft specialization is associated with the general indices of cultural complexity, it is most strongly associated with the political indicators of social stratification, political integration, and community size (Clark and Parry 1990:315). The association was less strong with the indices of population density and agricultural dependence, which are important to neo-evolutionary models. Additionally, the strongest correlations were between patronized and attached craft production, rather than full-time production. The greatest increase in specialization coincides with social stratification (Clark and Parry 1990:315).

As an alternative to these social evolutionary models [and the third model posited by Brumfiel and Earle (1987)], the political model emphasizes the role of elites in economic activity. In contrast to the managerial and adaptationist models, the political model sees cultural complexity not as a natural consequence of economic growth but rather a result of elite activity in the economic process. Elites act for their own self-interest, not to benefit society as a whole. Elite economic activity is extractive, requiring surplus production from domestic contexts to fuel its own accumulation. Specialization, within this perspective, is a response to elite demands, not an efficiency decision. It may be either "full-time" or "part-time," but the core production unit is construed to be a household rather than a workshop. Markets tend to play a secondary role within elite political and economic priorities. Therefore, markets may not have institutional importance attached to them, though markets are not unexpected within contexts of increasing complexity, especially within Mesoamerica. Instead, elites control the demand economy, supporting their wealth primarily through staple finance or appropriation of objects signifying wealth and prestige.

The political model has been applied to Mesoamerican research as well, particularly to the Aztec case. Pedro Carrasco (1982, 1983) maintains, "the economic process was embedded in the political institutions of a stratified society" (1983:24-5). While households produce to meet their own needs and the market fills the economic voids, the elites actually control production and economic processes important to their maintaining and expanding political power. Craft specialization was either a part-time activity within the rural household (though in response to elite demand) or a full-time activity under the direct control of the elites. Aztec rural household-based production has been documented in places like Huexotla (Brumfiel 1980, 1987a), Otumba (Charlton et al. 1991; Charlton et al. 1993) and elsewhere (Brumfiel 1987b, 1996). Markets played an important role, as they became necessary suppliers of the raw materials needed for some of this surplus production and places where elites could turn luxury items into foodstuffs (Brumfiel 1987b).

These models are not necessarily mutually exclusive within Mesoamerican archaeology. Minc cogently points out (1994) that the work of some authors who place themselves within a somewhat more political model context, such as Liz Brumfiel (1987a), actually prove to be good examples of adaptationist modeling. This is because within both the cultural model and the political economy model, the market can be—and has been—emphasized to varying degrees, seen especially within models of the nature of the Aztec state and later empire. The basic difference in the two larger models of cultural evolutionary theory and political economic theory is not the presence or importance of the market, but the degree to which the elites manipulate the economic structure for their own benefit or for the benefit of all. As such, there are differences in the expectations each model has for the organization of production within changing social structures and the emergence of the state.

Each broad theory of the emergence of social complexity has different expectations regarding the organization of production within society, including the role, intensity, and timing of craft production. Social evolutionary theory contends that craft specialization is a normal aspect of natural economic growth and, as such, responds to market, not elite, forces. Production intensifies in response to market demands and will organize itself in an efficient manner, including the implementation of laborsaving techniques and centralized, urban workshops. Craft specialization is concurrent with the growth of social complexity, and specialists of varying tasks are indicative of complex societies, that is, states.

A political economic model, on the other hand, contends that specialization is not a normal by-product of expected economic growth but primarily a result of elite involvement with the economic and social system. As such, specialists respond to elite, not market, demands and are organized to be responsive to elite pressures. As a result, there is little overt expectation of organization to maximize efficiencies of scale (i.e. workshops) and household production may not only persist, but may also be the key production unit. As craft specialization is a result of elite activity, craft specialists can emerge whenever elites are active and are not necessarily indicative of only "state-level" societal complexity.

ORGANIZATION OF PRODUCTION: DEFINING AND MODELING CERAMIC PRODUCER SPECIALIZATION IN ARCHAEOLOGICAL RESEARCH

Definitions

While archaeologists can easily agree that craft specialization is an expected aspect of complex societies, a definition of specialization is more problematic. Typically, craft specialization is set aside from agricultural specialization, as something beyond both subsistence production and surplus agricultural production. It typically involves the emphasis on another form of production, usually of another resource and of another end product. Various definitions of craft specialization abound in the literature, emphasizing different aspects of specialization, such as the producers, the context, the consumers, and the product.

Bayman uses one of the broader definitions, recasting the term as "craft economies," thereby "to encompass the process whereby ancient peoples negotiated the acquisition of raw materials, fashioned them into finished goods, and consumed or distributed such commodities into larger economic networks" (1999:252). While Bayman is correct in looking at production in the larger framework of raw material acquisition and product distribution, not just production (e.g. Pool 1992; Rice 1981), he does not emphasize the aspect of specialist production as production of goods for others. Production for others is a strong theme in other definitions. For example, Clark and Parry emphasize, "craft specialization is production of alienable, durable goods for nondependent consumption" (1990:297). Costin adds to this the idea of variability of surplus production, stating

> ...Specialization is a differentiated, regularized, permanent, and perhaps institutionalized production system in which producers depend on extra-household exchange relationships at least in part for their livelihood, and consumers depend on them for acquisition of goods they do not produce themselves (1991:4).

This mutual relationship is a key component of Brumfiel and Earle's definition, where "specialization involves economic differentiation and interdependence: the existence of individuals who produce goods or services for a broader consumer population" (1987:5).

Taken as a whole, specialization is a complex notion, involving a process from acquisition of raw resources through production of goods in quantity at least beyond household need, and incorporating a relationship between producer and consumer. In this study, the focus is narrower, on the producer and the organization of production typically found with increasing "functional differentiation and integration." It is not a question of "full-time" or "part-time," as any production beyond household needs is considered specialization, at least at an incipient level. The question under study is less whether some specialization occurs prior to state formation, but whether and when production is reorganized at a level consistent with expectations regarding "state" formations. This is a diachronic consideration, answerable only within studies of single cultural traditions. While this situates craft specialization within a larger social and cultural context, further unpacking is necessary before an application of this fact of social analysis can be made with regard to the archaeological record.

Modeling Specialization

Brumfiel and Earle (1987) divide their conception of "specialization" on the basis of the differences among 1) subsistence goods and wealth, 2) independent and attached specialists, and 3) staple and wealth finance. They focus on the differences in exchange systems of subsistence goods and wealth, and the interrelatedness of production, symbols and politics, rather than suggesting measurable parameters indicative of changes in the organization of production *per se*. In her seminal review article on ceramic specialization, Costin (1991:11-16) highlights the need to look at craft specialization, especially ceramic specialization, from the perspective of four dimensions or "parameters." These parameters are: context (relationship of producer to larger sociopolitical demand), concentration (the spatial aggregation or spread of producers within or between communities), scale (the actual organization of the "production unit") and intensity (the time spent in production). Costin's goal is to operationalize measurable parameters of craft specialization.

Costin's explanation of these parameters identifies an eight-part typology of specialized production: individual specialization, dispersed workshop, community specialization, nucleated workshops, dispersed corvée, individual retainers, nucleated corvée and retainer workshop (1991:8-9). Her typological organization is not unlike those proposed earlier, particularly by van der Leeuw (1977) and Peacock (1982). Though differing in their details (e.g. van der Leeuw has six types in his scheme), these typologies have been important in the conceptualizing and modeling of ceramic specialist production.

While these types tend to fit neatly with the types or stages of societies in social evolutionary models, they need not be so tightly applied to archaeological data. Indeed, they have spurred various other attempts to define the archaeological record more narrowly (e.g. Santley et al. 1989) in order to understand the archaeological remains. While not all archaeologists have tried to fit their data into one or another of these types, a strong connection has developed between the expectation of workshops (variously defined) and specialist production.

Similarly, the growth of craft specialization tends to be connected with growth in political, economic and social complexity. As sociopolitical complexity expands, archaeologists argue, so too does the specialization of production and the administration of production. Several examples include Rice (1981) and Blanton (Blanton et al. 1982) in Mesoamerican prehistory, and Wattenmaker (1998) from Mesopotamian prehistory. The latter two particularly emphasize expectations of increased complexity resulting in increased administration of production and increased specialization of production—at a workshop level. Self-sufficiency of households, they maintain, will be negatively affected by political elite demands for tribute, either in subsistence goods or material goods. Wattenmaker (1998) adds the expectation that with the emergence of sociopolitical complexity there will be an increase in the number of goods carrying social information and consumers will demand "standardized" products that reflect their social position.

Feinman is critical of this type of model, which he calls "monolithic" (1999:81-83). He argues that these models are basically expecting a dichotomy between relative social simplicity and social complexity. This dichotomy is to be found in or marked by the absence or presence of specialized production locales. These locales—workshops of whatever type—are expected to be in a non-domestic context and scale. Domestic production, then, is considered to be of low intensity—production basically for household consumption without important production for surplus exchange or for consumption outside of the household by others. This household-workshop dichotomy falls within the scope of the "standard view of technology" as articulated by Pfaffenberger (1992). Based on his work at Ejutla, Feinman argues that domestic contexts can instead be the locale or production context for specialized production. This production can be for local exchange or even for elite context/elite use. He cites the movement of shell products from the Ejutla Valley to the Oaxaca Valley and then for deposition at Monte Albán as an example (1999). It is possible, he argues, to have a far more complex specialized production picture than initially imagined within a typological construct. It is in fact possible to have a mix of production context and scales within the economy of a larger, socio-politically complex state.[i]

Household production and specialization have been documented in several places in Mesoamerica in addition to Feinman's work at Ejutla. Aztec period Otumba (Charlton et al. 1991; Charlton et al. 1993) demonstrates the importance of household production and the interplay between household production and market exchange. Households within Otumba demonstrate production in various crafts, such as obsidian, groundstone, fibers, figurines and lapidary (Charlton et al. 1993). Huexotla is another Aztec period site that indicates household production tied to both market demands and to urban elite demands for specific goods (Brumfiel 1980, 1987a). Brumfiel argues that demands upon households for tribute items stimulated both household production and market exchange (1980, 1987a).

Archaeological Expectations for Ceramics as a Case Study

Producer specialization has certainly been noted for many types of production and products. However, a principal artifactual category used to test ideas of craft specialization is ceramics. Ceramics are particularly useful to archaeologists because of their preservation qualities and their typically high numbers in archaeological contexts. They are also useful because of the highly plastic nature of their fabric and their use in commoner, elite and ritualistic contexts. They can be easily manipulated to carry information, while other raw materials can require more work. Additionally, it has been and still is possible to carry out ethnographic research on ceramic production and distribution (e.g. Arnold 1985, 1995; Balfet 1965; Kramer 1985; Longacre 1991; Longacre and Skibo 1994), thus providing useful analogues and models for archaeological research.

There are a number of ways to distinguish specialized ceramic production in the archaeological record. The evidence falls into two broad categories. The first category is that of evidence of the location of production, i.e. identification of

architecture required in manufacture, of caches of raw materials, of concentrations of production debris, of tools required in the manufacturing process. The second category of evidence for specialization is the final product itself, i.e. of standardization in preparation of raw materials and of final form. Costin drew this broad distinction (1991; as "direct" and "indirect evidence") and it serves a useful purpose when considering the archaeological evidence for ceramic production (and craft production in general).

Direct evidence of ceramic production includes kilns, special purpose space for drying, drying sheds, finishing tools, clay lumps/raw material caches, wasters, and other debris. In Mesoamerica, finds of formal kilns have traditionally been rare (cf. Payne 1982; Stark 1985). However, they are not unknown (cf. Santley et al. 1989), and firing pits (Balkansky et al. 1997; Feinman 1999) are also known in the archaeological record, as are associated ceramic production debris and tools.

Feinman (1999) argues that the discovery of formal kilns and the relatively high numbers of production debris and final products have typically led investigators to interpret such finds as evidence for nucleated, workshop production contexts. These would be formal, specialized contexts, as opposed to domestic, household contexts, where production is expected to be less intense, part time, with fewer products and production primarily for own domestic purposes. Feinman points to the preponderance of the "monolithic model" (1999:81-83) in such interpretations, the model of the increasing scale of production location context with the increase in overall specialist production.

Feinman (1999) cites van der Leeuw (1976) and Peacock (1982) as the core of the "monolithic" model, with Santley (Santley et al. 1989) as the key Mesoamerican application for ceramic production. Feinman (1999) also cites Spence (1967, 1981) and Shafer and Hester (1983) for obsidian production at Teotihuacan and Colhua, respectively, as representative of this model within Mesoamerican archaeology.

What is necessary, Feinman (1999) argues, is looking at the whole context, not just the kiln or the debris field. Feinman places such craft production, even in state contexts, well within the household as the production unit. Arnold also emphasizes context (P. Arnold 1999). He states that ethnographic information indicates kilns and open firing pits are both used in intensified ceramic production. Kilns tend to be used in contexts where firing areas are circumscribed and the necessity for control over firing is greater. He would argue that intensified production can occur within households and can occur without kilns. However, when kilns are present, they are indicative of specialized production.

In the absence of direct data for ceramic production, Costin (1991:32-43) cites several categories of indirect evidence for ceramic specialization: standardization of product, efficiency ("economizing behavior"), producer skill, and regional variation and falloff curves (that is, perceivable changes in the spatial distribution of ceramics types and styles). Costin admits, "at best, most indirect evidence for the organization of production provides information on the relative degree of specialization.... They rarely yield unequivocal evidence for the context, scale, or intensity of production" (Costin 1991:33). Costin is correct in her assessment, yet indirect data can provide testable data relating to her dimensions (context, concentration, scale, and intensity) of specialized production. Fry (cf. Fry 1979, 1980; Fry and Cox 1974) emphasized the geographic, or spatial, dimension of excavated ceramic materials from Tikal to unravel changing patterns of specialist production units and the distribution of their products. Using morphological and stylistic attributes, dissimilarity within known vessel classes such as plates, vases, and jars was measured using multidimensional scaling. Fry demonstrated distinct and changing patterns of vessel distribution, revolving around nodes of specialist ceramic production.

When the temporal, rather than spatial, dimension is strong within an indirect data set, the first three of Costin's evidence types are more important: standardization of product, efficiency, and producer skill. These three types have been subsumed and together form what is more consistently studied as the "standardization hypothesis" (cf. Blackman et al.1993).

RECOGNIZING THE RE-ORGANIZATION OF PRODUCTION AND PRODUCER SPECIALIZATION

The "Standardization Hypothesis"

Standardization of final product is often studied as a means of understanding producer specialization. Balfet (1965) was among the first to observe variation in the final products made by different potters. She noted that among the potters of the Maghreb a difference between the products made by women for their own household use and the products made by potters for commercial exchange that suggested that commercial producers created more homogenous, that is, standardized, products (1965:170). Since the potter has a relationship to both the pot and the consumer, Balfet suggests, "it should in fact be possible to infer from the techno-stylistic characteristics observed directly in the ceramics, certain conclusions on the economic and social structure of ancient societies" (1965:169). Balfet's observation collapses Costin's (1991) remaining indirect data indicators of specialized production—standardization, efficiency, and skill. Yet Costin highlights these three as uniquely different.

"Standardization," Costin argues (1991:33-36), is composed of two parts. The first is her simple assertion that a specialized production system will have fewer producers/production units, hence less variability in the overall assemblage. The second part is her assertion that standardization is a result of "cost-cutting strategies" involving the routinization of actions involved in the production of large numbers of final products. "Routinization" is the habit of motion. "Efficiency" (1991:37-39) is "economizing behavior," the relative amount of time, energy and materials invested in the final product. Costin distinguishes efficiency from standardization because some producers may reduce costs (leading to routinized actions), while other highly specialized producers may actually invest more time, energy or materials into their products depending upon the *context* of demand. Consequently, there is no necessary relationship between standardization and efficiency in Costin's model. Finally, "skill"

(1991:39-40) is the mastery the producer has over his or her materials and product (cf. Costin 1991:39; Longacre 1991:102). Skilled producers will create standardized products because they will commit fewer errors in the production process[ii]. Though obviously tied to the first factor, that of increasing repetition within mass production contexts, even small-scale producers become increasingly standardized in their final product, as noted above. Acquisition of skills necessary to the execution of pottery production are learned, and it can take many years for an individual to become a skilled potter, unless some form of technology, such as a mold, is used (Arnold 1985:206). It is easy to understand that the early products of novices exhibit greater variation that those of more experienced practitioners.

Costin (1991) took pains to make each notion separate and testable. However, most conceptions of "standardization" collapse these indirect indicators into one general model, the "standardization hypothesis" (cf. Blackman et al. 1993).

Rice defined ceramic standardization as "a relative degree of homogeneity or reduction in variability in the characteristics of the pottery or to the process of achieving that relative homogeneity" (1991:268). That is, ceramic standardization is the increasing similarity of ceramics and/or the process of creating similar products. Blackman, Stein and Vandiver used Rice's definition as the basis of a formal "standardization hypothesis" (1993:61). They proposed standardization as both a process of production and as an aspect of the final product, based on "the underlying assumption ... that a high degree of standardization or homogeneity in vessel dimensions reflects specialized mass production, while variation or relative heterogeneity is taken to indicate household production" (Blackman et al. 1993:61). The authors cite three 'factors' that are generally proposed as support for this hypothesis: cost effectiveness, conservative nature of pottery production, and communication of social information.

The first factor, "cost effectiveness," is similar to half of Costin's conceptualization of standardization (1991:33). Essentially, products will become more similar as producers turn to techniques of mass production, routinizing and mechanizing their production process. Their repeated actions lead to habitual action, and thus increasingly similar products. Blackman, Stein and Vandiver (1993) cite Feinman (Feinman et al. 1984) and Balfet (1965) for this observation. Others who have used this as a basis for studying producer specialization include Rathje (1975), Rice (1981), and Sinopoli (1988).

Interestingly, Costin separates the concept of "efficiency" from this aspect of standardization (1991:37). For Costin, efficiency is less the habit of motion than the simplification of action to become easier, shorter, and/or quicker in order to save costs (Costin 1991:39, Hagstrum 1985:72). In an example of this conception of efficiency, Hagstrum analyzed the number of gestures and brushstrokes on two types of American Southwest pottery, arguing that the fewer the gestures and brushstrokes the more indicative it is of specialized production (1985:73, 74; see also Costin and Hagstrum 1995). The "production step measure" (Feinman et al. 1981) is based on a similar premise that the simplification of steps in the production process is indicative of increasing specialization.

The conceptualization of ceramic specialists creating economies of scale has been criticized as being a Western notion (cf. Arnold 1991; Feinman 1999). Ethnographic research has demonstrated the reasonableness of this criticism in that the products of ceramic specialists demonstrate relatively little variation, even so-called "part-time" specialists within household contexts (Arnold 1991; Arnold and Nieves 1992; Benco 1988; Kvamme et al. 1996; London 1991; Longacre et al. 1988; Longacre 1999; Sinopoli 1988). Yet these potters have used at least some aspects of routinization of production steps in their production.

Additionally, at least some level of specialized training, practice, and skill is necessary to create assemblages that exhibit little variation (Longacre 1999). Longacre's study involved potters using hand-building techniques. Arnold (1985:205-6) notes that molding techniques can significantly reduce the time necessary for learning sufficient potting skills and can enable even an adult learner to create marketable vessels quickly[iii]. Molds are used in higher-volume production than hand-building techniques used alone (Rice 1987:126; citing Peacock 1982). Either highly trained, skilled potters or the use of molds both point to standardization as a basic measure of production organized around at least some specialization of production.

The second factor of the standardization hypothesis as formulated by Blackman, Stein and Vandiver refers to Rice's (1991:268) suggestion that the nature of ceramic production is conservative. This is a common assertion in ceramics research. Arnold (1985:220-224) highlighted various factors that tend to push potters toward conservatism, such as previously learned motor habits, the potter's own social organization, and larger cultural attitudes, beliefs and practices. Not all potters are conservative, however (Arnold 1985:202-221). Innovations in production technology (such as adoption of molds), drying facilities, and firing technology can increase productivity.

The third factor Blackman, Stein and Vandiver (1993:61) cite is Wattenmaker's suggestion that,

> Specialization permits greater control over the information conveyed as a result of the greater skill of the specialists and elimination of irrelevant information such as individual variability in manufacturing skill and techniques. Therefore, specialization would serve to standardize the messages conveyed through materials. For this reason, I suggest that specialization, and concomitant standardization, arose partially in response to a need to enhance the effectiveness of the material component of the communication system. The clarity of information conveyed by specialist-produced goods may have been part of their appeal to all consumers. (Wattenmaker 1998:14).

A demand for goods communicating the right social message may be one reason, Wattenmaker argues, for why people even desire specialist-produced goods. It is also possible that a given culture will not value absolute precision in standardization in order to either produce or consume a vessel[iv].

An additional influencing factor offered by Rice (1991) is the need for ""quality control" over a finished product intended for wide distribution" (Rice 1991:268). Quality control is particularly important in cases where products need to be stacked or are used as standard measures of a product (cf. Rice 1987:202).

All of these factors, along with the ethnographic observations, form the basis of studying indirect evidence for ceramic specialization in the archaeological record. However, Longacre challenged the utility of studying standardization in the archaeological record.

> The archaeological situation creates a major analytical stumbling block because *statistics that describe variation are totally dependent on how the ceramic classes or types happen to be defined*.... Inadvertent lumping of multiple size classes by the archaeologist has the effect of inflating the apparent variation of the measurements. (Longacre et al. 1988:106-107, italics in original)

Longacre is quite correct in noting that archaeologists cannot assume they are creating a typology that is identical to the cultural emic categorizations of the archaeological population. This criticism has long been a part of archaeological theory (cf. Hill and Evans 1972), with long and passionate discussions within the archaeological literature regarding classification and typology (cf. Rouse 1960; Sabloff and Smith 1969; Spaulding 1953; Whallon and Brown 1982; Wheat et al. 1958). Yet archaeologists can produce meaningful classifications, which are useful in testing models of social organization and change. It is necessary to be careful to ensure the classification scheme matches the analysis (Adams and Adams 1991; Chilton 1999; Hill and Evans 1972).

Additionally, studies of ceramic specialization and standardization produce *relative* results and must be undertaken within a cultural tradition, as strongly advocated by Arnold and Nieves (1992) and Costin (1991) (see also Blackman et al. 1993). Some insist that cross-cultural comparisons can be made, such as

Benco (1988), where known specialist-produced products were compared to ethnographic assemblages of part-time specialists in Northern Africa. Such a comparison only served to highlight that specialization is relative, not absolute. However, Eerkens and Bettinger (2001) insist that absolute standardization is possible to identify. They propose an independent measure for standardization studies, based on human sensory limits. Yet if categories are lumping multiple emic classes, as Longacre (1988) cautioned, then variation will seem greater and erroneous conclusions will be drawn about the nature of the specialization under study. With these problems in mind, it is possible to conduct a study comparing multiple assemblages within one cultural tradition. This study will produce relative results that can then be compared across temporal periods and against modeled expectations. When the categories to be compared are created in a controlled, equitable manner, the results should be particularly informative.

Measuring Standardization in Ceramic Paste and Form

Standardization of final product has been measured in various ways, which account for the form and style of the final product, the technology of production, and the raw materials of production. In this study, the measurement of standardization will occur across four dimensions, which take both final product and assemblage composition into account. The four dimensions are: labor investment, intensity of production, product standardization, and concentration of production. A tabulation of these dimensions occur in Table 2.1.

Table 2.1 Measurements of ceramic production and theoretical expectations

DIMENSION	MEASUREMENT	SOCIAL EVOLUTIONARY THEORY	POLITICAL ECONOMIC THEORY
Labor Investment	Chi Square measurement of ordinal-scale variables across temporal phases	Increased production efficiency over time: less decoration and elaboration over time	Little expectation of increased production efficiency of general products; increased elaboration of elite-symboling products with elite activity
Intensity of Production	Test of assemblage homogeneity using Cluster Analysis and One-Way ANOVA	Economies of scale: increased standardization within groups over time; more groups to choose from over time	Increased specialized products with increased elite activity: greater elaboration
	One-Way ANOVA test of common rim form diameters	Rim form groups showing greater standardization over time	Rim forms associated with elite activities demonstrate greater standardization than non-elite forms
Product Standardization	One-Way ANOVA and C.V. tests of elemental concentrations	Increasing standardization over time; many products with fewer producers	Increasing standardization of elite- associated pastes as they come under elite control; relatively less standardization in non-elite pastes
Concentration of Production	INAA identification of pottery group and clay sample provenance	Increasing number of production loci as more producers compete within market system	Shift in elite-associated pastes toward a centralized, elite-controlled location; no shift in utilitarian pastes

Labor Investment—the technology of production

Technology of production is difficult to study without direct evidence—such as kilns, wasters, tools—but not impossible. Indirect evidence for technology can be found in the porosity of sherds and vessels, indicating possible vessel function and quality of craftsmanship (cf. Curet 1997; Feinman et al. 1984). Re-firing experiments, the determination of firing temperature (cf. Curet 1997), and completeness of firing can indicate skill (Hagstrum 1989 cited by Costin 1991:40). Labor investment can be approximated, using indicators such as labor invested into the production process (Feinman 1980; Feinman et al. 1981) or decoration process (Costin and Hagstrum 1995; Hagstrum 1985). Occasionally, the actual production method leaves traces on the final product, indicating the use of coiling or other hand-building techniques, forms and/or molds, tournets or wheels (cf. Blackman et al. 1993).

Within this study, the frequency of decorative techniques, i.e. the use of slip, the use of paint and the number of paint colors, the use of resist, will be compared across time to find phases where labor investment in decoration increases or decreases.

Intensity of production—assemblage homogeneity and product standardization

Perhaps the most common means for studying ceramic standardization involves the application of formal statistical tests to metric variables collected from a ceramic assemblage. Several techniques have been used, including histograms and distribution curves (Rice 1981), factor analysis

(Hagstrum 1985) and diversity measures (Benco 1989; Rice 1989). However, most studies rely on the application of formal, inferential statistics on metric data. There is some variability in the tests used, but most common are applications of contingency tables (Feinman et al. 1984 used Phi), F-tests, Coefficient of Variance, and ANOVA (e.g. Arnold and Nieves 1992; Benco 1988; Blackman et al. 1993; Longacre 1991; Longacre et al. 1988; Sinopoli 1988). Kvamme (Kvamme et al. 1996) offers a counterpoint to this, insisting that the use of nonparametric tests is often necessary. They argue normality in the data set must be established, and suggest the Shapiro-Wilkes test for normality. If the sample is not normal, they propose applying the Brown-Forsythe non-parametric test of one-way ANOVA with confidence intervals determined through a jackknifing method.

In every case, the authors use metric data sets drawn from whole vessels and from identified, well-established vessel classes. Most of them (e.g. Longacre 1991; Longacre et al. 1988; Kvamme et al. 1996) use ethnographically derived classes and have the luxury of obtaining large, statistically significant samples. The rest use archaeological samples, typically from unique circumstances, such as a cache of whole vessels used by Sinopoli (1988) from the site of Vijayanagara, South India, or a set of stacked wasters from Leilan, Syria (Blackman et al. 1993). Not all archaeological assemblages are as neat as these cases. In situations where the assemblage is dominated by sherds, alternative methods have been used, such as diversity measures (Benco 1989; Rice 1981) or Multidimensional Scaling (Fry 1979, 1980; Fry and Cox 1974). In this study, Cluster Analysis will be used to identify groups within the assemblage that will be measured and compared for changing variation.

While individual vessel types have been studied for evidence of specialization, few authors have considered what specialization will look like in terms of the entire assemblage. Costin only notes that "specialized systems have fewer producers," (1991:33) but takes this observation in the direction of expected morphological standardization of final products, not overall assemblage diversity or simplicity. Rathje (1975), in proposing his three-step production-distribution trajectory tied to information processing for the prehispanic Yucatán, proposes increasing assemblage variation on the local level, though it is increasingly integrated on the system level. That is, a cultural system changes over time in the manner in which it handles matter, energy, and information. A culture's information/communication subsystem cannot grow quickly enough for the overall culture's needs. As a result, cost-cutting ("mass replication") will become the norm in craft-produced items that communicate messages, such as ceramics. This is the material expectation for the basic standardization hypothesis. Rathje includes, however, expectations for the overall assemblage structure. The basic sequence is in three steps: starting with 1) high investment in low numbers of vessels; followed by 2) overall standardization of decoration for the communication of set messages; and ending with 3) generally standardized techniques being tweaked for local consumption demands—an increase in the overall variation of form and decoration (Rathje 1975:414-415). Presumably the numbers of vessels being produced is increasing throughout steps two and three.

The needs of the information system, he argues, may modify and standardize the overall information-bearing system, but local innovation will continually create variation in the overall availability of ceramics.

Rice (1981:221-222), using data from the Mayan site of Barton Ramie in Belize, advances a similar view in her four-step model on ceramic specialist production. Rice expects "a significant increase in variety" (1981:222) within the production system as producers compete with one another for resources and market share. Eventually, however, "there should be a broad distribution of standardized forms, types, etc." (Rice 1981:222) as the production system slows down under stratified societal conditions. At that same time, there is also an expectation of elaboration in the decoration of elite-oriented and ceremonial ceramics. Rice equates the elite elaboration with the increased variation of the "local" level in Rathje's model (1981:222). Ceramic "choices" are measured in this study through the determination of "rate," the number of clusters divided by the sample N.

From a social evolutionary perspective, then, the general expectation is increasing variety in the overall ceramic assemblage as potters experiment with cost-cutting techniques, compete for resources, and compete for market share. As would-be specialists fall out of the production system, the assemblage should reflect a tightening of the variation of forms and decoration available within the system. The possible caveat to this decline in variation is on the "local" level: either in continued local experimentation or continued elaboration within products destined for ceremonial or elite contexts.

Product standardization—stability of paste categories through time

The raw material of production, the clays, pastes and inclusions used to create vessels, are amenable to questions regarding uniformity of materials acquisition and their stability over time, as well as questions of production loci and final product transport. Various means are available to identify the mineralogical and chemical composition of the ceramic pastes that have been used, such as petrographic analysis (e.g. Blackman et al. 1993), various inductively coupled plasma (ICP) techniques (Hart et al. 1987; Mallory-Greenough and Greenough 1998; including weak acid preparation, Burton and Simon 1993), and instrumental neutron activation analysis (INAA) (e.g. Bishop et al. 1982, 1988; Neff 1992).

INAA has a long history of application within archaeology, especially with ceramic materials (see discussion in Harbottle 1976, Neff 1992). Briefly,

> INAA is a technique for characterizing the chemical composition of materials and is based on the counting of gamma rays emitted from a sample that has been exposed to a source of neutrons (usually nuclear reactor). Atoms of different elements are "activated" through the addition of a neutron to their nucleus, and these radioactive isotopes decay with characteristic half-lives and gamma-ray energies. The quantification of these energies yields an indication of the amount of the original element in the sample. (Arnold et al. 1999:61)

INAA has been applied to questions of ceramic raw materials (e.g. Arnold 2000; Arnold et al. 1991; Arnold et al. 1999), ceramic provenance and exchange networks (e.g. Foais and Bishop 1997; Hodge et al. 1992), and ceramic production organization (e.g. Minc 1994).

Rice (1981, 1991) and Costin (1991) suggest that standardization of paste is a signifier of specialized production. The argument rests on both the assumption of fewer numbers of producers, thus fewer numbers of paste "recipes" being used and on the assumption of elite control over resources (especially in Rice 1981, 1991). Arnold (2000) disputes such an argument, saying instead that clay selection and preparation are dependent upon a number of behavioral factors, including (but not limited to) clay and temper availability, intended use of vessel, and shape and size of the vessel. However, Arnold (2000) also notes that pastes and paste recipes change over time in response to behavioral and environmental concerns (e.g. source exhaustion). So, while a paste may not be readily identified as "standardized," changes in paste composition over time is readily traceable.

Concentration of production—spatial distribution of ceramic producers

An important application of INAA is to provenance studies, determining the location of clay and temper sources or source zones for ceramic material. This has been a fruitful application of INAA, and has contributed to the identification of exotic materials, the determination of distribution networks, and the clarification of market networks (e.g. Foais and Bishop 1997; Hodge et al. 1992). Arnold (Arnold et al. 1991; Arnold et al. 1999; Arnold 2000) emphatically states that INAA can link ceramics to clay sources, particularly in regards to the diluting or enhancing effects of temper, firing, water, and additive or leaching post-depositional effects.

> Since I began my research using INAA in 1969, I have been concerned with the chemical variability introduced by mixing clays with water, postdepositional leaching by groundwater, and firing. While such factors certainly affect paste composition, my colleagues, Hector Neff, Ron Bishop and I have been convinced by a variety of evidence that such changes will rarely compromise the ability to relate pottery to clays. (Arnold 2000:339, footnote 2)

A related issue is the precision of the assignment of provenance. Using ethnographic materials, Arnold (Arnold et al. 1999; Arnold 2000) tested wasters from potter's kilns and matched them against the potter's clay source. He concludes that, at best, an individual "community resource area" can be distinguished. Potters, he argues (Arnold 1985, 1988, 2000), would not typically go beyond a 7km radius to procure clays, and usually limit themselves to a 3-4 km radius (unless assisted by easy transport such as water or mechanical means). As potters will likely utilize clay sources near their workplace, and hence near each other within a community, INAA data will not be able to distinguish particular households or workshops from one another within a community. INAA can distinguish between communities that use clays that exhibit a distinctive identity.

MODELS AND EXPECTATIONS OF TARASCAN CERAMIC ORGANIZATION

All arguments regarding the organization of ceramic production begin with the assumption of the relationship between state formation and the specialization of ceramic production. This study considers that relationship even while evaluating the relative changes in the ceramic assemblage in terms of labor investment, assemblage homogeneity, product standardization, and production centralization. The general hypothesis, whether from a social evolution or political economy perspective, is that there is a relationship between the rise of elites and the formation of the state and an increase in ceramic specialization. The alternative hypothesis is that there is no relationship between the rise of elites and the formation of the state and an increase in ceramic specialization. Both theoretical models expect a relationship: it is the timing of the relationship that differs from model to model.

A ceramic standardization study requires temporal control, a single ceramic tradition, appropriate variables, and an appropriate means of measurement. Relative changes in the ceramic dataset will then be measurable, and can be compared to the expectations of the two broad models of the emergence of social complexity within Mesoamerica.

This analysis starts with sherds, not with whole vessels or even well-defined whole vessel categories. As a result, once establishing that there is patterning within the data set, groups will be developed using cluster analysis on temporally defined portions of the data set. Those groups will then be tested for variability, and then tracked over time in terms of changing composition and variability. The *intensity* of production, following Costin (1991), will be measured through the application of the "standardization hypothesis." Standardization will be measured by greater or lesser variability between the phases. Lesser variability in the data set will indicate greater standardization, while greater variability in the data set will indicate lesser standardization of the assemblage. Expectations for the onset of standardization are coincident with the emergence of social complexity, or just before, within a model of social evolution. A political economy model expects greater standardization with greater elite activities.

Stylistic and morphological variation and standardization will be measured over time and then compared to elucidate a pattern of relative standardization between the temporally distinct assemblages. The number of groups or clusters will measure this variation in the data within a time period, with the expectation that greater specialization will be evidenced by greater numbers of classes, indicating greater competition between producers for market share.

Variability in paste will be considered using INAA across two key dimensions. First, two key paste categories will be assessed over time to discover whether they are temporally stable or variable categories across time. Second, within the last temporal period that reflects the developed Tarascan state, samples from the site of Urichu will be compared to sherds from the Tarascan capital. This comparison undertakes a preliminary look into the possibility of the centralization, the *concentration* of production, to follow Costin (1991), of ceramic production into workshops under elite control at the Tarascan capital.

These two dimensions, of intensity and concentration, will then be compared in a diachronic fashion, against the expectations of the two larger models of sociocultural change. The managerial/adaptational models expect gradual change, a general increase in specialization over time leading to the presence of full-time specialists within states. A political economy model expects greater specialization in response to elite activity, not as a gradual increase but rather as a fit and start pattern. The specialization is not expected to be exclusively "full-time."

ENDNOTES

[i] Workshops require another level of organizational complexity, which is dependent upon the larger economic context, not on the craft specialists. Acheson's (1995) study of furniture makers in the Purépecha community of Cuanajo, Michoacán, revealed the role of transaction costs and the necessity of working capital, transportation to regional markets, and record keeping. Otherwise, furniture makers are small in scale, using only personal networks and making furniture in short runs. They have no advantage of economies of scale. So too prehispanic potters would have encountered transaction costs, notable transportation costs in moving the final product (ceramics are friable), scale of available markets (only one large urban market at Tzintzuntzan, and that one only experienced greater growth with the transition from the Tarascan state to the Tarascan empire), and labor costs (limited by kinship relationships and reciprocal obligations).

[ii] Specialists producing value-added or elaborated objects also require skill, Costin notes, in order to create their more artistic products. Either way, skill is a requirement for specialized production (Costin 1991:39-40).

[iii] Arnold writes: "Molded items require far less skill to produce, can be made quickly and have much less investment of time and labor. Furthermore, the work of an amateur is virtually indistinguishable from that of a master potter. Mold-made vessels can thus be marketed easily and immediately without a lengthy apprenticeship period during which the novice produces items of poor or mediocre quality or those that require only rudimentary skill" (Arnold 1985:206).

[iv] Even a society as complex and specialized as the 21st Century United States would not create an assemblage of vessels that would be completely standardized. Any contemporary American assemblage could contain factory-made vessels, workshop-made vessels, and hand-made vessels. While certainly the latter two categories would be swamped in number, they are reasonably expected. This follows Wattenmaker's (1998) suggestion, that choice against standardized products would also indicate aspects of consumer options, choice and demand.

CHAPTER THREE

THE LAKE PÁTZCUARO BASIN AND CULTURE CHANGE: THE CONTEXT FOR THE ORGANIZATION OF CERAMIC PRODUCTION

The Tarascan state, when it emerged ca. A.D. 1350 during the Late Postclassic, was heir to a rich and complex history not only in its own lake basin, but also in terms of western Mesoamerica as a whole. The Relación de Michoacán [(RM 1956, 1980) recorded in 1539-41], the basic ethnohistorical document for the Tarascan state, describes the formation of the state as the work of Tariacuri, the legendary leader of the *Uacúsecha*, a late-arriving "Chichimec" people to the Lake Pátzcuaro Basin. Tariacuri established the state on the basis of strategic marriage and military alliances. This establishment is placed at ca. A.D. 1350, and the Tarascan state persisted until 1530, when the last *Cazonci*, or king, of the Tarascans died at the hands of the Spanish (Warren 1985).

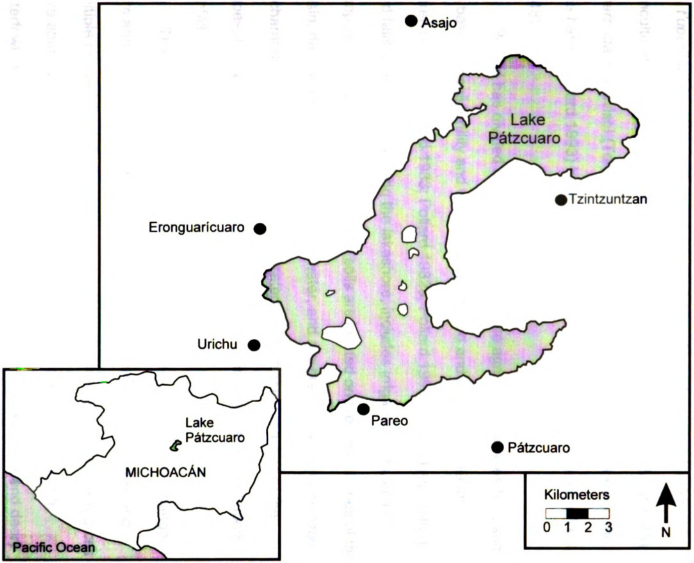
The Tarascan State is known in ethnohistoric and historic documents, and has received attention from archaeologists since the 1930's.[i] This chapter is an overview of what is known from documentary and archaeological research regarding the Tarascan state and its political precursors in the Tarascan core area, the Lake Pátzcuaro Basin, in particular regard to the ecological and cultural context for ceramic production. Evidence from the lake basin indicates two types of pressure on craft specialists, particularly for ceramic production. Against a backdrop of continuity in local (basin) ceramic production, potters needed to respond to either or both market forces and elite demands. Each pressure has a distinct requirement for producer specialization.

THE ECOLOGICAL CONTEXT: THE LAKE PÁTZCUARO BASIN

The Lake Pátzcuaro Basin is centrally located in what is now the state of Michoacán, Mexico within what has been called the "Tarascan Central Plateau" (Gorenstein and Pollard 1983) (Figures 1.1, 3.1). More specifically, it is located at a latitude of between 19°45' and 19°25' and a longitude of between 101°55'and 101°25'. An interior drainage basin, the Pátzcuaro Basin is situated at approximately 2035 m above sea level, covering an area of 929 km2.[ii] The lake level is known to fluctuate widely, both within a given year (dry season to wet season) and with microclimatic change (e.g. Fisher et al. 1999; O'Hara 1993; West 1948).

The topography of the basin was determined by volcanic activity.[iii] The basin contains approximately 1000m of relief, from flatter regions around the southern lake margin to forested basalt lava flows and cinder cones from volcanic activity. Soils within the basin are a result of the weathering of the volcanic deposits. A study of the contemporary and historic Purépecha language reveals a complex soil classification scheme including an array of categories and sub-categories (Toledo and Argueta 1993:231, citing Barrera-Bassols 1988; Toledo et al. 1980). While texture, such as powdery, muddy, and sandy, seems to be a key criterion for the classification (Toledo and Argueta 1993:231, citing Barrera-Bassols 1988), the practical application of the classification is to facilitate productive activities such as agriculture, forestry, and even craft production (in terms of contemporary production). Toledo (et al. 1980:25, 27) indicates that the basic soils for adobe construction are a mixture of *tupuri* and *charanda*. *Tupuri*

Figure 3.1 Lake Pátzcuaro Basin, showing settlements mentioned in text



(cf. *t'upuri*) is an andosol (Toledo et al. 1980:27), known for being a good agricultural soil for its moisture retention and resistance to erosion (West 1948). *Charanda* is a luvisol (Toledo et al. 1980:27). It is the most common soil in the lake basin (Pollard 1993) but it looses moisture readily and erodes easily (West 1948).

Pollard has divided the Basin land into three agricultural classes (I, II, and III) based on soil fertility and water access (Pollard and Gorenstein 1980; Gorenstein and Pollard 1983; Pollard 1982a; Pollard 1993). Class I agricultural land falls predominantly along the lakeshore, includes irrigable lands, and is composed of lacustrine soils. Class II soils are located on the lower slopes of the Basin, depend on the rainy season for water, and are predominantly composed of charanda soils. Class III lands are located on the highest reaches of the slopes; they are the lowest in fertility of the soils and are also dependent upon rainfall.

The Basin is rich in natural resources, having as it does relief (a change from approximately 2000m to 3000m), rainfall (sufficient for agriculture), and multiple microenvironment zones within the basin.[iv] Natural biological resources were abundant in Prehispanic times, including animal resources (e.g. fish, waterfowl, marsh animals, and small and large game such as rabbits and deer) and plant resources (e.g. nopal cactus, maguey, marsh reeds, pine and oak forest). These resources provided not only food, but also materials for construction, basketry, weaving, fiber, and canoes. Clays suitable for adobe construction and the production of ceramics are abundant but dispersed within the basin. With approximately 1000mm of rain (a contemporary average, Toledo 1991) during the rainy season (June-October), agriculture is reliable. A diverse group of domesticates, such as the dominant maize-beans-squash group, along with amaranth and chili peppers, were grown within the basin.

This diversity of natural resources was exploited by prehispanic communities and households and is a pattern replicated today in indigenous Purépecha communities in the basin (Toledo 1991). Pollard and Gorenstein estimated the prehispanic carrying capacity of the basin between 41,000 and 98,000 people who used prehispanic technology and grew traditional varieties of maize and beans (Pollard and Gorenstein 1980; cf. Gorenstein and Pollard 1983). The larger number is an estimate at nearly starvation rations, and they believe the smaller number to be more likely for the bulk of the history of the basin.[v]

Basic resources missing from the basin include salt, lime, cotton, obsidian and other chippable stone, such as chert and flint, with the exception of basalt, which is useful for ground stone tools. Pollard develops a fuller discussion of foodstuffs, raw materials, goods and services that were used by basin inhabitants, especially during the Tarascan Protohistoric period (Pollard 1982a; Gorenstein and Pollard 1983).

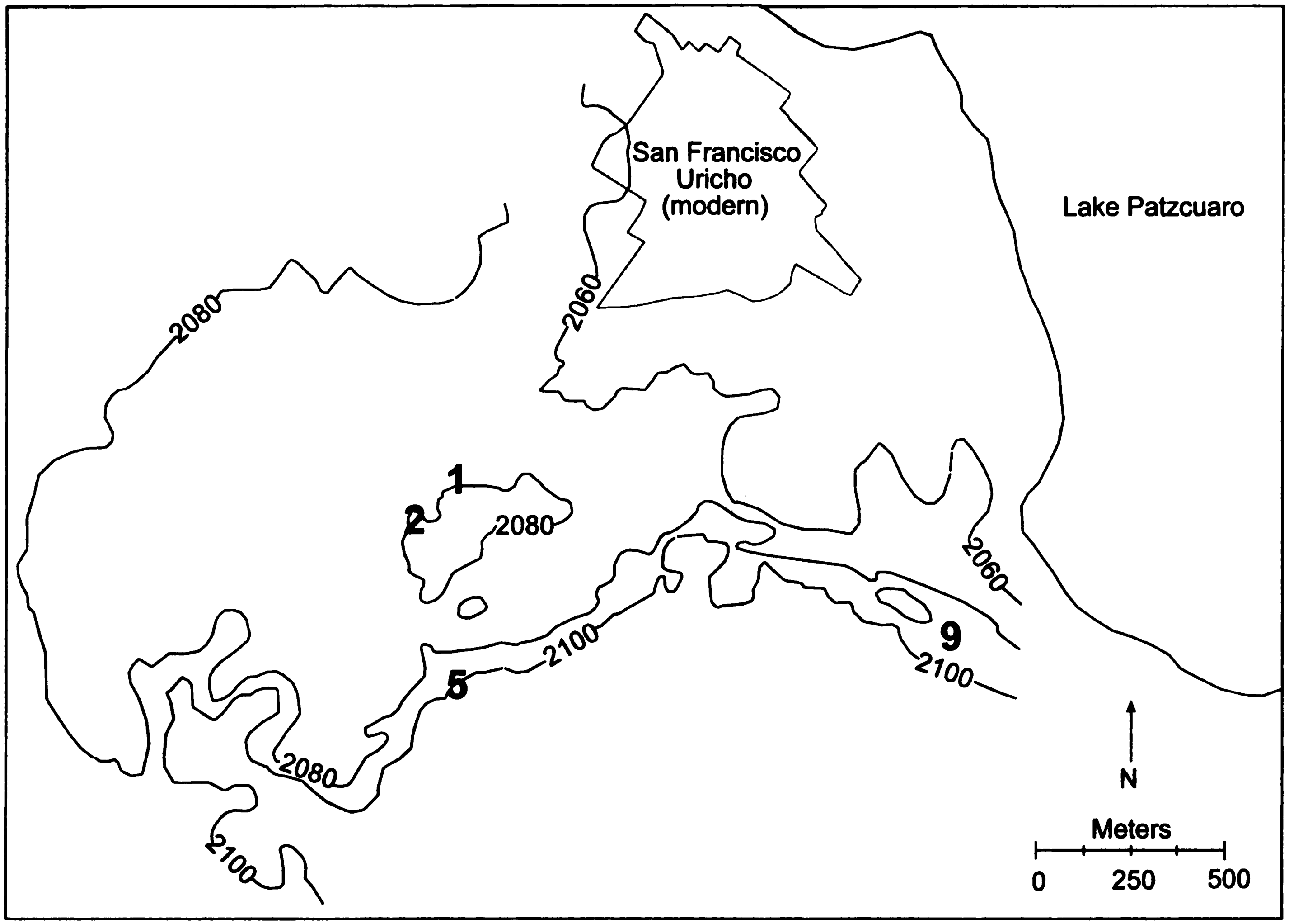
In summary, the Lake Pátzcuaro Basin was capable of supporting a reasonably large population, and yet the people who lived there still needed outside contact to bring in some basic resources as well as resources and goods, such as turquoise, copal, shell, and cacao, used later to establish and support an elite culture. Indeed, archaeological evidence supports the proposition of the basin inhabitants participating in a larger regional culture early in the known archaeological record. For example, luxury "exotic" articles from outside of the basin, such as green Pachuca obsidian, are well documented as early as the Middle Classic period, ca. A.D. 350 (Pollard 2000a).

CULTURAL CHRONOLOGY IN THE LAKE PÁTZCUARO BASIN

The RM, in following the adventures of Tariacuri, the legendary founder of the Tarascan State, recounts a history of intermarriages, deceits, and conflicts among the peoples and communities of the Lake Pátzcuaro Basin prior to the establishment of the state. Pollard and Gorenstein add to those activities environmental and demographic factors, including rising lake levels, loss of prime agricultural land, and a burgeoning basin population (Gorenstein and Pollard 1983; Pollard 1982b, 1993). These pressures are hypothesized by Pollard and Gorenstein to have prompted elite-elite competition, leading to political alliances, consolidations, and the eventual unification of the basin. Research in the Lake Pátzcuaro Basin has enabled us a better understanding of events in the basin and to evaluate aspects of the Pollard and Gorenstein model.

Recent research under the direction of Pollard, at the site of Urichu, Michoacán, Mexico, in the southwestern corner of the Lake Pátzcuaro Basin (Figure 3.2), divided the culture history of the basin into six temporal phases, stretching from the Terminal Preclassic (ca. AD 100) to the end of the Late

Figure 3.2 Archaeological site of Urichu, Michoacan, Mexico
(showing areas metioned in text; after Pollard 2000a)



Postclassic and the arrival of the Spanish (AD 1522). Five phases were identified in the excavations at Urichu: Loma Alta 3-Jarácuaro, Lupe-LaJoya, Early Urichu, Late Urichu, and Tariacuri (Table 3.1).

The site of Urichu was continuously inhabited throughout this sequence, providing the first long-term archaeological insight into the formation of the Tarascan state. According to the RM (1980), the elites of Urichu represent an ethnicity other than that in Tzintzuntzan, the Tarascan capital. Urichu thus provides a comparative assemblage to that available at Tzintzuntzan. The sixteenth century at Urichu was marked not only by the arrival of the Spanish, but also by the Spanish consolidation of Basin settlements from the hill slopes to the lakeshore. The former site of Urichu, approximately 90 ha in size, is now either scrub/woodland or is under cultivation by the inhabitants of the modern village of San Francisco Uricho.

The areal extent of the pre-Tarascan Urichu polity was based on estimated boundaries between polities prior to the emergence of the Tarascan state (Gorenstein and Pollard 1993). A survey conducted in 1996 of the areas around Urichu, Xaracuaro, and Pareo indicates shifting settlement patterns coincident with the phases demarcated by the excavations at Urichu.

Loma Alta 3 AD 350-500/550 and Jarácuaro AD 500/550-600/650

The first two phases spanning the Early and Middle Classic periods were defined on the basis of comparison with descriptions of work in the Zacapu Basin, approximately 25 km to the north (Arnauld et al. 1993; Michelet 1992;

Table 3.1: The Chronology of the Lake Pátzcuaro Basin, Michoacán, Mexico*

GENERAL PERIOD	BASIN PHASE	DATES
Late Postclassic	Tariacuri	AD 1350-1525
Middle Postclassic	Late Urichu	AD 1000/1100-1350
Early Postclassic	Early Urichu	AD 900-1000/1100
Epiclassic	Lupe-LaJoya	AD 600/650-900
Middle Classic	Jarácuaro	AD 500/550-600/650
Early Classic	Loma Alta 3	AD 350-500/550
Preclassic	Loma Alta 2	50 BC-AD 350

* Phases from Pollard 2000a:48; Tariacuri was defined in 1972 (Pollard 1972) based on materials from Tzintzuntzan; Urichu based on materials from excavation at Urichu; Lupe, LaJoya and Loma Alta based on the Zacapu project 1983-1987 (Michelet 1992) and excavations at Erongarícuaro (Pollard 2002).[vi] Earlier habitation of the basin is currently not known from excavations, but is suspected.

cited in Pollard 2000a:374-5). Occupations of the Early Classic Loma Alta 3 and Middle Classic Jarácuaro phases are deeply buried in the lake basin and are not identifiable in surface surveys in the basin. An agricultural canal, dating to ca. AD 120-590, was found in proximity to Urichu (Fisher et al. 1999). Fisher argues this canal is indicative of agricultural intensification in response to greater elite activities. Ceramics include jars and bowls, typically with buff slip alone or with negative or red paint and red slip alone. While some articles from outside the basin were recovered (e.g. shell from the Pacific coast and obsidian blades from the Pachuca source), for the most part the "exotic" materials were few in number. The earliest occupation at Urichu is known from the lowest levels of excavations in Area 1 and Area 5. Later Classic Period occupations of Urichu concentrated on the higher slopes of an old basalt lava flow on the southern edge of the site, Area 5.

Lupe-LaJoya AD 600/650-900

Materials from outside of the basin may have been few in number in the Loma Alta 3 and Jarácuaro periods, but by the end of the Classic period, they are more common (Pollard 2000a; Pollard and Cahue 1999). Mortuary goods in the Lupe-LaJoya phase (hereafter "Lupe") include obsidian artifacts from various obsidian sources, such as green Pachuca obsidian, turquoise, and marine shell (Pollard 2000a; Pollard and Cahue 1999). Social ranking is first identified in this phase. Social ranking is indicated by variation in mortuary treatment and the presence of imported materials (both resources and goods) in the mortuary contexts. Pollard argues that "at Urichu, the increase in grave goods appears to reflect an enhanced ability of local elites to obtain and bury exotics, and also capture the labor of local producers of polychrome and resist ceramics" (Pollard and Cahue 1999:276; c.f Pollard 1995). Occupation at Urichu continued to favor higher elevations on the edge of the basalt flow. Survey sites also indicate small settlements clustered closer to the lake margin. Approximately AD 750-1000 the lake levels dropped an estimated 4-5 meters, probably due to droughts (Fisher et al. 2003; Pollard 1997)

Archaeological data from Michoacán during the Epiclassic Period indicates a general reorganization of elite culture. Larger sites were built such as at Tres Cerritos near Lake Cuitzeo and at Tingambato to the southwest of Lake Pátzcuaro (Weaver 1993). Evidence form Urichu indicates participation in this larger restructuring and Urichu becomes a comparable elite center (Fisher et al. 1999; Pollard 1997). This general restructuring reflects influence from the north and east, and from the west after A.D. 800 (Pollard 1997). Teotihuacano contact (or at least influence) is evidenced in the appearance of ballcourts, plazas, pyramids and large group tombs (Pollard 1997). The tomb at Urichu, though smaller than other known Classic Period group tombs, is still an example of continuity in mortuary treatment (Pollard and Cahue 1999). Pollard argues that the grave goods from the Classic period display an "acquisitional" pattern of elite consumption indicative of elite participation in a larger economic network for provisioning of elite goods reflecting power and status within the community (Pollard 1995; Pollard and Cahue 1997). With the exception of most of the ceramic mortuary vessels and basalt tools, the bulk of the grave goods appear to be imported to the basin as either raw material resources or finished products (Pollard an Cahue 1999:270).

Early Urichu AD 900-1000/1100

The Early Postclassic period is marked by the Early Urichu phase. There is an increase in sites from the survey area surrounding Urichu and also a shift in habitation at Urichu. The higher, southerly slopes of Urichu (Area 5) were still occupied as well as an additional area at a slightly lower elevation that looked out upon the lake (Area 9). The survey found that settlements tended to nucleate, and that lakeshore sites were abandoned in favor of the hillsides. The Early Urichu phase is in many other ways a continuation of the Lupe-LaJoya phase, though with greater outside influences demonstrated, such as in shared ceramic styles. Pollard (2000a) cites similarities to the ceramics of Tula (Cobean 1990), and Chapala de Cojumatlán (Lister 1949). The ceramics tend to exhibit mamiform supports and polychrome decoration such as seen in the Lupe-LaJoya phase (Pollard 2000a). A survey of the core area (Area 9) for this period at Urichu exhibited a relatively high number of sherds from the ware Querenda White, which was first described in Pollard (1972; cf. Gorenstein 1985). A second agricultural canal was built in proximity to the first canal dates at ca. AD 885 (Fisher et al. 1999). Fisher argues that this canal indicates greater elite activity at this time.

Late Urichu AD 1000/1100-1350

The Middle Postclassic Late Urichu phase is known from an increase in the number of survey sites, many again at the lakeshore, but also in upland areas as well. Sites tended to grow in size and in number. Settlement at Urichu favored a slight rise in the center of the site (Area 2). The ceramic decoration continues with negative, red and white paint over slip, but the slip has shifted in color from darker cream (sometimes identified as "buff") to a lighter cream. Different support forms and a general increase in tripod bowls are also new. The ceramics are similar in form and decoration to the later Tariacuri phase. This similarity prompted Pollard to write:

> Mientras todas las fases muestran gran continuidad, el complejo cerámico Urichu Tardio es claramente la base para la alfareía de la elite tarasca más tarde. (While all of the phases largely show signs of continuity, the Late Urichu complex is clearly the basis for the pottery of the later Tarascan elites). (Pollard 2000a:377-378, translation mine).

As the Late Urichu phase ends, erosion from settlements increases (indicative a larger settlement size) and at approximately A.D. 1300 the lake level begins to rise (Fisher et al. 2003; Pollard 1997).

Early Postclassic and the Middle Postclassic evidence indicate a general rearrangement of regional exchange systems, though with no regional authority within or without the basin, and with elite competition within the basin (Pollard 1997). Evidence at Urichu and in the survey area indicates nucleation of settlements and growth in settlement size over time. This pattern is paralleled in the Zacapu Basin (Pollard 1997, citing Michelet et al. 1992; Michelet et al. 1999). The tomb dated to the Classic and Epiclassic periods fell into disuse, and burials tended to be located within structures (Pollard and Cahue 1999). Eastern (Central Mexican) influences weakened. Monumental architecture shifts toward rubble-core mounds and plazas (Pollard 1997).

There is no evidence for ceramic production at the site of Urichu, though it is possible that Urichu ceramics, especially the elite-oriented ceramics, were coming from Erongarícuaro. According to the RM (1980), Erongarícuaro and Urichu shared ethnic affiliation and were allied prior to the emergence of the Tarascan state.

Tariacuri AD 1350-1525

The Late Postclassic or Tariacuri phase is marked by the emergence of the Tarascan state, of which Urichu became a part. The lake level rose during the Late Urichu and Early Tariacuri period, increasing to a height of 2043m +/- 1.5m (O'Hara 1993). This was another period of community nucleation, as the overall number of settlements dropped again but settlement size continued to increase. Settlements moved back to the higher elevations across a greater proportion of the site and a greater amount of Class II agricultural lands were put under cultivation (Pollard 2000a:378). Population in this phase is estimated at ca. 82,875 (Gorenstein and Pollard 1983). It was also a period of urban growth, especially at Tzintzuntzan, marked by the building of monumental architecture. Tarascan monumental architecture consists of large rubble-core, keyhole shaped pyramids called *yacatas*, upon which smallish wooden structures were built.

Tzintzuntzan has five such structures commanding the large, central ceremonial plaza. Smaller pyramids existed at other important Tarascan centers, such as Ihuatzio and Pátzcuaro.

Tarascan elite ceramics have been previously defined by work at Tzintzuntzan (Castro-Leal 1986; Pollard 1972, 1993). Tarascan period ceramics at Urichu include distinctive spouts, handles, and decoration motifs on Tarascan elite fine wares and also on utilitarian wares as well. Imported materials and objects continued to enter the basin and included increased amounts of some materials, such as obsidian from Zinapécuaro-Ucareo, a source to the north (Pollard 1997, Pollard and Vogel 1993). Analysis of mortuary goods from the Late Postclassic indicate a shift from "acquisitional" elite consumption of exotic materials and objects to elite consumption of goods produced by local skilled craftsmen (Pollard 1995; Pollard and Cahue 1997).

The last *Cazonci* ceded the Tarascan Empire to the Spanish in 1522. The end of the archaeological phase, A.D. 1525, is marked by the erection of the Santa Ana chapel at the Tarascan Capital of Tzintzuntzan. Warren (1985:236) places the end of the Tarascan state at 1530, the year of the death of the last Tarascan *Cazonci*, who died at the hands of the Spanish. At Urichu, a small chapel was erected in the late 1500's and early 1600's on a high elevation at the site and its cruciform outline is still barely visible today, along with a few colonial period ceramics on the surface. The early Seventeenth Century population of Urichu was moved north, closer to the lakeshore, and a new chapel was built at the new habitation location. The date on the new chapel of San Francisco Uricho is 1606 (cf. Pollard 2001a and Warren 1985 for further information on the Spanish political and architectural impact on the Lake Pátzcuaro Basin).

PRE-STATE AND STATE ECONOMICS AND PRODUCTION ORGANIZATION

Pre-state Economics and Production Organization

Pre-Tarascan state economics within the lake basin are not well known, but can be reconstructed based on what we do know from archeological, ethnographic, and documentary evidence. From the RM (1980) we know that some communities were specialized, particularly for the exploitation of lacustrine resources. One excellent example is Xaracuaro, one of several island communities (RM 1980; Pollard 1982b). Most shore-side communities, however, were able to access the broad range of resources available in the basin, as most had both land and water holdings (Gorenstein and Pollard 1983; Pollard 1982b). Even today, most communities reserve access to a range of resources between shore and higher forested slopes (cf. van Zantwijk 1967; West 1948). In addition to community access to a diversity of resources, households would have had access to a range of resources, too. Toledo (1991) recognizes the foraging capabilities of contemporary households within the basin. He suggests the exploitation of multiple environmental zones is a prehistoric pattern that reduces risk for households (1991:152, 157).

As not all necessary resources were available within the basin, notably salt, obsidian, lime, and cotton, it is probable that basin inhabitants long participated in a regional exchange system to acquire these basic and luxury resources. Markets are considered a hallmark of Mesoamerican society (cf. Wolf 1959:17). The RM (1980) is most useful for the Tarascan period, but it does mention several markets, including four in existence at or before state emergence (cf. Pollard 1982a). Two are within the basin, one just to the northwest, and the fourth is located approximately 20 km to the southwest of the basin. These markets would have given basin inhabitants the opportunities necessary for an exchange of basin resources for necessary, non-basin resources.

Probable basin exports included fish, waterfowl, feathers, marsh animals and marsh plants, such as reeds and products made from reeds. Pollard suggests that clays and clay products were among the probable exports (1982b). Particularly as basin populations grew, basin inhabitants would turn increasingly to craft specialization, including specialist ceramic production, in order to make up for potential food shortfalls (1982b:9-10). The addition of craft production activities to predominantly agricultural households is noted within the literature (cf. Arnold 1985:168-196).

From a consideration of the mortuary goods, particularly from the Classic and Epiclassic periods, Pollard suggests that the early elites were involved in the acquisition of goods designed to bring themselves prestige and power (Pollard and Cahue 1999). Many mortuary items, such as shell plaques and bracelets, green obsidian, hematite, and turquoise, indicate the ability of the emerging elite to consistently bring in non-utilitarian items. Given the low numbers of status exotics and the strong presence of locally produced status ceramics, it is probable that these were elites who were able to capture some economic power, but were not able to extend themselves politically outside of the basin, at least not with economic strength.[vii] The emphasis on exotic objects is characterized by Pollard as "acquisitional" (Pollard 1995; Pollard and Cahue 1999:277, following Helms 1993), whereby elite power is based in geographically distanced ideological centers and local control of exotic goods networks. The presence of the locally produced ceramics prompted Pollard to suggest that local elites were able to appropriate the production, even the labor, of local fine ware ceramic producers as part of their acquisitional policies (Pollard and Cahue 1999:276).

To summarize, two economic processes are expected within the pre-state lake basin. First, a generalized market response to basic resource needs and potential food shortfalls induced reliance on a diverse economic strategy of craft production along with or in lieu of agricultural production. Though always a background factor, it is expected that rising lake levels would indicate times of greater market reliance, such as prior to A.D. 750-1000 (a period of lake level decline) and again at A.D. 1300 (a period of lake level increase). And yet, second, as basin inhabitants participate in the market system, elites were extracting wealth, including ceramic fine ware production. Though the elite presence intensifies throughout the later Classic and Postclassic periods, exhibition of elite activity is expected to be at its greatest within the Epiclassic and the Late Postclassic periods (Lupe-LaJoya and Tariacuri phases).

Tarascan State Economics and Production Organization

The Tarascan state was a highly centralized state system. Tzintzuntzan, the capital, was a primate center of 6.74 km^2 (or 674 ha) in size, with a population of approximately 30,000 people (Pollard 1993:33). It was the political, religious, and elite cultural center for the state and later for the empire. None of the other basin settlements ever reached a size or population near those numbers. In Tzintzuntzan, the royal Tarascan elite consolidated their political, social, and economic power.

Tzintzuntzan was the undisputed center of the Tarascan state, but not without compromise. The political, religious, and social systems centered on Tzintzuntzan were each, in turn, supported by multiple secondary and even tertiary centers within the basin (Pollard 1993). These secondary and tertiary centers had been paramount polities in their own right prior to state formation, and their continued persistence as political, religious, or social players evidences the compromises the Tzintzuntzan elites were required to make (Gorenstein and Pollard 1983). Though reduced in power, these former paramounts represented prior, multiple political, religious and social (and ethnic) systems. The resultant Tarascan political, religious, and social systems were not spatially concordant.

The compromise evidenced in the political, religious, and social systems are also noted in the state market system. Markets existed prior to the state and were apparently not under the daily control of the *Cazonci*. Markets are known from the same four locations as from the pre-state market system, including a market at Tzintzuntzan. The market at Tzintzuntzan was probably quite large in this period and is thought to have met on a year-round, daily basis (Pollard 1993). It is unknown if the other markets were daily or met on another schedule. The RM (1980) mentions the market at Tzintzuntzan being suspended twice, both extreme circumstances. One suspension was to honor the death of the *Cazonci* and the other suspension was in response to the arrival of the Spanish.

The other basin market was at Pareo, in the southern portion of the basin, to the east of Urichu. It is easily accessible by canoe. Another market was located at Asajo, located just outside of the basin to the northwest. While not accessible by canoe, it is located in a key northern pass in and out of the basin and is accessible by the northern basin communities.

The markets evidently continued to serve as the primary economic mechanism for commoners to obtain items not available locally (e.g. salt, lime, chert), in short supply within the basin (e.g. "fine clays," basalt, and marsh products), or of general use (e.g. clays, fish, basketry) (Pollard 1982b:155, 157). These goods are in addition to services obtainable at the market, such as water carriers, corn grinders, and slaves (Gorenstein and Pollard 1983; Pollard 1982b, RM1980). In order to sustain the great quantities of imports, export goods had to be generated. These exports included fish and manufactured goods such as "basketry, mats, ceramic vessels, and metal objects" (Pollard 1982b:263).

While markets remained the primary exchange mechanism for commoners, elites also experienced the need for acquiring foodstuffs, in addition to their acquisition of status objects. Pollard and Gorenstein indicate that solving the food shortage became the major Tarascan state preoccupation (1980), and the shortfall affected commoner and elite alike.

The state used both tribute and long-distance trade to support itself. Tribute was the primary means of support. The greatest import according to ethnohistoric and historic sources (cf. Gorenstein and Pollard 1983; Pollard 1982b; Pollard and Gorenstein 1980) was maize. Pollard suggests that elite specialization in warfare was their adaptation to ecological stress, both prior to state formation and continuing thereafter (1982:265). Beltrán, citing Zorita (1544), goes a step further:

> The fiscal tributes were given "...para la sustentacion de la republica, y para las querra que eran ordinaries." In its military aspect, we know that large amounts of tribute were used for the support of the frontier garrisons and that participation in the 'wars of the king" was mandatory for everybody. The "support of the republic" meant running of the state apparatus, which ultimately meant the support of the palace and its various officials. Obviously, this also should have meant the support of the religious ceremonies. (1982:157).

Tribute, maize included, was meant for the support of the state, but also for the elites, who were the state.

Maize was by no means the only import the tribute system brought into the Lake Pátzcuaro Basin. Status and utilitarian goods are also noted in the documents (cf. Gorenstein and Pollard 1982; Pollard 1982b; Relaciones Geográficas 1985). A wide range of resources was imported, including other foodstuffs (e.g. tropical foods and large game), metal (especially copper and copper alloys), obsidian, luxury items (e.g. cacao, tropical feathers, and precious metals), and cotton cloth and clothing (Gorenstein and Pollard 1983; Pollard 1982b, 1993). Tribute demands were regionally specific. These resources provided the state with an important source of income to support the elites in Tzintzuntzan and the entire elite system, if not the state. The tribute system also enabled the royal elites at Tzintzuntzan to maintain power by redistributing food, goods, and services to other elites in the basin and regionally.

While tribute from beyond the basin was important, a within-basin tribute system also existed and acted as a source of revenue for Tzintzuntzan elites. The evidence for this is incomplete, but there is some evidence for tribute moving within the basin to Tzintzuntzan. Beltrán's discussion of tribute makes a few distinctions between tribute from without the basin and tribute from within the basin (1982). However, he indicates local tribute as belonging to the *Cazonci* and to the community heads. Pollard discusses the tribute owed by Urichu to Erongarícuaro, a pre-state polity and Tarascan secondary administrative center, and the tribute Erongarícuaro owed to Tzintzuntzan (based on the Caravajal Visita of 1523-4, presented in Warren 1985; Pollard 1980). Intra-basin tribute presents a picture of pre-state allegiances and tribute system persisting into the Tarascan era. The form of the within-basin tribute is difficult to determine (cf. Beltrán 1982; Pollard 1982b). It is possible that those communities owed labor to the state's land or that they owed surplus from agricultural and craft production.

The second means of state support, and of secondary importance, was control over long-distance trade via specialized merchants. Trade acquisitions both overlapped and extended the range of resources available through the tribute system. Merchants moved both east and west, though apparently they did not actually enter into Aztec territory (Pollard 2000b:73). Very little is known about what the Tarascans offered in trade, for sources only specifically mention foodstuffs and manufactured metal objects. Pollard (2000b:73, based on Sahagun) indicates it is possible that fish, featherwork, and wood products were also exported.

The RM (1980) discusses the organization of the *Cazonci's* court and names the supervisors for various services and good produced under the royal elite's direct control. Among those listed are supervisors for goods that may have been of utilitarian or of elite use: clay, gourd, and wood products. While the supervisors seem to have been agents of the state, their relationship with the producers of these products is more problematic. It is unknown for certain whether craft specialists were living and working at Tzintzuntzan under direct state authority. It is possible that they lived in different areas within the basin, providing products for the state as demand dictated. These questions likely have multiple answers, and systems of oversight probably varied for different aspects of the economic system.

Organization of Metal, Obsidian, and Maize Production in the Tarascan Economy

It is constructive to consider the organization of three key material culture categories in order to model the organization of ceramic production in the context of growing elite power. The first is metal. It was almost exclusively an elite-consumed resource, though as a raw resource is found outside of the Tarascan political core and was never under complete and direct state control. The second material class is obsidian. Obsidian was both an elite and commoner resource, and it underwent a change in its consumption pattern with the emergence of the state. It was also a resource found outside of the basin. The third is the agricultural base, especially maize production. As maize provided the core calorie content of the diet, maize formed an important resource category. These three classes are chosen because the details of their procurement, production, and distribution are reasonably well known. They also provide a comparative framework, as they represent both elite and non-elite production.

Metal

Metallurgy in West Mexican Mesoamerica has deep roots, to ca. AD 650 (Hosler and MacFarlane 1996:1819) in the Classic Period. Though it appears to have been a borrowed technology from Central and South America, it was transformed to represent uniquely West Mexican ideology and forms (Hosler 1988b). Metal goods in West Mexico were not the result of the application of new technology to old forms, that is, replacing obsidian prismatic blades with metal knife blades. Rather, the bulk of the metallurgical industry produced forms uniquely suited to metallic properties: e.g. bells, sheet ornaments, tweezers, and rings (Hosler 1988a, 1994). Hosler (1994) argues that from the beginning, metal goods were attached to the elites, as it was a local (regional) resource infused with West Mexican meaning, but with exotic South American roots.

Two phases of prehispanic metallurgical production are known (Hosler 1988a, 1994). The first dates from AD 800 to AD 1200-1300, corresponding roughly to the period of regional elite reorganization prior to the emergence of the

Tarascan state. Metal goods are not known from the Lake Pátzcuaro basin during this period. This is most likely due to sampling error and the small amount of pre-state research in the basin. Yet it also highlights the lack of regional power the elites in the basin had prior to state emergence.

The second phase Hosler identified was AD 1200-1300 to AD 1520 and the Spanish arrival (1988a, 1994). This period also roughly corresponds to the emergence of the Tarascan state, dated at ca. AD 1350. The metallurgical transformation marking this period occurred along two lines: (1) introduction of new manufacturing techniques and copper alloys; and (2) introduction of morphologically innovative subtypes of previously made objects classes (e.g. of tweezers, of bells, etc.). In particular bells and sheet metal ornaments, engineered for sound and color attributes, were used in quantity by the Tarascan state elite (Hosler 1994, 1995; Pollard 1987).

Metal ores were located away from the Tarascan political core, to the northwest and the south. Specialized mining and smelting communities existed prior to state formation and persisted until long after. The state positioned itself to control the mining regions early in its history. Tribute demands were placed on some communities, while others were absorbed directly under state control. A few communities were founded by the state. The communities varied in distance from Tzintzuntzan, but averaged 1-3 day's journey (Pollard 1987; Gorenstein and Pollard 1991).

The Tarascan elite used the metal objects in two key ways. First, they were used to symbolize their own power and prestige. Bells, tweezers, and other symbols of status are commonly found in Tarascan elite contexts. The second use was as an export item, for elite gift giving and for long-distance exchange. Tarascan bells and other metal goods are distributed widely in western and central Mesoamerica.

Obsidian

As with metal, obsidian was a raw material resource found outside of the lake basin. It was used to produce both utilitarian and elite goods. Elaborate distribution systems existed for various obsidian sources, such as the Pachuca source in central Mexico and the Zinápecuaro-Ucareo sources to the north east of the Lake Pátzcuaro Basin, near Lake Cuitzeo. These latter obsidian mines produced material that has been found at Teotihuacan and in Central Mexico (Pollard and Vogel 1994). Obsidian from these sources experienced changing distribution patterns over time, demonstrating large-scale trade networks and their response to the political climate.

Prior to state formation, the amount of obsidian excavated in the basin is small, though present. Some of it is used for burial items, but for the most part items fashioned from obsidian are utilitarian in form and function. It is also typically in small pieces, demonstrating conservation of use.

With the formation of the Tarascan state, the amount of obsidian material increases greatly. In particular, the Ucareo material, once found throughout Central Mexico prior to the formation of the Tarascan state, and in commoner pre-state contexts,[viii] moved almost exclusively into the political core with state formation.

Based upon recent chemical characterization work (Pollard et al. 1999; Pollard 2000b), it would appear the Tarascans directly controlled the Ucareo source, and as a state resource all of its production was solely directed to the Tarascan elites. Ucareo obsidian dominates the obsidian assemblage from Tzintzuntzan during the Tariacuri period (Pollard and Vogel 1994).

Green obsidian, known exclusively from the Pachuca source, is found in elite mortuary contexts both before and after the state emerged.

Other obsidian sources seem to continue to move through market exchange networks, even after the emergence of the state. Obsidian at Urichu is dominated by obsidian from Cerro Varal, with some also from Cerro Zinápero. Both sources were within the Tarascan Empire, but were not resources directly controlled by the state (Pollard et al. 1999).

Agriculture

As already noted, the Lake Pátzcuaro Basin is a good place for agricultural production, with sufficient rainfall and sufficient arable land. A range of crops can be planted and grown. However, the Basin has a limit to the number of people it can support.

Pollard and Gorenstein specifically identified that carrying capacity by reconstructing Tarascan diet and land production. They concluded that for the basin, during the Tarascan state, "the maize production potential is approximately 10,421,200 kg/year, supporting a population of 41,000 persons" (1980:275), based on a daily intake of 700 g of maize per person per day, roughly 80-85 percent of the daily diet.

With a population of ca. 30,000 at Tzintzuntzan, and a basin population of ca. 80,000 (between 60, 750 and 105,000, Pollard 1993:79), the basin could not support the population. Commoners were expected to have had direct access to land and maize production. Elites, especially at Tzintzuntzan, would have experienced a shortfall as their numbers grew. The importation of maize constituted part of the tribute economy.

Maize is known from documentary sources to have moved through both the tribute and the market system (Gorenstein and Pollard 1983; Pollard 1982a). Within the tribute system, the movement is based upon both elite demand and power to command. However, commoners needed to be able to participate in an exchange context to alleviate their shortages. It has been hypothesized (Pollard 1982a, 1982b) that commoners turned increasingly to craft production to meet the exchange demands, exchanging finished goods for maize.

All three of the elite consumer goods categories discussed fell under Tarascan elite control, though to varying degrees. Metal was strongly associated with elites, while elite control of obsidian resources varied under the Tarascan state, and some sources were under direct elite control. Both metal and obsidian are "point resources," limited in their spatial distribution. Maize production was not restricted like in this manner, nor was it important to the elite identity or to state ritual. However, it was important to the maintenance of the elite population.

In turning to the organization of ceramic production, it is necessary to note that resources for ceramic production were widely distributed within the basin. However, ceramic final products are pliable and can communicate ideological messages. The Tarascan elites used ceramics to convey information (cf. Pollard and Cahue 1999; Versluis 1994). As such, it is expected that the production reorganization found with metal, obsidian, and maize will also be found with the organization of ceramic production.

CERAMICS AND EXPECTATIONS REGARDING THE REORGANIZATION OF CERAMIC PRODUCTION

Ethnographic Research on Ceramic Production in and around the Lake Pátzcuaro Basin

Modern ethnographic research on traditional potters in the Lake Pátzcuaro Basin, notably by George Foster (e.g. 1948a, 1948b, 1960b, 1976) and in the Purépecha region (e.g. Shott 2001; West 1948; Williams 1994) have produced a fine body of research which bears upon the modeling of prehispanic ceramic production. Indeed, Foster argues that the traditional potters he studied in Tzintzuntzan, long a mestizo community by the time he arrived, were direct heirs to the prehispanic tradition (Foster 1948). A similar assertion of the relevance of contemporary ethnoarchaeological ceramic studies in the region to understanding of archaeological materials is also made by others (cf. Shott 2001, Williams 1994). This ethnographic literature bears upon two general themes of importance to this study: the organization of ceramic production and its material culture correlates, and the typical consumption of ceramics within households. Both provide insight for archaeological expectations regarding prehispanic organization of ceramic production.

Though traditional ceramic production in Michoacán is widely dispersed, it is found only within certain communities. West notes a pattern, as pottery-producing communities are located near the "clay-soils district north of the Sierra" (1948:62), in the Zacapu Basin and in the Lake Pátzcuaro Basin. West indicates these communities are located near appropriate clay resources and abundant water supplies (1948), with the exception of one community that makes figurines in the wet season, as there is insufficient water in the dry season for any pottery production. Water supply is not a problem in the Lake Pátzcuaro Basin. Fuel for firing is not listed by West or other authors as a potentially limiting resource, though it is required for firing ceramics. Fuel for firing in Michoacán includes wood (pine) (Foster 1948a). This discussion is limited to producers of household or tourist wares and not exclusive tile or figurine producers.

The basic Purépecha economic unit is the household (van Zantwijk 1967), and ceramic production is based in the household (cf. Foster 1948a; Gortaire Iturralde 1971). Just as Purépecha households exhibit some division of labor on the basis of gender and age, so too does ceramic production (Foster 1948a; Gortaire Iturralde 1971; van Zantwijk 1967). In Ihuatzio, van Zantwijk notes that households are exogamous and occupations are passed down within families ("destinos") (van Zantwijk 1967). While no ceramicists are found in Ihuatzio, Foster (1948) finds a similar situation in Tzintzuntzan. It is interesting to note that both Foster and Gortaire Iturralde find potting households (and barrios) to be well organized, though typically quite poor (Foster 1979; Gortaire Iturralde 1971).

Pottery production is somewhat divided by gender, though not exclusively so, with men typically collecting clays and fuel and conducting the bulk of the firing with women preparing the clays (multiple steps involving drying, grinding or sieving the clays, and formation of small damp clay "tortillas" for formation of vessels). West indicates that in traditional hand-building households, only women do the vessel formation (1948). In households where molds are used, both men and women tend to participate in vessel formation. Foster (1976:28-29) indicates that women are traditionally potters, except in situations where large quantities are required for export. Women potters and hand-building techniques seemed to have been far more common in the Eighteenth Century, according to West (1948:63).

Ceramic production seems to be the primary source of income for the majority of the potting households in the ethnographic literature (Foster 1948a; Gortaire Iturralde 1971; West 1948), though is it not the exclusive pattern (West 1948, noted for seasonal figurine producers).

Traditional ceramic production requires material correlates in both architecture and tools. However, as production occurs within a household context, few correlates are exclusively used for ceramic production, or are made of perishable raw materials. Architecturally, ceramic production requires a space for drying clay, which may be a patio or even the street (Foster 1948) with additional uses. Drying the clay is a requirement for mold-made ceramics, but not for hand-built ceramics (Foster 1976). Once dry, clays are crushed with a granite boulder (Foster 1948a) and then ground or sieved. Sieving is a later technique, with grinding a traditional, labor-intensive technique, using a stone metate (Foster 1948), also a tool expected within a household context. Mixing of clays and vessel formation likewise do not require special space, only sufficient space (Foster 1948a; Williams 1994). For potting households in Huáncito, Michoacán, Williams found that traditional conceptions of "activity areas" do not work well for understanding the spatial structure of potting activities, where a space may be used for several activities and where some activity spaces are cleaned (1994:204). As a result, while ceramic production may leave a residue, it is not exclusively a potting residue.

Ceramics are either built using modeling or coiling techniques, or by using molds, or a combination of techniques (Foster 1948; West 1948). Foster argues for the prehispanic existence of "mushroom" molds, which are simple, shallow bowls with a central handle on the concave side (Foster 1976). The initial clay "tortilla" prepared for the vessel is placed on the convex side of the shallow bowl portion. While the handle (the "stem" of the "mushroom") may have been a development since prehispanic times, Foster argues for the basic mold's antiquity (Foster 1948a, 1948b, 1976), though he admits there is little direct evidence (1948b). Such molds tend to be made from clay, are fired, and can be repaired with pitch (Foster 1948). While molds are expected within the archaeological record, they may not be easily identifiable as molds, masquerading simply as "crude pottery" (Foster 1976) when broken. Wasters are also expected, even with pit firing. Williams notes the accumulation of wasters within households, used for covering the kiln during firing (1994:214 Fig. 14).

The tools for forming, scraping, shaping, smoothing vessels are for the most part perishable and not readily identifiable as specifically for potters. The different materials include: damp cloths, stones, maguey fibers, horsehair, a knife, and a ring made of *tule* (a marsh plant used in weaving) (Foster 1948a, 1967, 1976). Other tools, such as bowls for measuring and mixing clays, bowls for water, and such are either wood or are ceramic vessels themselves (Foster 1948a:80-81).

A major architectural feature of contemporary traditional ceramic production is the kiln. It is usually a simple construction, round, with a lower opening for fuel, a grate of some sort, and open at the top (Foster 1948a, 1976; Gortaire Iturralde 1971). Every family in Tzintzuntzan has its own kiln (Foster 1948a) a pattern that is also seen in Santa Fe (Gortaire Iturralde 1971, though kilns are shared by extended families from different households). Foster argues that the kiln is of Spanish origin (1948a, 1948b, 1960a, 1976), noting that is essentially the same as a traditional kiln from Spain (Foster 1960a), and not a feature of prehispanic ceramic production. Foster further notes that open firing is associated with the far more traditional hand building techniques. West describes an open firing technique, which he concludes, "probably represents the truly aboriginal technique" (1948:63). West reports that fuel for these open firings include manure, rotten wood and pine bark (1948:63).

According to Foster, each potting household procures it own clay resources from the area around Tzintzuntzan, never further than 4 km (1948a). The clay is transported on donkeys, in sacks. Each potter exploits multiple clay sources, and vessels are made from a mixing of "red earth" and "white earth" (local terminology, Foster 1948a:79-80). The resulting paste is not tempered (Foster 1948a:79). The potter's mixture of clay source and proportion of "red and "white" vary according to the type of vessel to be made (Foster 1948a:80). Foster also notes that mixtures vary between households (1948a:81).

Foster indicates that the ceramic classification at Tzintzuntzan was rather complex, with four major types, each sub-classified 12 to 15 times (Foster 1948a:85, Table 15). The four major types are *ollas* (jars), *canteros* (water pitchers), *comales* (flat cooking surfaces) and *cazuelas* (casserole-like dishes). The variation in measurements (such as diameter, depth, capacity) varied 5 to 15 percent from the mean (Foster 1948a:85 footnote one). Some of the subtypes carry names of Spanish derivation, and some correspond with Spanish vessels (Foster 1948a, 1960a). The classification at Santa Fe is less complex, containing only 16 different vessels, plus assorted traditional artistic forms, such as candlesticks (Gortaire Iturralde 1971:112).

Consumption of ceramics is variable, depending on the needs of the household and the life expectancy of the particular vessels. Foster cites the basic strength of the vessel, its frequency of use, and the exposure of the vessel to accident (e.g. children and cooking low to the ground), and replacement cost (low in Tzintzuntzan, a potting community) as factors in the breakage rates of vessels (Foster 1960b). According to Shott, expected use-life is related to the expected frequency of vessels in an assemblage, and to the amount of energy that is put into its initial manufacture (Shott 1996:464). Shott further explains that factors involved in the expected use-life of a vessel are complex and are relationally complex (1996:465). From a study of ceramic vessels in households in four communities in Michoacán, Shott and Williams conclude that vessel size, particularly height, is a major determinant in the life of a vessel, along with age of vessel, though they were not the only factors (2001:109). Ollas, though sometimes quite large, are often protected, and survive more readily than do smaller, more frequently used and moved items such as *cazuelas*. *Comales*, for all intent and purposes have no "height" and therefore maximum diameter was a more important indicator.

Ethnographic information on traditional ceramics production in Michoacán allows us to model more closely the expectation for the organization of ceramic production in prehispanic contexts. From the information outlined above, ceramic production can be expected within household contexts, drawing upon the labor of multiple household members, both male and female, though most likely female. The household context will provide little in the way of direct production debris, except for possibly large firing pits, a few specialty tools (such as smoothing stones), a small accumulation of wasters, and other production debris. An archaeological assemblage of household ceramics should be skewed positively toward smaller vessels with which most of the cooking is conducted. Vessel pastes should reflect localized clay procurement patterns, and only ratio differences from one potting context to another, which may not be discernable within larger assemblages. Some pastes may relate to particular vessel categories.

Ceramic Studies of Tarascan Ceramics

Tarascan period (Late Postclassic) ceramics have been identified and dated with confidence for a long time. Indeed, one motivation for early archaeological work at Tzintzuntzan was to provide collections of Tarascan pottery for the National Museum (Pollard 1993:19 citing Caso 1930 and Noguera 1931). However, while the ceramics themselves are highly identifiable, Pollard describes the archaeological work in and around the basin as "limited and sporadic" (Pollard 1993:19). The published descriptions and studies of Tarascan ceramics are as equally uneven, usually as short discussions in larger works. In her volume on Tzintzuntzan, Castro-Leal (1986) discussed the history of Tarascan ceramic descriptions and analysis published to that point, including work of Noguera (1931, 1965), Rubin de la Borbolla (1939, 1948) for the Basin, and Moedano (1941, 1946) for nearby Zinapécuaro along with discussions by Cabrera Castro (1996:37-40) and Moguel Cos (1987:5-11). Castro-Leal (1986) points to these studies as laying a foundation for her analysis, and she expands upon their work with her own typology.

Relying on ceramics excavated from the main platform and burials at Tzintzuntzan, Castro-Leal presents a typology broken into two unequal parts, domestic ceramics ("Cerámica Domestica," two types) and sumptuary ceramics

("Cerámica Suntuaria," nine types) (Castro-Leal 1986:80-114). These types were described on the basis of paste (temper, texture, color, firing), surface decoration (color, surface treatment), and form. Sumptuary ceramics also had the additional category of decoration (technique and motif), where applicable. A complete rendering can be found in Castro-Leal (1986:80-128).

In general, Tarascan state ceramics are well made, with an emphasis on cream, red, white, and resist (negative) in surface decoration, resulting in polychromes with geometric designs. Forms include spouted vessels, stirrup handles, large tripods, and miniature vessels mimicking a range of full-size vessels.

Moguel Cos (1987) adds to these types as a result of her own work on ceramics from salvage surveys in Guanajuato and Michoacán, including the Cuitzeo Basin, Pátzcuaro Basin, and the Zirahuén Basin. Her typology, broken into three unequal groups of monochromes, bichromes, and polychromes included thirty-three types covering four time periods. Of note is the presence of "Bicrome-Bandes Anchas Roja/Bayo" (Moguel Cos 1987:94), which seems to be the ware Querenda White, first described by Pollard (1927; Gorenstein 1985). Both Castro-Leal and Moguel Cos privileged the role of surface decoration as did their predecessors.

Where possible, these two studies by Castro-Leal and Moguel Cos have been taken into account by Pollard (1993, 2000a, 2001), particularly in terms of her use of their group names, where applicable. However, as Pollard points out (1993:201) her work also crosscuts some of their groups. Pollard's analysis

(1972, 1993) is both a modal analysis and a Type-Variety analysis, starting with the ceramic paste. This same technique forms the basis of this study (see above). The Type-Variety analysis results in types and groups that are rooted in the potter's starting point—the paste, and at least for the Tarascan case, crosscuts surface decoration and vessel categories. A full description of Pollard's ceramic work can be found in her 1972, 1993 works, as well as the Informe Final for the recent work at Urichu (Volumes I and III, 2000a and 2001).

Ceramic evidence to this point indicates only indirectly the control the Tarascans exerted over ceramic production. Mortuary goods revealed a shift in elite status-building from the prior pattern of acquiring exotic objects to the use of local products. "They were buried with goods that reinforce the distinctiveness of Tarascan elite culture and the Tarascan state religion" (Pollard and Cahue 1999:278). Versluis (1994) analyzed the designs and motifs of the iconography found on Tarascan elite fine wares. He concluded that while he could identify recurrent themes, the expression of the overall iconography had not yet become standardized. Rather, the iconography was only in the "process" toward standardization. This incomplete standardization reflects the emergence of the new "Tarascan" identity from the previous basin ethnicities. It may also reflect a lack of direct control over the production, and especially the decoration, of ritual and status ceramics. As the various communities in the basin continued to exert some power within the Tarascan political and religious system, so too they may have persisted in the production of ceramics which reflected the absorption of their local community elites into the new Tarascan system.

Ceramic production within the Tarascan state seems to be composed of two dimensions: utilitarian, market-oriented production intended to create an exchangeable surplus of vessels; and status and/or ritual vessels created within an elite context (maximally) or for elite consumption (minimally). Market-oriented production should respond to market demands and economies of scale. Elite-oriented production may exhibit some of those same tendencies, but should also indicate greater labor investment and a range of variability [especially given Versluis's findings (1994)].

Expectations for the Urichu Ceramic Assemblage

As stated in chapter two, the primary hypothesis of this study focuses on the relationship between the state formation and craft specialization. Given both the larger theoretical expectations for the co-occurrence of social complexity and craft specialization and the Tarascan cultural evidence for the reorganization of certain specialized production with the emergence of the state, there is a great likelihood of ceramic production also becoming more specialized with the emergence of the Tarascan state.

In general, the ceramic assemblage is expected to change over time, exhibiting either a trend toward or the onset of standardization. In doing so, the assemblage should exhibit greater heterogeneity over time, as vessel categories proliferate, as types become standardized (and thus increase their variation between types), and as greater investment in elaborated forms increases.

Within social evolutionary theory, the emergence of specialization is gradual, with production becoming intensified and concentrated over time. Within this particular sequence, the first state emerges with the Tariacuri phase in the Late Postclassic (A.D. 1350), though there is growing elite activity leading up to the state within the phases prior within the basin. Producer specialization and product standardization should be greatest in the Tariacuri phase (Table 3.1). In addition to elite ceramics, commoner production was presumably basin-based and market-driven, which implies standardized products borne of efficiency. Though ceramics are rather friable, they can be easily transported by canoe within the basin. Canoe transport allows freer movement of the ceramics than if transported only by porters. There is no mention of the regulation of ceramic vessels, though, and it is possible that copying of elite vessels occurred.

Political economic models expect greater craft specialization with any period of intensified elite presence and action, not just with the emergence of "the state." Therefore, increases in production specialization should be identifiable in the Jarácuaro phase (the Middle Classic period, A.D. 500-600/700), through the Early and Late Urichu phases (the Early and Middle Postclassic, A.D. 900-1000/1100 and A.D. 1000/1100-1350, respectively), and again in the Tariacuri phase (the Late Postclassic, A.D. 1350-1525). Evidence has already been given for some artisans being closely associated with the state and for a state controlled tribute system that did not respond to market demand, but was rather manipulated to support the elite class and power structure.

However, ethnographic studies indicate that Purépecha ceramic production today occurs within households, even for market distribution. Using easily accessed resources, this production process leave few overt material correlates of ceramic production. Based on these studies, it is reasonably expected that much of the prehispanic ceramic production also occurred on the household level. This expectation runs contrary to much—though not all—of the literature on ceramic production specialization.

In the next three chapters the relative standardization of the ceramic data set from Urichu is explored. Chapter four discusses how to study the relative standardization of a ceramic sherd assemblage. Chapter five undertakes that study, comparing the overall assemblage within temporal phases and between phases. Chapter six analyzes chemical information from Urichu soils and Tzintzuntzan ceramics in comparison with previously analyzed Urichu sherds. The conclusions that can be made from these analyses are presented in chapter seven.

ENDNOTES

[i] Pollard (2000b:59, 65-68) provides a brief overview of the research on the Tarascan state since the 1930's.

[ii] A fuller discussion of the typology, geomorphology, ecology, and use of the basin can be found in the work of Goerenstein and Pollard (1983; Pollard 1993; Pollard and Gorenstein 1993) and Chacón (1993a, 1993b).

[iii] West (1948:2) indicates the volcanic activity dates as far back as the Eocene, with most activity occurring in the Tertiary and Quaternary periods. Activity continues into the present, as evidenced by the eruption of Parícutin in the 1940's. Steam still vents from the cone of Parícutin today.

[iv] Refer to Gorenstein and Pollard (1983) for a fuller discussion of the identified zones: open water, tule-marsh, lakeshore, lower sierra slopes, upper sierra slopes, and alpine.

[v] Their analysis is based on kilograms of maize per person per year, along with other foodstuffs such as terestial game and fish.

[vi] The chronological sequence was determined on the basis of carbon-14 dates from burial, architectural, and midden contexts. For more information, refer to Pollard (2000a:48-50).

[vii] This conclusion is based on research as Urichu. Recently completed excavations (Summer 2001) at Erongarícuaro indicate that the quantities and quality of goods may have been higher than previously expected (Pollard, personal communication 2003).

CHAPTER FOUR

TESTING THE STANDARDIZATION HYPOTHESIS: TARASCAN CERAMICS AND THE MEASUREMENT OF VARIATION

Most studies of ceramic specialization center on the now well established "standardization hypothesis" as the measure of ceramic specialization. As noted in chapter two, those studies largely rely upon whole vessels. However, the ceramics from the site of Urichu, on the shore of Lake Pátzcuaro, Michoacán, Mexico (see Map 3.2) consist predominantly of sherds. The majority of the sherds are too small for many usual vessel measurements, such as maximum height. While some studies use monothetically-classified sherds to study culture change, such sets are not necessarily appropriate to the identification and study of the changes in the variation of an assemblage over time, changes reflective of ceramic production organization. This study explores the appropriateness of a polythetic typology and the application of Cluster Analysis to the question of producer specialization in the Lake Pátzcuaro Basin during the emergence of the Tarascan state.

CERAMIC RECOVERY

Most archaeological research in the Lake Pátzcuaro Basin has occurred at Tzintzuntzan, the site of the Tarascan Capital (see Map 3.1) (cf. Castro Leal 1986; Pollard 1972, 1993). In an effort to understand the emergence and the structure of the Tarascan state, the site of Urichu, in the southwest corner of the lake basin, has become the focus of excavations under the direction of Helen P.

Pollard, 1991-1998 (Pollard 2000a). These excavations were conducted in three phases, from 1990-1996. The first phase determined the extent and range of deposits at Urichu and involved a site survey and the excavation of 10 test units in Areas 1 (five units), 2 (three units) and 5 (two units) (Areas designated on Map 3.2). The second phase involved block excavations in Areas 1, 2, and 5, focusing on elite deposits in an effort to define the range of material goods for the social classes of each temporal period and to determine the nature and amount of exchange within and between the pre-Tarascan polity of Urichu with others in the various time periods (Pollard 2000a). Phase three of the project consisted of the majority of the field laboratory analysis for the excavated materials and included an extensive survey of the neighboring polities of Xarácuaro[i] and Pareo, to the east (Map 3.1). The boundaries of these polities were determined by Pollard's (1982b) application of Theissen polygons. A 100% survey of these two polities, including test excavations on the island of Jarácuaro, were conducted in order to provide a comparative sample with which to evaluate culture change within the basin. Unfortunately, some of the deposits excavated on the Island of Jarácuaro were deflated and do not provide a useful comparative sample for the work at Urichu.

Urichu Area 5 is an artificially terraced platform with cultural materials representing the Classic, Epiclassic and Postclassic periods. It is located in the southern portion of the site, elevated, and along the edge of a basaltic lava flow. Under a stone paved plaza representing the Late Postclassic Tarascan occupation, the area yielded a Classic period tomb, several other extended burials, and architecture. The excavations in Area 5 formed a 6m x 10m rectangle, incorporating one original test pit. The sample in this study also includes an additional test pit located approximately 2 m north of the block excavations. Excavations in Area 5 ceased in sterile parent material at approximately 1.5 meters below the surface.

Area 1 is another artificial terrace, positioned at a lower elevation and further north, closer to the lake than Area 5. Originally thought to represent only the Tarascan occupation of the site, radiocarbon dating has revealed a much older occupation layer in the lower levels, dating to the Loma Alta 3-Jarácuaro phase (Table 3.1). The area appears to have an Early Classic period occupation, then a hiatus until the Late Postclassic. A rubble-core double pyramid base remains on the terrace. A series of nine adjacent 2m x 2m units composed the excavations in Area 1, placed adjacent to 4 of the 5 original test pits. The deposits were deeper in places in Area 1 than in Area 5, attaining depths of just over 2 meters. In addition to midden fill, the area yielded architecture, a number of flexed burials, and an interesting cache of refittable Tarascan-period pottery vessels, including two vessels in the shape of ducks.

Excavations in Area 2, thought to be a Middle Postclassic occupation, remain incomplete. Apart from the three test pits excavated in 1990, and due to the vagaries of fieldwork beyond the excavator's control, only three incomplete units of a proposed four-unit block were excavated. Ceramic materials from the later excavation will not form a component of this research project. The test pits varied in depth from 1.5 meters to over 2.5 meters in depth, and provide crucial Middle Postclassic information.

In the Urichu project, ceramic materials were deemed to have a three-fold purpose. The first goal was to develop a "fine-grained" chronology, the first of its kind for the basin and for the Postclassic in Michoacán. The second goal was the identification of the ceramic material expression of the elites in the three target periods, prior to state formation, state formation, and during the state. The third goal, the focus of this dissertation, was to understand the nature of and changes in craft specialization, including ceramic production.

CERAMIC CODING AND TYPE-VARIETY ANALYSIS

Over 178,000 ceramic items compose the ceramic assemblage collected during the three phases of the project. H. P. Pollard analyzed the phase one ceramics in the 1992 field season, with the assistance of the author. The majority of the analysis of the phase two ceramics was conducted in 1996 by this author, with assistance from Melissa Byers, Richard McCosh, and H. P. Pollard. The total number of ceramics used in this analysis is 37,301.

Ceramics recovered in excavations were washed, dried, sorted, and counted during the regular excavation seasons. Special items were sorted out from each level: figurines, pipes, circles, and other worked sherds, such as those exhibiting grinding and/or notching. These items were handled and cataloged separately and do not compose a component of this research project. All other sherds--supports, handles, spouts, rims, and bodies--were grouped together by unit and level and cataloged as a totality, though eventually analyzed individually. Ceramics used in this study came from test units and block excavations in three areas of the site, Area 1, Area 2, and Area 5 (Map 3.2; Table 4.1).

A sample of the pilot phase (phase one) ceramics was coded in the 1992 field season. In 1996 the coded sample was enlarged. Sherds from ten of the twenty-five completely excavated units in the second phase of the project were chosen, representing over 48,000 sherds, of which over 34,000 were completely coded. All sherds larger than 1-inch square (2.5 cm^2) within a unit and level were coded for this study. At the time, it was felt Area 5 would yield a longer, more continuous sequence than would Area 1, so Area 5 received greater attention. Excavations in Area 2 had been interrupted in the 1995 field season, and though attempts were made to return to those units, the team was never able to do so. Thus, Area 2 ceramics, though by no means unimportant, are less numerous in this analysis. They represent one excavation level, the deepest achieved in the block excavations (level 6, Tariacuri Phase) and two of the test pits from the pilot project.

Area 5 was more heavily sampled than Area 1 because prior to the radiocarbon dates, Area 5 appeared to hold the older deposits and a longer continuous sequence. Later it became evident that the oldest levels (attributed to the Loma Alta 3-Jarácuaro phase) were actually present in Area 1. The Area 1 Loma Alta 3-Jarácuaro sherds were undecorated. However, Area 5 did include the longer sequence (Jarácuaro to Tariacuri phases). In all, seven phases were

Table 4.1 Distribution of ceramic assemblage by area and phase

PHASE	PHASE NAME	SITE AREA	CULTURAL CONTEXT	BODY*	RIM	SUPPORT	TOTAL
T8	Tariacuri	5	Elite ritual	7315	866	86	8267
T7	Tariacuri	2	Commoner residential	1434	344	21	1799
T6	Tariacuri	1	Elite ritual and residential	2679	241	17	2937
T5	Late Urichu	2	Commoner residential	535	108	5	648
T4	Early Urichu	5	Socially ranked residential	8866	687	62	9615
T3	Lupe	5	Socially ranked residential	7711	551	43	8305
T2	Jarácuaro	5	Residential; ranked status probable	4719	244	7	4970
T1	Loma Alta 3-Jarácuaro	1	Residential	708	48	4	760
	TOTALS			33889	3089	245	37301

* Includes sherds with handles and spouts

represented, providing a continuous sequence from the Middle Classic period to the end of the Late Postclassic period, that is, the end of the Tarascan state (Map 3.1; Table 4.1).

All sherds were coded for paste and surface decoration attributes, following Pollard (1972, 1993). The sherds were initially coded for "paste," on the basis of the eleven paste categories Pollard identified at Tzintzuntzan (1972, 1993), with the addition of two more identified by Pollard from the pilot excavations at Urichu (Pollard, personal communication). Pastes were originally identified on the basis of the following attributes (following Gorenstein 1985, Pollard 1972, 1993): color range (Munsell Soil Color Chart, 1971), texture (percent of inclusions), size of particles, firing, and inclusions. These attributes are identifiable using a combination of visual inspection and using a binocular microscope (10x power). Unknown pastes, either because the paste was unrecognizable as one of the 13 paste categories, or because burning obscured the paste category, were marked as "unknown."

After paste identification, various formal, morphological, and surface attributes were then coded. All sherds were coded as from an open, closed or indeterminant vessel[ii]. No further formal or morphological variables were coded for body sherds[iii]. Formal and morphological attributes collected for rim sherds were:

Form of lip (rounded, squared, tapered)
Thickness of lip (millimeters)
Form of rim (bolster, convex, everted, incurved, straight)
Thickness of rim (millimeters)
Diameter of orifice (centimeters, estimated[iv]).

Formal and morphological attributes collected for support sherds were:

Support fill (hollow or solid)
Support form (almena, anular, base, bulbous, circular, conical, cylindrical flat, mamiform, nubbin, slab, spider)
Support height (millimeters)
Support width (Maximum) (millimeters).

All sherds were coded according to the following surface decoration attributes:

Presence of slip
    Color of slip if present
Presence of paint
    Color of paint if present
Presence or absence of resist
Type of morphological manipulation of sherd, if present
Intensity of finish (polish, smooth, wiped, or left as rough).

The resulting data set contained information at a variety of levels: binary, multistate character (nominal), multistate ordinal, and continuous. The data were collected within the parameters of the Type-Variety typological system, and were initially conceived of as contributing to the construction of types within a Type-Variety System (cf. Pollard 1972, 1993, 2000a, 2001b).

The typology constructed from the Tzintzuntzan and Urichu ceramics by Pollard (1972, 1993, 2001b) was carefully designed to fit within not only her early work, but also the types identified by other researchers within the lake basin and within the larger cultural region (e.g. Arnauld et al. 1993; Braniff 1998; Cárdenas Garcia 1990; Castro Leal 1986; Cobean 1990; Faugére-Kalfon 1996; Kelly 1947; Macías Goytia 1990; Manzanilla Lopez 1988; Michelet et al. 1989; Moguel Cos 1987; Pereira 1999; Piña Chan and Oí 1982; Tommasi de Magrelli 1978). Pollard combined the Type-Variety System with an analytic system from her dissertation work (1972) with the ceramics from the survey at the Tarascan capital of Tzintzuntzan. The ceramics were collected to isolate both temporal variation and intra-site variation (1972:204). Instead of using simply a Type-Variety method, Pollard analyzed the ceramics combining the two methods:

> In order to derive the maximum information from the collection, and to make it useful not only for the purposes of this work, but for comparison within Mesoamerica, two classificatory procedures were undertaken. One procedure, termed analytic classification involves the isolation of modes (Rouse 1960).... The second procedure is a form of taxonomic classification which has been extensively utilized in Mesoamerican archaeology, the Type-Variety System. (Pollard 1972:205)

In combining these two techniques, Pollard followed the lead of Sabloff and Smith (1969) in attempting to increase the applicability of the Type-Variety System to a wider range of anthropological questions (Pollard 1972:205; see also Rice 1987:284). Pollard's modes are related to slip color and paint decoration.

To construct this typology, Pollard (1972) started with the identification of wares and groups. The formal typology (including types and some varieties) was not developed until after the excavations at Urichu were completed (Pollard 2001b). Pollard defined these various hierarchical levels as follows:

> Wares, groups, types and varieties are differentiated by the sharing or lack of sharing of similar states of particular attributes. Wares are distinguished by the attributes of paste composition and surface finish. Types are distinguished by the attributes of vessel form and decorative technique. Varieties are distinguished by minor variations in attributes of vessel form, decorative technique, or decorative style. The group is considered a "super-type" (Parsons 1967:53) that is composed of closely related types showing essential homogeneity in the range of variation of form and surface color. (Pollard 1972:206)

The resulting typology is useful, particularly as it is comparative, but unfortunately some of the types include multiple forms, which indicate the use of similar decorative technique and motif across multiple functional classes (Pollard 2001b)[v]. The crosscutting of form and surface decoration is indicative of the complexity of the ceramic assemblage at Urichu.

Pollard identified 110 different types and varieties at Urichu (2001:96-100), as follows:

PERIOD	NUMBER OF TYPES & VARIETIES REPRESENTED
Tariacuri	45
Late Urichu	35
Early Urichu	43
Lupe	62
Jarácuaro	50
Loma Alta 3-Jarácuaro	23

It is obvious that there are changes in the ceramic sequence, with an increase in type variation from the Loma Alta 3 through the Lupe phases. At that point, the variation decreases for the next two periods; it then rebounds slightly with the appearance of the Tarascan state in the Tariacuri period. Among the 110 types and varieties, only five varieties occur throughout the six phases of the excavation sequence and only three others occur within the last five temporal periods. Twenty-five occur only in the last two and seven occur only in the last period.

Only seventy whole vessels were excavated at Urichu, the largest number of them dates to after the emergence of the Tarascan state (the Tariacuri phase) (Pollard 1996). Not only are the seventy vessels unequally distributed among the temporal phases, but they also represent a mixture of vessel types and forms. While there are too few whole vessels for statistical analysis by form and temporal phase, a few observations can be made. The percentage of bowls to jars changes, from only bowls (in only burial contexts), to 64% bowls and 36% jars (one bowl from a non-burial context), to only 29% bowls compared to 71% jars (both from burial and non-burial contexts, with a few more jars coming from non-burial contexts). While this distribution is somewhat reflective of ceramic production, it is a stronger indicator of social decisions regarding what to include in a burial as well as unequal recovery of whole vessels from non-burial contexts.

The number of whole vessel types over time is similar to the pattern seen among sherds. There are three types for six vessels in the Jarácuaro phase, and none repeats in the whole vessels. There is one type for one vessel in the not so neatly defined Jarácuaro-Lupe, and the type repeats in the also not-so-neatly defined Lupe-Urichu phase, which has twelve types for twenty vessels. Only one type for Lupe-Urichu carries into the Tariacuri phase, which has nine types for thirty-eight vessels. This is the lowest number of types in a phase that has a higher number of samples in the Tariacuri phase. The fewer number of types possibly indicates a decrease of variation with an increased number of samples: a diminishment of variation within the assemblage.

MEASURING CERAMIC STANDARDIZATION: TRADITIONAL STATISTICAL APPROACHES

In assessing craft specialization using standardization of ceramic production as a proxy, most studies rely on vessel categories and whole vessel samples, and thus the data drawn from the assemblages tend to be simple variables on a continuous scale (e.g. vessel height, maximum diameter, orifice diameter, etc.) The continuous data are then subjected to various, simple statistical tests, such as t-test or Coefficient of Variation (C. V.), to determine whether or not vessels come from one or more populations and to determine the amount of variation within a given vessel class. A number of these studies have already been discussed in Chapter Two and the emphases in these studies are typically ethnographically derived assemblages of vessels (e.g. Arnold and Nieves 1992; P. Arnold 1991; London 1991; Longacre 1988, 1991). Archaeological examples are found in Blackman et al. (1993) and Sinopoli (1988). Blackman and his co-authors studied a group of twenty-seven stacked, fused wasters, of a single type of vessel, indicative of one production event from Leilan, Syria (1993:63). They used metric measurements as one "index" of standardization, measuring "rim diameter, wall thickness one centimeter down from the rim, vessel height, base diameter, and maximum basal thickness" (Blackman et al. 1992:71). These continuous variables were analyzed using the Coefficients of Variation and F-ratios, and from the low Coefficients of Variation the authors concluded "metric data from the Leilan wasters show a level of homogeneity consistent with expectations for specialized mass production of standardized utilitarian goods" (Blackman et al. 1993:73).

Using a cache of "small water-serving or transport vessels" from a rock-cut well at Vijayanagara, India, Sinopoli used rim diameter, rim angle, and rim height as her key measurements indicating standardization of the vessels (1988:587-589). Comparing the mean and standard deviation of the vessels, Sinopoli concluded the vessels were standardized. The results of the cache were compared with a small sample of similar vessels from the site as a whole, and the entire set still indicated relative standardization, though the vessels from the rock-cut well indicated less variation than the vessels from the site as a whole (Sinopoli 1988:588-589).

While useful with ethnographically derived assemblages and the occasional cache of whole vessels from the archaeological record, most archaeological assemblages are not composed of whole vessels but of partial vessels. The whole vessels that are recovered are often in low numbers and fall across vessel categories, thus creating an assemblage that is not statistically significant in number, such as is the case in this study.

Sherds are not without utility, however. Feinman (1980) used sherds, categorized according to the Type-Variety System, for the Valley of Oaxaca, to identify pottery production areas and changes in production intensity over time. The sherds were acquired as part of the intensive survey of the valley and represented multiple time periods from a large, well-established region. The counts for the sherds from each period and site were studied using the Phi Coefficient of Association, a non-parametric measure of association between two variables. By measuring density within a time period and changes in density over time, Feinman (1980) was able to distinguish changes in the intensification of pottery production associated with changes in the political structure.

These archaeological examples required either whole vessels for the measurement of continuous variables or a large survey data set with which to measure changes in local density. Additionally, they each required highly identifiable types of formal similarity. It is clear that another method must be found for dealing with assemblages dominated by sherds, assemblages that present issues of formal variability within types and assemblages from one site.

TYPOLOGY AND ALTERNATIVE METHODS FOR MEASURING ASSEMBLAGE VARIATION

The Type-Variety System originated within American Southwestern archaeology (Wheat et al. 1958) from older ideas regarding the use of binomial division of attributes to create a ceramic classification scheme (Willey and Sabloff 1980). It was quickly picked up and spread to other archaeological regions, including the Mayan region (Gifford 1960; Smith et al. 1960). It has since become the standard classification method for pottery within Mesoamerica (cf. Rice 1976). It is a taxonomic system, with types being determined on the basis of hierarchical decisions regarding the importance of various ceramic attributes, such as paste or surface decoration. The original research goals of a Type-Variety System involved cultural-historical questions, especially those focusing on issues of chronology, seriation, and cultural affiliation.

The Type-Variety System developed at a time when archaeological debate centered over the nature of typology and the relationship of types to archaeological research questions (Willey and Sabloff 1980:143; see also Dunnell 1971; Hill and Evans 1972). To follow Hill and Evans (1972), the debate raged over whether types are "real" (natural) or "invented." "Real" types, some argued, are the same types as those understood and used by the people within a particular culture. The real types are simply found by archaeologists (e.g. Ford 1954). Others argued that types were "invented" through the research process. A research question guides the choice of attributes relevant to the research question, and the resulting types are usefully applied to the research question (e.g. Spaulding 1953). In the former view, patterns are considered to be reflective of actual, deliberate thought. In the latter, the patterns are measurable and quantifiable, and are also reflect cultural patterns, though they were not necessarily the direct result of conscious choice. Accordingly, a Type-Variety System was contrasted to an "analytic" system such as that proposed by Rouse (1960) for the creation of "modes," where a "mode" is "any standard, concept, or custom which governs the behavior of the artisans of a community" (Rouse 1960:313). In other words, it is a "selected attribute or cluster of attributes which display significance in their own right" (Sabloff and Smith 1960:279). Sabloff and Smith (1969) proposed combining the two techniques of Type-Variety with modal analysis in order to provide the resulting types with greater explanatory power.

This debate over which is "better" has been resolved by archaeologists coming to the understanding that some typologies are better suited to some questions, while other typologies are better suited to other questions (cf. Adams and Adams 1991; Rice 1987). Basically, this is the solution Hill and Evans proposed:

> That we should not pursue all-purpose, standardized typologies; if our types are to be maximally useful, they must vary with the specific problems and hypotheses we are interested in. We will argue that archaeological materials can be typed in many different

> ways, and have many different meanings. (Hill and Evans 1972:237)

Similar statements can be found in Adams and Adams (1991) and Rice (1987).

It is interesting to note, as did Rice (1987:278-279), that ethnographic data on folk classifications of ceramics tend to be based on vessel function. Furthermore, vessel function tends to be fluid and changing as vessels break over time and come to be used for other purposes. Vessel function is not necessarily difficult to identify archaeologically in general, but may be more difficult to identify in specifics. We may not be able to identify the "real" classification, but we can certainly identify patterns in the actual cultural remains.

The Type-Variety System provides types that are monothetic and hierarchical in structure (Dunnell 1971; Rice 1987). Statistical analysis of attributes can provide typologies that are phenomena-oriented, that are groupings based on the objects being sorted and grouped (Dunnell 1971, Rice 1987). These phenomenal groups can be either polythetic or equivalencies (Rice 1987). In either case, statistical techniques can find patterning within the data set and can provide the means to measure the patterns mathematically. Groups formed on the basis of mathematical distance are easily quantified for the similarity between group members and the variation between groups.

There are essentially two types analytic classifications: monothetic and polythetic. Monothetic groups "are formed by rigid and successive logical divisions so that the possession of a unique set of features is both sufficient and necessary for membership in the group thus defined" (Sneath and Sokal 1973:20). In other words, all group members must posses all of the features necessary to define that group, without variation. On the other hand, members of polythetic groups "have the greatest number of shared character states, and no single state is either essential to the group membership or is sufficient to make an organism a member of the group" (Sneath and Sokal 1973:21). In other words, the groups are defined by similarity in the proportion of attributes present, not on the absolute presence or absence of attributes. Sneath and Sokal argue that polythetic groups are "natural" groups, that they have high information content, and that they are useful to many purposes (though admittedly they are not perfectly suited for any one purpose) (1973:21-22). Clarke (1968) strongly argues that archaeological assemblages and types are by nature polythetic and need to be defined and used as such. In this study, polythetic groups are of most use and interest because this data set is complex and the co-occurrence of attributes forms the interesting structure of the data set.

Even when combined with a modal analysis (such as that proposed by Sabloff and Smith 1969), a Type-Variety System does not provide an ideal typology for the study of ceramic standardization, at least not in this research study. In stating this, the goal is not to overturn the Type-Variety System as a means of developing "standard types" for purposes of discussing ceramics and for comparison with other regions. The types developed by Pollard (1972, 1993, 2001) are irreplaceable in terms of the archaeological research in the Tarascan region. Rather, this discussion highlights the reasons for not using the types derived by a Type-Variety System in this study of the organization of ceramic production in the Lake Pátzcuaro Basin. It is expected that the types determined by Pollard and the groups discovered within this study, while not equivalent, will not be contradictory. Rather, the polythetic groups will be amendable to a study of ceramic standardization at the assemblage level, in describing variation within the assemblage divided by time, and also in tracking changes in variation over time.

A number of alternative techniques exist for understanding variation within a data set and for creating polythetic classifications useful to different types of research questions. Of them, three have been successfully applied to archaeological ceramics. Rice (1980) proposed using diversity measures, borrowed from the ecological sciences for application to ecosystem modeling. Sneath and Sokal (1973) discussed the application of ordination techniques, such as multidimensional scaling and factor analysis, to problems of classification. These techniques have been applied to classification and ceramic research questions. Cluster Analysis is another classification technique used in archaeological studies. In the following discussions, each technique, its relative merits, and its application to archaeological studies will be discussed. As the goal of this study is to understand changes in the organization of ceramic production, it will be seen that Cluster Analysis provides the most appropriate statistical technique to the study of the Urichu ceramic assemblage.

Diversity Measure of Archaeological Assemblages

In 1980, Rice introduced an important model for the study of ceramic standardization, a model that relied on the concepts of diversity, richness and evenness for the measurement of assemblage variation. Rice applied diversity statistics from mathematical ecology (cf. Pielou 1977) to measure the variation over time in ceramics from Barton Ramie, a Mayan site in Belize. She used mathematical ecology concepts of diversity, specifically of "richness" (the range and number of categories present) and of "evenness" (the smoothness of the distribution of the categories). Using the Shannon-Weaver index, Rice measured richness and evenness for variability in form, technology and decoration of ceramic types from six phases at Barton Ramie. In comparing richness and evenness through time, Rice discovered that she actually has several patterns of change, highlighting differential changes in slipped and unslipped vessels, and in the attributes of the types. She concluded that the differential changes reflect "idiosyncratic fluctuations of periods of competitive variability" (Rice 1981:227).

Nancy Benco (1987) also utilized diversity as a measure of overall complexity with four assemblages from al-Basara, a North African medieval site. Her four assemblages represented four consecutive temporal phases, the first three of which were explicitly treated using the diversity method. These three phases represent a changing pattern of political centralization and craft production. Using ceramics identified by functional class (morphological-functional attributes such as size and shape) and technological class (production-reflecting attributes such as paste, decoration, and neck/rim morphology), Benco measured total diversity, H', as (1987:146):

$$H'(f,t) = H'(f) + H'(t)$$

"where H'(f,t) is the toal diversity; H'(f) is the diversity of functional groups; and H'(t) if the weighted mean diversity of technological types within functional groups." After comparing changes in total diversity over time, she then broke down the diversity scores into constituent parts, such as the diversity accounted for by functional class. Using the working assumption that domestic production contexts represent multiple types of ceramics produced and workshop production contexts represent a single type of ceramic produced, Benco compared changes in proportion of types and charted larger changes in political centralization and economic competition.

Rice (1991) cites other applications of diversity measures in archaeology, including Braun (1985), Rice (1989), and Stark and Hepwoth (1982) for production, and DeBoer and Moore (1982) and Dickens (1980) for stylistic attributes. Though Rice has continued to be an avid supporter of diversity measures, they have not been widely used in archaeological studies. Rice (1996:177) suspects that the lack of positive response is due in large measure to the discouraging words of influential methodological archaeologists George Cowgill (1989) and Robert Dunnell (1989). Both Cowgill and Dunnell concern themselves with the importance of understanding what has been sampled and the relationship between the population and the sample (and even whether or not the sample is the same as the population). What is sampled, they argue, has a direct impact upon the result of the diversity index. Dunnell emphasizes further the methodological issues of interpreting *what* is being measured with the diversity index: are the categories (at either the population level or the entity level) being measured appropriate to the measurements being made within a given diversity index? In other words, can an artifact be equated to a species? Can that artifact—for example a ceramic sherd—be assigned the same weight as an organism? Cowgill argues that richness and evenness are incomplete measures of assemblage diversity for archaeological questions. For questions involving ceramic standardization, Cowgill stresses the importance of the range of the "richness," the need to pull "standardization" from the concept of richness, and the need to define the "uniformity of standardization" within an assemblage (Cowgill 1989:135). Dunnell further critiques the application of diversity indices to archaeological data sets as the application of methodology for the measurement of spatial but relatively timeless distance upon essentially dynamic assemblages and research questions.

Though not presently applied to ceramic studies with any consistency, diversity measures continue to be used in archaeological studies with assemblages, stone tools, and faunal remains (cf. Baxter 2001:715).

Ordination Techniques: Non-Metric Multidimensional Scaling

Statistical scaling techniques, such as factor analysis, principle components analysis, and multidimensional scaling have also been applied to ceramic assemblages. In such approaches, data are measured as representing similarity or dissimilarity, and can be measured by a spatial representation of the amount of distance (space) between data points. Multidimensional scaling (MDS) in particular represents data in a spatial map, which can be easily inspected for one, two, and sometimes three dimensions of relationship, the structure being the relationship between the independent and the dependent variables.

> *Multidimensional scaling* (MDS) procedures are designed to detect the hidden structure of similarity judgments. That is, MDS is a statistical tool to determine which particular characteristics are most important in discerning the pattern in similarity judgments out of a set of plausible defining features. Because MDS analyzes pair wise comparison data (perceived relatedness between two items of a category), it has a wide array of applications in business, psychology, political science, health fields, communication, advertising, and criminal justice (Stalans 1995:138).

MDS has also been applied to anthropological studies, including studies using ceramic materials.

MDS was developed in the early 1950's for application within psychometric studies (Young 1987:16), in response to the need to distinguish not just that individuals perceived a difference between two alternatives, but also to measure how great was that difference. Building on some incomplete work from the 1930's and early 1940's, metric MDS was introduced to deal with the magnitude of perception difference in a spatial context. Non-metric MDS, which has less stringent data requirements, followed in the 1960's (especially in the work of R. Shepherd and J. Kruskal, Sneath and Sokal 1973:249). By the end of the 1970's, MDS "consolidated" (per Young 1987:31-33) with the establishment of goodness-of-fit tests and techniques of determining the correct number of dimensions in the data. It is now routinely applied to statistical problems throughout the social sciences.

MDS takes "relational" (Kruskal and Wish 1978) data and measures their proximities, representing the results as coordinates in space. The resulting configuration may have one (linear), two (planer), three (spherical), or more dimensions. While one, two, and even three dimensions may be identified visually, linear regression can be used to identify all (including additional) meaningful dimensions in the data. Each dimension accounts for the dependent variables, and the final result is to account for or explain the most important variables in the data set (Stahlans 1995:153). Goodness-of-fit is measured by the "stress," that is, the "square root of a normalized 'residual Sum of Squares'" (Kruskal and Wish 1978:49) and is scored from 0 (good fit) to 1 (bad fit) (Stalans 1995:149).

Applications of MDS in archaeological ceramic studies typically involve seriation problems. Patricia Wattenmaker (1998) used MDS to seriate occupational phases from multiple excavation areas from Kurban Höyük, Turkey. She chose MDS "because it provides a measure of the temporal distance between variables (occupational phases) in contrast to non-scaling methods that simply provide an ordering of variables" (1998:207). She was able to seriate the occupation phases on the basis of eleven ceramic types, representing 42,551 sherds. Robert Drennan (1976) did a similar study at Fábrica San José, Oaxaca, Mexico to discern shorter temporal phases within a larger, 400-year temporal phase that could not be separated into smaller sub-phases using heuristic methods. He scaled excavation proveniences using ceramic attribute occurrence frequencies.

Seriation of constrained numbers of ceramic attributes has also been undertaken using MDS. Recognizing that variation over time rarely, if ever, varies unidimensionally, Cowgill (1972) discussed the application of MDS to the problem of changing ceramic types over time. In the Wattenmaker and Drennen studies the seriated entities were temporal units, in Cowgill's discussion the seriated variables were the ceramic types. Lovis (1973) additionally seriated ceramic attributes using ceramics from seven sites in the northwestern portion of the Lower Peninsula of Michigan.[vi] Wattenmaker (1998:207) cites Pollock (1985) and Steponaitis (1983) as additional examples of MDS applications along seriation lines.

In another application of MDS, Fry (1979, 1980; Fry and Cox 1974) also had multiple occupational phases, but he had very strong spatial data for ceramics at Tikal. He used the strong spatial component of his ceramic data to study the exchange networks of potters within Tikal and then compared these networks over time. Again, he was able to track his variables (ceramic locations) on the basis of tightly defined ceramic types.

Metric MDS requires interval-scale data. Because the technique measures proximity as the spatial distance between two points, in order to measure similarity the data need to on an ordered scale. Non-metric MDS requires only ordinal scale data. The latter has therefore found wider applications within the social sciences because of the less stringent data requirements. The ordinal data translates into the coordinates indicating spatial relationships and the structure of the MDS map. This requirement often precludes the use of nominal or categorical data, and nominal data tends to produce not a spatial model but rather a tree-structure model (Corter 1996:51). However, Meara (Meara et al. 2000) demonstrates MDS's ability to use binary data, and Sneath and Sokal (1973) indicate that MDS, as an ordination method, is applicable to numerical taxonomy problems. In such cases, if the data set is not ordered, a matrix of dissimilarity coefficients is required. While non-metric MDS can provide solutions of relationship within multidimensional space, it may be difficult to discern discontinuities within the data beyond the first few dimensions, whether they are "sharp" or "fine" (Sneath and Sokal 1973:252). Additionally, non-metric MDS has difficulty with large numbers of characters and observations, and some discussion remains about the usefulness of the first dimension of a MDS solution when there are inequalities of data set size (Sneath and Sokal 1973:252). For a standardization study, it is expected that MDS would also have trouble handling the sheer number of variables and observations available in this study. Additionally, while MDS would be able to identify the dimensions along which the assemblages vary, it may not be able to elucidate whether they are becoming "more" standardized.

Cluster Analysis

"Cluster Analysis" is the generic name for a wide variety of procedures that can be used to create groups in a data set, that is, a typology. These procedures statistically form "clusters" or groups of similar entities. More specifically, a clustering method is a multivariate statistical procedure that starts with a data set containing information about a sample of entities and attempts to reorganize these entities into relatively homogeneous groups. (Aldenderfer and Blashfield 1984:7). It is important to note the polythetic nature of this grouping: multiple, not single, variables are taken into account to form the groups with no one variable sufficient or necessary to group membership. The groups are formed by data entities that are closer to other entities within the data cluster than they are to any other entity outside the cluster. Cluster Analysis is similar to the distance-dependent measurement of MDS. But while MDS reveals the dimensions of the structure between groups of data, Cluster Analysis brings like data into groups.

Cluster Analysis, at least portions of it, has been around for a long time. Sneath and Sokal (1973:13-15) indicate the application of "numerical methods" to taxonomic problems dates to the very end of the nineteenth century. In its current form, Cluster Analysis comes out of numerical taxonomy, applied to problems of classification in biological sciences (Sneath and Sokal 1973), which can be dated to the late 1950's and early 1960's. Cluster Analysis has been usefully applied in research in a variety of natural science and social science contexts, including—but not limited to—biology, zoology, botany, psychology, sociology, and anthropology.

Cluster Analysis is actually a group of related techniques used for the discovery of groups within data (Aldenderfer and Blashfield 1984; Baxter 1994). It does not involve a null hypothesis and significance test. Therefore, appropriate decision-making is crucial to each step of the application. Baxter (1994) cites this as a criticism of the technique. However, the two main types of cluster procedures, k-means and hierarchical, have both been the subject of examination and testing within the clustering literature (cf. for general references Aldenderfer and Blashfield 1984; Clifford and Stevenson 1975; Everitt 1980; Sneath and Sokal 1973). The decisions can be made thoughtfully and in accordance with research goals and available data to produce an appropriate cluster solution.

K-means clustering is an iterative process, passing through the data multiple times in order to find an optimal result. Its advantages lie chiefly in its capacity to cluster the dataset directly, to cluster large (easily into the ten thousands) datasets, and to compare every case with the generated clusters, moving cases as needed in succeeding iterations. However, k-means clustering requires a decision of the starting point of the clustering process and a statement of the number of clusters expected ("k"). Both need to be chosen in regards to the data set, and yet are unknown when beginning a Cluster Analysis. One way to select the number of clusters is to start with probable solutions on the basis of the data, then compare solutions to determine which "seems" to fit the data best. This comparative process is cumbersome and lacks a formal means of determining the "best" number of clusters. The other problem, choosing a starting point for the clustering process, can also affect the final cluster solution. One way of dealing with the starting point is to run multiple clustering solutions with multiple random starts, then choosing the best solution or creating a composite solution. Using multiple solutions can also be cumbersome and difficult to implement.

The hierarchical clustering procedure (or hierarchical agglomerative clustering) involves grouping the data in one pass, starting with each case in its own cluster, then adding cases and clusters together on the basis of similarity or dissimilarity. A general hierarchical Cluster Analysis is composed of four basic steps: application of a similarity or distance statistic to pairs of observations within the data set, application of a clustering algorithm to the resulting similarity or dissimilarity matrix, determination of cluster boundaries, and validation of the clusters.

The first step in a hierarchical analysis is the computation of a proximity matrix, whether it is a similarity matrix or a dissimilarity matrix.[vii] The need to cluster the similarity or dissimilarity matrix is a limiting factor on the size of the data set to be clustered. This is one of the difficulties with hierarchical clustering: matrices require extensive computing power[viii]. A number of different ways exist to compute the proximity matrix necessary for hierarchical clustering, particularly for data at ordinal, interval and continuous levels. For data collected at mixed levels, fewer choices are to be had. The most important coefficient for mixed level data is Gower's Coefficient (Gower 1971), which can handle data at all three levels at once. Gower's coefficient has been applied to a number of studies, including an application to archaeological ceramics (Rice and Shaffer 1982). Aldenderfer and Blashfield noted (1984:32) that the coefficient was not widely used in the social sciences, probably due to its exclusion from commercial statistical packages. I found this to be the case as well, though it is included in specialized software, such as CLUSTAN and ClustanGraphics (www.clustan.com). An alternative to the simultaneous use of mixed level data is to reduce the ordinal and nominal data to a binary state, and then use the continuous variables as a means of testing the variation within the resultant clusters. For binary data, Jaccard's coefficient is appropriate because it computes a similarity score on the basis of the presence of attributes, not the cojoint absence of an attribute.

The second step, once the similarity or dissimilarity matrix has been created, is applying a clustering algorithm to the matrix to create clusters. As with the computation of the proximity analysis, there are a number of alternatives available in the choice of the clustering algorithm. These can be thought of as either "space-conserving" or "space-dilating" (Aldenderfer and Blashfield 1984:45; cf. Clifford and Stephenson 1975:106). The key algorithms under consideration for this study are the average linkage (also known as the unweighted pair group method using arithmetic average, or UPGMA) and the

Increase in the Sum of Squares (also known as Ward's Method, also known as Incremental Sum of Squares).

Average linkage is a space-conserving algorithm that "defines distance between groups as the average of the distances between all pairs of individuals in the two groups" (Everitt 1980:31). Multiple variants of this algorithm exist (Aldenderfer and Blashfield 1984:41). It was proposed as a corrective to the long, dispersed clusters ("chaining") often achieved with single linkage, and the hyper-compact and spherical clusters of complete linkage.

A key space-dilating algorithm is Increase in Sum of Squares. One criticism of space-dilating algorithms is that it becomes increasingly more difficult to add new items to clusters the larger they become, which results in "secondary" clusters (Clifford and Stephenson 1975:106-7), and clusters roughly similar in size. Another criticism of the increase in Sum of Squares is that it is sensitive to elevation (Aldenderfer and Blashfield 1984:43-44). Increase in Sum of Squares is related to the Euclidean distance measure. It

> "Proposes that at any state of an analysis the loss of information which results from the grouping of individuals into clusters can be measured by the total sum of squared deviations of every point from the mean of the cluster to which it belongs. At each step in the analysis, union of every possible pair of clusters is considered and the two clusters whose fusion results in the minimum increase in the error Sum of Squares are combined." (Everitt 1980:31)

While there are problems with Increase in Sum of Squares, it is one of the most intensely studied of the clustering algorithms and it has been given the most powerful "stopping rules" for the mathematical determination of the optimal number of clusters (Mojena 1971; Mojena and Wishart 1980).

The clustering algorithm provides a solution in the form of a tree diagram, or dendrogram. This tree diagram indicates in a visual form the distances and relationships of cases and clusters within the solution. As the cases are clustered, they are increasingly nested into larger and larger clusters, ultimately forming one large cluster. Each addition of a case or cluster is represented by a fusion value.

The third step is determining the best cluster solution (number of clusters). Because Cluster Analysis will find clusters in a data set no matter what, and because it is difficult to determine the appropriate number of clusters, some severely criticize Cluster Analysis as not having useful applications to data sets (e.g. Baxter 1994). This criticism returns the discussion back to typological issues in general within archaeology. We know that a data set has patterning if there are any relationships between the cases or items. That patterning is what the Cluster Analysis will find. As for determining the exact number of clusters and validating their existence, the question is a little more complicated.

For determining the best cut through a cluster tree, the most common techniques involve using the fusion values, the values generated by the addition of one case or cluster to another cluster (Aldenderfer and Blashfield 1984). The resulting tree-like structure of the Cluster Analysis may be visually or mathematically interpreted for clusters. As clusters are often difficult to interpret heuristically, several mathematical procedures have been adopted. One is to graph the fusion coefficients of the cases against the number of clusters indicated by those coefficients to look for a natural curve indicating the number of clusters. This is similar to the "scree test" of factor analysis (Aldenderfer and Blashfield 1984). The other, introduced in the work of Mojena (1971, Aldenderfer and Blashfield 1984), mathematically computes the number of clusters on the basis of a "significant jump" (Aldenderfer and Blashfield 1984:57) in the fusion coefficients. The equation for this test is (Aldenderfer and Blashfield 1984:57):

$$z_{j+1} > z + ks_z$$

"Where z is the value of the fusion coefficient, z_{j+1} is the value of the coefficient at state j+1 of the clustering process, k is the standard deviate, and z and s_z are the mean and standard deviation of the fusion coefficients, respectively. If the inequality cannot be satisfied, this suggests that the data have only one cluster" (Aldenderfer and Blashfield 1984:57).

The fourth step—validating a clustering solution—is even trickier. As there is no null hypothesis to test, the validation goal is for the solution to remain stable. Thus replication of the clustering solution with alternative methods and samples is often used as a means of validating the original clustering solution. Another technique for validation is to perform significance tests on relevant variables not used to generate the original Cluster Analysis. In this study, overt validation will not be conducted, as the clustering will occur using two clustering techniques on the same dataset. The resultant structure should be stable and appropriately clustered. The two techniques are hierarchical clustering followed by k-means clustering. One concern with hierarchical clustering is that only one pass is made through the data, which might result in the inappropriate assignment of cases within the final clustering solution. The alternative method, k-means, is an iterative method, which assigns and re-assigns cases as the change in the means of the clusters changes with the reassignments. While this produces good cluster membership, the necessity of pre-determining the number of clusters and starting points of each cluster makes it a difficult method to appropriately apply to data sets.

This analysis will use a modified clustering method that attempts to utilize the strengths of each method. Each data set will be clustered using a traditional hierarchical method, and the resulting tree diagram will be checked for an optimal solution. The tree diagram will then serve as the basis of a k-means method application, where the number of clusters is determined by the previous hierarchical result. The tree partitions will serve as the starting points for initial k-means iteration. The k-means method refines the hierarchical result, moving cases that were initially miss-assigned in the one-pass hierarchical result, thus "refining" the cluster solution.

The combination of the hierarchical and k-means methods is not novel, though it is a new application to ceramic clustering. Aldenderfer and Blashfield mention that several studies have been conducted using various hierarchical methods as a means of determining the most appropriate number of clusters within a data set (1984:48-49). Wishart (1999), in the documentation provided for ClustanGraphics 5, actively promotes this combination. He writes:

> If a case if found to be nearest to a cluster other than the one it currently belongs to, k-means will move it to its nearest cluster. When this happens, the cluster centers are re-computed and thus the current cluster model is progressively refined
>
> If any cases have been moved, the cluster centres will have changes and it may therefore be necessary to check the cases

> again. In this way, the cluster model can be progressively calibrated over several iterations. (Wishart 1999:38)

As the lack of appropriate validation techniques is a common and appropriate criticism of Cluster Analysis, it is offered that the combination of the two methods will increase confidence in the final clustering solution.

Archaeology and Cluster Analysis

Archaeological applications of Cluster Analysis have been around since Cluster Analysis emerged as a technique. From at least the 1950's, proponents such as Clarke (1968), Cowgill (1968), Hodson (1970), Hodson, Kendall, and Tăutu (1971), Thomas (1972), and Aldenderfer and Blashfield (1978) have written of its merits and applications to archaeology. Baxter (1994:179-184, 284-292) highlights three areas of application of Cluster Analysis to archaeology: compositional analysis, spatial analysis, and typological analysis. Typological applications follow closely the numerical taxonomy applications within ecological studies, and the work by Sneath and Sokal (cf. 1973) has been influential in this regard.

Many typological cluster analyses involve the clustering of like assemblages, such as burial, room, site, etc. Other studies have applied Cluster Analysis to the analysis of different types of artifacts or other archaeological remains, such as projectile points and broaches (again, see Baxter 1994). These applications also include ceramics, such as the work of Costin (1986) with archaeological ceramics and Kaplan (1994) with ethnographic ceramic samples. Whallon (1984) applied the technique to spatial analysis.

R and Q modes within Cluster Analysis

Thus far, the discussion has resolved around clustering the cases in a data set. This is called the Q-method or Q-technique. A general Cluster Analysis clusters the variables. In order to cluster the variables, the data matrix is transposed so that the columns are composed of the specific cases and the rows are the attribute variables. In this study the variables are the coded ceramic attributes. Clustering the variables is termed the R-method or R-technique.

The R-method developed primarily out of factor analysis (cf. Sneath and Sokal 1973:258), and most discussion of the method refers exclusively to its application in factor analysis (e.g. Aldenderfer and Blashfield 1984; Everitt 1980; McKeown and Thomas 1988). Generally speaking, an NxN correlation matrix is computed from the data, whereby N=the number of cases. A factor analysis is applied to the NxN matrix, resulting in the computation of factor scores, or loadings, for each case. These factor loadings are then used to assign cases to particular clusters[ix]. The factor loading (or the principal components in a principal components analysis) acts to reduce the variability of the data set. In other words, to reduce the number of variables used from every available attribute to the small set of factor loadings.

The application of R-techniques to archaeological assemblages was championed by Christenson and Read (1977, 1978). They argued 1) Cluster Analysis is basically equivalent to numerical taxonomy and that as such the search for "natural taxa" without regard to theory is unscientific. Further equating

Cluster Analysis with numerical taxonomy, they argue 2) that the lack of weighting characters is to disregard the need and nature of typological classification in science, especially archaeology. Finally they argue 3) that a trial run of Cluster Analysis on known data resulted in a spurious classification, one that did not correspond to the known structure. Aldenderfer and Blashfield (1978) respond to each charge, acknowledging that numerical taxonomy is a radical and controversial classification perspective. However, they argue, Cluster Analysis is not numerical taxonomy. Rather, Cluster Analysis does not require numerical taxonomy theoretical assumptions; instead it is common sense "systematically applied to data to create homogeneous categories" (Aldenderfer and Blashfield 1978:503). As such, decisions regarding character weighting are to be made within a Cluster Analysis. Finally, they argue that the supposed "failure" of Cluster Analysis to reproduce the desired structure in Christenson and Read's (1977, 1978) trial is due more to choice of algorithm than to a fundamental failure within Cluster Analysis itself. Each type of Cluster Analysis "reflect(s) many different approaches to classification" (Aldenderfer and Blashfield 1978:504). This is not what Christenson and Read wanted to hear. In defense of their dismissal of their Cluster Analysis trial they opine, "what we want, ultimately, is an objective procedure" (Christenson and Read 1978:506). But, as should be clear for the earlier discussion on typology within archaeology, there is no one typological scheme that will necessarily fulfill all research questions and conditions. As such, the multiple options and opportunities of Cluster Analysis remain viable for application to archaeological problems.

An "R" application appropriate for this study is to use the clusters of variables as a guide to understanding the variation in the clusters of the cases, but not for the creation of loadings or components as with factor analysis or principal components analysis. Once the variables have been clustered and the cases have been clustered, the changes in cluster variability over time will be easier to track and interpret.

CLUSTERS, STANDARDIZATION, AND TARASCAN CERAMIC EXPECTATIONS

The ceramics recovered from Urichu constitute a strong data set, with excellent temporal and recovery contexts. However, they are overwhelmingly composed of sherds, rather than whole vessels, and as such constitute the accumulation of used vessels, and not pottery production. Typical standardization studies rely on the formal statistical analysis of metric indicators from whole vessels (such as maximum vessel height and diameter). Such variables are often not available within an excavated assemblage, and as a result, the available variables tend to be along multiple variable scales, such as continuous, ordinal, and nominal. The variables collected from the Urichu ceramics are particularly strong in nominal-scale (i.e. multistate character) variables.

Several types of statistical techniques within the literature have been applied to attempts to understand the dimensions of excavated ceramic assemblages. However, Cluster Analysis is the most powerful technique for providing groups that can then be tested for within and between group variations.

In this study, the ceramic assemblage from each temporal phase will be clustered. These clusters are polythetic groups of paste categories, morphological attributes, and surface decoration attributes. These polythetic clusters represent producer and consumer decisions. Each cluster has a within cluster error sum of squares (ESS), which is a mathematical statement of the amount of variation within the cluster. The ESS for the clusters in each temporal phase will be compared using a One-Way ANOVA in order to determine whether the variation in each phase is significantly different from the variation in each of the other phases.

The number of clusters, standardized and compared over time, is indicative of the relative overall standardization of the assemblage. Greater numbers of clusters indicates greater variation in the assemblage—and thus greater variation in producers and in consumer choice. This is an indication of increase producer competition and the relative importance of marketplace distribution of ceramics. In tracking the proportions of different attributes within the clusters, assemblage variation can be followed over time. Changes in cluster composition indicate shifts in ceramic production and the relative standardization of ceramic categories.

ENDNOTES

[i] Xarácuaro refers to the prehispanic polity. Jarácuaro is the contemporary spelling of the island, and refers to both the island and the contemporary community found on the island. Jarácuaro also refers to the Middle Classic temporal phase.

[ii] The designation of "open" or "closed" was determined along rather simple lines, rather than a formal determination of "unrestricted" and "restricted" by comparing orifice to maximum diameter: "If it (the orifice) is equal to or greater than the maximum diameter, it is described as an unrestricted orifice. If it is less than the maximum diameter, it is called a restricted orifice" (Rice 1987:212). As the maximum diameter of the vessel is often unknown from a sherd, a less formal, but more functional, test was used to determine "open" or "closed." "Open" and "closed" are conceived of as being more functional than merely morphological, based on discussions with Helen Pollard.

Body sherds were grossly designated as "closed" if the interior (as determined by concave curvature) was unfinished or only roughly slipped. If the surface within was smoothed or treated in any way, such as slipped or painted, it was considered to be "open." A possible caveat to this gross open/closed distinction exists. It is possible that some closed vessels were produced in parts, and the individual parts were finished on the inside, either just enough ("smoothed") or more (even painted to convey a message? This is unknown within the Tarascan ceramic tradition), and then the parts combined. Support sherds with an interior surface from the vessel were classified "open" or "closed" in the same way as body sherds.

A rim sherd was classified as "closed" when it obviously demonstrated a curve back under itself, or enough of the neck remained to determine a small orifice compared with what was indicated on the rest of the vessel, and the rim was obviously from a closed jar or jar-like vessel. Classification also occurred when "closed" was not quite so obvious, such as when the rim was a large rim (specially in the coarse wares) where a curve was not necessarily seen, but was necessary given the weight of the rim and the angle of the rim (a relatively acute angle, ca. 45-75 degrees), and with a definite everting of the rim. Often a closed rim is thickened, even bolstered at the top, though that in and of itself is not indicative of being a closed vessel.

A rim was classified as "open" when it was slightly or noticeable concave, was straight and at 90 degrees or less, or was only slightly out-flaring and enough of the rim remained to determine that the vessel had no neck/constriction. In some cases, rims that were technically "restricted," according to Rice, but were still able to function as a bowl were classed as functionally "open," such as *tecomates*. The greatest restriction was at the orifice, but it still acts as an open vessel. The category of "vase" could poses some difficulty. Vases do not appear to be common in known Tarascan ceramic vessels, and none are identified within this analysis. Vases would be an "open" vessel in this model, however.

[iii] Actually, wall thickness of body sherds was coded for a sample rather than all sherds because of time constraints. Unfortunately wall thickness was recorded in such a way as to deny matching a particular sherd with a particular thickness measurement. This data is not used in this analysis.

[iv] Orifice diameter was estimated using the Metric Ceramic Diameter Template available from Archmat, Merrimack, NH.

[v] Moguel Cos (1987) does not refine her typology to the level of "type," but her groups include forms with multiple rim forms and often include multiple vessel forms. Castro-Leal's (1986) typology is refined to the level of types, and some of her types include multiple vessel forms, as do the types identified by Rubén Cabrera Castro (1996).

[vi] Lovis (1973:264-277) also contains a brief but comprehensive discussion of MDS and its application to attribute seriation.

[vii] The resultant similarity or dissimilarity matrix does not provide the researcher with orthogonal information; that is, there is no geometric dimensionality to the interrelationships among the variables.

[viii] The literature consistently indicates a small data set to be no more than a few hundred items. The actual upper limit is dependent upon the requirements of the software and the computing capabilities of the computer used in the analysis.

[ix] This description follows Aldenderfer and Blashfield (1984) and McKeown and Thomas (1988). For further discussion, see McKeown and Thomas (1988).

CHAPTER FIVE

TARASCAN CERAMIC CLUSTERS AND THE "STANDARDIZATION HYPOTHESIS"

The "standardization hypothesis," built upon assumptions of production efficiency, expects that the producer's activities become more routinized and efficient as ceramic production intensifies. Labor investment and product variation are expected to decrease as a result. This chapter overviews the structure of the data set for this study, then considers labor investment over time in regards to the decoration of sherds over time. This chapter also discusses the form of the data for the analysis, the determination of the attributes used in the Cluster Analysis, and the clustering methods used to cluster the cases. After the clusters are determined for each phase, they are described and compared, noting significant differences in variation between temporal phases. The social evolutionary model and the political economy model each expect ceramic specialization, but within different social contexts.

GENERAL PATTERNS IN THE DATA AND LABOR INVESTMENT

The data for this analysis is composed of 37,301 sherds from six temporal phases dating to the Classic and Postclassic periods in the Lake Pátzcuaro Basin, Michoacán, Mexico (Table 3.1; Table 4.1; Table 5.1). Ceramic sherds were identified as body sherds, rim sherds, support sherds, handle fragments or spout fragments in the original field analysis. The number of handles within the

Table 5.1 Ceramic sherd distribution by part and phase

PHASE	BODY	RIM	SUPPORT	HANDLE	SPOUT	TOTAL*
Tariacuri	11390	1451	124	28	10	13003
	87.6%	11.2%	1.0%	0.2%	<0.1%	100.0%
Late Urichu	532	108	5	3	0	648
	82.1%	16.7%	0.7%	0.5%	0.0%	100.0%
Early Urichu	8850	687	62	16	0	9615
	92.0%	7.1%	0.6%	0.2%	0.0%	99.9%
Lupe	7694	551	43	17	0	8305
	92.6%	6.6%	0.5%	0.2%	0.0%	99.9%
Jarácuaro	4715	244	7	4	0	4970
	94.9%	4.9%	0.1%	0.1%	0.0%	100.0%
Loma Alta 3-	708	48	4	0	0	760
Jarácuaro	93.2%	6.3%	0.5%	0.0%	0.0%	100.0%
TOTALS	33889	3089	245	68	10	37301
	90.9%	8.3%	0.6%	0.2%	0.0%	100.0%

* Discrepancies between reported and 100% due to rounding errors

overall assemblage is quite low, only 68 out of 37,301 sherds (less than 0.2%). The distribution of handles varies a little over time, however (Table 5.1). The 0.5% of handles in the Late Urichu phase may be due to the sampling of a residential, as opposed to a ceremonial, location. As the only exclusively commoner residential area excavated, it may indicate that handles occurred with greater frequency throughout the sequence, but that our samples are inadequate to assess this. However, it is reasonable to suggest that handles were not particularly common in any of the phases. This is partially surprising, as stirrup-handled closed vessels are a highly identifiable ceramic form among the known whole Tarascan-period vessels. Spouts, another Tarascan state form, are only known within the assemblage within the Tariacuri phase, and as with handles, their numbers are also low. Only 10 spout fragments were excavated, accounting for less than 0.1% of the Tariacuri phase assemblage.

Compared with the whole vessels excavated in this project, and the extant corpus of whole vessels known from the Tarascan Period (e.g. Versluis 1994), the low number of handles and spouts are surprising. Surprising, too, are the low number of supports. Based on the vessels excavated from burial contexts, Tarascan period vessels are expected to exhibit high frequencies of handles and spouts (cf. Pollard 1996; Pollard and Cahue 1999). Of the 38 whole vessels excavated at the site of Urichu from the Tariacuri period, four have spouts, five more have spouts and handles, seven more have only handles, and five have supports. These forms account for 55% of the whole vessels in the Tariacuri phase. While spouts occur only in the Tariacuri period, of the 32 whole vessels from pre-state contexts, four have handles, two more have handles and supports, and seventeen more have only supports (Pollard 1996). That accounts for 72% of the pre-state whole vessels excavated at Urichu. Even accounting for the fact that the sherd sample is composed of pieces that may have come from vessels with supports, handles, or spouts, the low total numbers in the sherd sample of supports, handles and spouts indicates that different behavioral pattern created the burial assemblages. The general sherd assemblage is indicative of a wider range of behaviors and thus indicative of the larger "consumer" choices available.

There is a discrepancy between the number of open sherds represented in the body sherd and rim samples (Table 5.2). (Support sherds are almost exclusively on open vessels). The difference may be accounted for by the simple observation that open vessels tend to have greater rim surface represented given the area of the of the vessel body. Closed vessels have less rim proportionate to the amount of vessel body. Hence, open vessels will have greater representation in rim sherds, and less in body sherds and the opposite will be true for closed vessels.

A Pearson Chi Square of time compared to constriction provides a p-value of $p<0.001$, indicating constriction changes with time. The phases with the most open vessels are Tariacuri Area 2, Tariacuri Area1, and Loma Alta 3-Jarácuaro, respectively. The lowest are the Jarácuaro, Lupe, and Early Urichu Phases, respectively. That there would be an increase in open vessels with the state is not surprising, as open serving vessels are associated with state ritual, but that it is distributed between the elite and commoner contexts is worth noting.

Table 5.2 Percentage of open and closed vessels by phase

PHASE	OPEN			CLOSED		
	BODY	*RIM*	*TOTAL*	*BODY*	*RIM*	*TOTAL*
Tariacuri	26.3	45.3	34.0	61.3	18.3	66.0
L Urichu	16.5	27.8	31.6	44.5	20.4	68.3
E Urichu	25.1	57.0	29.0	72.7	13.8	71.0
Lupe	22.7	61.2	26.3	76.4	11.8	73.7
Jarácuaro	20.0	55.3	22.2	79.6	13.1	77.8
Loma Alta 3-Jarácuaro	29.7	68.8	32.8	70.3	8.3	67.2

Percentages based on inclusion of all sherds identifiable as open or closed, including handles and supports, in each phase total

In terms of the consistency of the data set, of twelve pastes identified at Urichu, only two (Urichu Fine and Ichupio Coarse) do not appear in all six phases (Table 5.3). The pastes will be discussed further. Only three slip colors and eight paint colors occur within the assemblage as a whole, with three of those paint colors present only in the final, Tariacuri, phase.

The whole vessels set up expectations in terms of decoration as well as form. Twenty of 32 pre-state whole vessels are painted (63%) and 17 of 32 (53%) have resist. Thirty-one of 38 Tariacuri period whole vessels are painted (80%), while 12 have resist (38%). The expectation is for an increase in paint and resist with the Tariacuri phase. However, paint and resist-covered sherds are not this frequent in the sherd assemblage (about 9% and 1%, respectively).

In terms of overall standardization, it is worth comparing the six phases on the basis of labor investment and multiplicity of finished products. Extra labor, in terms of the mere handles and spouts, seem to make little overall difference to the labor input for any time period. Handles do not seem to increase in number over time. Spouts (on Tarascan closed vessels) appear only in the Late Postclassic, but in very low numbers (10 of 13003 sherds: Table 5.1). However, their presence in the assemblage is indicative of a new form within the assemblage. A greater range of choices is indicative of an increase in the number of producers striving for a portion of market share (cf. Rathje 1979; Rice 1981). Surface treatment categories, such as slip and paint, should also indicate changes in the organization of production.

Table 5.3 Distribution of paste by phase

PASTE	T1	T2	T3	T4	T5	T6, T7, T8	TOTALS*
Tariacuri Brown	4.7	10.6	6.8	3.8	10.6	5.0	6.0
Black Polish	2.5	1.9	2.2	0.9	1.1	0.8	1.3
Yaguarato Cream	23.4	9.4	22.2	21.2	22.2	15.7	17.9
Tarerio Cream	0.7	5.9	6.3	6.4	6.9	3.8	5.3
Tariacuri Coarse	5.3	24.8	14.9	12.7	19.9	13.5	15.1
Yaguarato Coarse	12.1	12.4	15.7	20.5	17.7	20.7	18.2
Querenda White	5.3	2.8	4.9	7.1	7.6	8.1	6.3
Siphio Gray	50.0	29.6	23.6	24.2	8.3	24.5	26.9
Urichu Fine	0.0	0.1	0.1	0.0	2.6	0.1	1.3
Ichupio Coarse	0.0	0.8	0.4	0.3	0.4	0.7	0.5
Tecolote Orange	0.8	0.2	0.4	0.4	2.5	1.2	0.7
TOTALS	104.8	98.5	97.1	97.4	99.8	99.1	99.5

* Discrepancies between reported and 100% due to rounding errors and unclassified sherds

Slip, paint and finish are more likely indicators of labor investment (cf. Feinman 1980; Feinman et al. 1984; Hagstrum 1988). All of the sherds in the Loma Alta 3-Jarácuaro phase are slipped, using the slip colors of cream and red. In the succeeding phases cream and red remain the most important slip colors, respectively. However, the succeeding phases also include both self-slipped sherds and sherds without any slip (Table 5.4) in addition to the red, cream, and white slip colors. Self-slipping of vessels remained an uncommon practice in all phases. Slip absence became more common over time. It might have become most common in the Late Urichu phase because this sample is overwhelmingly from a commoner residential portion of the site. Regardless, the difference between the Early Urichu and the Tariacuri phases indicate that leaving vessels unslipped become a more common practice. White slip also became more "common" over time, though it never became a norm within the assemblage. Throughout the temporal sequence the norm remained slipping the vessels in cream or red. Using slip as an ordinal variable (i.e. no slip, self-slip, and slipped), the p-value for a Pearson Chi Square is $p<0.0001$, which indicates that there is relationship between time ("X") and slip ("Y"). The phases with the most slipping are the three earliest phases, Loma Alta 3-Jarácuaro, Jarácuaro, and Lupe. The phases with the least amount of slipping are Tariacuri Area 7 and the Late Urichu phase, respectively.

The absence of paint dominates all phases in the sequence (Table 5.5). Painted sherds do occur within all phases, with colors being used alone, in pairs, or in threes. The incidence of three colors is low (6 of 13,003 sherds,

Table 5.4 Distribution of slip by phase

PHASE	NO SLIP	SELF SLIP	CREAM	RED	WHITE	TOTALS*
Tariacuri	5.6	<0.0	75.6	18.2	0.4	99.8
Late Urichu	19.5	0.0	50.5	28.2	1.8	100.0
Early Urichu	4.8	<0.0	71.4	23.4	<0.0	99.6
Lupe	2.6	<0.0	70.4	26.4	0.2	99.6
Jarácuaro	1.0	<0.0	74.3	24.6	<0.0	99.9
Loma Alta 3-Jarácuaro	0.0	0.0	87.9	12.1	0.0	100.0

* Discrepancies between percent total and 100%
due to rounding errors and missing cases deleted from total

Table 5.5 Percentage of painted and unpainted sherds by temporal phase

PHASE	NO PAINT (ACTUAL N)	NO PAINT	ONE COLOR	TWO COLORS	THREE COLORS
Tariacuri	11263	86.6%	11.0%	2.3%	<0.0% (N=6)
Late Urichu	552	85.2%	12.3%	2.3%	0.2% (N=1)
Early Urichu	8898	92.6%	7.0%	0.4%	0.0% (N=0)
Lupe	7790	93.8%	6.0%	0.3%	0.0% (N=0)
Jarácuaro	4720	95.0%	4.6%	0.4%	0.0% (N=0)
Loma Alta 3-Jarácuaro	705	92.8%	5.9%	1.3%	0.0% (N=0)

comprising less than 0.1 percent of the total sample), and only occurs in the Late Urichu and Tariacuri phase (representing the Middle and Late Postclassic). The use of three paints is noteworthy, as three paints require greater labor than two paints, and the only incidence of three paints occurs in the Late Urichu and Tariacuri phases. One and two paint color combinations occur throughout the sequence, with one color dominating the painted sherds. A Pearson Chi Square of time against paint as an ordinal variable (i.e., no paint, one paint color, two paint colors, three paint colors) gives a p-value of $p<0.0001$. This p-value leads to a rejection of the Chi Square null hypothesis of there being no relationship between the variables of time and paint. The phases with the least amount of any paint are, in order, Jarácuaro, Lupe and Loma Alta 3-Jarácuaro. Meanwhile, the phases with the most paint are, in order, Late Urichu, Tariacuri Area 2, Tariacuri Area 1 and Tariacuri Area 5. These phases also tend to have the most paints in terms of the number of colors of paint as well, given the total N for each phase.

While there is a slight increase in the amount of painting being done to ceramic vessels, the increase is predominantly absorbed within the one color combination. The most common paint color is red. Other colors appear alone on sherds: black, brown, pink, and white. Only in the Tariacuri phase are the colors of orange and yellow present, and then only in combination with other colors. If two paints occur on a sherd, typically the combination is red and white, though rarely it is black and red, or black and white. Black, white and red occurred once in the Late Urichu phase and three times in the Tariacuri phase. Orange and red, yellow, red, and black, and yellow, red and white each occurred once in the Tariacuri phase.

The amount of "finish" of a sherd, whether it was simply wiped, smoothed, or polished (burnished), was tracked in the excavation sherds (though not in the pilot project sherds). Though all of the sherds in the Loma Alta3-Jarácuaro phase were either smoothed or polished, wiped sherds show up in the following Jarácuaro phase and remain as a small proportion (about 2% or less) of the assemblage in the succeeding phases. The Loma Alta 3-Jarácuaro phase has a 10% showing of polished sherds. The succeeding phases range between 2.5% and 4%, except the Early Urichu phase, which contains about 7% polished sherds. "Polish" is marked by sheen on the surface of a sherd, a form of burnishing. "Smooth" is the most common treatment, accounting for 89% to nearly 96% of all sherds in each phase. Comparing time to finish as an ordinal variable (i.e. wiped, smoothed, polished), the p=value for a Pearson Chi Square is $p<0.0001$, which indicates a relationship between time and finish. The commoner areas, Late Urichu and Tariacuri Area 2, both contain a high percentage of wiped and polished sherds for their total sample size. While the rest of the wiped sherds are somewhat predictable in pattern (an increase in wiped sherds from Loma Alta 3-Jarácuaro through Early Urichu), the pattern is not similar for the polished sherds. The four phases with the least amount of polish are, in order, Tariacuri Area 5, Early Urichu, Jarácuaro, and Tariacuri Area 1. As Tariacuri Area 5 and Tariacuri Area 1 are elite ritual and residential areas, the low percentage of polished sherds are surprising. However, they are among the highest for smoothed sherds.

Plastic decoration, the manipulation of the clay body, in such forms as appliqué or incision, also forms a small component of the overall assemblage. Overall, ten types of manipulation were identified: appliqué, drilled, excision, flange, engraved, incised, modeled, notched punctate, and raised[i]. These different types of manipulations are dispersed widely and in low numbers throughout the six phases (Table 5.6). While each of these manipulations conceivably added to the producer's labor costs, they did not, in and of themselves, comprise the bulk of the ceramics in the collection. A common plastic manipulation is punctate occurring on the interior lower surface of a bowl: the bottom of the bowl was partially punctuated, with the roughened edges of the partial puncture acting as the roughened portions of a grater, or a *molcajete*. The greatest range of manipulations occurred in the Early Urichu phase, which corresponds with the Early Postclassic period, a period of increased elite activity. A Pearson Chi Square comparing time again the occurrence of plastic yields a p-value of $p<0.0001$, which again indicates there is a relationship between time and the occurrence of plastic. The three phases with the most plastic manipulation are Tariacuri Area 2, Loma Alta 3-Jarácuaro, and Late Urichu, though it always occurs at a low level. This indicates an importance of graters in these phases, but also the use of plastic as decoration in the earliest and in the later commoner areas. Plastic as a percentage of the total sample is nearly non-existent in the rest of the phases.

Table 5.6 Distribution of plastic decoration by phase

PHASE	TOTAL N PLASTIC	TOTAL % OF PHASE	# OF DIFFERENT TYPES REPRESENTED
Tariacuri	112	0.9%	8
Late Urichu	6	0.9%	4
Early Urichu	70	0.7%	10
Lupe	91	1.1%	8
Jarácuaro	40	0.8%	7
Loma Alta 3-Jarácuaro	9	1.2%	4

Tarascan fine wares are known for exhibiting *resist*, a technique whereby wax is applied to a fired vessel and then fired again in a reducing atmosphere. Wherever the wax was not applied, the vessel is smudged, leaving it black. The wax melts away, but not before it protects the design underneath. Resist requires a second firing, thus increasing labor costs for fuel and firing. Within this assemblage, resist does increase slightly over time (Table 5.7). A Pearson Chi Square of time and resist give a p-value of $p<0.0001$, which indicates that time and resist are related. The phases with the most resist are, in order, Late Urichu, Tariacuri Area 2, and Tariacuri Area 1.

Several observations need to be made about the pattern of resist. First is the low percentage of sherds exhibiting resist within the Tariacuri phase. The expectation was actually higher based on the whole vessels (17 of 38 whole vessels from this period exhibit resist). Second is the high presence of resist in what are essentially commoner contexts (Late Urichu and Tariacuri Area 2). Nor is there an appreciable indicator of a substitute for resist in the commoner contexts. While the paint color black occurs in the Tariacuri phase as well as resist, its numbers are low (11 sherds of 13003, either alone or in combination) and therefore it was apparently not being used as a laborsaving substitute for resist. Third, resist is lowest in the Jarácuaro, Lupe and Early Urichu phases.

In summary, the overall assemblage demonstrates variations in the patterns of colors and techniques used to create the overall ceramic assemblage at Urichu. The use of Pearson Chi Square demonstrates that there are relationships between the frequencies of certain decorative techniques and

Table 5.7 Distribution of resist by phase

PHASE	NUMBER	PERCENTAGE
Tariacuri	129	1.0%
Late Urichu	21	3.2%
Early Urichu	20	0.1%
Lupe	11	0.1%
Jarácuaro	4	0.1%
Loma Alta 3-Jarácuaro	6	0.8%

certain phases. While there is not a marked pattern that holds for all decorative categories, the general pattern is a decrease in (or at least a lower frequency of) additional productive effort from the earliest phase, Loma Alta 3-Jarácuaro through the succeeding three phases until Early Urichu. This decrease is seen in the pattern of slip, paint, finish, plastic, and resist. With the Late Urichu phase, the frequency of occurrence of these categories generally increases as percentages of the total sherd sample for the phase. However, the two Tariacuri phase elite areas, Area 1 and Area 5, are not necessarily expressing the highest frequencies of the states of the variables requiring the most labor input. In terms of plastic, resist, polish and three paint colors, the two commoner areas (Late Urichu and Tariacuri Area 2) actually have higher percentages as a portion of the total phase sample. The two commoner areas also exhibiting variation, as the most wiped sherds as a percentage of the total phase sample and the fewest slipped sherds also occur in Late Urichu and Tariacuri Area 2.

The general pattern is one of decreasing labor investment from the Loma Alta 3-Jarácuaro phase through the Early Urichu phase. With the Late Urichu, there is an increase in the labor investment in some ceramic products, though always with an underlying base of ceramic products without a lot of labor input. Though the elite areas of the final Tariacuri phase indicates a continuation of the increased labor investment, much of the elaborated production output actually ended up in the commoner contexts as well.

CLUSTERING METHOD

The cluster analysis for this study is a combination cluster method, combining both hierarchical and k-means cluster algorithms. The clusters will be tested for change in two ways: the clusters themselves will be tracked for change in internal variation over time and the rate or the number of clusters over time will also be tracked.

These data concern the paste, morphology and surface decoration of the sherds from the Urichu assemblage. The majority of the data are unordered multi-state character data (nominal) or ordinal data. Both the rim and support sherds have some continuous variables, though with a large number of missing cases. The rim sherds were coded for lip thickness, rim thickness, rim angle, and vessel diameter. The support sherds were coded for maximum width and height. The continuous data were not used in the cluster analysis, but will be examined separately from the nominal and ordinal data as a post-*hoc* analysis. The body sherds represent the largest component of the overall ceramic assemblage from Urichu, representing approximately 91.1% of the total sherds in this analysis. These sherds, including the handles and spouts, were clustered by phase and by functional constriction, that is whether they appeared to be open or closed. Tariacuri phase sherds—rims, supports and bodies—were additionally divided by area of the site (Area 1, 2, or 5). These divisions resulted in sixteen separate clustering solutions.

As the bulk of these coded data are multi-state unordered character data or ordinal data, the decision was made to transform the data into binary state data. In transforming all ordinal and nominal data to a binary state, I am following the suggestions of Sneath and Sokal (1973). Nominal data are really multi-state character data, and are typically coded as:

CASE	*SLIP*	*PAINT*
Case 1	Cream slip	Red paint
Case 2	Cream slip	White paint
Case 3	Red slip	Red on white paint

This can be recoded in a binary form as:

CASE	*CREAM SLIP*	*RED SLIP*	*RED PAINT*	*WHITE PAINT*	*RED & WHITE PAINT*
Case 1	1	0	1	0	0
Case 2	1	0	0	1	0
Case 3	0	1	0	0	1

Each case now is in binary form. Ordinal data is recoded in precisely the same way.

In the case of situations where two or three paint colors are present, the coding can be handled as above, with red and white paint (or red, black and white paint) as a separate variable. This multiplies the number of variables in the data set, and it has a tendency, within the data for this study, to skew the distribution of the variables, as there are far fewer cases (sherds) with two or three paints than one or none paint color, and those that occur are widely and unevenly distributed, raising concerns regarding parametric distributions. Additionally, the sherds were originally coded as red and white, red on white, white on red, and so forth. Even combining them as simply "red and white" (as in the above example) does not create a large number within any one data set.

Therefore, the use of "additive coding" (Sneath and Sokal 1973:150) is particularly useful. With additive coding, there is not a separate variable category for "red and white," but rather the case is coded "1" for both red paint and white paint, as below:

CASE	*CREAM SLIP*	*RED SLIP*	*RED PAINT*	*WHITE PAINT*
Case 1	1	0	1	0
Case 2	1	0	0	1
Case 3	0	1	1	1

This has two effects on the data set. First, it reduces the number of variables necessary in the computation. Second, it slightly weights the paint-related variables, giving greater weight to the cases with great number of paints, that is, the cases with greater labor input (which are of interest in this study).

The absence of slip, paint, and mechanical manipulation of the vessel (the category "plastic," including such things as incision, appliqué, and punctuates) is of concern at this point. It is possible to construct a variable "no slip" or "no paint" on the same binary scale as the presence of a given slip color or paint color. However, given that the emphasis of the Jaccard Coefficient is to eliminate co-joint absences, is their inclusion required? I believe that the absence of slip and paint are necessary, as the presence of both are common in the overall data set and their absence is indicative of a less labor input. Additionally, the character state of "absent" for slip, paint, resist and plastic was also used. Where appropriate, handle, no handle, spout, and no spout were also used (cf. Table 5.8). If a variable was constant (in absence or presence) throughout a data set, it

Table 5.8 All possible binary variables (excluding paste)

Common to all sherds:				
Constriction:	Closed	Open		
Finish:	Polish	Smooth	Wiped	
Slip:	No slip	Self slip	Cream slip	Red slip
	White slip			
Paint:	No paint	Red paint	White paint	Cream paint
	Black paint	Orange paint	Yellow paint	Pink paint
	Brown paint			
Resist:	No resist	Resist		
Plastic:	No plastic	Appliqué	Drilled	Excised
	Notched	Punctate	Modeled	Engraved
	Flange	Incised		
Rims only:				
Lip:	Round lip	Square lip	Tapered lip	
Rim:	Straight rim	Bolster rim	Convex rim	Everted rim
	Incurved rim			
Supports only:				
Fill:	Hollow	Solid		
Form:	Almena	Annular	Base	Bulbous
	Flattened	Mamiform	Nubbin	Slab
	Conical	Cylindrical	Circular	Spider
Bodies only:				
Handles:	Handle	No handle		
Spout:	Spout	No spout		

was removed from the analysis for that data set. The overall assemblage was broken into sets for ease of comparison and for logistical reasons. The body sherds (including handles and spouts) were numerous and were divided on the basis of phase and functional constriction ("open" or "closed"). The rim sherds were divided only on the basis of phase and clustered only as rims, with "open" or "closed" constriction acting as variables. The support sherds were clustered in the same way.

The clustering software used in this study was ClustanGraphics version 5.25. CLUSTAN is commonly used clustering software (cf. Aldenderfer and Blashfield 1984), and ClustanGraphics is the PC version of the UNIX-based CLUSTAN (cf. Wishart 1999; www.clustan.com).[ii]

A hierarchical clustering analysis begins with the computation of a proximity statistic, in this case the Jaccard Coefficient of Similarity. The attraction of the Jaccard Coefficient is that it computes a similarity score on the basis of the co-occurrence of data, and not the conjoint absence.[iii] Once the proximity matrix is computed, it is converted into a dissimilarity matrix for use with the Increase in Sum of Squares (i.e. "Ward's Method") clustering algorithm.[iv] Output for the hierarchical portion of the clustering solution includes a cluster tree and fusion coefficients for the tree.

The number of clusters in the cluster solution is determined by an application of the "upper tail rule" ("stopping rule one" in Mojena 1977; see also Mojena and Wishart 1980).[v] The "upper tail rule" determines the *largest* number of clusters significant at a one-tail α=0.95 and determines that to be the appropriate cluster solution.

Validation of cluster solutions remains one of the difficulties of the application of cluster analysis. In this study, the hierarchical cluster solution is re-clustered using k-means clustering to "calibrate" the hierarchical one-pass solution with multiple passes (cf. Milligan 1980; Wishart 1999). The k-means algorithm uses the hierarchical solution as the initial cluster centers ("seed points") and for the determination of the appropriate number of resultant clusters. The k-means criterion used in this analysis is Euclidean Sum of Squares. The k-means solution typically requires only a few passes to finalize the cluster solution. As the data are in a binary state, outliers cannot be identified as such and cannot be removed.[vi]

Clusters have innate characteristics, such as spread, dispersion, and elevation. However, because the data used in the analysis are binary state, the amount of output describing the clusters is severely constrained. The output cluster data output is limited to a tree diagram for the hierarchical cluster solution. The k-means provides more information, including exemplar cases for each cluster, the distance of each exemplar from its cluster mean, the total distances of each case in a cluster from its cluster mean, and the total Within Cluster Error Sum of Squares (ESS) for each cluster in the cluster solution. ClustanGraphics does not provide the between cluster Error Sum of Squares or theTotal Error Sum of Squares. Additionally, ClustanGraphics does not provide the cluster mean or the cluster variance with binary data.[vii]

This output is sufficient to track changes in relative cluster variation, however. Each cluster has an exemplar, the case closest to the mean of the cluster. At the upper tail solution, many clusters are or are nearly monothetic, and exhibit very little variation (perhaps one or a few cases with one or two different variables.) However, every phase exhibits polythetic clusters, clusters with multiple cases of variables that vary from the exemplar. Each cluster will be described according to its exemplar, but divergence from the exemplar will also be noted. Clusters will be grouped and discussed according to the most important attributes in a given grouping.[viii]

Direct comparison of variation in the clusters is a little more difficult to track. The exemplar distance and the cluster distance are method dependent (in this analysis they are measured as Euclidean Sum of Squares). The Within Cluster Error Sum of Squares (ESS) is data dependent rather than method dependent, however, and as such provides an appropriate cluster solution result for further measuring cluster variation and changing cluster variation over time.

The ESS for each cluster from each phase will be compared using a one-way analysis of variance (ANOVA). The null hypothesis is whether the means from each phase are equal to one another (e.g. $\mu_{T1} = \mu_{T2} = \mu_{T3} = \ldots\mu_{T8}$). The alternative hypothesis is that the means are not equal. If the means are equal, it is an indication that there is an insignificant difference in cluster variation between phases, as measured by the ESS, so as to distinguish the phases. If the means are unequal, the clusters are demonstrating a significantly different amount of cluster variation. Therefore, changing variation can be tracked and the phases with greater or lesser amounts of cluster variation can be identified.[ix]

The continuous variables reflecting morphology from the rims data set can be tracked over time. These continuous variables (e.g. rim diameter) contain a large number of missing cases, however. It is not necessarily prudent to compare the distribution of each cluster, especially as some clusters may contain no cases or only one case of continuous data. Hence, these clusters should at some level be grouped for further analysis.

The upper tail stopping rule allows for the largest number of clusters significant at the $\alpha = 0.05$ level. This can be a rather large and unwieldy number of clusters, especially with large data sets with large numbers of variables, as is the case here. The mathematically derived clusters need to be grouped into smaller units.[x] A subjective technique that has been applied to cluster analysis is a modified scree test:

> Heuristic procedures are by far the most commonly used methods. At the most basic level, a hierarchical tree is "cut" by the subjective inspection of the different levels of the tree.... A more formal, but still heuristic, approach to the problem is to graph the number of clusters implied by a hierarchical tree against the fusion or amalgamation coefficients, which is the numerical values at which various cases merge to form a cluster. The values of the fusion coefficients are shown along the y-axis in the tree diagram. This test, a variant of which was proposed by Thorndike in 1953, is analogous to the "scree test" of factor analysis. A marked "flattening" in this graph suggest that no new information is portrayed by the following mergers of clusters." (Aldenderfer and Blashfield 1984:54-55).

This scree test will be applied to the original hierarchical tree for each cluster solution in order to group the more mathematically rigorous clusters into smaller units for the purposes of discussion and comparison.[xi]

A total of 12 pastes have been identified in the Lake Pátzcuaro Basin (Pollard 1972, 2001b). Ten of the 12 occur at Urichu and are included in the coded sherds. As the preparation of the paste forms the initial production step for the formation of ceramic vessel, the identification of the paste is important to understanding the overall organization of ceramic production. As this analysis was begun, ceramic paste was included as one of the variables used in the cluster analysis. However, it was quickly discovered that the various paste categories acted in a strongly polythetic manner and did not strongly structure the clusters. Other variables, notably decoration variables such as slip and paint, cross cut any groupings based upon paste.[xii] The removal of pastes from the cluster analysis lowered the number of clusters found with the upper tail rule in every phase except the earliest (Loma Alta 3-Jarácuaro). The clusters formed without paste tend to emphasize decoration variables, such as slip and paint. This pattern of slip and paint crosscutting paste matches that of Pollard's in her initial and recent typology of the ceramics from Tzintzuntzan and Urichu (Pollard 1972, 1993, 2001b).

The lack of a discernible, meaningful relationship between paste and form and of paste and decoration indicates several important facts about the ceramics in this study. First, paste is relatively meaningless in terms of the final vessel form, decoration, and, presumably, function (cf. Arnold 1984—he stresses the various properties of clays and tempers and their relationship to vessel function). Second, the diversity of pastes and their patterning suggests multiple producers using multiple paste "recipes" to create similar end products. This implies, firstly, that particular ceramics are not necessarily coming from particular producers. It also implies, secondly, that there is no overall centralization of production, but rather a localized production system and perhaps a larger market system through which the similar products are moving.

RESULTS OF THE CLUSTER ANALYSIS

Rim sherds

While composing only about 8% of the overall assemblage, the rims sherds are arguably the most important type of sherd, providing morphological, stylistic and decorative information. The rims in the assemblage are strongly structured by lip form, slip, and paint. Cluster tree diagrams for each phase showing the cluster solution determined by an application of the upper tail rule are provided in Appendix A along with the modified scree tests. Appendix B contains tabular descriptions of all clusters in each phase using exemplar cases for each cluster.

Loma Alta 3-Jarácuaro

The 48 sherds of this phase cluster into ten clusters (Appendix A.1) using the upper tail rule.[xiii] The exemplars and within cluster error sum of square (ESS) are given in Table B.1. Using fusion values in a modified scree test (Figure A.2), the clusters form four groups. Group A is composed of clusters 1 to 4, and is dominated by round lipped straight or convex vessel with cream or red slip. Cluster 3 is decorated with modeling, but the rest of the sherds in this group of clusters are undecorated. Group B is a mix of lip and rim forms, either red or cream slipped, but undecorated. Group C is predominantly painted, with round lips and straight rim forms. Group D is composed of *tecomate* sherds, with incurved rims, tapered lip forms, and polished cream slip finish. One group D sherd exhibits punctate. No one cluster can be identified with red slip.

Jarácuaro

The Jarácuaro phase includes 244 sherds, which formed thirty-one clusters (Appendix A.3). Table B.2 provides an exemplar and the ESS for each cluster. The clusters form five or six groups using a modified scree test (Figure A.4), though five is a better solution given the marked flattening of the slope of the line. Group A, clusters 1 to 4, is primarily composed of undecorated, round lip, everted rim closed sherds with cream slip. Group B, clusters 5 to 10, are round lipped-convex rimmed or square lipped-straight rimmed, with cream slip and paint. Group C can be divided into two parts if six groups are chosen: clusters 11 to 13, which are predominantly tapered lipped-straight rimmed cream slipped painted sherds; and clusters 14 to 20, which are a tapered or rounded lips with a mix of rim forms with cream slip. Group D, clusters 21 to 24, is composed of round lips with a mix of rim forms, with red slip. They are otherwise undecorated. Group E, clusters 25 to 31, is composed of squared or tapered rims associated with straight or convex rims with mostly red slip and no decoration.

Lupe

Fifty-two clusters were formed from the 551 sherds from the Lupe phase. The exemplars and ESS for each cluster are given in Table B.3. Using a modified scree test (Figure A.7), the clusters form five groupings. Group A, clusters 1 to 8, is composed of undecorated tapered lipped sherds with mostly everted or straight rim forms. While they are undecorated, they are either red slipped or cream slipped. Group B, clusters 9 to 15, is dominated by undecorated, squared lip, straight or everted rim sherds with, again, either red or cream slip. Group C, clusters 16 to 31, is predominantly rounded lips with a mix of rims forms, cream slip and undecorated. Most are open sherds. Group D, clusters 32 to 38, is similar to group C, with rounded lips and little to no decoration with open constrictions, but with red slip instead of cream. Group E is dominated by paint decoration, with rounded lips and straight rims.

Early Urichu

With 687 rim sherds, the Early Urichu phase contains the largest number of rims sherds for a phase. These sherds created 59 clusters (Figure A.7). Table B.4. contains the exemplars and ESS for each cluster. Four groupings are present from an application of a modified scree test (Figure C.8). Group A, clusters 1 to 24, is constructed of almost all rounded lip forms, straight and a mixture of other rim forms, and a mix of red and cream slip. The sherds are predominantly open and they are also predominantly undecorated. Group B is strongly identified with the tapered lip form, with straight or everted rims forms. The clusters are a greater mix of open and closed sherds and the dominant slip is cream. They are also predominantly undecorated. Group C is identified on the basis of the squared lip form. It has a mixture of rim forms, constrictions, and slip colors; it is predominantly, but not exclusively, undecorated. Group D is dominated by paint decoration with cream slip. The lip and rim forms are mixed, and most sherds are from open vessels. As in the Loma Alta 3-Jarácuaro phase, no single cluster can be identified with red slip.

Late Urichu

The Late Urichu phase has 108 rim sherds, clustering to form sixteen clusters (Figure C.9). Table B.5 provides the exemplars and the ESS for each cluster. Using a modified scree test (Figure C.10) the clusters form five groupings. Group A is composed of clusters 1 and 2 and is dominated by the rounded lip form and red slip with little decoration. Group B is composed only of cluster 3, and it is a rounded lip form with cream slip and no decoration. Group C is composed of clusters 4 to 8. It contains a mix of lip and rim forms, but is highlighted by the no slip or cream slip without decoration. Group D is composed only of red slipped clusters. Group E is composed of cluster 10 to 16. This group is dominated by the use of paint or paint with resist. It, too, has only no slip or cream slip, no red slip. The Late Urichu phase is the first phase in which the slips are clearly sorted and group distinctly from one another. This phenomenon is repeated with the body sherds.

Tariacuri Area 1

Thirty-one clusters were formed from the 241 sherds of the Tariacuri Area 1 phase. The exemplars and ESS are given in Table B.6. The clusters form two or five groupings (Figure C.12), though two is the best, given the marked flattening of the slope of the line. Group A, clusters 1 to 27, is marked by the preponderance of cream slip and decoration. If 5 groups were chosen, group A would have four parts: 1) clusters 1 to 10, with tapered or straight lip forms with everted or straight rim forms, open, with a predominance of cream slip and no decoration; 2) clusters 11 to 17, with rounded lip form, a mix of rim forms, open constrictions, and cream slip with a marked absence of decoration; 3) rounded lip form, with a mix of rim forms, but with an open constriction, cream slip and paint; 4) rounded or tapered lip forms, with everted rims, closed constriction, no slip or cream slip, with paint. In contrast to the cream slip and decoration of group A, group B (clusters 28 to 31) are red slipped without decoration. The lips are rounded or tapered and the rim form is everted or straight.

Tariacuri Area 2

Three hundred and forty-four sherds comprise Tariacuri Area 2 phase, which form 25 clusters (Appendix C.13). The exemplars and ESS are provided in Table B.7. Using a modified scree test (Figure C.14), the clusters form four groupings. Group A tends toward red slip and a general (but not exclusive) absence of decoration. The lip and rim forms are mixed. Group B is marked by cream or white slip and decoration, typically paint decoration. The lip forms are typically round or squared, and the rims forms or everted or straight. Rounded lip forms and an absence of decoration highlight group C. Red slip and the rounded lip form, as opposed to group A, which did not have a single strong lip form trend, mark group D.

Tariacuri Area 5

The 244 sherds from this phase formed 31 clusters. The tree diagram is found in Appendix C.15. Table B.8 contains the exemplars and ESS for each cluster. Using a modified scree test (Figure C.16), the clusters form four or seven groupings, though four is best given the marked flattening of the slope of the line. Group A is formed from clusters 1 to 6 and is dominated by the rounded lip form, everted rims form, red slip, and absence of decoration. Group B is composed of clusters 7 to 13. These are clusters marked by the rounded lip form, a mix of rim forms, the cream clip, and an absence of decoration. If seven groups were chosen, cluster 13 would be separated from the rest of the clusters, with a tendency toward everted rims and closed forms. Group C would be divided into three parts if seven clusters were chosen: 1) clusters 14 to 36, with a mix of lip and rim forms, with a mix of no, red and cream slip, all basically undecorated; 2) clusters 37 to 42, with the tapered lip form with cream slip and paint decoration; 3) clusters 43 to 51, with squared lip, cream lip and paint decoration. Group D, with clusters 52 to 61, is marked by the rounded lip form, a mix of rims forms but emphasizing the straight rim form, with cream slip and paint decoration. Resist also occurs in group D.

Overall Rims Analysis: Comparison of ESS and Continuous Variables

Each cluster has an associated Within Cluster Error Sum of Squares (ESS). This value is a statement of the amount of variation within each cluster and it is data, not method, dependent. A simple one-way ANOVA tests the null hypothesis that the mean cluster ESS of each phase is equal to the means of all of the other phases. If they are equal, then there is no significant difference in the variation exhibited by the clusters of all of the phases. If they are significantly different, then there is a significant difference in the variation within clusters between phases.

A one-way ANOVA of the ESS of the clusters indicates that indeed there are significant differences between the means. Of the eight time periods, only one has a normally distributed ESS (Table 5.9)[xiv], and the variances are also unequal. Therefore, the non-parametric Wilcoxon/Kruskal-Wallis test is necessary. The p for the test is 0.0204, which is less than the $\alpha = 0.05$, so the null hypothesis is rejected in favor of the alternative hypothesis, which is that there is a significant difference between the means in the different temporal phases. Unfortunately, with a non-parametric context, inference tests such as the Tukey-Kramer HSD ("honest standard deviation") are not applicable.

Table 5.9 Results of the rim sherds ESS one-way ANOVA

ESS TEST FOR NORMALITY

PHASE	*N CLUSTERS*	*SHAPIRO-WILK W TEST*	*PHASE MEAN ESS*
Tariacuri Area 5	61	p=0.0001	0.111800
Tariacuri Area 2	25	p=0.0001	0.072935
Tariacuri Area 1	31	p=0.0005	0.048115
Late Urichu	16	p=0.3400	0.050729
Early Urichu	59	p<0.0001	0.103050
Lupe	52	p=0.0015	0.081194
Jarácuaro	31	p=0.0023	0.118600
Loma Alta 3-Jarácuaro	10	p=0.0856	0.070131

ESS TEST FOR EQUAL VARIANCE

Brown-Forsythe Test: P<0.0001

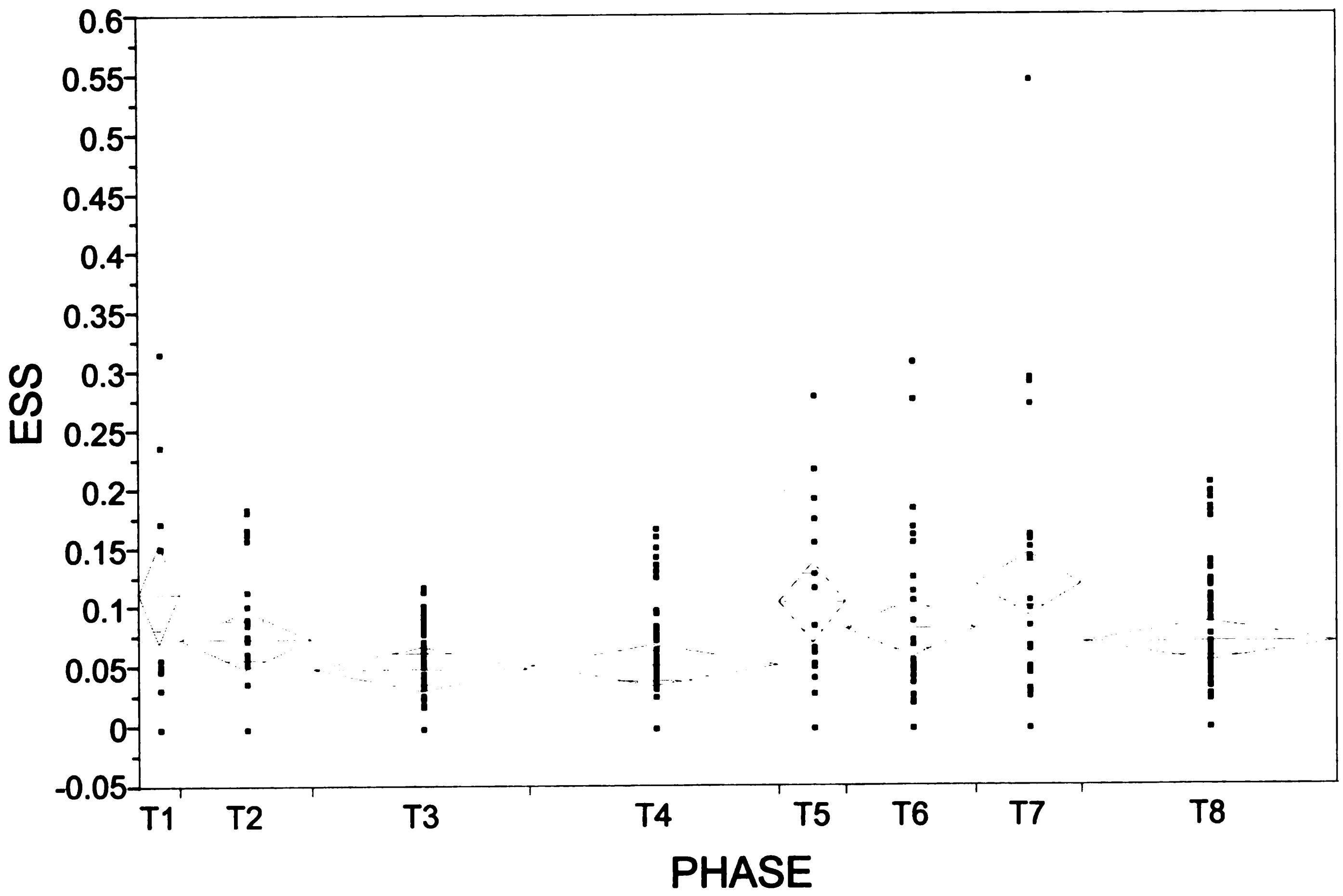
NON-PARAMETRIC ANOVA

Wilcoxon/Kruskal-Wallis Test: P=0.0204

However, from Figure 5.1, which shows the distribution of the rims ESS mean of each phase-by-phase, it appears as though there is a significant difference between T1 and T3 (Loma Alta 3-Jarácuaro and Lupe) and between T3 and T7 (Lupe and Tariacuri Area 2). Table 5.9 contains the results of the assumption tests and the ANOVA result. A noticeable decline in the ESS is apparent between T1 (Loma Alta 3-Jarácuaro), through T2 (Jarácuaro), and finishing with T3 (Lupe). Variation also increases from this point on, reaching a high in T7 (Tariacuri Area 2), which is the most domestic context from the Tariacuri phase. The overall Tariacuri mean is 0.089975,which is a decline from the T5 (Late Urichu) mean, but an increase from the T4 (Early Urichu) phase.

Due to problems in understanding the dimensions along which the different cluster vary from one another, it is inappropriate to run One-Way ANOVAS on small groupings of clusters comparing one time period to another time period. However, there are three key rim forms that compose the bulk of the rim forms within each one of the phases. The three forms are: closed everted rims, open straight rims, and open convex rims. By using these three as basic morphological categories, ignoring both morphological and stylistic differences in lip form and the stylistic differences of decoration, it is possible to generally track the changes in rim diameter over time. The other continuous variables (lip thickness, rim thickness and rim angle) are more closely tied to vessel style than to vessel form and function.

Figure 5.1 Plot of rim sherd cluster ESS means by temporal phase



The distribution for each of the three types was checked for outliers by a box plot and all outliers are removed from this analysis. Each phase was compared for the general range and coefficient of variation.

For the closed, everted rims, there is no overall bi- or tri-partite division of the distributions. The typical range of variation falls within 3 to 30 cm diameter (except for T6, Tariacuri Area 1, which is 7 to 48 cm) (Table 5.10). Outliers removed from the analysis were typically larger, though in such small numbers that they do not constitute a bimodal distribution. No outliers were removed from T1, T6, or T7. The resulting distributions were all normally distributed (Shapiro-Wilk p values in Table 5.10). The Coefficient of Variation (C.V.) indicates a change in the variation of diameter distributions, from low to lower (T1 to T3) to higher (T6). As the variances are not equal (Brown-Forsythe $p<0.0001$), a non-parametric ANOVA test is required. A non-parametric ANOVA of the diameter means indicates that the means are not equal, with T2 and T6 showing the most difference. This indicates a significant difference in the means of T2 and T6, with T6 showing the larger mean. T7 has the second largest mean and C.V. T2, T3, and T4 demonstrate less variation than do the phases T6, T7 and T8 (though T8 is closer to the pre-state levels.)

Open, straight rims also demonstrate a single distribution within each phase, with the exception of T8. In T8, there were 15 outliers, all too large for the general distribution (all greater than 30 cm). Of these 15 outliers from T8, 14 outliers formed a normal distribution of their own, ranging from 32 to 46 cm. Outliers were removed from all of the other phases except T1. The typical range

Table 5.10 Diameter results for closed and everted rim sherds by phase

PHASE	N CASES	SHAPIRO-WILK W TEST	DIAMETER MEAN	RANGE	Std Dev	C.V.
T1	3	0.4632	14.3333	11 TO 19	4.1633	29.0465
T2	21	0.8656	12.5714	4 TO 21	3.7091	29.5039
T3	23	0.3694	16.1739	8 TO 24	4.1303	25.5367
T4	39	0.5891	16.3333	4 TO 28	5.4112	33.1296
T5	2			21 & 40		
T6	28	0.7472	25.2500	7 TO 48	10.0577	39.8325
T7	22	0.3394	18.6364	5 TO 30	7.0207	37.6720
T8	59	0.2882	15.8136	3 TO 30	5.7938	36.6382

TEST FOR EQUAL VARIANCE
Brown-Forsythe Test: P<0.0001

NON-PARAMETRIC ANOVA
Wilcoxon/Kruskal-Wallis Test: P<0.0001

of variation is 6 or 7 cm to 32 or 35 cm, though the outliers were typically larger. All of the phases are normally distributed except T3 and T8. Neither of those phases demonstrates a bimodal distribution, however. All results for these diameters are presented in Table 5.11.

The C.V. results for each phase indicate that the post-state diameter distributions are both smaller and larger than the pre-state distribution. T6 was also large for the closed and everted diameters. The distribution of large rim diameters and their small C.V. in T8 indicates the presence of large open bowls of fairly standardized diameter.

A non-parametric ANOVA without T5 or T8A demonstrates that the means are not equal (Table 5.11). The smallest mean is in T2, with an increase in phases T3, T4 and T6. T7 and T8 do have as much variation as T6, but they are all larger than T2.

The situation for open, convex rim sherds is more complex. Four of the seven diameter distributions are not normal (Table 5.12). Their distributions are not distinctly bi- or tri-modal, but they are definitely not all of one piece. They exhibit a smaller range of diameter sizes than do the open, straight rimmed sherds, but within the range, the distributions are varied. It would appear as though there are several key sizes of open, convex bowls from T3 (Lupe) through the end of the sequence. As they cannot be identified more clearly, they will be treated as entire distributions.

Table 5.11 Diameter result for open and straight rim sherds by phase

PHASE	N CASES	SHAPIRO-WILK W TEST	DIAMETER Mean	RANGE	Std Dev	C.V.
T1	12	0.6768	18.6667	9 TO 26	5.4160	29.0144
T2	50	0.3066	13.9600	6 TO 24	3.9896	28.5786
T3	164	0.0343	16.6951	7 TO 29	4.6211	27.6792
T4	157	0.1107	18.5159	7 TO 32	5.1833	27.9938
T5	2			12 & 20		
T6	35	0.0513	19.0571	8 TO 35	7.0458	36.9721
T7	12	0.5031	16.1667	11 TO 20	2.6572	16.4362
T8	186	<0.0001	16.9731	7 TO 30	5.1930	30.5952
T8A	14	0.26	37.1429	32 TO 45	4.3475	11.7049

TEST FOR EQUAL VARIANCE:
Brown-Forsythe Test: p=0.0175

NON-PARAMETRIC ANOVA
Wilcoxon/Kruskal-Wallis Test: p<0.0001

Table 5.12 Diameter results for open and convex rim sherds

PHASE	Number CASES	SHAPIRO-WILK W TEST	Mean	RANGE	Std Dev	C.V.
T1	7	0.0324	19.0000	14 TO 32	6.3246	33.2871
T2	33	0.0448	17.2727	5 TO 31	6.3407	36.7093
T3	51	0.1580	15.2745	8 TO 27	4.2992	28.1463
T4	68	0.0035	16.7500	9 TO 32	5.0913	30.3960
T5	1			17		
T6	11	0.6917	15.7273	11 TO 21	3.1966	20.3251
T7	9	0.9639	16.5556	9 TO 26	5.3645	30.4030
T8	74	0.0037	16.8378	7 TO 32	5.8964	35.0189

TEST FOR EQUAL VARIANCE

Brown-Forsythe Test: p=0.3035

NON-PARAMETRIC ANOVA

Wilcoxon/Kruskal-Wallis Test: p=0.6772

The C.V. is almost an inversion of previous trends. The smaller C.V. scores belong to the T3 and T6 phases. With the exception of T6, though, there is not a lot of variation between the phases (Table 5.12)

A non-parametric ANOVA for the diameters indicates no difference between the means of the phases in the sequence (Wilcoxon/Kruskall-Wallis p=0.06772).

Support Sherds

The support sherds from phases supply a little more difficulty in interpretation because they are far fewer in number. One cannot conduct a cluster analysis when the number of variables is greater than the number of cases to be clustered. This is not an issue with the rim sherds or the body sherds, but it is an issue with the support sherds. The support sherds are only a limited percentage of the entire data set (refer to Table 5.1). The numbers are so small in the Loma Alta 3-Jarácuaro, Jarácuaro, Late Urichu, Tariacuri Area 1 and Tariacuri Area 2 phases that nothing can be clustered. However, what can be clustered, the Lupe, Early Urichu and Tariacuri Area 5 phases, offer an opportunity to compare clusters of pre-state and state ceramics. This comparison is in addition to a discussion of patterns of sherds over time.

One factor in the large of number of variables being used is the diversity—in each phase—of the number of different supports exhibited. This diversity is exhibited in both the form of the supports (e.g. annular, conical) and in the "fill" of the supports, i.e. whether the supports are hollow or solid. While hollow or solid may seem to be mutually exclusive categories, it is important to note that several support types defy this simple dichotomy. Annular bases, circular bases, and simple vessel bottoms are neither hollow nor solid. In constructing the binary data sets, the two variables, fill and form, could have been collapsed, with binary designations of annular, circular, base, hollow conical, solid conical, etc. This often created more binary variables than the use of fill and form separately. Therefore, the decision was made to create "fill" as either hollow (present or absent) and solid (present or absent) with a "missing" designation for truly missing or indeterminate and also for the annular, circular, and base (vessel bottom) supports. This decision changes the character of the resulting clusters, as annular bases tend to float around both hollow and solid supports. However, it is noteworthy that the clusters emphasize slip and paint, just as was seen with the rims and will be seen again with the body sherds.

Because only three of the eight phases can be clustered, they will be discussed in general before turning to the three clustered phases. Tables B.9, B.10, B.13, B.14, and B.15 are the support data sets for Loma Alta 3-Jarácuaro, Jarácuaro, Late Urichu, Tariacuri Area 1 and Tariacuri Area 2 phases, respectively. Tables B.11, B.12, and B.13 are the exemplar tables for phases Lupe, Early Urichu and Tariacuri Area 5, respectively. From these data sets, it is possible to see a few trends in the variables. Due to the low number of cases, these trends are suggestions only.

In terms of support morphology, there appears to be a slight shift in the emphasis of support forms from annular bases (Lupe phase contains 12 of the

23 total found in all time periods) to conical (22 of the total 40 are found in the Tariacuri phase, with 20 of the 22 in Area 5). Circular (11 of 18 from the Tariacuri phases) and cylindrical (9 of 14 from the Tariacuri phases) also seem to be more common later in time. The percentage of hollow and solid supports also shifts, from only solid in Loma Alta 3-Jarácuaro and Jarácuaro, to a large percentage in both Lupe and Early Urichu (13 of 43 in Lupe, 32 of 62 in Early Urichu). In the combined Tariacuri phases, only 31 of 124 sherds are hollow, while 49 of 124 are solid. This is surprising, as Tarascan state vessels are noted for large, bulbous (trapezoidal), hollow tripods. The only support sherds identifiable as bulbous tripod legs are found in Tariacuri phase, and only in Area 5. However, in the complete vessels, there are four tripod bowls with bulbous legs, and each came from Area 1. Three were reconstructed from what was evidently a cache of fine ware vessels and the fourth came complete from a burial. Evidently, there is a greater mix of solid supports associated with the hollow bulbous legs. (It should be noted that some of the bulbous supports look similar to small mini-jars, which are known from Tarascan-period ceramic assemblages. It is possible that the hollow, bulbous legs are underrepresented in the supports data sets because they were miss-identified as mini-jar sherds and placed into the body data sets.) Nubbin legs—small, squat, solid tripod legs—are most numerous in the Lupe and Early Urichu phases, which account for eight of the 12 in the overall sherd data set (the other four are from two of the Tariacuri areas). In contrast, the whole vessels remain a mix of hollow and solid forms in the earlier phases, while the Tariacuri phase is only hollow supports or

simple bases for closed vessels. There are no annular or circular bases in the whole vessel assemblage.

Rattle legs are also expected within Tarascan ceramic assemblages. From the whole vessels, they are expected throughout the sequence. However, none of the legs in the overall supports data set indicated that a rattle was at one time present. The hollow supports are at best indeterminate, but nothing could be coded with certainty. Therefore, the presence/absence of a rattle was simply not used as a variable in any of the cluster analyses.

Almost all of the vessels represented by the supports are open vessels. The most common exception is simple vessel bottoms (bases), which represent both open and closed vessels.

The decorations found on the supports mimic the patterns seen in the rim and body sherds. The amount of finish given sherds—whether wiped, smoothed or polished—is rather evenly distributed throughout the data sets. The Jarácuaro, Lupe and Early Urichu phases demonstrate a little more polishing than in other phases (28%, 25% and 18%, respectively). Only six support sherds in the three Tariacuri phases are polished, while 68 are smoothed (54%). Wiped supports constitute only a small portion of the entire data set, and only occur in the Lupe, Early Urichu, Tariacuri Area 2, and Tariacuri Area 5 phases.

Slip again is an important variable. No slip is most frequent in the Early Urichu phase (10 of 43 sherds, 17%) and white slip occurs only once, in the Tariacuri Area 2 phase. Otherwise, the support sherds are slipped with cream or red slip. Cream always is more common, though red varies in its proportion of the data set, usually at a rate of one red slipped sherd to three to six cream slipped sherds. No red slipped sherds occur in the Loma Alta 3-Jarácuaro or Late Urichu phases (both of which have very low overall sherd frequencies). The ratio of red to cream is 7:8 in the Tariacuri Area 2 phase. Red may be acting as a stand in for red paint in this somewhat more domestic context, though red painted sherds also occur in the same phase.

Paint and plastic manipulation of the clay are also present in the overall data set. Plastic is rare, occurring most commonly as punctates. These punctates are usually on the interior of the bowl rather than on the support itself. Most of these punctated open vessels are *molcajetes* (semi-punctated bowl interiors used as graters). Paint is a far more common means of decorating supports, though it becomes more common over time. Only one sherd is painted in each of the first two phases. From there, painting becomes more common, with a slight depression in the Late Urichu phase.

Support Sherds: changing cluster sizes

Two continuous variables were collected for all support sherds: maximum support height and maximum support width. Unfortunately, most of the sherds were broken, and therefore the maximum could not actually be collected, just an indication of the sherd not being smaller than a given height or width, and even then, most of the support sherds could not provide even a good estimate and are coded as "missing." Therefore, the continuous variables will not provide a good indication of changing morphological variation in the overall data set are will not be used as such.

Using the Error Sum of Square (ESS) result for each cluster in the three clustered phases, Lupe, Early Urichu and Tariacuri Area 5 (see Table B.11, B.12, B.16) an one-way ANOVA was conducted. The ESS for the Lupe and Early Urichu phases were tested as normal using a Shapiro-Wilk Goodness-of-fit test ($p=0.2703$; $p=0.0652$, respectively) (Table 5.13). The ESS distribution for Tariacuri Area 5 phase was not normal, with $\alpha=0.05$ ($p=0.0422$) (Table 5.13), but it was close and a decision was made to act as though it was normal. The variances for each of these three phases were compared (Brown-Forsythe $p=0.2096$). The resulting ANOVA $p=0.1106$. This indicates that the Null Hypothesis is to be accepted, that the means from each phase are equal, is to be accepted. Figure 5.2 contains a plot of the support sherd ESS means by phase.

This situation implies that the population means for the three time periods are not significantly different from one another. However, Lupe phase support sherds and Tariacuri Area 5 phase support sherds may exhibit a slight difference from one another. Therefore, it can be said from the supports sherds that there is no significant change in the ESS variation demonstrated by pre-state and post-state support sherds. Nor is there a significant change in the variation of support sherds ESS from the Lupe phase to the Early Urichu phase.

Table 5.13 Results of the support sherds ESS one-way ANOVA

ESS TEST FOR NORMALITY

PHASE	*N CLUSTERS*	*SHAPIRO-WILK W TEST*	*PHASE MEAN ESS*
Tariacuri Area 5	12	p=0.0422	0.097417
Early Urichu	10	p=0.0652	0.121400
Lupe	6	p=0.2703	0.035667

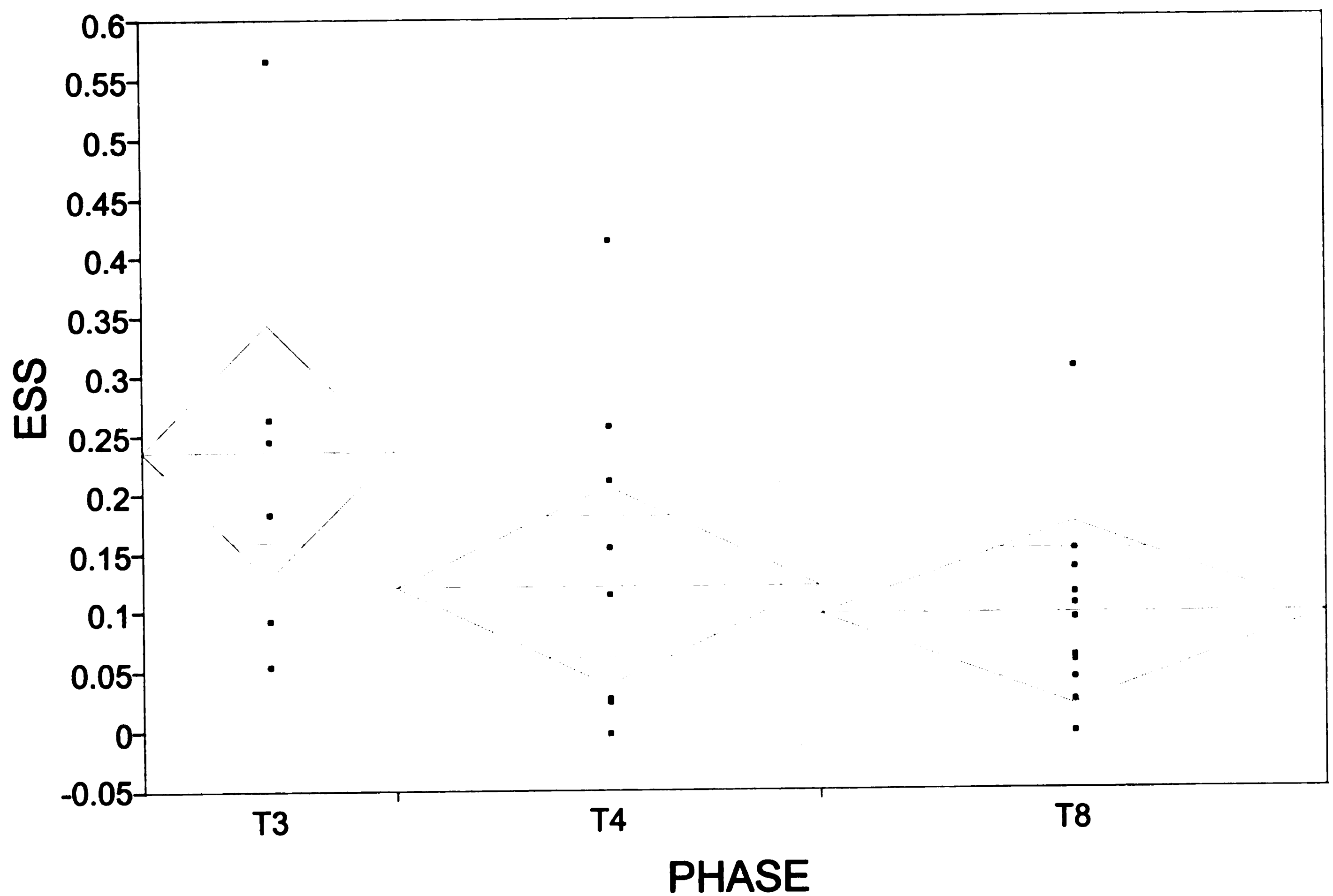
ESS TEST FOR EQUAL VARIANCE

Brown-Forsythe Test: P=0.2096

PARAMETRIC ANOVA

ANOVA: P=0.1106

Figure 5.2 Plot of support sherd cluster ESS mean by temporal phase



Body Sherds

In this analysis, "body sherds" refers to true body sherds, plus sherds with handles and spouts. Spouts only occur in the Tariacuri phase, and then only in Areas 1 and 2. The ceramic patterns identified in the rim and support sherd categories are also identifiable with the body sherds, with a few differences. One is that most of the body sherds were identified as coming from closed vessels, a caveat already noted in chapter four. A second difference is the strength of division of these sets into, a) closed, cream-slipped smooth vessels and b) all other types of vessels, particularly open plain vessels and both open and closed decorated vessels. While a number of the phases actually group into three or four clusters, this general division is still apparent.

As with the rim and support sherds, the modified scree results are given in Appendix A.[xv] Appendix B contains, in tabular form, descriptions of exemplars for each cluster identified using the upper tail rule.

Loma Alta 3-Jarácuaro

Seven hundred and nine body sherds clustered into 17 clusters in this phase. Exemplars and ESS for the 17 clusters are given in Table B.17. Using the modified scree test (Figure C.23), there are three groupings of clusters. Grouping A is equivalent to cluster 1, which is basically a cluster of closed, smooth, cream slipped plain sherds. This is also the most populous cluster in the phase. Group B is composed of clusters 2 and 3, essentially open, smooth, cream slipped plain vessels. Group C contains all of the other clusters, 4 to 17.

This group contains a mix of open and closed vessels, predominately smoothed or polished, and exhibiting decorative variation. This variation includes red slips, and red, white and black paint, either alone or in combination. While more closed vessels tend to carry red slip and open vessels do not, this slip color is not usually associated with paint. Red slip may be acting in the same manner as red paint is acting. Painted sherds are usually cream slipped (whether open or closed), and paint is predominantly red or in combination with white or black. Very few sherds exhibit any manipulation of the clay, though a little appliqué, incision, and punctate is observed. These 14 clusters of decorated sherds represent only 22% of the total sherds in the phased data set.

Jarácuaro

The Jarácuaro phase body sherd data set is composed of 4719 sherds, which is 35 clusters. Table B.18 gives exemplars and ESS for each of the clusters. Figure C.24 is the modified scree test, in which only two groupings of clusters are identified. Group A is composed only of plain closed, smoothed (or missing) finish sherds with cream slip (cluster 1). Grouping B is composed of all other sherds from every other cluster (2 to 35). Many of these sherds demonstrate decoration. Red slip is more common on open sherds than closed sherds, and paint is rarely associated with red slip (cluster 30). It appears as though red slip acts in a manner similar to red paint. Most paint occurs on cream-slipped sherds, most of which are open (9 clusters) rather than closed (3 clusters). Manipulation of the plastic body is also uncommon, but more frequent that in the previous phase (31 sherds expressing appliqué, flanging, engraving, incision, modeling, punctuating, or formation of raised areas). The 34 clusters of group B representing decorated sherds represent 44% of the total sherds within the phase.

Lupe

Forty-six clusters were formed from the 7711 sherds from the Lupe phase body sherds. Exemplars and ESS for the 46 clusters are given in Table B.19. Either three or five groups can be identified using a modified scree test (figure C.25). Three is the more appropriate decision, as the line truly flattens at that point. The three groups are A, composed of clusters 1 to 44; B, cluster 45; and C, cluster 46. A five-group solution only refines group A. Group C is the expected plain closed cream-slipped sherds. Group B is also plain and closed, but it is red slipped. Group A includes all of the decorated sherds, whether open or closed. However, group A is dominated by cluster 44, which is composed of plain, open cream slipped sherds, and a group of 4 clusters (clusters 40-43) which are basically open and red slipped sherds, though the decoration may be plain, painted or some manipulation of the plastic body. The rest of group A are a mix of no slip, cream, red and white slip, either plain, painted or again exhibiting some type of manipulation to the plastic body. Paint and manipulation do not overlap. Group A composes 32% of the overall data set for the body sherds in this phase.

Early Urichu

The Early Urichu phase body sherd data set is the largest body sherd assemblage, composed of 8866 sherds. Forty-five clusters were identified. Exemplars and ESS for the each cluster are found in Table B.20. Using the modified scree test (figure C.26), either two or five groups can be identified, though two is the more appropriate decision, as the line truly flattens at that point. Group A is composed of the first 39 clusters. It includes cluster 1, which is the expected cluster of plain, closed cream slipped sherds; it is also the largest cluster in the upper tail solution. Unlike previous phases, however, group A also includes all of the decorated sherds, whether open or closed, and whether by paint or by manipulation of the plastic body. If a five group solution is chosen, Group A is divided as follows: cluster 1 and 2, plain closed cream slipped sherds; clusters 3 to 21, open and closed vessels with a mix of slips and relatively little decoration except for manipulation of the plastic body; and clusters 22 through 39, a mix of open and closed vessels of predominantly cream slip and paint. All handles also occur in group A. Group B is composed of clusters 40 to 45, which includes undecorated sherds without cream slip (plain sherds with cream slip are included in group A). If 5 clusters are chosen, group B is divided into two parts: clusters 40 to 42, which is composed of plain open and closed sherds with missing or no slip; and of clusters 43 to 45, which are plain closed or open red slipped sherds. Excluding clusters 1 and 2 from group A, the decorated sherds comprise 27% of the data set.

Late Urichu

The 535 body sherds from the Late Urichu phase clustered into 23 clusters. Table B.21 describes the exemplars and gives the ESS for each cluster. Using the fusion values modified scree test (Figure C.27), there are three cluster groupings. Group A is composed of clusters 1 to 13, including cluster 1 which is the largest cluster. The cluster exemplar has a missing determination of the sherd constriction, but the cluster is only composed of missing or closed sherds. All of the sherds in this cluster are cream slipped and plain. It is part of group A because this group includes all of the cream slipped sherds, whether open or closed, as well as all of the white slipped sherds and one cluster (number 13) of red slipped sherds. These sherds tend to be among the most highly decorated in the data set as well, including red alone and combinations of paint colors. Very little manipulation of the plastic body occurs anywhere in this data set. Group B, composed of clusters 14 to 18, tends to have no slip, with some red paint evidenced. Group C, composed of the last 4 clusters, tends to be red slipped sherds, with some paint manifested. This is the first phase in which slip color strongly defines the sherds clusters rather than the interaction of slip and decoration. Group A accounts for 56% of the data set, group B for 20%, and group C for 24%.

Tariacuri Area 1

The 2679 body sherds of this phase formed 46 clusters. Exemplars and the ESS for the 46 clusters are given in Table B.22. Using the modified scree test (Figure C.28), there are three cluster groupings. Group A is dominated by cluster 5 and is composed of plain, closed, cream slipped sherds. The rest of the clusters in group A are also of plain closed vessels, predominantly cream slipped. Clusters 2 and 3 are also marked by the presence of spouts. This is surprising, but if the spouts themselves did not include decoration, and if the spouts did not have any attached vessel, they would be included in clusters of plain sherds. Group B (clusters 6 to 8) are marked by plain, open, cream slipped sherds. With the exception of cluster 7 which is composed of polished, cream slipped, and modeled open sherds, all of the sherds in groups A and B are undecorated and predominantly cream slipped. Group C is also predominantly cream slipped, though it also includes red slip and white slip and absence of slip. In this phase, red slip again acts as a sherd decoration, as does red paint. Most of the red slipped and no slip sherds are plain. Most of the cream and white slipped sherds are decorated, usually with paint. The presence of resist seems to dominate the formation of clusters 41 to 46 in group C. With its decorated sherds, group C accounts for 24% of the sherds in the Area 1 Tariacuri phase data set.

Tariacuri Area 2

The Tariacuri Area 2 phase body sherd data set is composed of 1434 sherds, which formed 41 clusters. Table B.23 provides exemplars and the ESS for the clusters. Using the modified scree test (figure C.29) four groups can be identified. Group A is composed of 11 clusters and is composed of relatively plain, cream slipped sherds, with both open and closed constrictions. The decoration is limited to manipulation of the plastic body and handles. Group B is composed of clusters 12 to 34 and contains the majority of the decorated sherds, especially sherds decorated with paint and resist. While the bulk of these sherds are cream slipped, white and red slips are also included. Group C is composed of only 2 clusters. These two clusters are unslipped, plain sherds, representing missing, closed, and open constrictions. Group D is predominantly composed of undecorated red slipped open and closed sherds. As with the Late Urichu phase, slip is a major structuring factor in the clusters of these sherds.

Tariacuri Area 5

The data set for this phase is composed of 7315 sherds; 44 clusters were formed. Exemplars and ESS for the 44 clusters are given in Table B.24. Using the modified scree test (Figure C.30), either three or five groups can be identified, though three is the more appropriate decision, as the line truly flattens at that point. Group A (clusters 1 to 35) is predominantly, though not uniformly, cream slipped. Sherds are open or closed, and most are decorated. Group A is divided into two parts if a five cluster solution is chosen: clusters 1 to 24, which are predominantly decorated with paint and resist; and clusters 25 to 35, which are predominantly decorated with plastic clay manipulation. The decorated sherds of group A accounts for 15% of the sherds in the data set. This percentage excludes cluster 35, which is a large cluster composed of undecorated, missing or open constriction, cream slipped sherds. Including cluster 35, the percentage included in group A increases to 33%. Group B is composed only of cluster 36, which is the expected plain, closed, cream-slipped cluster of sherds. One sherd in this cluster has a slip designation of cream/red, indicating that the sherd appeared to be slipped in two colors, though in actuality it may have been unslipped with a red slip on only one sherd surface, or it may have been red paint, not red slip. In either of those cases, the sherd would have been assigned into a red slip or a red paint cluster. Undecorated sherds without cream slip define group C, representing clusters 37 to 44. If a five-group solution is chosen: clusters 37 to 41 are red slipped; clusters 42 to 44 have no slip.

Body Sherds: changing cluster sizes

The body sherds do not have any continuous variables associated with them. Samplings of sherd thicknesses were collected in the field, but do not constitute a robust sample for analysis. Therefore, the only variable which can be tested for increasing or decreasing cluster variation is the within cluster error sum of square result for each cluster. The distribution of the ESS for each phase was tested for normality, and none of the phases are normally distributed (Table 5.13). However, the Brown-Forsythe test for equal variance indicates that the variances are equal (Table 5.14). Because one of the two key criteria for a parametric ANOVA is violated, a non-parametric ANOVA must be used. The Wilcoxon/Kruskal-Wallis test results in a score of p=0.1116, which indicates that the Null Hypothesis of equal means of the ESS scores between the populations is to be accepted (Table 5.13). Figure 5.3 charts the distribution of ESS scores by temporal phase.

It is surprising that there appears to be no change in the amount of cluster variation throughout the body sherd sequence, especially given the drop between T1 (Loma Alta 3-Jarácuaro) and T2 (Jarácuaro) and the remarkable rebound to T7 (Tariacuri Area 2). The high means of T1 (Loma Alta 3-Jarcuaro) and T7 (Tariacuri Area 2) probably raised the overall mean for the non-parametric ANOVA and allowed for the acceptance of the null hypothesis.

While some change in the bodies is expected given the changes in the rim sherds, there are reasons why the body sherds will not exhibit as much variation. Each phase is dominated by the long-term pattern of closed, plain, smoothed, cream-slipped vessels. The general consistency in decoration (cream slipped, red slipped, some paint and other decoration) indicates a relatively stable ceramic tradition. There are no indicators of a major change in the symboling universe of the potters or the context of the vessels. While there is some change in the amount of variation, there is nothing to indicate a major change in the organization of ceramic production.

Overall cluster analysis: rate changes

Another way to track potential changes in the organization of production is to track the actual changes in the number of clusters. The actual number of clusters in any given phase is dependent upon the number of cases and the number of variables. Thus the resulting raw number of clusters is not particularly

Table 5.14 Results of the body sherds ESS one-way ANOVA

ESS TEST FOR NORMALITY

PHASE	*N CLUSTERS*	*SHAPIRO-WILK W TEST*	*PHASE MEAN ESS*
Tariacuri Area 5	44	p<0.0001	0.017136
Tariacuri Area 2	41	p<0.0001	0.040415
Tariacuri Area 1	46	p=0.0000	0.023652
Late Urichu	23	p<0.0001	0.030217
Early Urichu	45	p<0.0001	0.022022
Lupe	46	p<0.0001	0.017761
Jarácuaro	35	p<0.0001	0.012200
Loma Alta 3-Jarácuaro	17	p=0.0003	0.043177

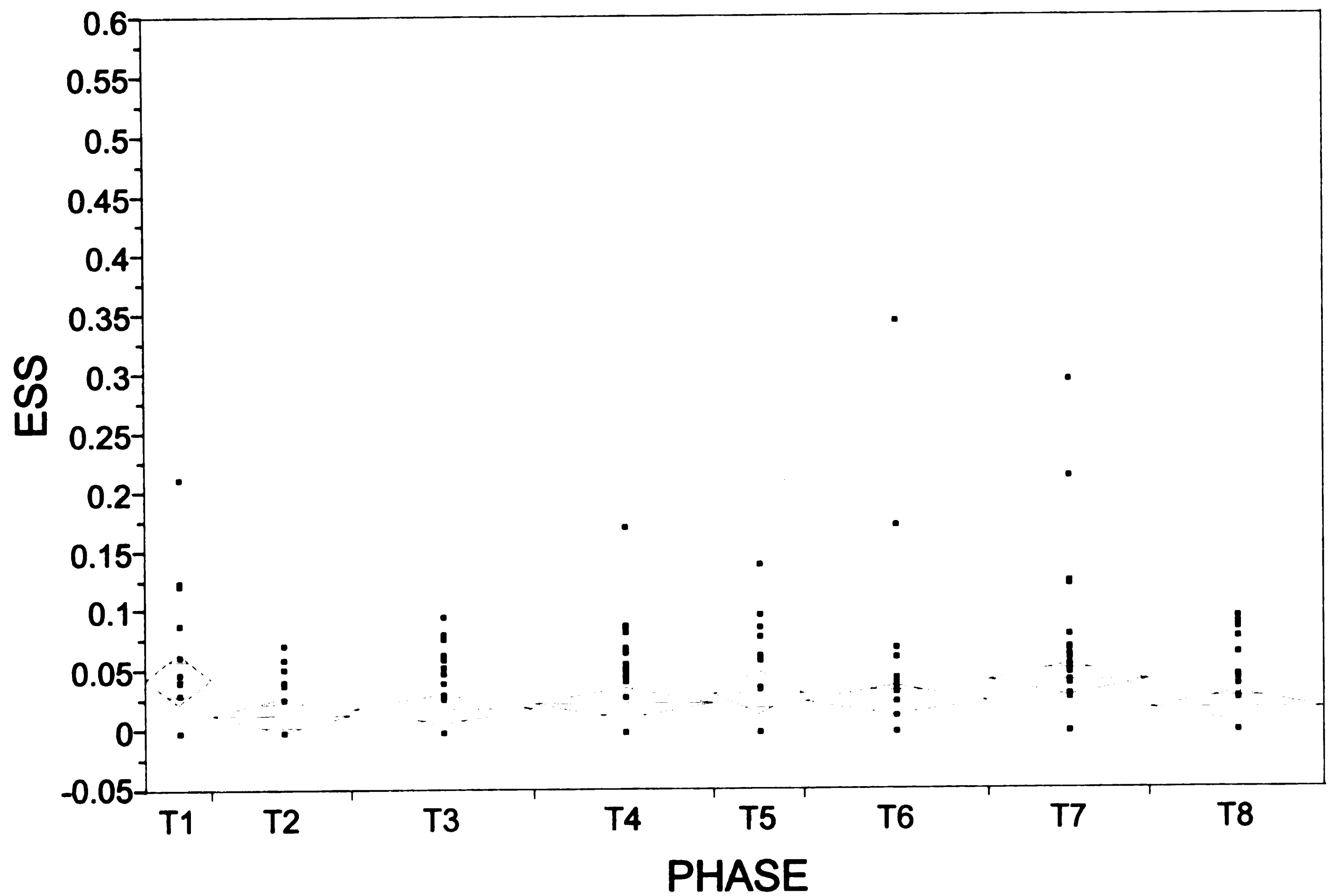
ESS TEST FOR EQUAL VARIANCE

Brown-Forsythe Test: p=0.0465

NON-PARAMETRIC ANOVA

Wilcoxon/Kruskal-Wallis Test: p=0.1116

Figure 5.3 Plot of body sherd cluster ESS mean by temporal phase



helpful in determining whether or not there is an increase or decrease in the clusters relative to another phase. Dividing the number of clusters by the number of cases can control this variation to some extent. Table 5.15 shows the rate of clusters per phase for the rim sherds, body sherds, and the three clustered support sherd phases. The rims and bodies exhibit a similar pattern (Figure 5.4) from T1 (Loma Alta 3-Jarácuaro) to T4, with either a decrease or a staying constant in the controlled cluster rate. Supports show a slight increase between T3 (Lupe) and T4 (Early Urichu) when both rims and supports stay even. Rims go up in T5 (Late Urichu), while bodies go down, and the opposition pattern remains throughout the rest of the sequence. Support sherds show a decline from T4 (Early Urichu) to T8 (Tariacuri Area 5).

The interpretation is not quite so straightforward. The rate is a proxy for consumer choices, and in a period of production expansion driven by market forces, choices are expected to increase, and then level off (cf. Rathje 1979, Rice 1981). The body sherds demonstrate a slight decline, a holding steady, and then an incline (the Tariacuri average rate for all three areas is 0.02, the same as the rate for T1, Loma Alta 3-Jarácuaro). The relative stability of the body sherd cluster rate is due to the consistency of the body sherd variation. For the most part, there is little in the way of body sherd decoration (most being on the rims and the presence of supports). The T5 decline is due to a domestic context with most of the decoration shifting to the rims. The Tariacuri incline is due to a greater emphasis on overall increase in body sherd decoration.

Table 5.15 Rates of cluster appearance by phase

RIM SHERDS

PHASE	N CLUSTERS	N CASES	RATE	TARIACURI AVERAGE
T8	61	866	0.07	0.09
T7	25	344	0.07	
T6	31	241	0.13	
T5	16	108	0.15	
T4	59	687	0.09	
T3	52	551	0.09	
T2	31	244	0.13	
T1	10	48	0.21	

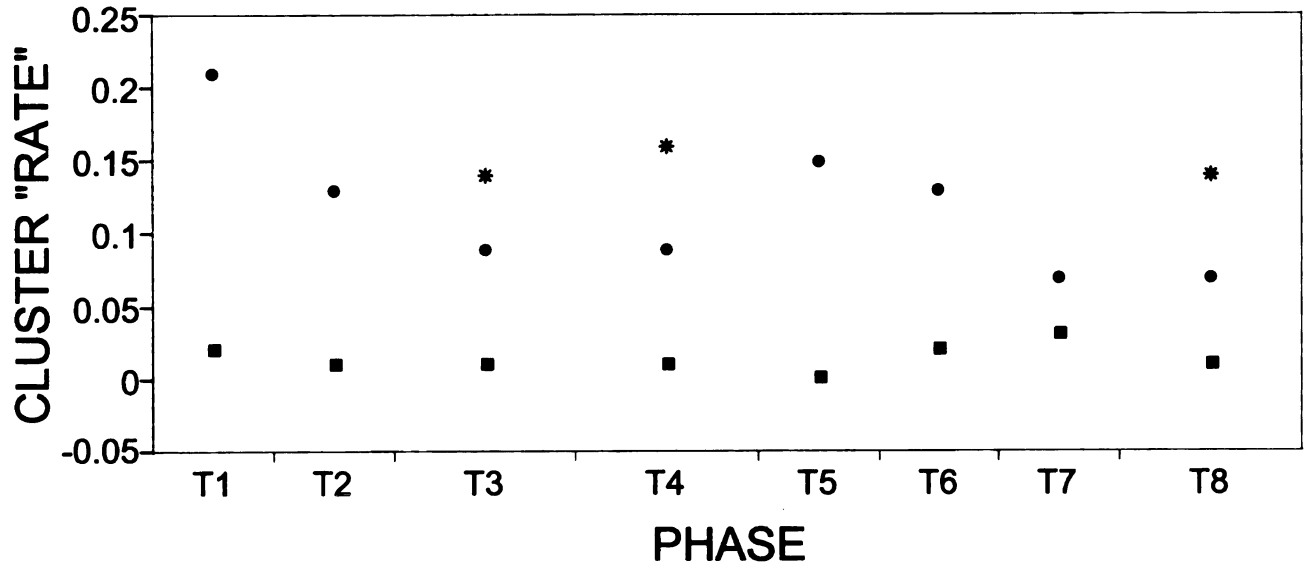
BODY SHERDS

PHASE	N CLUSTERS	N CASES	RATE	TARIACURI AVERAGE
T8	44	7315	0.01	0.02
T7	41	1434	0.03	
T6	46	2679	0.02	
T5	23	535	0.00	
T4	45	8866	0.01	
T3	46	7711	0.01	
T2	35	4719	0.01	
T1	17	708	0.02	

SUPPORT SHERDS (CLUSTERED ONLY)

PHASE	N CLUSTERS	N CASES	RATE
T8	12	86	0.14
T4	10	62	0.16
T3	6	43	0.14

Figure 5.4 Cluster rate by phase



Where: ● = rim sherds; ■ = body sherds; * = support sherds

The rims exhibit greater change because they are a more visible and plastic aspect of a ceramic vessel. The rims decline then hold steady. The decline is indicative of eroding options. But the rate for T3, T4 and the average rate for all Tariacuri Areas is 0.09. The T7 (Tariacuri Area 2) decrease in rim options and a slight increase in body sherd options indicates a limitation on the rim (and morphological) forms available in this domestic context, but with some greater emphasis on the body sherd decorations—to make up for the limits. Tariacuri area 5 (T8) shows a general decline in all three: rims, bodies and supports). Tariacuri Area 1 (T6) show and increase in both rim and body options. Area 1 was the key ritual and elite residential space for the Tariacuri period.

SUMMARY AND CONCLUSIONS

The cluster analysis of the nominal data from Urichu indicates a ceramic sequence steeped in tradition and consistency, but with change. Those changes reflect some ceramic trends of differentiation, but there is no one period of major reorganization of the ceramic production.

The consistency is aptly demonstrated in the body sherds. The ESS ANOVA indicated that the null hypothesis was to be accepted, indicated no variation in the means between the time periods. This same lack of difference is seen in the "rate" changes: the rates are small and the differences minor. The support sherds back up this consistency with the acceptance of the null hypothesis regarding the ESS of the three clustered phases. The "rate" change, while at a higher level indicative of the larger number of variables in the analysis, still shows little change. Pollard (2001) observed that the ceramic tradition was relatively unchanged throughout the excavated sequence. The body and support sherd information bears that out. There is no major moment of ceramic production reorganization.

However, there are some small moments of production shifts. The transition from Loma Alta 3-Jarácuaro to Jarácuaro is the most important one. In this transition, there is a decline in the "rate," indicative of falling choice. There is a change in the paste pattern, indicative of changing numbers of producers. And there is an ESS change, indicative of decreasing variation. Though the Loma Alta 3-Jarácuaro and Jarácuaro are related, there are subtle changes in the ceramics indicating increasing specialization.

Another shift occurs in the Lupe and Early Urichu phases. These seem to be continuations of the increasing specialization already started in the Jarácuaro phase. Patterns of difference either continue or hold steady, in both "rate" and in the ESS patterns. The rims ESS ANOVA does not indicate a significant change, but both the rims and body sherds show a decline in variation through the Lupe phase and only a slight rebound in the Early Urichu phase. The Lupe and the Early Urichu phases coincide with increase elite activity, as evidence from geomorphologic and mortuary information (Fisher et al. 1999; Pollard and Cahue 1999).

While the Late Urichu and Tariacuri phases demonstrate different patterns, they do not demonstrate a significant departure from the overall pattern.

Thus, it is reasonable to conclude that there is no reorganization of ceramic production on the eve of or the emergence of the Tarascan state.

Changing patterns of variables indicative of labor investment also highlight a similar pattern. There is a decline in labor input from the Loma Alta3-Jarácuaro phase through the Early Urichu phase. Some ceramics maintain a low level of investment (e.g., relatively higher percentages of wiped and unslipped sherds in the Late Urichu and Tariacuri phases). But there is an increase in the labor investment in other categories, such as polishing, number of paint colors, and resist. These increases are really a matter of percentages, however, and not of disjunctions in the overall ceramic tradition. The changes expected from the known whole vessels in both form and decoration are not as great in terms of the overall ceramic assemblage.

ENDNOTES

[i] To define:

- Appliqué: addition of decorative clay to the vessel body
- Drilled: the sherd exhibited a puncture through the entire wall of the vessel, creating a hole
- Engraved (Grabado): a deep groove cut into the vessel before drying
- Excision: the dried vessel was etched using a sharp tool
- Flange: a widening of the wall of the vessel for artistic effect
- Incised: an etching of the vessel prior to drying
- Modeled: a shaping of the vessel other than for a rim or flange
- Notched: small cuts made into the sherd or vessel
- Punctate: creating alternating depressions and raised areas; most often but not exclusively associated with the creation of graters
- Raised: pushing on the clay to produce areas that are either raised above the rest of the vessel or alternatively raised and depressed (ridged)

[ii] Cluster analysis is a well known and often used statistical technique in a number of disciplines, and most commercial software packages contain at least basic hierarchical (agglomerative) and k-means techniques as part of their basic package. ClustanGraphics was chosen because it is relatively well known in the literature, as stated, and therefore its algorithms are established and accepted within the literature. David Wishart continues to present and publish white papers on Clustan's clustering abilities (see www.clustan.com for a list of papers). Additionally,

ClustanGraphics supports only clustering techniques and therefore uses less RAM when computing the proximity matrix for larger data sets. This software also has easy input and output interfaces with common spreadsheet and word-processing programs.

[iii] Jaccard's Coefficient is computed as: A/(A+B+C). Another option is Gower's similarity coefficient (cf. Gower 1971). Gower's is attractive because it can compute a matrix from mixed-level data, such as nominal, ordinal and continuous. This is attractive because the clusters would be formed from the nominal and the continuous morphological data in the rim and support data sets. Gower's similarity coefficient reduces to Jaccard's similarity coefficient when only binary data is present (Aldenderfer and Blashfield 1984:31). The problem with Gower's in the current analysis is that it has limited output in ClustanGraphics and is not conducive to a follow-up k-means clustering. The loss of the k-means "calibration" limits the confidence that can be placed in the actual cluster solution, as there are no other viable validation techniques.

[iv] "Increase in Sum of Squares: The Euclidean Sum of Squares E_p for a cluster p is the sum of the Squared Euclidean Distances between all the members of cluster p and its mean:

$$E_p = \frac{\Sigma_{i\epsilon p}\Sigma_j(x_{ij} - \mu_{pj})^2}{V}$$

where for each variable j, xij is the value in case I, μ_{pj} is the mean in cluster p, and v is the number of variables" (Wishart 1999:28, section 4.8).

[v] "The upper tail rule takes the fusion values as a series, computes the mean and standard deviation, and a t-statistic as the standardized deviation from the mean. It then computes the standard deviate for each fusion value on this distribution (assumed normal), and selects the first one as "significant" if its t-value exceeds the 5% level. So the null hypothesis is that the kth fusion value comes from the normal distribution of fusion values. The original paper containing these rules was published by Prof. Dick Mojena in the Computer Journal, 1977. Some further tests were completed by Mojena and Wishart, and presented at Compstat 1980. Their main conclusion was that the upper tail rule... performed creditably in tests." (www.clustan.com/best_cut.html)

[vi] Outliers cannot be identified as such in terms of how a k-means cluster analysis is typically conducted, by indication of a distance threshold. However, typically clusters of one, two, or three cases can be identified from the hierarchical portion of the cluster analysis. These could have been removed and the remaining data set reclustered. However, it was found that their removal did not particularly affect the composition of the new cluster tree or the clusters as compared with the larger data set. Therefore, the decision was made to keep all of the sherds in the dataset in the cluster solution.

[vii] In corresponding with David Wishart (personal communication, 2003), he indicates that this information would require additional computing time, and that he is programming ClustanGraphics for speed (as a data mining program) rather than for complete output.

[viii] The identification of the most significant variables for each cluster is more appropriately conducted using multiple correspondence analysis. Multiple correspondence analysis is an extension of simple correspondence analysis. Lebart (1994) advocates the use of cluster analysis of large data sets as a form of data reduction then an application of multiple correspondence analysis in order to understand the interrelationship among multiple variables within a cluster solution of a few clusters. Multiple correspondence analysis is far more mathematically rigorous than the method used in this analysis. However, while simple correspondence analysis software is included in most commercial software packages, multiple

correspondence analysis software is not widely available in commercial software packages. The software that is available is often severely constrained in the number of variables it can analyze.

[ix] One limitation of this application of cluster analysis is that the dimensionality of variation within each cluster (that is, the orthogonal relationships between variables within a cluster) is unknown. As a result, one cannot compare a subset of clusters from one temporal phase directly with the clusters from another temporal phase (e.g. one cannot compare red slipped clusters from two temporal phases to test whether variation increases or decreases). They are not necessarily comparable because it is not known with certainty whether the slip color is the variable that accounts for the variation within and between clusters. As a result, this study will somewhat more subjectively describe changes in what appear to be the dominant variables within and between temporal phases. A small test of basic rim form-rim diameter data will also be used.

One way to study the orthogonal relationships is to use factor analysis or principal components analysis. These statistical techniques are of limited utility in this study as they each have difficulties with nominal scale data. Correspondence analysis is the only viable alternative, as it is designed for application with nominal data. Multiple correspondence analysis is useful for understanding the relationships among multiple variables. In a large data set, however, it is appropriate to reduce some of the dimensionality of the cases, not just of the variables. Lebart (1994) advocates a two-step process of k-means cluster analysis and correspondence analysis to reveal relationships among clusters in geometric space. Logistical issues precluded application of Multiple Correspondence Analysis to this study, but I believe it is a fruitful avenue for further research. I have found one archaeological study that combined correspondence analysis with K-means cluster analysis, though the focus of that study was micro-seriation and relative dating (Duff 1996).

[x] Dr. Bruce Pigozzi, of the Geography Department, Michigan State University, recognizes this problem with cluster analysis and suggests using an "incremental F-value" test from the results of sequentially larger k-means cluster solutions to determine the optimal number of clusters in the data (personal communication). The equation is:

$$F_{q,N-q} = \frac{(R2q - R2q-1)/q}{(1-R2q)/(N-q)}$$

where q=the number of groups or clusters, N=the number of pieces of information (cases), and R2=(1-Within Cluster Error Sum of Squares)/(Total Error Sum of Squares). This technique is related to the use of R in a regression analysis. ClustanGraphics does not provide the between cluster Error Sum of Squares nor the Total Error Sum of Squares, only the within cluster sum of squares (ESS).

[xi] The original hierarchical tree is not identical to the final k-means cluster solution. However, it is close enough to provide an appropriate basis upon which to group the upper tail cluster solution. ClustanGraphics 5.25 provides a way to create a cluster tree from a k-means cluster solution. However, I cannot find evidence in the literature of the acceptance of this tree as an adequate representation for the cluster solution. Therefore, I will rely on the original cluster tree.

[xii] A Goodman-Kruskal Chi square analysis of paste against all of the other variables in the overall rim data set could not give reliable results because of the extremely low expected frequencies of some squares: regardless, no Chi square result came close to indicating any importance of paste in the pattern of the other variables.

[xiii] Each cluster solution was determined using the upper tail rule (cf. Mojena 1977 and Mojena and Wishart 1980). This statement will not be repeated for each cluster solution.

[xiv] A lognormal transformation of the ESS values is of no assistance in resolving the normality concern in any of the three time periods, and would make the interpretation of the resulting ANOVA a little more difficult.

[xv] The tree diagrams for the body sherds, given the size of the cluster solutions, are too large for useful application. Copies of the body sherd tree diagrams are in the Author's files and can be copied upon request.

CHAPTER SIX

STANDARDIZATION AND LOCALIZATION OF CERAMIC PRODUCTION

This chapter examines two small, preliminary studies of the chemical composition of sherds from Urichu and Tzintzuntzan in order to understand long-term ceramic production and distribution within the Lake Pátzcuaro Basin. The INAA portion of this dissertation considers the dimensions of product standardization and production provenance.

IDENTIFICATION OF PASTE CATEGORIES AND DESCRIPTIONS

In the first systematic typology of ceramics in the Basin, Pollard identified eleven different paste categories at the site of Tzintzuntzan. These categories were based on a set of attributes: color (Munsell Soil Color Chart 1971), texture (percent inclusions); size of particles; hardness (Moh's scale); evenness of firing, fracture (straight, irregular, friable), and inclusions (Pollard 1972, 1993:202). Two additional paste categories were identified at Urichu (Pollard 2001b). Table 6.1 contains the pastes identified at each site. The inclusions were studied by I. M. Drew, of the Sackler Laboratory, Columbia University. She concluded that the inclusions occurred naturally (with the possible exception of sherd temper, or grog, Pollard 1972, 1993:202).

These characteristics are identified visually, with the naked eye or with a binocular microscope (a 10x microscope was used in the field for the Urichu portion of the study). These categories are identifiable, consistent, and

Table 6.1 Paste categories from Tzintzuntzan and Urichu

TZINTZUNTZAN	URICHU
Tariacuri Brown	Tariacuri Brown
Yaguarato cream	Yaguarato cream
Tarerio Cream	Tarerio Cream
Ichupio Coarse	Ichupio Coarse
Querenda White	Querenda White
Tecolote Orange	Tecolote Orange
Tariacuri Coarse	Tariacuri Coarse
Yaguarato Coarse	Yaguarato Coarse
Sipiho Grey	Sipiho Grey
Patambicho Red	Urichu Fine
Sanabria Red	Black Polished

patterned—they are real. However, as noted in chapter five, these categories are not typically reflected in the final ceramic product: producers may or may not consciously create them, but consumers are not choosing them; instead ceramic consumers are choosing on the basis of form and decoration instead.

Preliminary work was done on the Tzintzuntzan ceramics, using INAA at the Ford Nuclear Reactor, the University of Michigan, and by then graduate student Christopher Fisher using petrography and weak-acid ICP analysis at the University of Wisconsin (Pollard personal communication; Fisher, n.d.). Only a total of 31 fine ware sherds were analyzed in these two studies and the studies were not considered to be conclusive. However, one theme ran through the results: Querenda White and Tecolote Orange formed one group, and all the other pastes formed another group. The first two pastes were identified as predominately composed of compressed volcanic ash, locally known as *uiras*, "white earth."

Instrumental neutron activation analysis (INAA) is a method of identifying and measuring trace quantities of elements in many types of materials. Briefly, a sample is exposed to a neutron flux in a nuclear reaction, exciting the constituent elements into a radioactive state. As the elements decay into their stable state, they give off gamma energy that can be measured. Each element has a unique energy signature, which allows the detection of a wide range of elements in their actual, not relative, proportions. The INAA method has been applied to a wide range of materials, including archaeological ceramics (For a brief history of INAA, see Harbottle 1976; Neff 1992; for examples of archaeological applications of INAA, see the other papers in the same volume as Neff 1992).

With archaeological ceramics INAA is typically applied to studies of paste composition and provenience. In order to begin to understand the role and importance of pastes, a small instrumental neutron activation analysis was conducted at the Missouri University Research Reactor (MURR). A sample of 70 sherds and 18 clay samples were analyzed in order to understand the composition and stability of these paste categories over time. A follow-up study of 59 sherds and six soil samples continued this general inquiry and allowed for comparison with the ceramic assemblage at Tzintzuntzan. These samples were run at the Ford Nuclear Reactor and Phoenix Memorial Laboratory at the University of Michigan.

MURR INAA RESULTS

The first study INAA study was of a sample of 70 sherds and 18 clay samples prepared, irradiated, and analyzed at the Missouri University Research Reactor (MURR) under the direction of Hector Neff and Michael Glascock (Hirshman et al. 1999; Pollard et al. 2001; Neff and Glascock 1999). The clays represented a small sample of widely dispersed clays from the Lake Pátzcuaro Basin (Figure 6.1) from a variety of easily accessed contexts, but predominantly from Bt horizons of extant surface cuts, whether from erosion, clay brick makers yards, or road construction (Table 6.2). In two cases

Figure 6.1 Location of clay samples within the Lake Patzcuaro Basin (after Pollard et al. 2001)

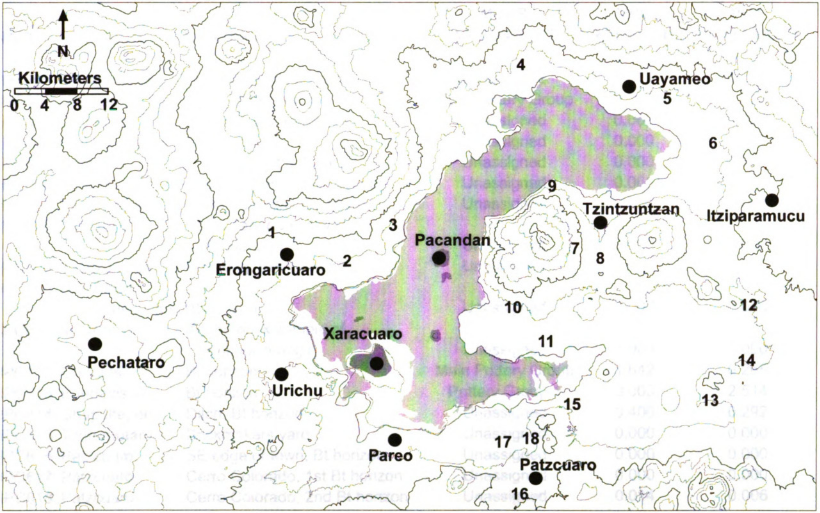


Table 6.2 Original basin clay samples

INAID	LOCATION	CONTEXT	MURR ASSIGNMENT	MPG PROBABILITY	PG1 PROBABILITY
HPC601	Erongaricuaro	Brickmaker, Bt horizon	Unassigned	0.001	0.001
HPC602	Napizero	Ditch, Bt horizon	Main Pottery Group	3.010	0.372
HPC603	Caucuaro	Roadcut, Bt. horizon	Unassigned	0.002	0.020
HPC604	San Jeronimo	Bt horizon	Unassigned	0.000	0.158
HPC605	Santa Fe	Clay mine, Bt horizon	Unassigned	0.000	0.000
HPC606	Quiroga	Brick yard, Bt/argillic horizon	Unassigned	0.063	0.149
HPC607	Tzintzuntzan	Cerro Tariaquri, Bt. Horizon	Unassigned	0.000	0.001
HPC608	Tzintzuntzan	Cerro Tariaquri, clay mine, Bt Horizon	Unassigned	0.000	0.000
HPC609	Tzintzuntzan	Bull Ring, Bt/argillic horizon	Unassigned	0.000	0.000
HPC610	San Pedro Cucuchuchu	Bt horizon	Unassigned	0.007	0.040
HPC611	Ihuatzio	Adobe brick sample of unknown origin	Unassigned	0.000	0.000
HPC612	Corrales	Bt horizon	Main Pottery Group	1.642	0.265
HPC613	Buenavista	Bt horizon	Pottery Group 1	0.000	2.514
HPC614	Chapultepec	Ditch, Bt horizon	Unassigned	0.400	0.292
HPC615	Tzurumutaro	Brickmakers yard	Unassigned	0.000	0.000
HPC616	Patzcuaro	SE edge of town, Bt horizon	Unassigned	0.000	0.000
HPC617	Patzcuaro	Cerro Colorado, 1st Bt horizon	Unassigned	0.000	0.000
HPC618	Patzcuaro	Cerro Colorado, 2nd Bt horizon	Unassigned	0.014	0.006

contemporary clay mines were sampled (sample ID numbers HPU605 and HPU608 in Table 6.2).

The 70 sherds represent six of the most frequent fine ware pastes identified at the site of Urichu (Table 6.3): Yaguarato Cream, Querenda White, Tariacuri Brown, Sipiho Grey, Tarerio Cream, and Tecolote Orange. All of the temporal phases are sampled, though not in great detail. The most common phase represented in the sherd sample is the Tariacuri phase.

The sherds and clays were prepared for analysis and irradiated according to MURR research standards (Glascock 1992, Neff and Glascock 1999). Three gamma counts from both the short poly vial and longer quartz vial irradiations resulted in a suite of 33 elements for further examination. Two elements, nickel and terbium, were discarded because they were below detection limits or were suspected of "systemic analytical error," respectively (Neff and Glascock 1999:3). See Glascock (1992) for further details on MURR experimental standards.

The remaining 31 elements were then analyzed using multivariate statistics and bivariate plots.

> The goal of quantitative analysis of the chemical data is to recognize compositionally homogeneous groups within the analytical database. Based on the "provenance postulate" (Weigand, Harbottle, and Sayre 1977), such groups are assumed to represent geographically restricted sources or source zones. (Neff and Glascock 1999:3-4).

These data were examined using bivariate plots of log-transformed variables and through biplots of the principal components of a principal components analysis.

Table 6.3 Paste by time in MURR analysis

PHASE	PASTE Querenda White	Sipiho Grey	Tarerio Cream	Tariacuri Brown	Tecolote Orange	Yaguarato Cream	Totals
Tariacuri	8	8	6	8	4	5	39
Late Urichu	5	0	0	0	0	4	9
Early Urichu	5	0	0	0	0	2	7
Lupe	2	0	0	0	0	5	7
Jarácuaro	2	0	0	0	0	4	6
Loma Alta 3-Jarácuaro	0	0	0	0	0	2	2
Totals	22	8	6	8	4	22	70

These data yielded eight principal components (Neff and Glascock 1999). Potential group membership was refined on the basis of the Mahalanobis distance statistic and the use of jackknifing to prevent the inclusion of outliers. (See Glascock 1992 for a fuller discussion of the statistics involved in the identification of compositional groups at MURR.)

On the basis of the principal components analysis, three pottery groups were identified: "Main Pottery Group," "Pottery Group One," and "Pottery Group 2." The Main Pottery Group (MPG) was distinguished from Pottery Group One (PG1) and Pottery Group Two (PG2) on the basis of relatively higher portions of rubidium, potassium, thorium, cesium, uranium and tantalum. The MPG also tends to have higher portions of transition metal elements (Hirshman et al. 1999; Neff and Glascock 1999). Figure 6.2 is a biplot of the first two principal components.

PG1 and PG2 are distinguished on the basis of the relative concentration of tantalum. PG1 has a higher concentration than does PG2 (Hirshman et al. 1999; Neff and Glascock 1999). Figure 6.3 is a biplot of the first and eighth principal components.

On the basis of these elemental concentrations, 40 sherds were assigned to the MPG, 18 to PG1, and 5 to PG2. Seven sherds were unassigned, and Neff and Glascock (1999) indicate that they seem to be outliers from the MPG rather than PG1 or PG2. No sherds appear to be from outside of the Basin.

Table 6.4 indicates the distribution of identified paste by MURR group assignment. As one of the questions guiding the sampling of Querenda White

Figure 6.2 Biplot of the first two principal components from the MURR analysis (after Neff and Glascock 1999, Figure 1)

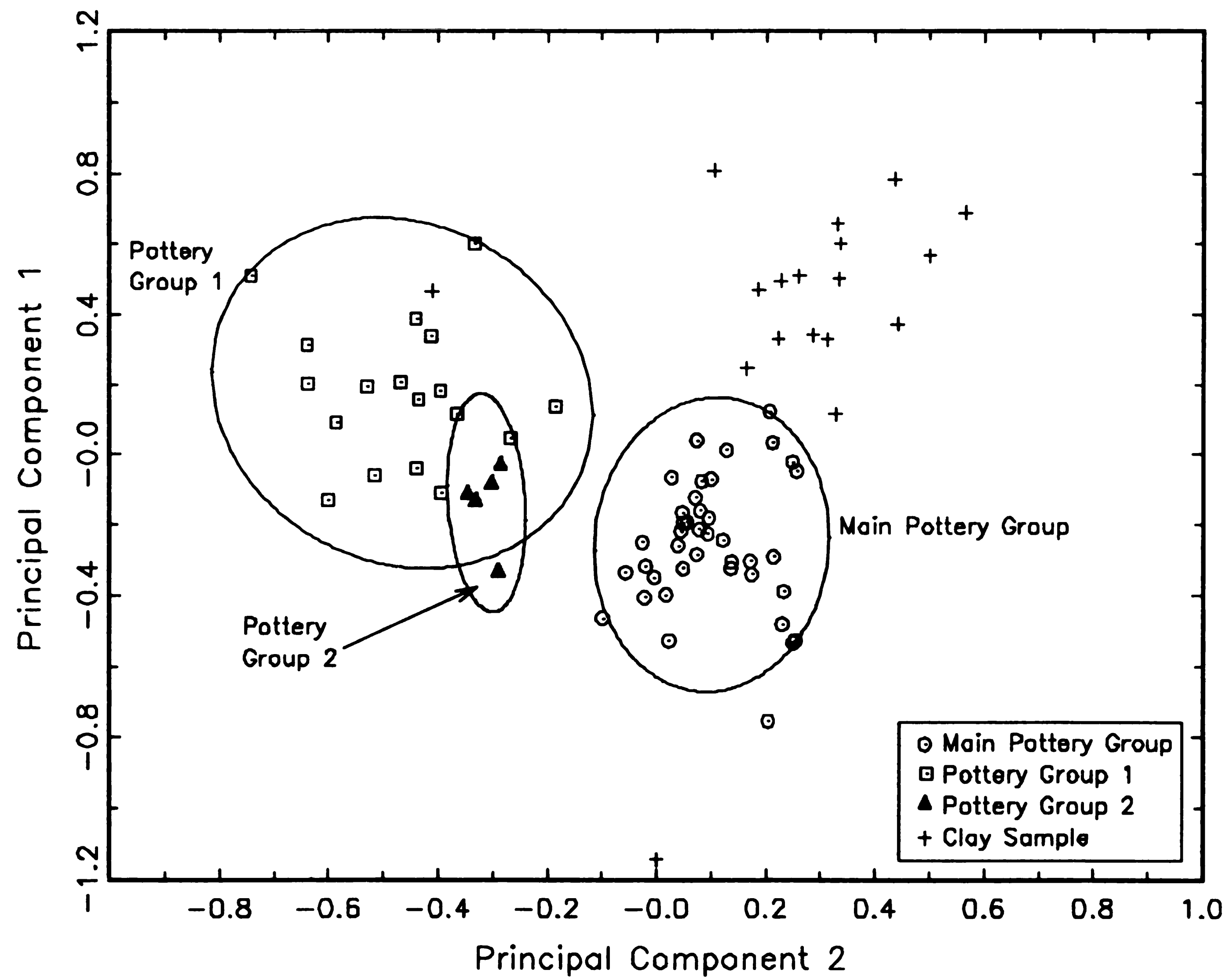


Figure 6.3 Biplot of the second and eight principal components from the MURR analysis (after Neff and Glascock 1999, Figure 3)

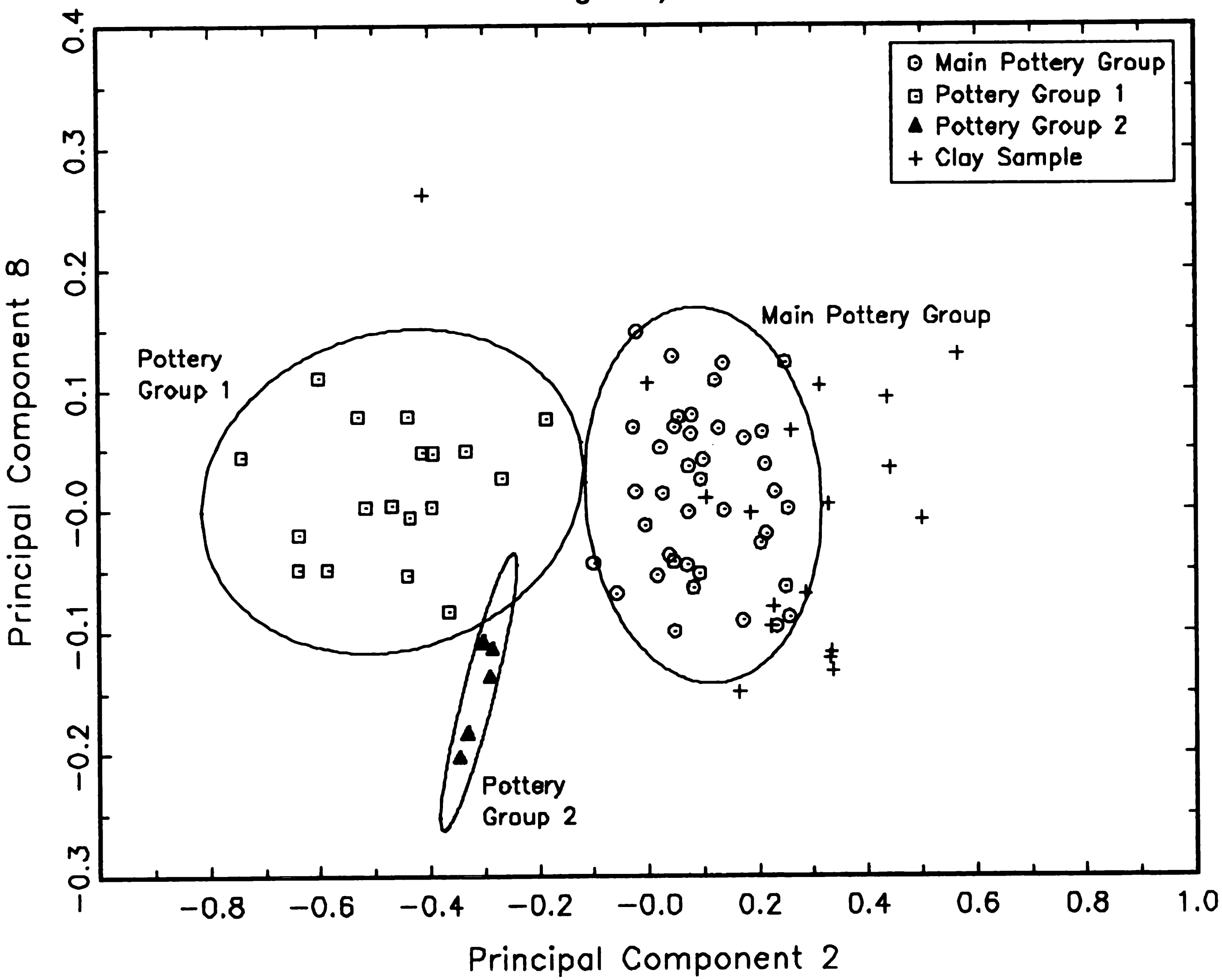


Table 6.4 MURR group assignment of paste

PASTE	MURR GROUP Main Pottery Group	Pottery Group1	Pottery Group 2	Unassigned	Totals
Querenda White	9	11	0	2	22
Sipiho Grey	4	4	0	0	8
Tarerio Cream	0	1	5	0	6
Tariacuri Brown	5	0	0	3	8
Tecolote Orange	1	2	0	1	4
Yaguarato Cream	21	0	0	1	22
Totals	40	18	5	7	70

and Yaguarato Cream was whether they form two different groups (Hirshman et al. 1999), it is interesting to note that Yaguarato Cream only occurs within the MPG. Querenda White occurs in both the MPG and PG1, though it is somewhat more abundant in PG1.

Of the 18 clay samples, only three could be assigned to a pottery group. Samples HPC602 and HPC612 exceed a 1% probability for inclusion based on the first eight principal components. HPC602, the clay with the better fit, comes from the southwestern portion of the Basin near Urichu. The third clay sample, HPC613, falls within the range of variation for PG1. It comes from Buenavista in the southeastern portion of the basin, and from this match it seems likely that PG1 has a southeastern provenience (refer to Table 6.1).

From these results, several preliminary conclusions can be drawn (cf. Hirshman et al. 1999; Pollard et al. 2001; Neff and Glascock 1999). First, all of the samples, particularly the sherds, appear to have their origin within the Basin. Neff and Glascock (1999) indicate that the clays largely differ from the sherds in that the sherds seem diluted with regard to their constituent elements as opposed to the clays, and that tempering materials can be responsible for this dilution.

Second, the MPG occurs in all time periods at Urichu (Table 6.5), and coupled with a clay sample from the southwestern portion of the basin, indicates it is produced locally near or at Urichu. Its persistence into the Tariacuri phase, which is concurrent with the emergence of the Tarascan state, is an indicator of

Table 6.5 MURR group assignment by phase

PHASE	MURR GROUP Main Pottery Group	Pottery Group 1	Pottery Group 2	Unassigned	Totals
Tariacuri	18	12	5	4	39
Late Urichu	4	2	0	3	9
Early Urichu	3	4	0	0	7
Lupe	7	0	0	0	7
Jarácuaro	6	0	0	0	6
Loma Alta 3-Jarácuaro	2	0	0	0	2
Totals	40	18	5	7	70

the persistence of local ceramic production and the continuity of the ceramic tradition.

Third, PG2 is identified at Urichu only from the Epiclassic period onward. It is distinct from the southwestern portion of the basin and includes decorated wares. Pollard notes that this grouping of four pastes is similar to the Coyoatlatelco ware of the Epiclassic and Early Postclassic (Pollard et al. 2001). It is probably imported into Urichu. Its presence at Urichu may indicate an increase in canoe traffic and market exchange in the lake basin. A market is known from the ethnohistorical sources at Pareo (Gorenstein and Pollard 1985; RM 1980), which is to the east of Urichu.

There is a change in the scale of ceramic exchange within the state (Pollard et al. 2001). In the Classic period, all of the ceramics at Urichu are local. In the Epiclassic non-local ceramics are introduced. By the Late Postclassic, the ceramics are a mix of local, represented by the MPG, and imported, represented by both PG1 and PG2.

Fourth, PG2, although small, is constrained by time and location. All of these sherds, identified as the paste Tarerio Cream, are from Area 5, in front of a small *yacata*, or pyramid, associated with state ritual. They were all thin-walled, closed vessels, most likely jars with everted, bolstered rims. It is possible these sherds represent specialized production for ritual use. It is more likely that they have an origin in the southeastern portion of the lake basin and were acquired by Urichu consumers through a market system (based on canoe traffic), probably at Pareo, to the east of Urichu.

These results are important and tantalizing, but preliminary due to the small number of sherds involved in the study. An opportunity to expand this initial study with 59 additional sherds and 6 soil samples enabled the refinement of two of these conclusions, albeit in a continued "preliminary" fashion.

FNR INAA RESULTS

Seventeen sherds from the surface collection from were prepared, irradiated, and tentatively analyzed at FNR in 1994. They were a particularly small and statistically insignificant sample on their own. However, coupled with 42 additional Tzintzuntzan sherds and six soil samples from Urichu, they comprise an excellent limited addition to the work at MURR.

The 17 sherds were chosen by Dr. Helen Pollard to test a range of variation in the most common fine wares found at Tzintzuntzan. The 42 additional sherds were chosen to further understanding of the composition of the MURR pottery groups, the MPG and PG1. Therefore, only three pastes were chosen: Querenda White, Tariacuri Cream, and Tariacuri Brown. The six soil samples come from excavated contexts at Urichu. They represent three Purépecha soil categories: *charanda* (two samples), *uiras* (three samples) and *tupuri* (one sample). All came from between 45 cm and 120 cm below the surface from excavations at Urichu.

These 42 sherds were prepared according to MURR standards in the sherd preparation laboratory at the University of Michigan by this author under the direction of Dr. Leah Minc. The clay samples were also prepared under the direction of Dr. Leah Minc. The ceramic and clay samples were irradiated and counted according to FNR standards. The results were adjusted according to inter-lab calibrations (based on Ohio Red clay; cf. Table 6.6).

While the MURR analysis used 31 of the 33 elements available to them, the analysis involving the FNR sherds used a smaller suite of elements. Nickel and terbium were not used by MURR, and they were also not of use in the FNR results. Additionally, seven other elements were excluded because their concentrations were below the detection limits of FNR. The elements removed from the analysis were: antimony, arsenic, calcium, neodymium, potassium, uranium, and zirconium. A suite of 24 elements remained.

The FNR sherds were tested against the pottery groups of the MURR analysis, as two MURR pottery groups (MPG and PG1) had a sufficient number of members for the core of the groups to be well established. The third MURR pottery group, PG2, has only five members, and as such is not as well defined. However, none of the FNR sherds fell within the parameters of PG2.

In order to compare the FNR sherds to the MURR groups, all of the sherds were subjected to a Principal Components Analysis. Five principle components were identified. The first four were chosen on the basis of an Eigen value above 1.0. The fifth was very close to 1.0 and also loaded high on cobalt, sodium and vanadium. Table 6.7 includes the Eigen values for the first five principal components (Prin1 to Prin 5) and the total structure coefficients for the elements. (A total structure coefficient is the correlation between the variable and the principle component.)

Table 6.6 FNR to MURR conversion factors based on New Ohio Red Clay[j]

ELEMENT[(a)]	LINE & ANALYSIS	FNR MEAN	MURR MEAN (N=175)	CONVERSION FACTOR FNR--->MURR[(b)]
Al (N=46)	Pt, @ 1779	97339	94986	0.976
As (N=92)	W1, @ 559	14.83	14.8	0.998
Ba (N=86)	W5, @ 496	592.1	611.3	1.032
Ca (N=17)	Pt, @ 3084	1450	1340	0.924
Ce (N=86)	W5, @ 145	111.3	112.3	1.009
Co (N=86)	W5, @1173	22.89	22.6	0.987
Cr (N=86)	W5, @320	90.33	90.3	1.000
Cs (N=86)	W5, @ 795	10.07	10.14	1.007
Dy (N=43)	H1, @ 94.7	7.25	7	0.966
Eu (N=86)	W5, @1408	1.72	1.72	1.000
Fe (N=86)	W5, @ 1099	50772	50498	0.995
Hf (N=86)	W5, @ 482	7.39	7.34	0.993
K (N=46)	H1, @1524	36265	34520	0.952
La (N=92)	W1, @1596	50.79	50.1	0.986
Lu (N=92)	W1, @ 208	0.59	0.587	0.995
Mn (N=46)	H1, @ 846.8	265.6	261	0.983
Na (N=91)	W1, @1368	1452	1375	0.947
Nd (N=87)	W1, @ 531	46.27	47.2	1.020
Ni (N=73)	W5, @ 810	73.44	74.7	1.017
Rb (N=86)	W5, @ 1076	180.2	181	1.004
Sb (N=86)	W5, @1691	1.14	1.1	0.965
Sc (N=86)	W5, @889	18.28	18.3	1.001
Sm (N=92)	W1, @103	9.51	9.25	0.973
Sr (N=11)	W5, @ 514	59.5	51.3	0.862
Ta (N=86)	W5, @ 1221	1.5	1.48	0.987
Tb (N=86)	W5, @ 879	1.23	1.24	1.008
Th (N=86)	W5, @ 312	15.32	14.85	0.963
Ti (N=46)	Pt, @ 320.1	6621	6134	0.926
U (N=92)	W1, @228	3.36	3.3	0.982
V (N=46)	Pt, @ 1434.1	208.6	202.7	0.972
Yb (N=86)	W1, @ 396	4.4	4.31	0.980
Zn (N=86)	W5, @ 1115	85.05	93.5	1.099
Zr (N=73)	W5, @ 756	192.3	180.6	0.939

[(a)] Numbers reflect sample size for FNR analyses.

[(b)] FNR x conversion factor MURR

Table 6.7 Principal components analysis on FNR sherds

	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5
Eigenvalue	10.6632	5.5367	1.9902	1.4056	0.9438
Percent	44.4301	23.0696	8.2924	5.8566	3.9323
Cum Percent	44.4301	67.4997	75.7921	81.6487	85.5811

TOTAL STRUCTURE COEFFICIENTS

	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5
La	0.4282	0.6965	-0.4177	0.0379	-0.1402
Lu	0.8934	0.2057	-0.1851	0.0457	0.0918
Sm	0.7405	0.462	-0.3382	0.1437	0.0141
Yb	0.9244	0.2495	-0.1249	0.049	0.0417
Ce	0.3069	0.7782	-0.2625	-0.2572	0.0698
Co	-0.4124	0.7946	-0.0742	-0.2533	0.1491
Cr	-0.4304	0.6125	0.4379	-0.0395	0.0483
Cs	0.8351	0.0959	0.3448	-0.0012	-0.0971
Eu	-0.5630	0.4703	-0.5592	0.1169	-0.0881
Fe	-0.5809	0.7357	0.2409	0.0878	0.0182
Hf	0.8692	0.2928	0.3454	-0.0743	0.0318
Rb	0.8836	0.0667	0.1140	0.0663	-0.0375
Sc	-0.7621	0.5020	0.0654	0.2272	0.0280
Ta	0.9122	0.1756	0.2909	-0.0234	0.0728
Tb	0.8443	0.3298	-0.1856	0.0610	0.0479
Th	0.9105	0.2118	0.2832	-0.1196	-0.0218
Zn	0.3822	0.4048	0.1813	0.5562	0.2288
Al	-0.3245	0.4027	0.3390	0.5508	0.1295
Ba	-0.2303	0.3210	-0.1995	0.5120	-0.5632
Dy	0.8997	0.2530	-0.0578	0.0263	0.0193
Mn	-0.2679	0.6970	-0.3117	-0.3477	0.1457
Na	-0.2023	-0.3830	-0.3443	0.3337	0.6520
Ti	-0.5791	0.6357	0.2961	-0.0716	-0.0657
V	-0.6512	0.5417	0.2561	-0.1808	0.1349

24 rows not used due to missing values.

Using the principal components, the Mahalanobis distances for the core MURR MPG and PG1 were calculated. Then each FNR group was individually compared to the core groups to determine the probability of their inclusion in one of the two groups. Using a cut off p-value of 0.05 (5%), 30 sherds were assigned to the MPG and 26 were assigned to PG1. Three sherds were unassigned. Of the six soils, two (one *charanda* and one *tupuri*) were assigned to the MPG (although they could possibly be assigned to PG1) and none were assigned to PG1. Four soils—all three *urias* and one *charanda*—were unassigned. These results indicate the robustness of the initial MURR groups, despite the relatively low numbers in the initial analytic sample. Table 6.8 includes the probability of inclusion for the two MURR groups. Table 6.9 is a summary of the inclusion of different pastes of the FNR sample into the MURR groups. Figure 6.4 shows the relationship of the MURR and FNR sherds in the first two principal components.

These results bear upon the previous MURR findings. First, the division between Querenda White and Yaguarato Cream is strengthened by the results from this sherd sample.

Second, the assignment of the two Urichu soils to the MPG strengthens the conclusion that the MPG is indicative of production at or near Urichu. The p-values are high enough for both pottery groups for inclusion into either group, but the p-values are so high for the MPG that they seem to fit best within the MPG. The lack of fit of the *urias* soil samples seems to indicate that this soil was not used for ceramic production.

Table 6.8 FNR sherd and soil probabilities for inclusion into pottery groups

INAID	MATERIAL	LOCATION	PASTE	GROUP	PROB (PG1)	PROB (MPG)
TZ-401	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.9104	0.0001
TZ-402	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.4858	0.0001
TZ-403	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.8262	0.0000
TZ-404	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.2011	0.0029
TZ-405	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.4482	0.0000
TZ-406	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.2891	0.0000
TZ-407	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.9146	0.0000
TZ-408	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.1587	0.0000
TZ-409	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.5326	0.0000
TZ-410	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.3924	0.0006
TZ-411	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.4443	0.0000
TZ-412	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.9536	0.0000
TZ-413	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.6682	0.0000
TZ-414	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.3321	0.0000
TZ-415	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.5099	0.0000
TZ-416	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.6352	0.0000
TZ-417	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.4780	0.0000
TZ-418	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.7994	0.0003
TZ-419	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0003	0.1187
TZ-420	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0030	0.3984
TZ-421	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0024	0.4877
TZ-422	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0039	0.5653
TZ-423	Pottery	Tzintzuntzan	Yaguarato Cream	Unassigned	0.0004	0.0003

Table 6.8 (cont'd)

INAID	MATERIAL	LOCATION	PASTE	GROUP	PROB (PG1)	PROB (MPG)
TZ-424	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0246	0.4912
TZ-425	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0321	0.7916
TZ-426	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0237	0.0751
TZ-427	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0094	0.4782
TZ-428	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0087	0.7460
TZ-429	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0347	0.4956
TZ-430	Pottery	Tzintzuntzan	Yaguarato Cream	Pottery Grp. 1	0.1462	0.0342
TZ-431	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0080	0.4029
TZ-432	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0446	0.0794
TZ-433	Pottery	Tzintzuntzan	Yaguarato Cream	Pottery Grp. 1	0.0821	0.0015
TZ-434	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0799	0.9941
TZ-435	Pottery	Tzintzuntzan	Yaguarato Cream	Pottery Grp. 1	0.3072	0.0233
TZ-436	Pottery	Tzintzuntzan	Tariacuri Br	Main Pottery	0.0005	0.0512
TZ-437	Pottery	Tzintzuntzan	Tariacuri Br	Unassigned	0.0040	0.0030
TZ-438	Pottery	Tzintzuntzan	Tariacuri Br	Main Pottery	0.0031	0.4713
TZ-439	Pottery	Tzintzuntzan	Tariacuri Br	Main Pottery	0.0042	0.1013
TZ-440	Pottery	Tzintzuntzan	Tariacuri Br	Main Pottery	0.0369	0.2086
TZ-441	Pottery	Tzintzuntzan	Tariacuri Br	Main Pottery	0.0016	0.1207
TZ-442	Pottery	Tzintzuntzan	Tariacuri Br	Main Pottery	0.0099	0.5377
TZ-443	Clay	Urichu	Clay	Unassigned	0.0005	0.0017
TZ-444	Clay	Urichu	Clay	Main Pottery	0.2067	0.8365
TZ-445	Clay	Urichu	Clay	Unassigned	0.2392	0.4072
TZ-446	Clay	Urichu	Clay	Main Pottery	0.0374	0.7041

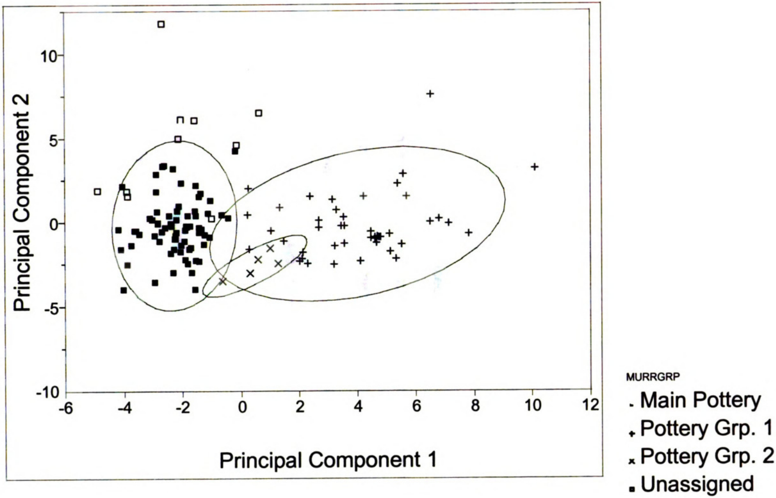
Table 6.8 (cont'd)

INAID	MATERIAL	LOCATION	PASTE	GROUP	PROB (PG1)	PROB (MPG)
TZ-447	Clay	Urichu	Clay	Unassigned	0.0000	0.0008
TZ-448	Clay	Urichu	Clay	Unassigned	0.0004	0.0017
TZ.01	Pottery	Tzintzuntzan	Tariacuri Brown	Main Pottery	0.0006	0.2425
TZ.02	Pottery	Tzintzuntzan	Tariacuri Brown	Main Pottery	0.0003	0.1072
TZ.03	Pottery	Tzintzuntzan	Tariacuri Brown	Main Pottery	0.0018	0.1724
TZ.04	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0020	0.2586
TZ.05	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0136	0.6003
TZ.06	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0054	0.3055
TZ.07	Pottery	Tzintzuntzan	Yaguarato Cream	Main Pottery	0.0109	0.5176
TZ.08	Pottery	Tzintzuntzan	Sipiho Grey	Main Pottery	0.0031	0.0759
TZ.09	Pottery	Tzintzuntzan	Sipiho Grey	Main Pottery	0.0091	0.2244
TZ.10	Pottery	Tzintzuntzan	Sanabri	Unassigned	0.0001	0.0000
TZ.11	Pottery	Tzintzuntzan	Sanagria	Pottery Grp. 1	0.2978	0.0005
TZ.12	Pottery	Tzintzuntzan	Patambicho	Main Pottery	0.0078	0.7735
TZ.13	Pottery	Tzintzuntzan	Tarerio Cream	Main Pottery	0.0043	0.0473
TZ.14	Pottery	Tzintzuntzan	Tecolote Orange	Pottery Grp. 1	0.0696	0.0000
TZ.15	Pottery	Tzintzuntzan	Tecolote Orange	Pottery Grp. 1	0.4287	0.0000
TZ.16	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.5066	0.0001
TZ.17	Pottery	Tzintzuntzan	Querenda White	Pottery Grp. 1	0.1899	0.0002

Table 6.9 FNR assignment to MURR group

PASTE	MURR GROUP Main Pottery Group	Pottery Group 1	Unassigned	Totals
Patambicho	1	0	0	1
Querenda White	0	20	0	20
Sanabria Red	0	1	1	2
Sipiho Grey	2	0	0	2
Tarerio Cream	1	0	0	1
Tariacuri Brown	9	0	1	10
Tecolote Orange	0	2	0	2
Yaguarato Cream	17	3	1	21
Totals	30	26	3	59

Figure 6.4 MURR and FNR sherd assignments for MPG, PG1, PG2
(with 95% confidence ellipses)



Third, the assignment of sherds from Tzintzuntzan to pottery groups defined by Urichu sherds indicates that the vessels that were generally obtained at Tzintzuntzan were not being locally produced, but rather were being produced at least within the southwestern and southeastern portions of the basin. Three Tzintzuntzan clay samples were run in the initial MURR analysis. None of those samples fit within the MPG or PG1.

Fourth, a question is raised regarding whether or not ceramics were being produced at Tzintzuntzan. The absence of a Tzintzuntzan-oriented production zone at this point is not sufficient evidence for the lack of Tzintzuntzan production because the samples are small. However, it does seem to indicate that the generally consumed ceramics at Tzintzuntzan were obtained through a basin-wide market network and were not locally produced. It remains to be seen whether the elite vessels recovered from Tzintzuntzan burials indicate the same patterns, or if they were produced locally, presumably by artisans attached to the state apparatus. But so far the paste evidence indicates there was not a marked spatial centralization of ceramic production with the emergence of the state.

PASTE STANDARDIZATION

While the pastes appear to be relatively stable over time, how standardized are they? There is no common test for the standardization of pottery, but it is useful to explore the elemental variability in the two key pottery groups, MPG and PG1. Due to their low frequency, the samples will be consolidated into two groups for comparison: pre-state and post-state.

Changes in elemental concentrations in the two composition groups are compared using the Coefficient of Variation. It is expected that the C.V. for each composition group will decrease with greater production specialization, as there are fewer potters working with greater intensity. Table 6.10 provides the pre- and post-state C.V.s for each element within the two composition groups. Sixteen elements are larger in the post-state context for the MPG; fifteen are larger for PG1. Clearly, these are not highly standardized composition groups in either temporal context. Neither composition group becomes more standardized with the emergence of the state.

CONCLUSIONS

Three general conclusions can be drawn from this admittedly preliminary chemical signature analysis of sherds from Urichu and Tzintzuntzan. First, there is evidence for the persistence of the production of ceramics in or around Urichu throughout the excavated sequence. This local production does not seem to change in terms of its standardization. Additionally, the local production becomes part of the larger ceramic market network within the basin and are consumed at Tzintzuntzan.

Second, early in the sequence there is evidence of ceramics being moved within a market system. The co-occurrence of the MPG and PG1 sherds at both Urichu (for multiple temporal phases) and Tzintzuntzan (for the last temporal phase) indicates ceramics were moved within the basin irrespective of rank in the political organization of the basin as a whole.

Table 6.10 Comparison of MPG and PG1 elemental C.V.

ELEMENT		MPG PRE	MPG POST	PG1 PRE	PG1 POST
Lanthanum	La	16.68	16.16	18.80	17.64
Lutetium	Lu	19.24	24.19	21.24	25.57
Samarium	Sm	16.61	19.32	23.95	20.47
Ytterbium	Yb	16.70	19.88	25.06	24.26
Cerium	Ce	24.29	29.12	43.80	22.53
Cobalt	Co	44.76	33.06	100.88	50.30
Chromium	Cr	18.28	32.48	16.79	30.01
Cesium	Cs	20.98	29.72	9.40	17.29
Europium	Eu	13.28	12.19	21.24	21.83
Iron	Fe	15.70	12.89	20.88	17.11
Hafnium	Hf	12.11	14.46	10.26	17.03
Rubidium	Rb	19.70	38.77	7.73	22.05
Scandium	Sc	13.00	11.12	18.95	18.38
Tantalum	Ta	20.28	25.64	14.66	24.84
Terbium	Tb	19.25	21.66	22.09	22.30
Thorium	Th	18.44	20.42	11.53	20.65
Zinc	Zn	24.92	25.39	8.80	18.31
Aluminum	Al	10.94	7.42	7.04	7.97
Barium	Ba	31.47	33.89	12.53	34.67
Dysprosium	Dy	17.69	20.43	19.00	23.65
Manganese	Mn	55.86	41.53	101.56	56.88
Sodium	Na	13.41	19.11	13.55	16.90
Titanium	Ti	14.28	17.98	13.96	18.30
Vanadium	V	14.21	13.85	25.47	20.12

Third, PG2 indicates that there might have been some specialized production of ritual ceramics. The occurrence of this pottery group in a ritual context suggests special use. However, there is nothing to suggest that this group was moved to Urichu in any manner other than through the market system. While it is possible that this pottery group indicates a subtle shift in ceramic production that occurred with the development of the state, there is currently insufficient evidence of any type of production re-organization.

This study opens avenues for future chemical and petrographic analysis. First, the basin as a whole needs to be analyzed for the chemical signatures of its soils. Ideally, a sampling of soils by individual water runoffs would allow for the strong identification of clay chemical zones, which can then be related to ceramics. The potential for such zones is evidenced by the two zones identified with the MPG and PG1, and also by the lack of fit between the pottery groups and of most of the basin clay samples from the MURR study. Along with this is needed a petrographic analysis of the naturally occurring inclusions in the basin clays and their comparison to the ceramics themselves. Neff and Glascock (1999) indicate that the ceramics appear to be diluted relative to the clays. In that case, are the inclusions truly natural? Or were the potters mixing clays, as is known from Foster's ethnographic work at Tzintzuntzan (Foster 1945).

Second, the lack of a Tzintzuntzan group is very surprising. It is possible that the pastes sampled simply were not Tzintzuntzan-produced sherds. It will be important to characterize the elite vessels from Tzintzuntzan burials and compare them with a fully characterized Tzintzuntzan resource zone. It may be that there were no ceramicists attached to the elite in Tzintzuntzan, but that seems rather odd, especially given Tzintzuntzan's current status as a pottery production center.

Despite the preliminary nature of this INAA study and the questions it raises, the results of this study are similar to that of the categorical sherd data in Chapter Five. There is a marked persistence and continuity in the ceramics at Urichu indicative of long-term ceramic production stability.

ENDNOTES

[i] Information from Minc, personal communication 2002.

CHAPTER SEVEN

CERAMIC PRODUCTION ORGANIZATION: THE VIEW FROM URICHU

This dissertation dealt with the organization of craft, specifically ceramic, production as evidenced in the ceramics from Urichu, a site from the core Tarascan region in the Lake Pátzcuaro Basin. It is a valuable case study for testing the competing theories of social evolution and political economy regarding the emergence of social complexity and craft specialization. This Tarascan case is a complementary case study to other, better known Mesoamerican examples of primary state formation from the Valley of Mexico and the Yucatan.

The competing theories of the emergence of social complexity are predicated on the assumption of craft producer specialization emerging with the state. Specialization is measured here along four dimensions: labor investment, intensity of production, product standardization, and concentration of production. This chapter reviews the organization of craft production, specifically the production of ceramic vessels, in the cultural sequence prior to and including the emergence of the Tarascan state. The results of this study indicate an inherent stability of the products of production processes through the temporal phases under review. This is contrary to the expectations of the key theoretical models regarding the emergence of social complexity.

CERAMIC PRODUCTION AND CULTURAL CHANGE WITHIN THE LAKE PÁTZCUARO BASIN

The cultural sequence at Urichu involves six phases identified on the basis of carbon dates and changing cultural materials. There is no major political reorganization of the Lake Pátzcuaro Basin prior to the emergence of the Tarascan state at AD 1350, in the Late Postclassic period. Prior to that time there are changes in the activity and status of the elites, but there is no basin unification. Elites are already present in the Loma Alta 3-Jarácuaro phase and steadily grow in rank and status from that point. A change in regional elite activity occurs at the end of the Epiclassic period, and this change is evidenced in the basin with a cessation of tomb burial practices (Pollard and Cahue 1999). There is also within the basin a change in the lake levels, with levels beginning to increase in the Early Postclassic.

The second phase of elite activity within the Pátzcuaro Basin is associated with the formation of the Tarascan state, which is placed at AD 1350. Ruling from Tzintzuntzan, the Tarascan elite incorporated the elites from other sites within the basin prior to their expansion of the state into an empire. The elite whole vessels known from this period are highly identifiable: well-made tripod bowls or stirrup-handled spouted vessels with red and white paint, resist, and polish. They are bold, vivid, unmistakable and unlike ceramics elsewhere. They also lead us to expect a definitive change in the ceramic production process: a change concurrent with the emergence of the Tarascan state. Comparison with the key Tarascan material categories of metal, obsidian, and agriculture additionally strengthens the expectation of the reorganization of ceramic production with the emergence of the state.

But does the expectation of ceramic production reorganization, based upon theory and material categories, really work when an assemblage is tested? Social evolutionary theory predicts increasing producer specialization and standardization of product, culminating in full-time producers working within state-level societies. Political economic theory predicts specialized production associated with elite activity for elite ends. Efficient, standardized production is not expected as much as elaborated, information-laden vessels for elite ritual and domestic consumption. As elites become active, greater specialization is expected, with greater specialization with the state. Four dimensions of ceramic production were tested in this dissertation. Each dimension has different expectations given the larger theoretical expectations (cf. Table 2.1).

Labor investment decreases continually from the Loma Alta 3-Jarácuaro phase until through the Early Urichu phase, even with increasing elite activity within the Lake Pátzcuaro Basin. With the Late Urichu phase there appears to be an increase in the amount of labor input, such as an increase in the number of paint colors or the rise in the percentage of polished sherds. However, as evidence by the mix of ceramics in the commoner contexts of Late Urichu and Tariacuri Area 2, there are also signs of continuing laborsaving techniques, such as the high percentage of wiped sherds. The continuation of the laborsaving techniques is expected within the social evolutionary model. The labor investment and elaboration of fine wares is expected within the political economy models. What is unexpected is the relatively high portion of elaborated sherds within the commoner Tariacuri Area 2 context: fine wares were not restricted in their distribution, indicating commoner access.

The intensity of production was tested using clusters of sherds from each phase. Clusters derived from cluster analysis have intrinsic properties, including geometric dimensions (volume). Clusters were generated using multistate character (nominal) data from the sherd assemblage from Urichu. Each type of vessel body part—rims, supports, and bodies—were clustered separately, by temporal phase. The within cluster error sum of squares (ESS) from each cluster was measured and tested to determine the amount of variation within each temporal phase. Variation generally declined from Loma Alta 3-Jarácuaro phase through the Early Urichu phase. Variation grew again in the Late Urichu and various Tariacuri phases. The differences in the cluster ESS means was not significant in the body or support sherds, but was significant in the rim sherds. On the assemblage level, decreasing variation indicates increasing ceramic homogeneity and possible production contraction. While this steady decline in variation coincides with the growth of social ranking and the eventual emergence of the state, there is apparently little direct impact upon the organization of ceramic production with the growing elite presence. Variation increases once again with the Late Urichu phase, with is being largest in the Tariacuri Area 2 commoner context. This increase in variation is possibly due to elaboration of certain elite-oriented ceramic types, but it is not restricted to elite contexts. As with the results of the test of labor investment, it would appear as though commoners had access to a wide range of ceramic materials, resulting in a varied and diversified ceramic assemblage.

A limited test of two specific constriction-rim forms (closed-everted and open-straight) also indicates greater variation in the Tariacuri phase than earlier. The open-convex rim demonstrated a nearly reverse pattern, though there is again a slight difference between pre-state and post-state forms.

Rathje (1979) and Rice (1981) both argue that there should be a change in the overall diversity, or choices, of a ceramic assemblage as the ceramic tradition moves towards greater social complexity. The number of choices should increase as more producers enter the marketplace, but should level off as both the number of producers stabilize and the market becomes entrenched within a state context. The "rate" of cluster formation in this study, a proxy for the varied choices consumers would have had in the marketplace, indicates that there was little change in the choices of closed vessels. This is not overly surprising, as these vessels would predominantly be for cooking, storage, and household tasks. However, there is a little more variation in the rim and supports sherds: sherds that reflect food serving and ritual in the culture. Both have a greater number of choices occurring at a higher level than that of the closed vessels (Figure 5.4). For the rims, the "rate" of choice is low in the Lupe and Early Urichu phases (T3 and T4). This coincides with the phases of lowest cluster variation (despite the large datasets for these phases). The lowest "rates" occur in the Tariacuri phase, in Areas 2 (T7) and 5 (T8). Area 2 was a commoner residential zone, and would not be expected to have a large variety of serving and ritual vessels. Area 5 was both a ritual zone associated with the state and with a residential association in the Tariacuri phase.

Product standardization was tested through the use of INAA. Using two pottery groups defined in a prior INAA study using Urichu ceramics, ceramics from Tzintzuntzan were also assigned to the groups. The groups were then tested for elemental standardization using the Coefficient of Variation and compared as pre-state and post-state groups. It was evident that these pastes were relatively stable through time and demonstrated internal cohesion, though they were not particularly standardized. The changes evidenced with the state were not significant enough to form new compositional groups. The lack of significant change in the pottery groups over time indicates the persistence of ceramic paste "recipes" and production-specific locales throughout the temporal sequence. The various pastes tend to pattern within the compositional groups. Since the pastes cross-cut the various clusters (Chapter Five), indicating that pastes are not closely identified with particular vessel forms, it is further evidence for the lack of strong standardization within the sherd assemblage at Urichu.

A test of the concentration of production, based on the provenance of the pottery groups, demonstrated several points. First, the Main Pottery Group is associated with the southwestern portion of the basin, in or around Urichu. Second, Pottery Group 1 is associated with the southeastern portion of the basin. Over time, Pottery Group 1 is introduced to the site of Urichu. It is highly likely that this was due to marketing within the basin, especially as ceramics would be easier to move via canoe within the basin, and meets the expectation of the social evolutionary model, that increasing numbers of production loci indicates more producers competing within a market context. The assignment of Tzintzuntzan sherds to the two pottery groups suggests that ceramic production was not centralized to the elite capital, but rather remained in the long-term production loci. While this is not definite proof, this indication is contrary to the political economy model expectation of production centralization under elite rule.

The four dimensions under consideration indicate a mix of production strategies and not one dominant pattern of production organization. A number of material expectations of the social evolutionary model are met: decreased labor investment, increasing group homogeneity, product standardization, and increased production loci. However, none of these trends are definitive, only indicative, and hard to discern with the emergence of the state, the point at which all of these trends should be at their greatest. For at the same time, some of the material expectations of the political economy model are also met: no overall significant change in labor investment in non-elite ceramics, elaboration with elite activity corresponding to the emergence of the state (but not in the earlier period of elite activity). However, there is also no as yet discernible change in ceramic production toward Tzintzuntzan, nor is there seemingly any control over the ceramics available in the market system.

Indeed, markets form a backdrop to this study. If the proveniences of the MURR pottery groups is verified in future studies, then there are at least two key zones of ceramic production: in the southwestern portion of the basin (associated with the Main Pottery Group), located in or near Urichu, and in the southeastern portion of the basin (associated with Pottery Group 1). The latter group shows up in Urichu in the Postclassic period, in the Early Urichu phase, and continues throughout the rest of the sequence. The appearance of Pottery Group 1 may indicate a growth in the basin market system, particularly the market at Pareo, which is known from the ethnohistorical record (Gorenstein and Pollard 1983).

A market system would also account for the presence of Main Pottery Group and Pottery Group 1 sherds at Tzintzuntzan, and an apparent absence of locally produced sherds at that site. The sherds for the FNR portion of the INAA study came from a surface collection that was intentionally biased toward the collection of fine ware sherds. For such fine wares at the Tarascan capital to actually come from a non-capital context indicates the low priority the elites felt for the control of the ceramic production process. This fits neatly with Versluis' findings that the Tarascan iconography was not standardized, but was rather "in process" (1994). Versluis' sample of whole vessels was drawn from both Urichu and Tzintzuntzan. The importance of a market system rather than an attached production context for elite status goods such as Tarascan fine ware ceramic vessels would support the social evolutionary assumption of elites as market managers more than the political economy model of elites as usurping market forces for their own social gain. However, given the larger context of elite control over metals, obsidian, and their reliance on tribute maize, it would appear as though ceramics were not as important to their political and social control. This conclusion needs to be tested against a fuller characterization of Tzintzuntzan soils and the characterization of ceramics from Tzintzuntzan's burials and elite contexts. It may be that there were a small number of attached ceramicists who created very special purpose vessels such as those found in burials on Tzintzuntzan's main ceremonial platform.

Conversely, ceramics may have moved to Tzintzuntzan as part of a within-basin tribute system. Such a system is little known and understood (cf. Beltran 1982; Paredes 1984). However, it is known from the Caravajal Visita (Warren 1985) that such a system existed. Additionally, it is known that Urichu, among a number of communities, paid tribute to Erongarícuaro, and that Erongarícuaro paid tribute to Tzintzuntzan. This within basin tribute system could also account for both the continuity of production loci, the increased labor investment in elite fine wares, and the presence of elaborated sherds in commoner contexts.

As the comparison of ceramics to other categories of elite material goods indicated, ceramics may not be important enough to the Tarascan elites to warrant direct control. Versluis's (1994) conclusions regarding Tarascan fine ware iconography was that it was only becoming standardized, but that it was not in actuality standardized. In other words, the Tarascan ceramics were created in response to larger social and political changes, but were not in themselves key indicators of those changes.

CERAMIC SPECIALIZATION AND STATE FORMATION

A striking observation regarding the ceramic sequence and the results of this study is the continuity expressed by the ceramic assemblage. Pollard expressed such an observation (Pollard 2001b) and this study proves the veracity of that observation. There are changes, but none are indicative of a re-organization of the ceramic production context or process.

Question of Ceramics as Indicators of Social and Political Change

The lack of concordance between ceramics and larger political and social processes has been noted in the literature, even though this is not the typical assumption on the part of archaeologists. Adams challenged the assumption of this relationship with a historically defined sequence of ceramics from Nubia (1979). Adams traces the "succession" of three ware groups as compared to the known historical sequence in the region (1979:729). In particular, he follows the progression of a "family" of wheel-made wares that he identifies as "the most stylistically sensitive" (1979:729). Within the general ceramic sequence, he found only two major breaks in which multiple features of the ceramics changed simultaneously. While the first break is usually associated with the end of the Empire of Kush, Adams argues that this event is poorly dated and in fact the ceramic transition occurred first. The second break in the ceramic sequence occurs "very nearly [at] the climax of stability and prosperity in the Kingdom of Makouria" (Adams 1979:732). "It seems, then, that of the two most abrupt changes in medieval Nubian pottery, at least one cannot be linked to immediate external causes.... It is apparent that the reverse is also true. The introduction of Christianity in the 6th century, although it was immediately reflected in architectural, artistic, and literary cannons, had not measurable impact on Nubian potters until 250 years later" (Adams 1979:732). In a brief treatment of hand-made wares, Adams summarizes:

> The Nubian hand-made wares represent the survival of a very old tradition.... So far as we know their manufacture was never industrialized; they were made locally, and chiefly for home consumption, by Nubian women in many different parts of the country.... Despite their widespread manufacture, however, the hand-made wares at any given time exhibited at least as much uniformity as the wheel-made wares.
>
> Within the hand-made wares family the pace of stylistic change was glacially slow (at least by comparison with that for the wheel-made wares) and occurred chiefly in the domains of slip color, painted decoration, and relief decoration.... It may be noted incidentally that the dates of stylistic change in the hand-made wares do not correspond in any meaningful way to those in the wheel-made wares. (Adams 1979:733)

Adams argues concisely that each ceramic family would give a different picture of the Nubian historical sequence, were ceramics the only line of evidence. He argues that ceramics are responsive to the social contexts of producers, consumers, markets and economic events of local importance but not necessarily those of larger political import.

Probable context of ceramic production

A reason for the consistency of the organization of ceramic production in the Lake Pátzcuaro Basin is the probably context for ceramic production throughout the excavated sequence. As discussed in Chapter Two, ceramic production in workshops is the expectation with the emergence of the state. However, as Feinman (1999) argued, household production within the state is not only probable, but also probably the norm. This model of household production is seen in many ethnographic examples, even of full-time potters (e.g. Longacre and Skibo 1994). This is also true of the ethnographic literature from the Purépecha region today (e.g. Foster 1948a; cf. discussion in Chapter Three). In the ethnographic literature, potters are found to be of the lower class (e.g. Arnold 1985) and potting is not an attractive profession. Most (not all) ethnographically known potters are women (e.g. Longacre and Skibo 1994) who augment family income with potting (though this is not found within the contemporary Purépecha literature).

FINAL OBSERVATIONS

The complete Tarascan ceramic vessels—whole vessels known from museum collections and burial assemblages—have given us a certain expectation regarding the nature of Tarascan ceramics and the role they played in the Tarascan political and social system. From the introduction of bulbous-legged tripods, basket-handled spouted vessels, eccentric forms and miniature forms, we expect Tarascan fine wares to be the workmanship of highly specialized producers, a phenomena associated with the formation of the state. This expectation is further strengthened by theoretical expectations from both social evolutionary theory (expectation of full-time producers) and political economic theory (attached specialists producing elite status goods). However, this study has found a different pattern: continuity within the ceramic production system.

There is no major disjunction in the ceramic tradition within the Late Pátzcuaro Basin between the Classic and Late Postclassic periods. Ceramic production appears to be localized and to remain thus throughout the cultural sequence in the basin. Decoration techniques remain stable, changing only in terms of relative proportion by phase. Finally, markets seem to be the important (though not necessarily the only) means of moving ceramics throughout the basin, and the ceramics act as consumer goods. Commoner zones exhibit access to a wide range of ceramic forms and decorative techniques.

Theories on the emergence of the state indicate that specialized craft production is a necessary requirement of complex societies. This study indicates that while larger social theories are correct in some of their expectations, the Tarascan case actually fits both theories—or neither—equally well.

Some questions remain, especially surrounding the role of Tzintzuntzan and ceramic production. In the future, more work needs to be done with the elemental characterization of the basin pastes and of excavated sherds from other portions of the basin in order to make more definitive statements regarding the dispersion of ceramic production within the basin. Additionally, comparison of these Urichu findings regarding the amount of variation within groupings of sherds needs to be compared with other stratigraphically excavated sites within the Lake Pátzcuaro Basin. For now, Urichu remains a case study.

However, this study, with its emphasis on the sherds rather than the whole vessels, and on the assemblage rather than restricted types, has provided a robust test of two key theories of social change and state formation. It has shown cluster analysis to be a useful method with multistate character data. It has also provided a correction and a direction to future ceramic research within the Lake Pátzcuaro Basin and the emergence of the Tarascan state.

What is critical about this study is the important role of the assemblage in correcting expectations based on whole vessels. From the assemblage, and from particular products within the assemblage, a picture of ceramic tradition continuity emerges; a tradition based upon the same colors, the same forms, and the same techniques. However, the tradition undergoes some change: increasing standardization and efficiency throughout the cultural sequence coupled with elaboration of design and energy input as state emerged. The sequence exhibits continuity and change—though without a major re-organization of the basic production process.

A CASE STUDY IN THE RELATIONSHIP BETWEEN SOCIAL COMPLEXITY AND THE ORGANIZATION OF CERAMIC PRODUCTION FROM THE LAKE PÁTZCUARO BASIN, MICHOACÁN, MEXICO

VOLUME II

By

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A DISSERTATION

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APPENDIX A:

CLUSTER TREE DIAGRAMS AND FUSION COEFFICIENT BIPLOTS

Figure A.1 Cluster tree for Loma Alta 3-Jarácuaro phase rims sherds with ten clusters highlighted (N=48)

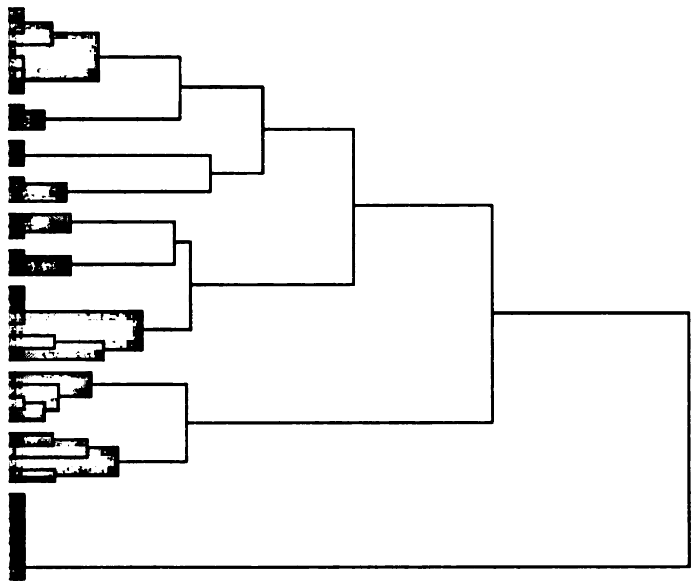


Figure A.2 Scree test showing four clusters for Loma Alta 3-Jarácuaro phase rim sherds with last 25 fusion coefficients plotted

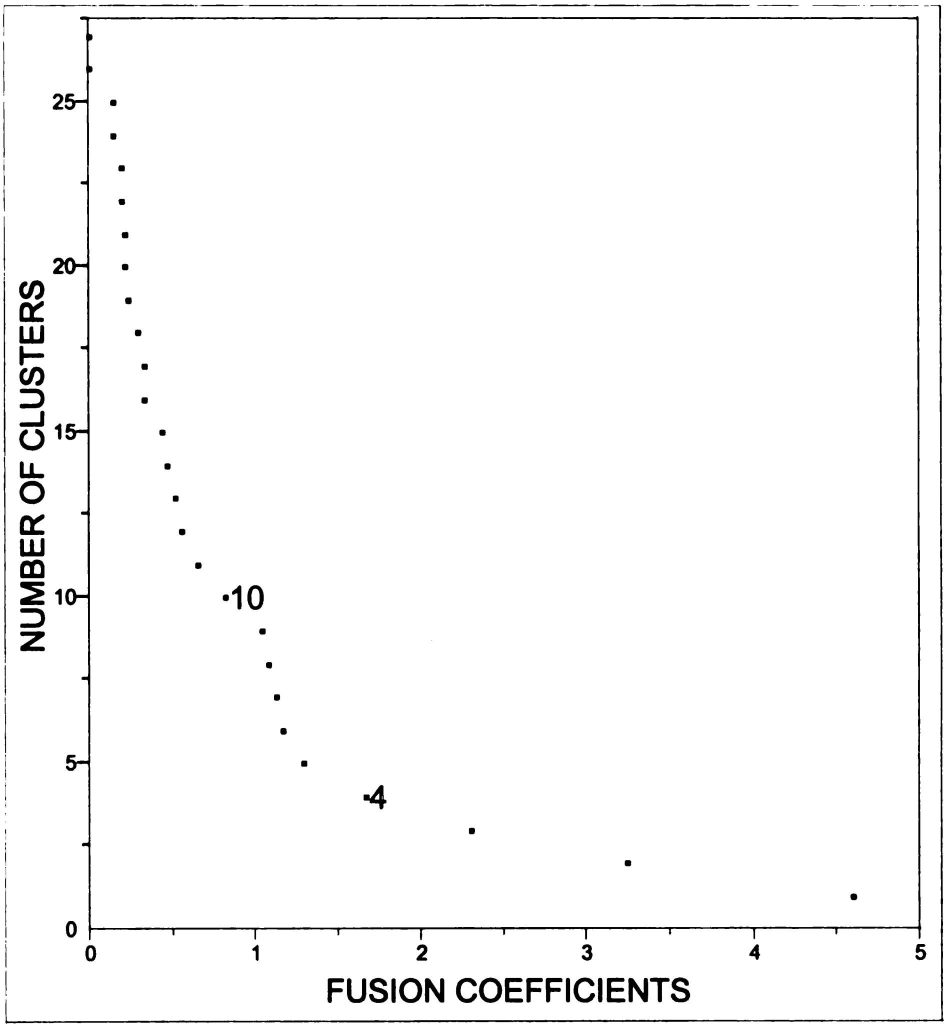


Figure A.3 Hierarchical cluster tree for Jarácuaro phase rim sherds with 31 clusters (N=244)

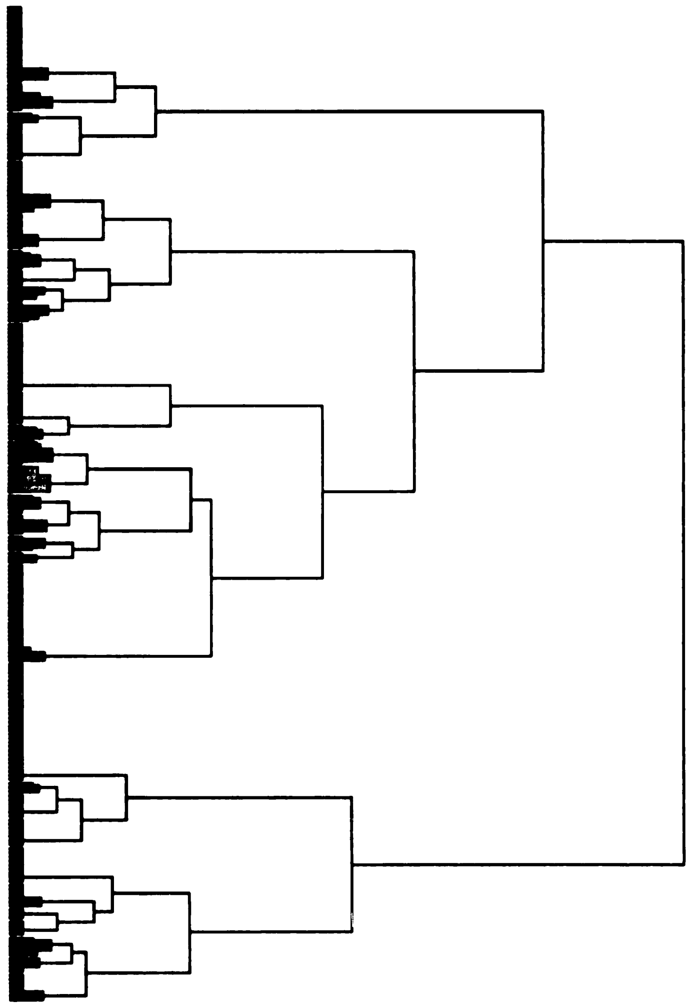


Figure A.4 Scree test showing five clusters for Jarácuaro phase rim sherds with last 69 fusion coefficients plotted

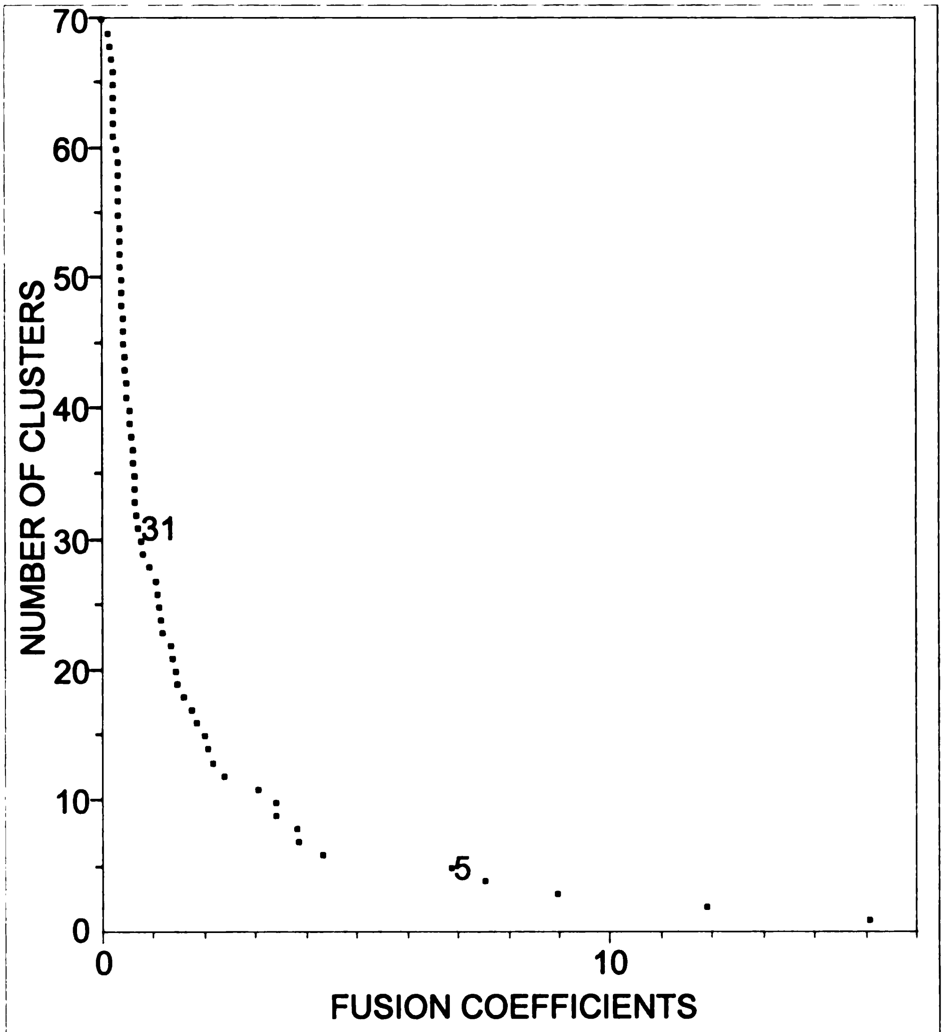


Table A.5 Hierarchical cluster tree for Lupe phase rim sherds with 52 clusters (N=551)

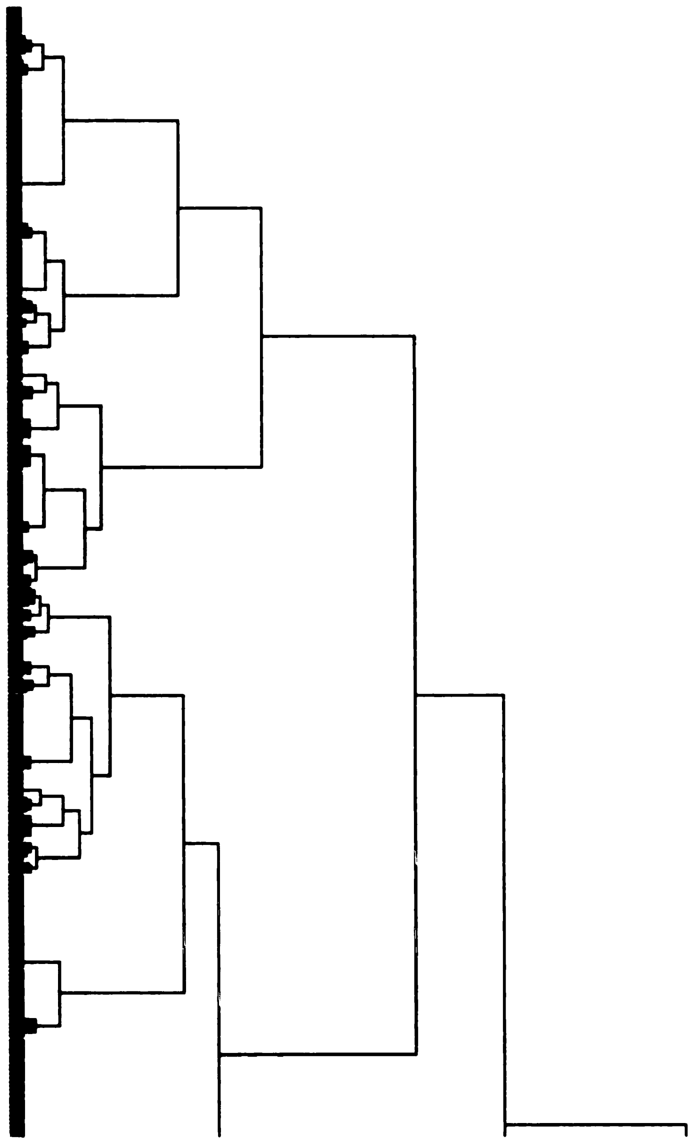


Figure A.5 (continued)

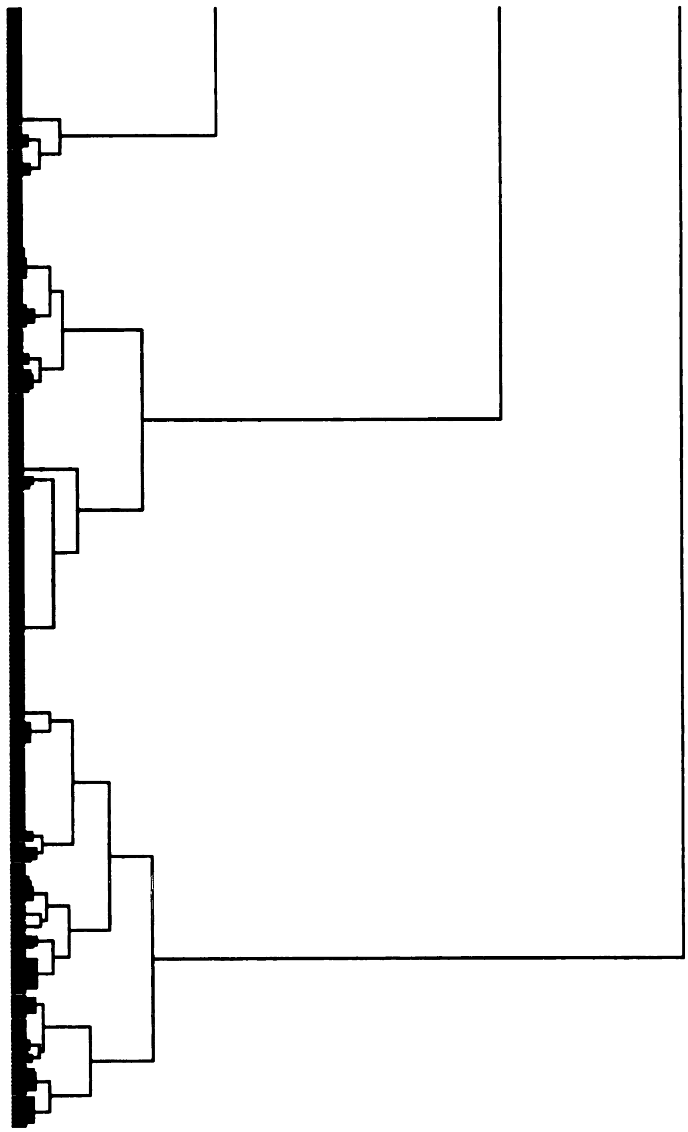


Figure A.6 Scree test showing five clusters for Lupe phase rim sherds with last 120 fusion coefficients plotted

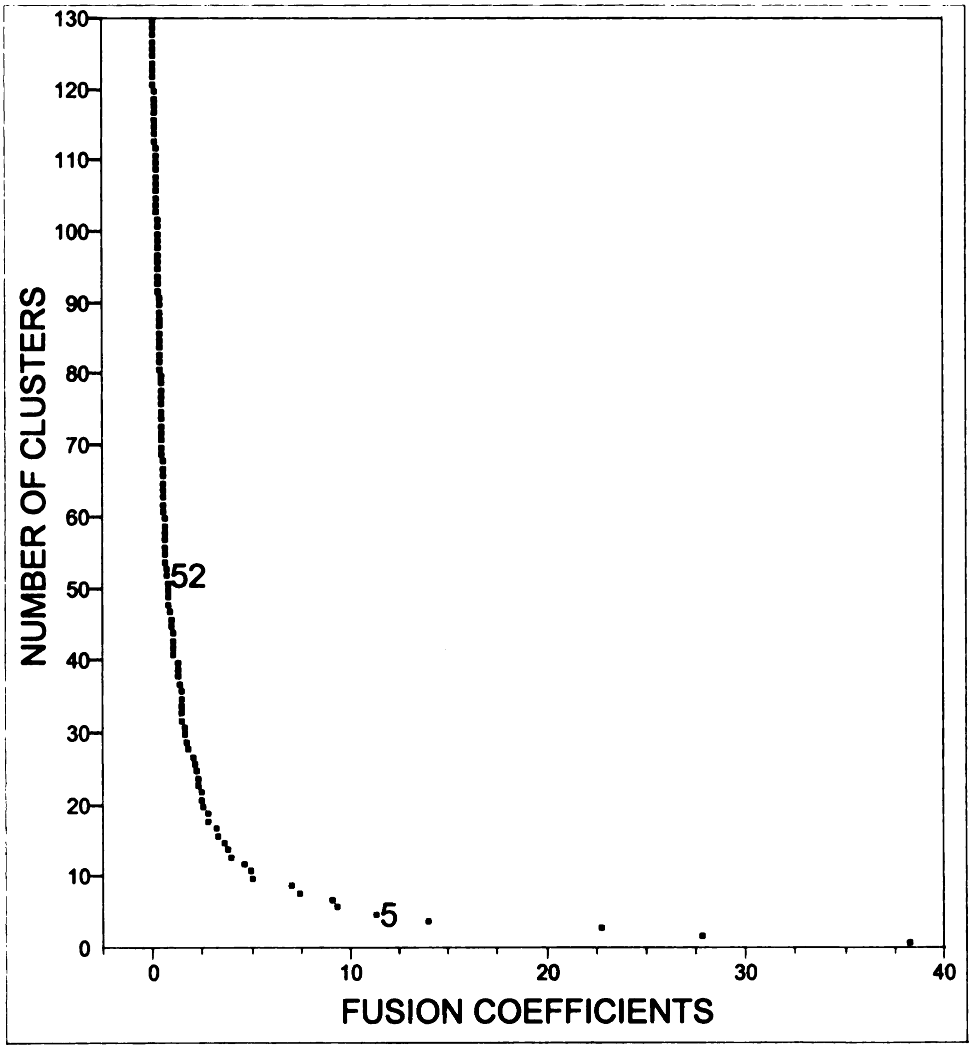


Figure A.7 Hierarchical cluster tree for Early Urichu phase rim sherds with 59 clusters (N=687)

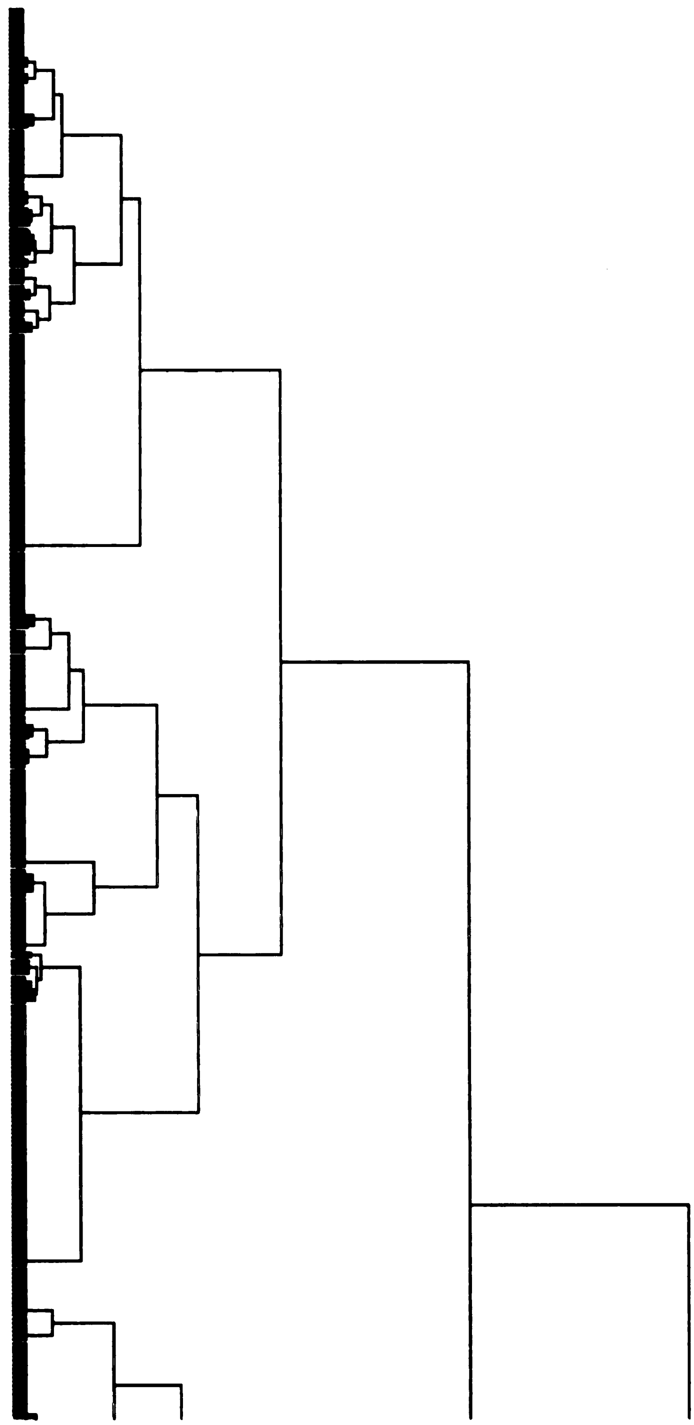


Figure A.7 (continued)

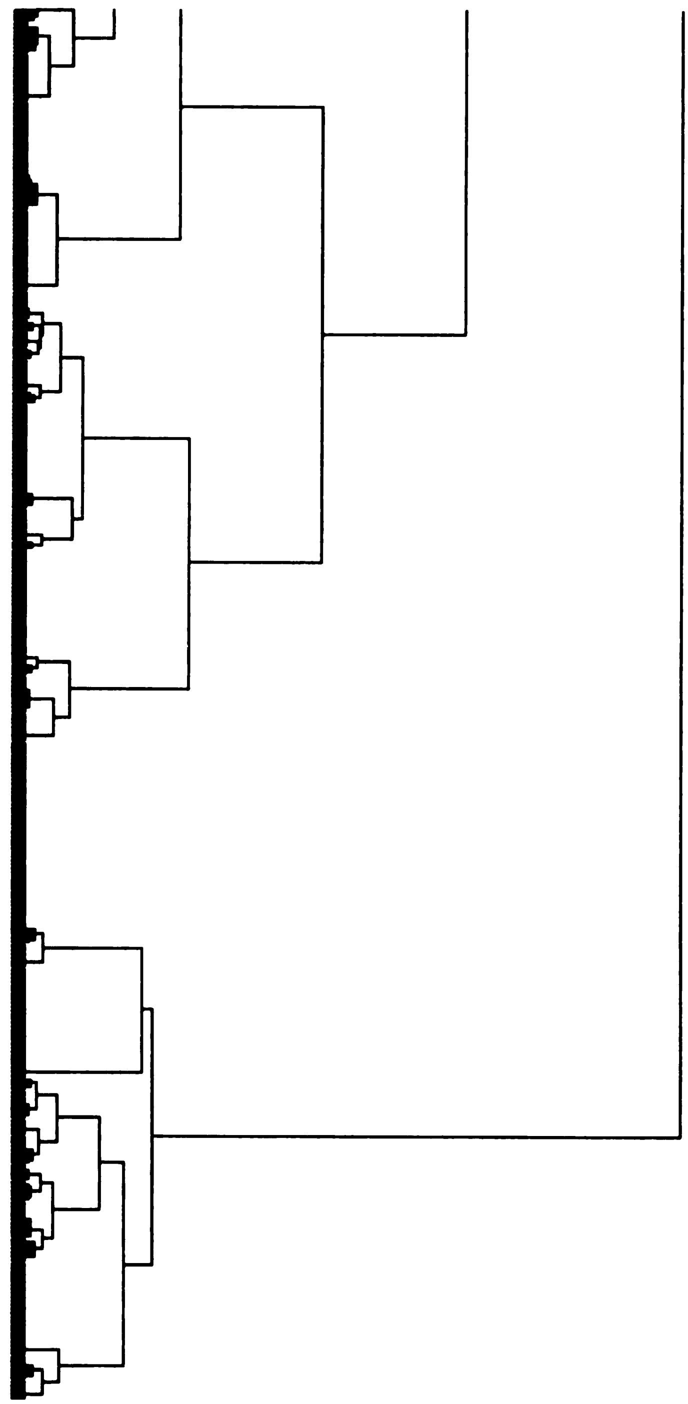


Figure A.8 Scree test showing four clusters for Early Urichu phase rim sherds with last 119 fusion coefficients plotted

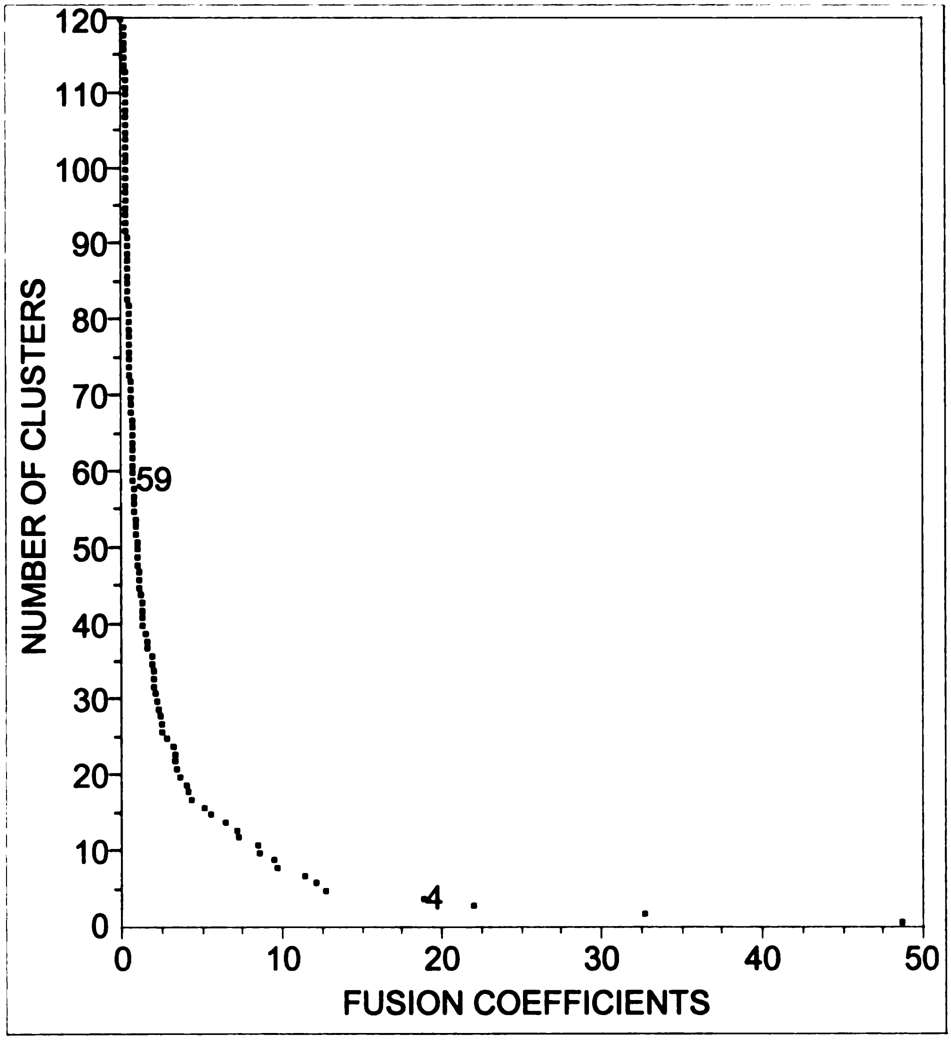


Figure A.9 Hierarchical cluster tree for Late Urichu phase rims sherds with 16 clusters (N=108)

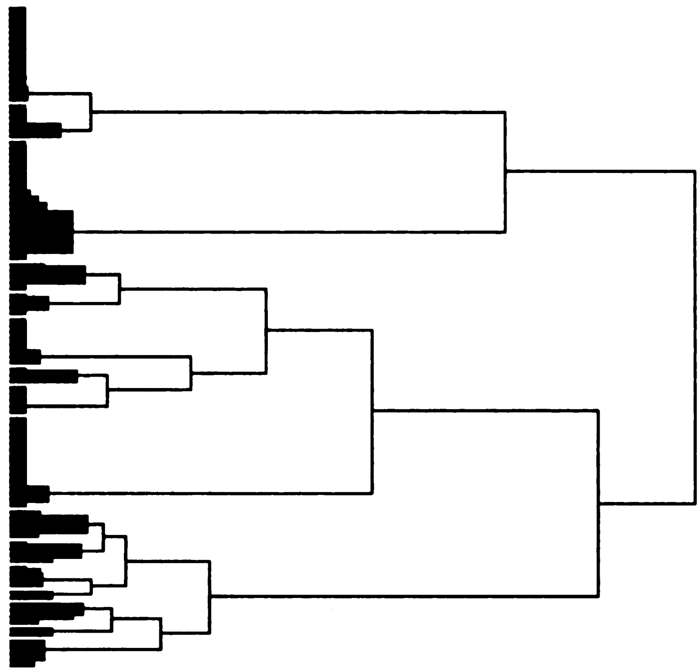


Figure A.10 Scree test showing five clusters for Late Urichu phase rim sherds with last 41 fusion coefficients plotted

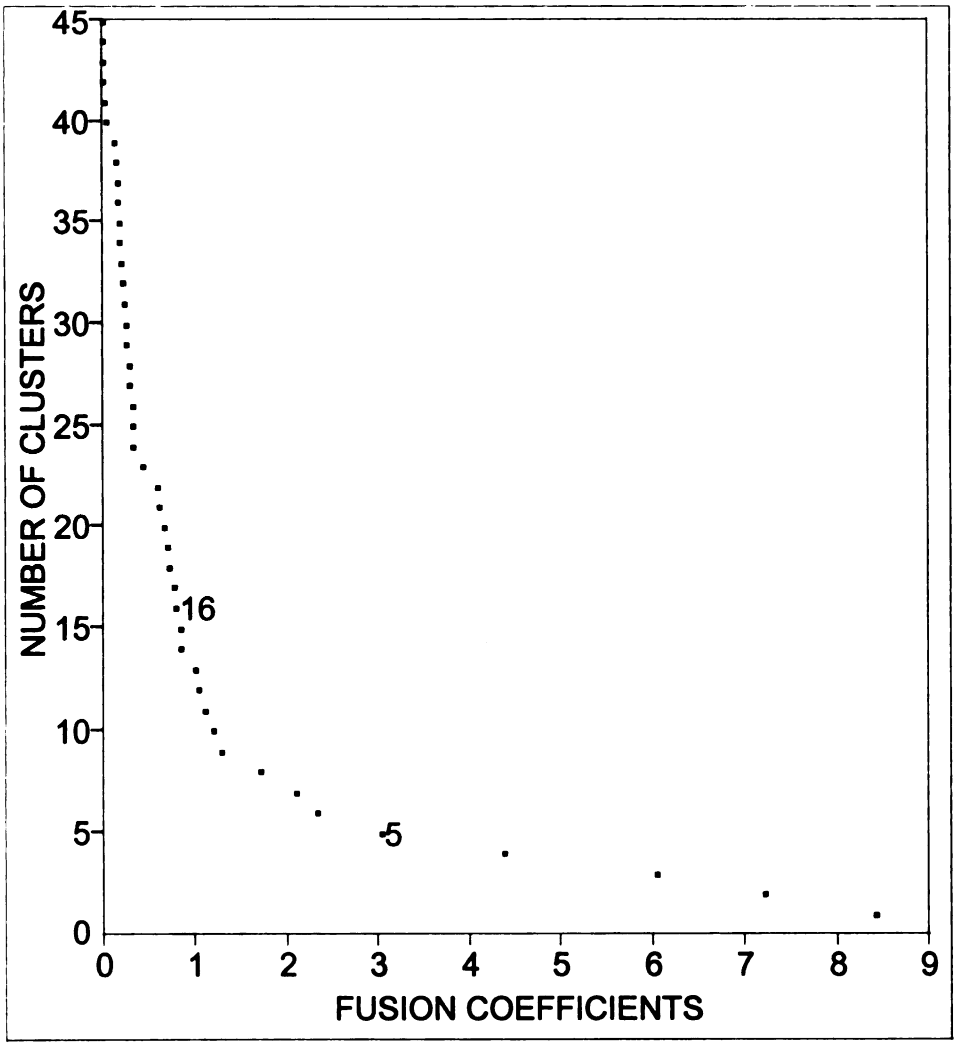


Figure A.11 Hierarchical cluster tree for Tariacuri Area 1 phase rim sherds with 31 clusters (N=241)

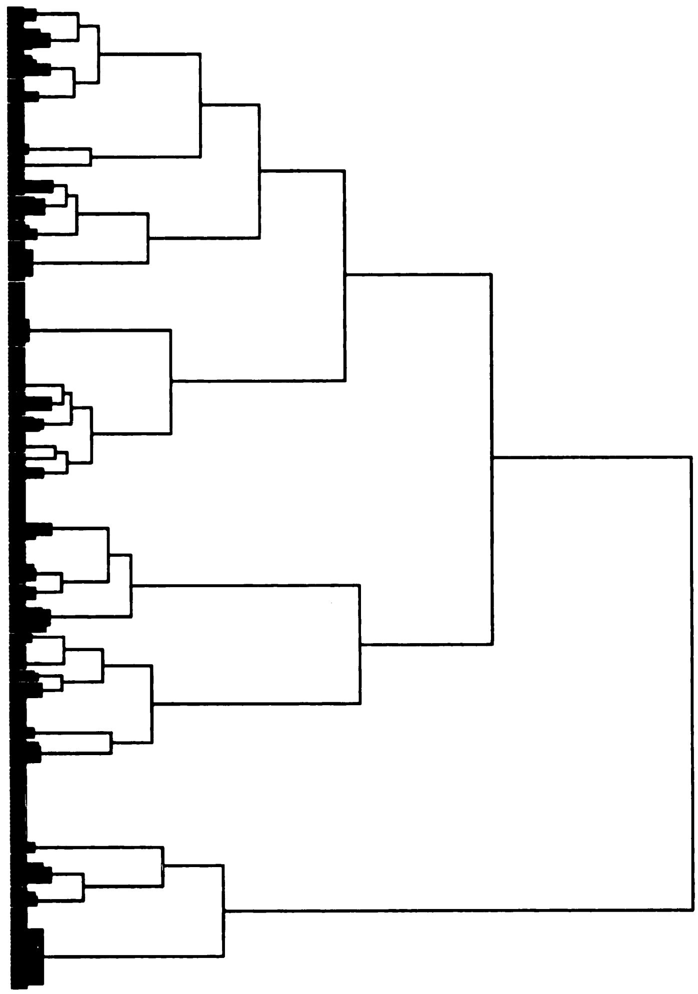


Figure A.12 Scree test showing two clusters for Tariacuri Area 1 phase rim sherds with last 76 fusion coefficients plotted

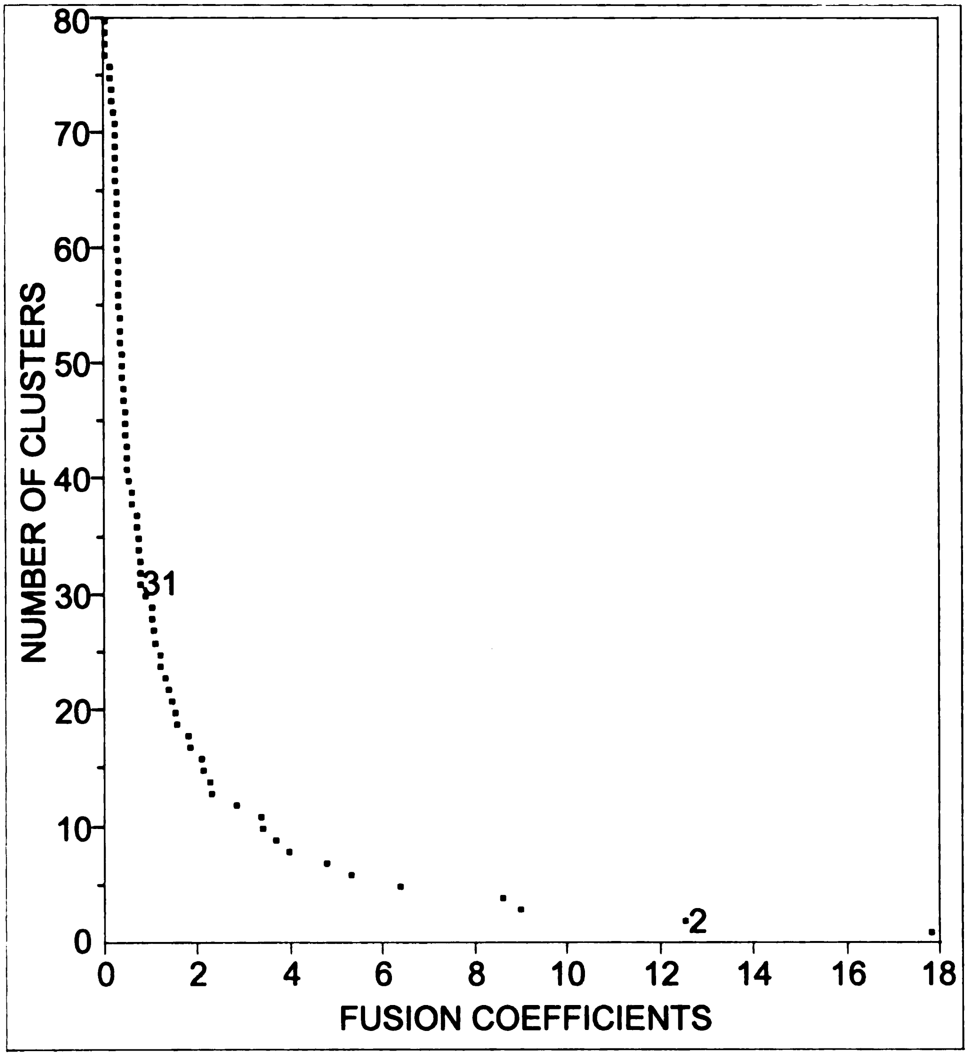


Figure A.13 Hierarchical cluster tree for Tariacuri Area 2 phase rim sherds with 25 clusters (N=344)

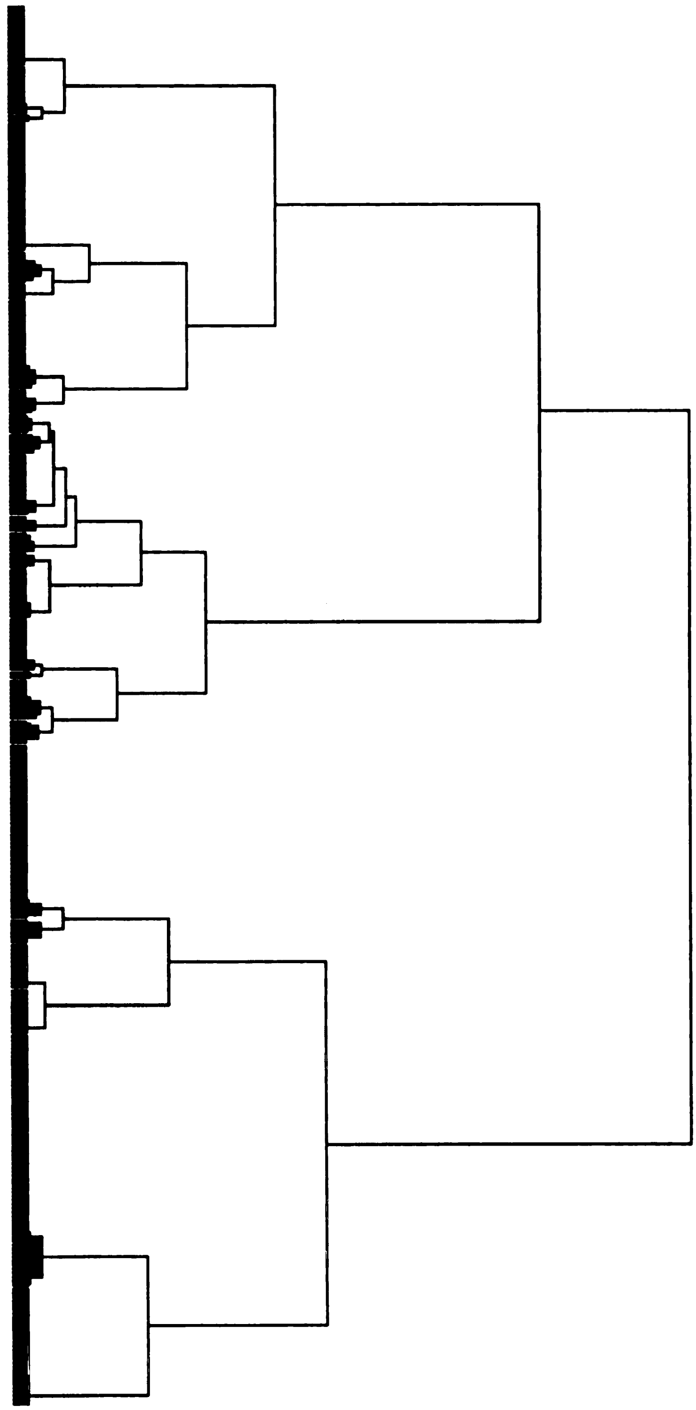


Figure A.14 Scree test showing four clusters for Tariacuri Area 2 phase rim sherds with last 67 fusion coefficients plotted

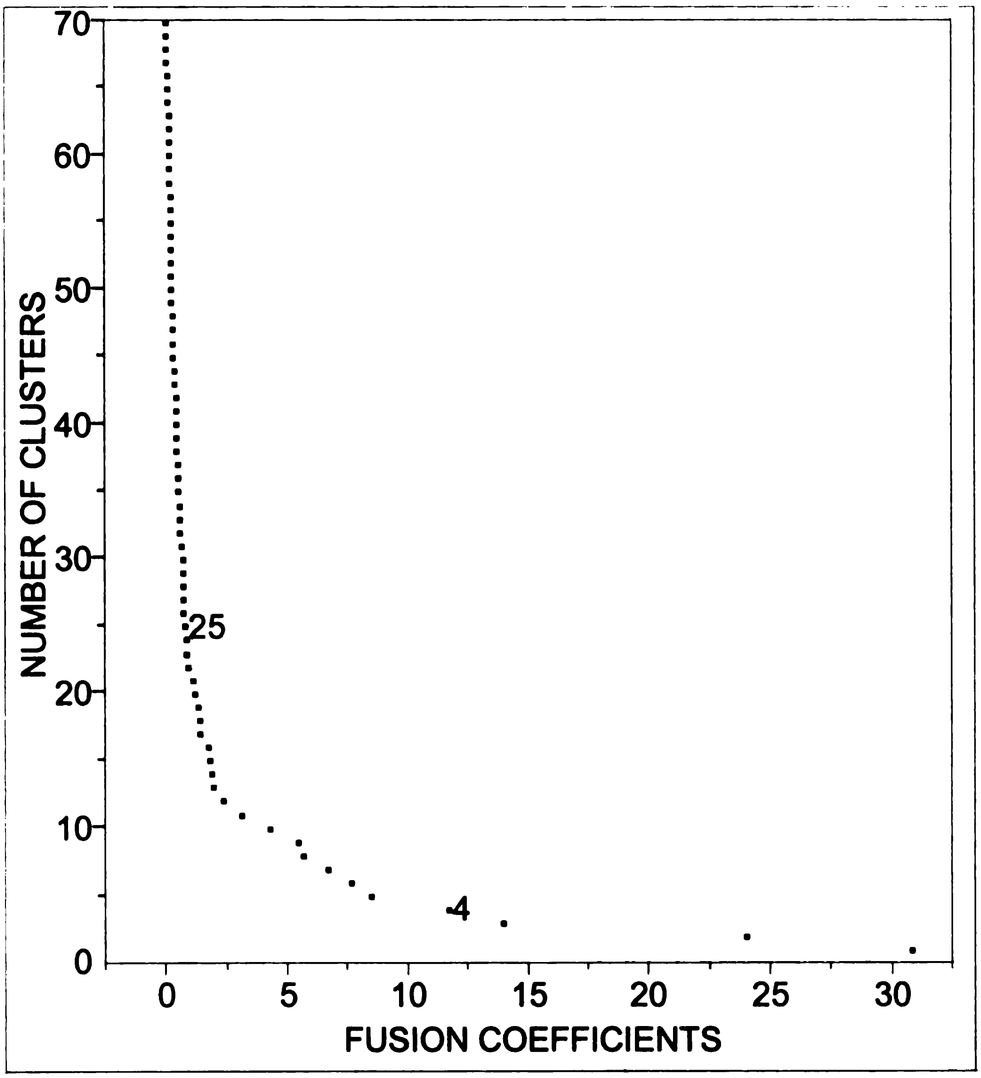


Figure A.15 Hierarchical cluster tree for Tariacuri Area 5 phase rim sherds with 61 clusters (N=244)

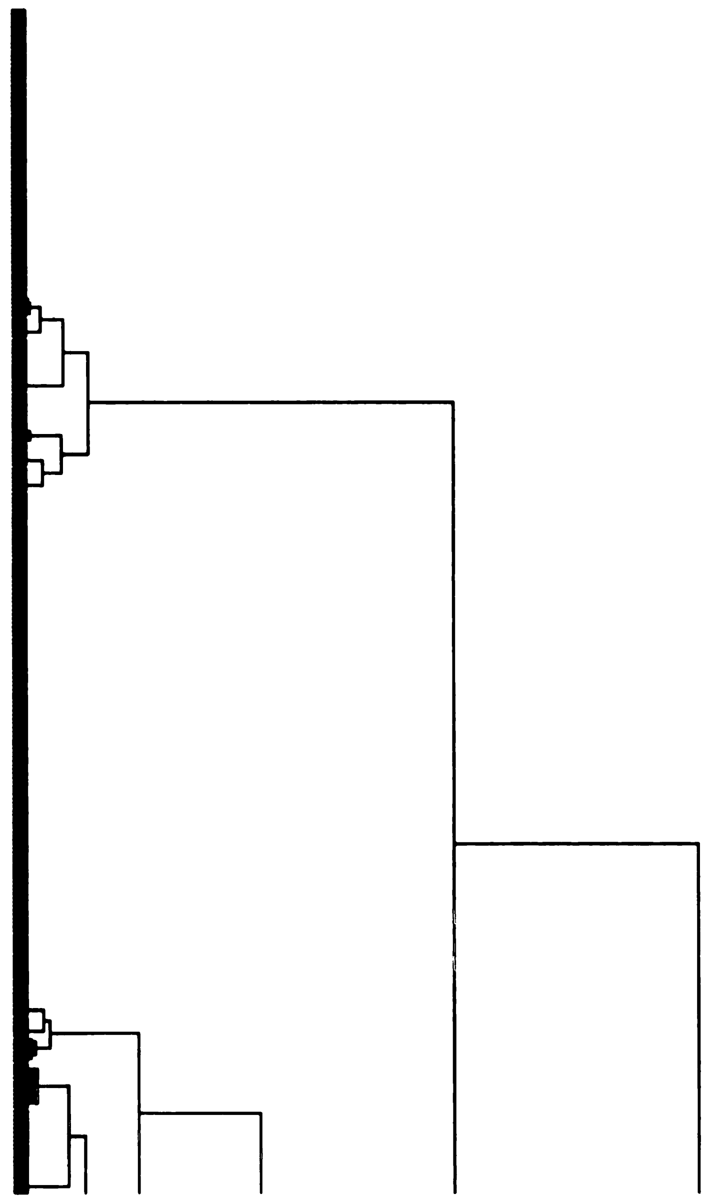


Figure A.15 (continued)

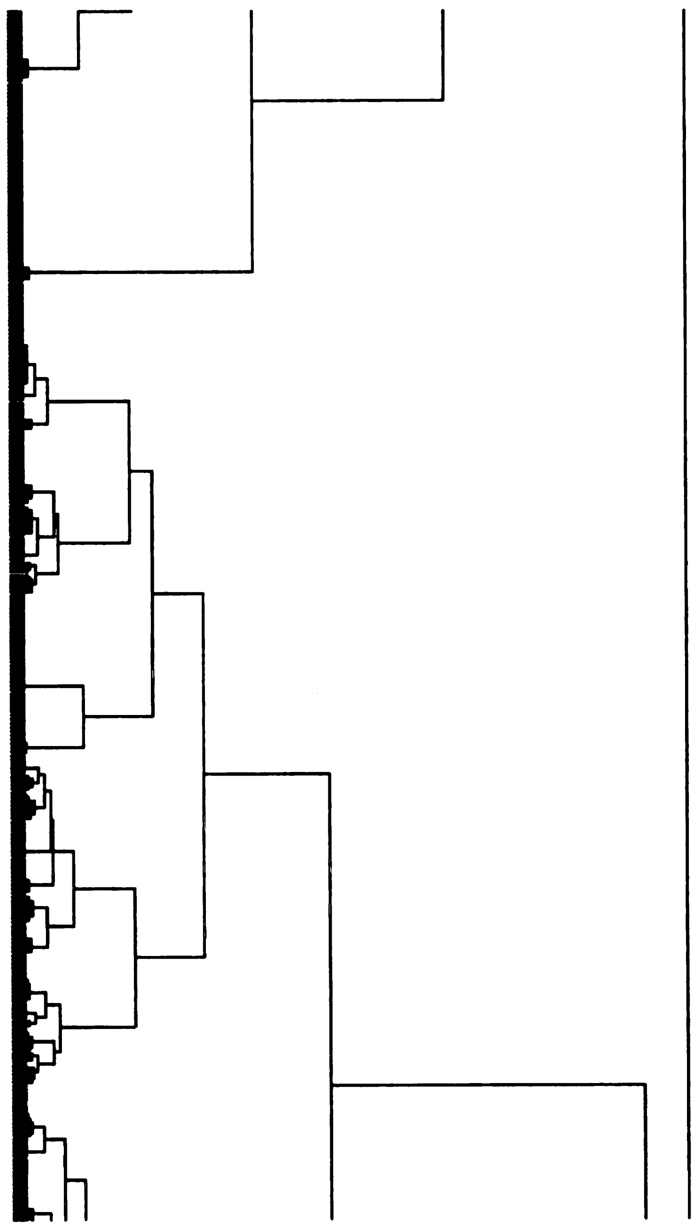


Figure A.15 (continued)

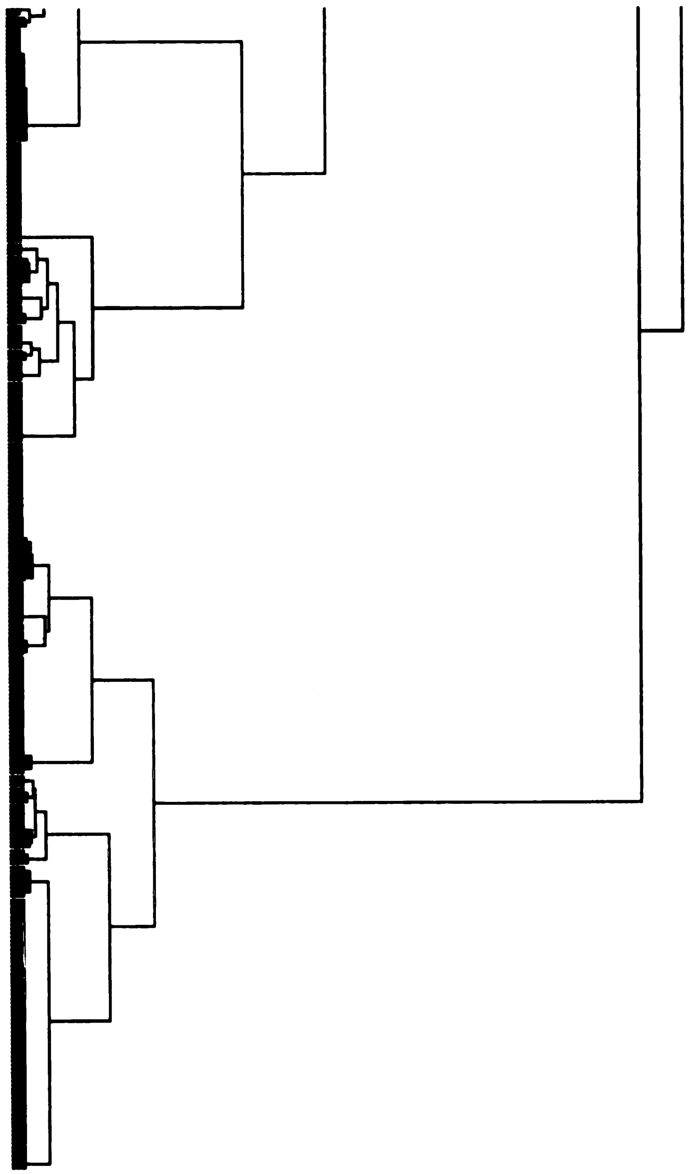


Figure A.16 Scree test showing four clusters for Tariacuri Area 5 phase rim sherds with last 135 fusion coefficients plotted

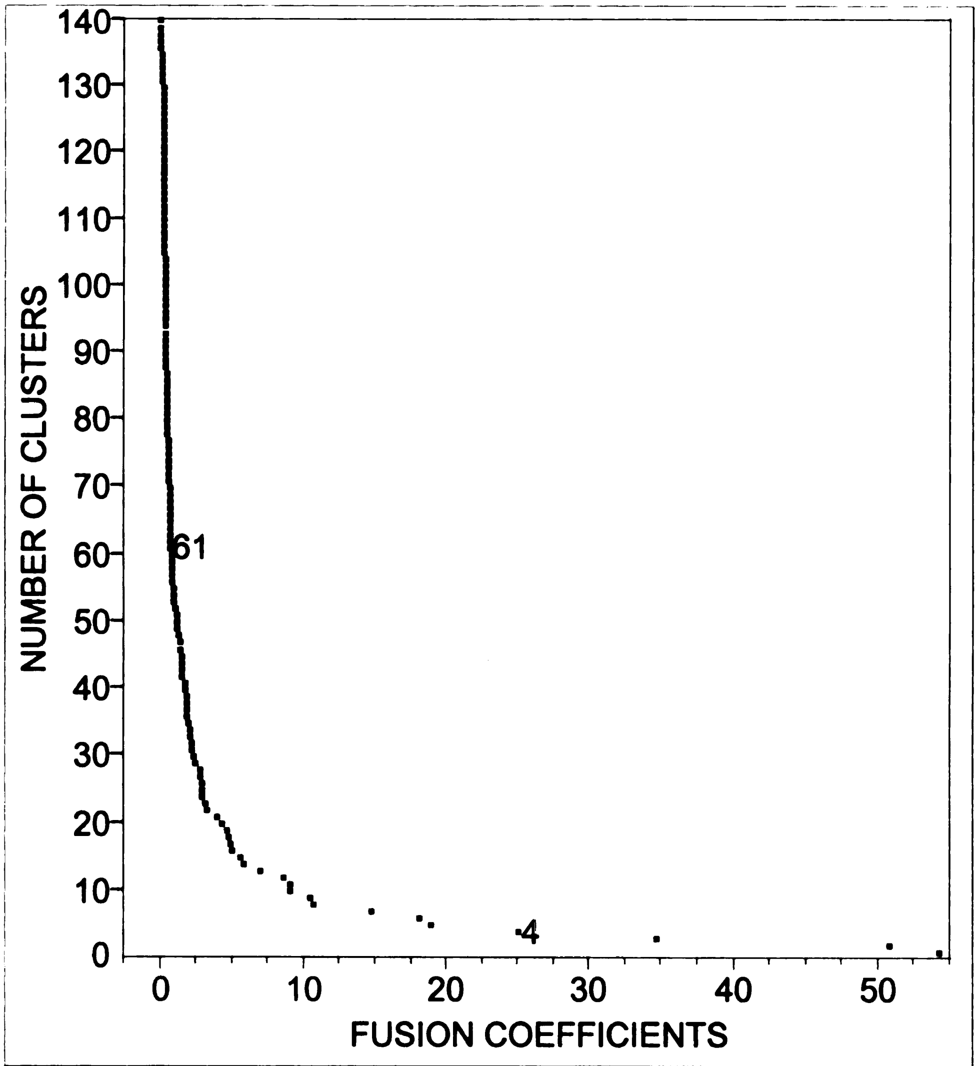


Figure A.17 Cluster tree for Lupe phase support sherds with six clusters (N=43)

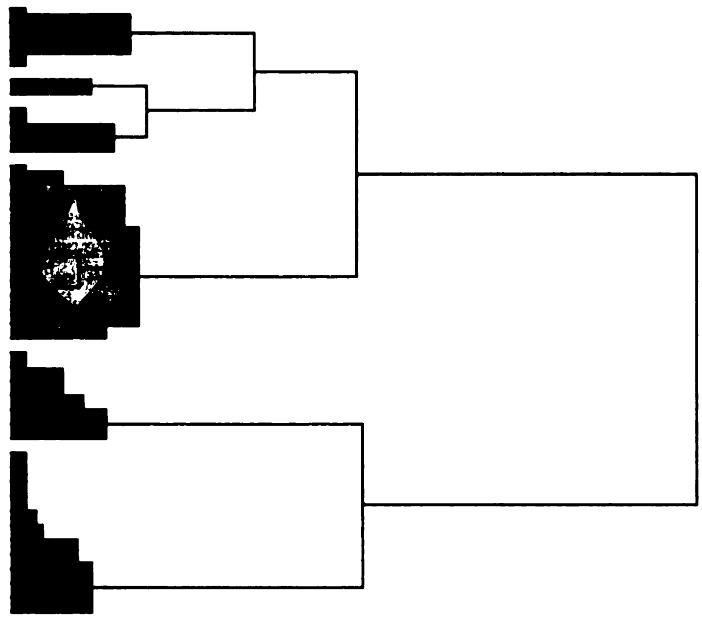


Figure A.18 Scree test showing three clusters for Lupe phase supports sherds with last 24 fusion coefficients shown

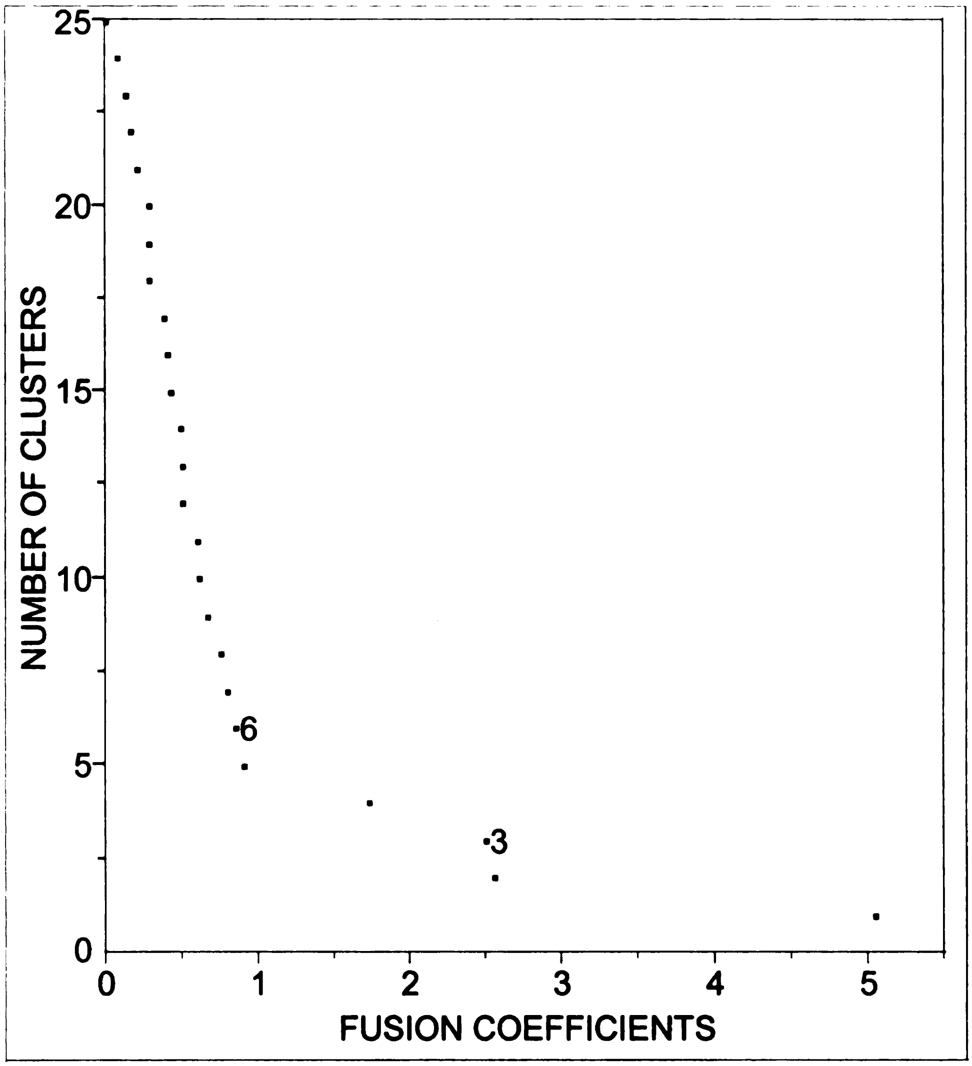


Figure A.19 Hierarchical cluster tree for Early Urichu phase support sherds with ten clusters (N=62)

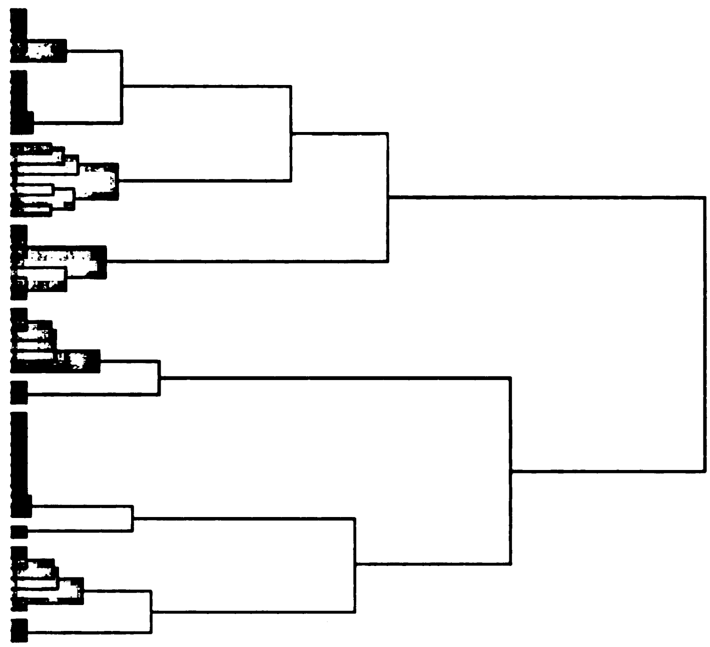


Figure A.20 Scree test showing two clusters for Early Urichu phase support sherds with last 28 fusion coefficients shown

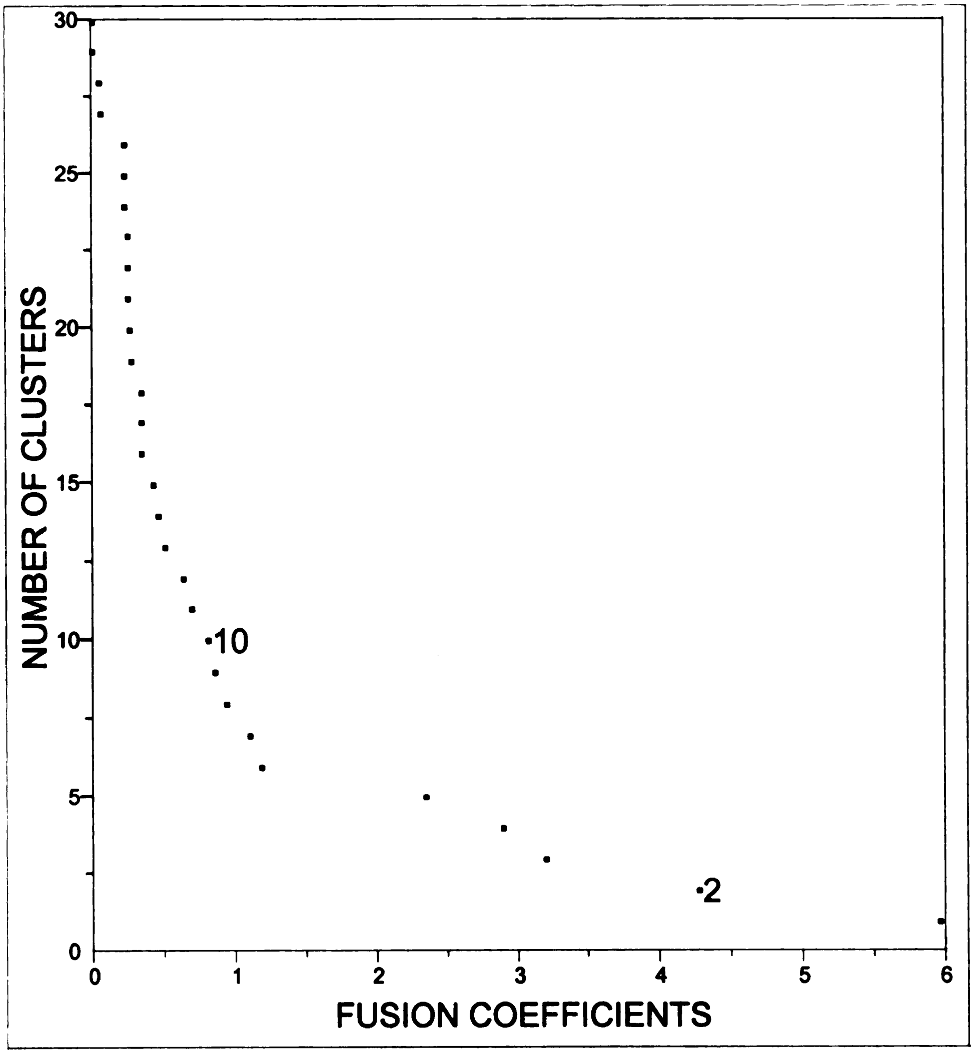


Figure A.21 Hierarchical cluster tree for Tariacuri Area 5 phase support sherds with twelve clusters (N=86)

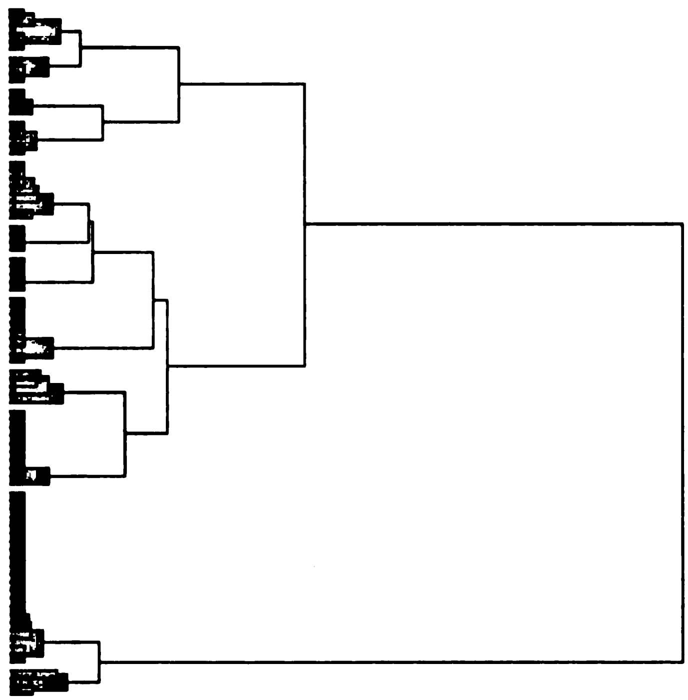


Figure A.22 Scree test showing two clusters for Tariacuri Area 5 phase support sherds with last 20 fusion coefficients shown

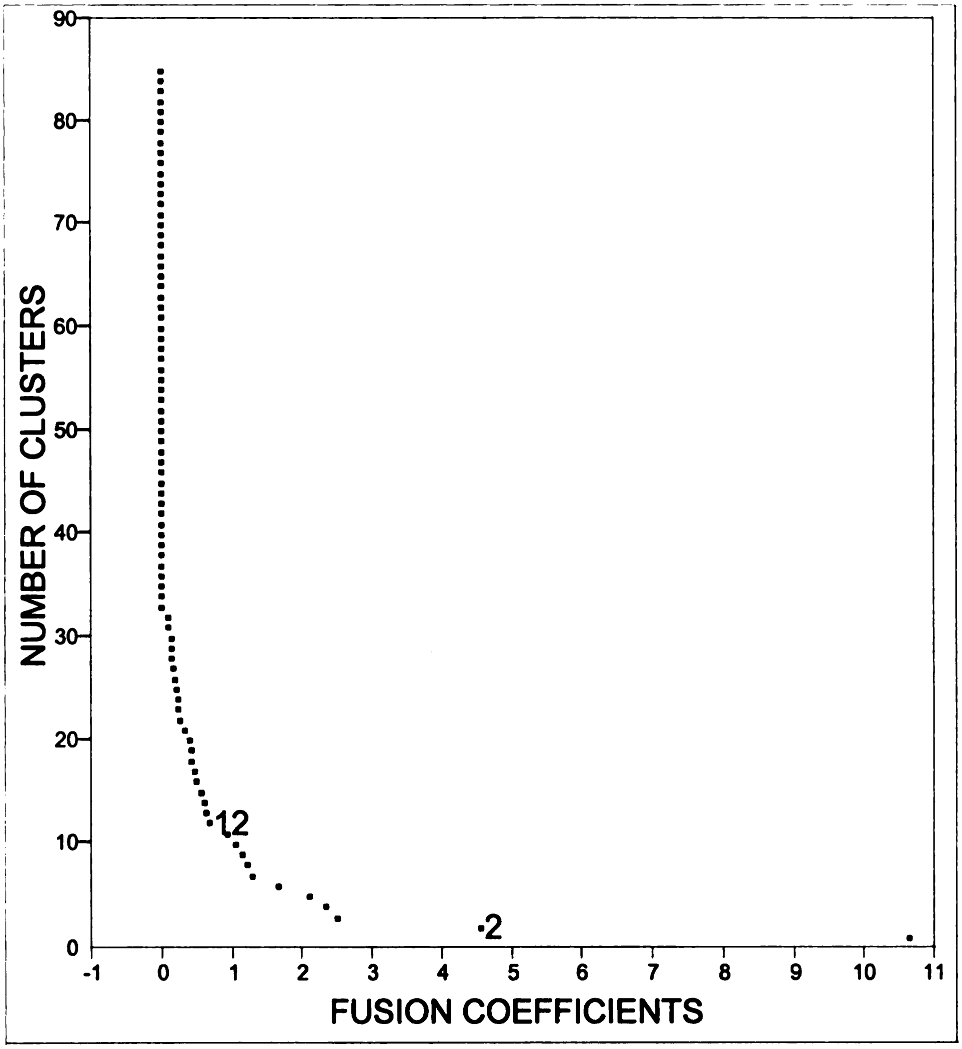


Figure A.23 Scree test showing three clusters for Loma Alta 3-Jarácuaro phase body sherds with last 27 fusion coefficients shown (N=708)

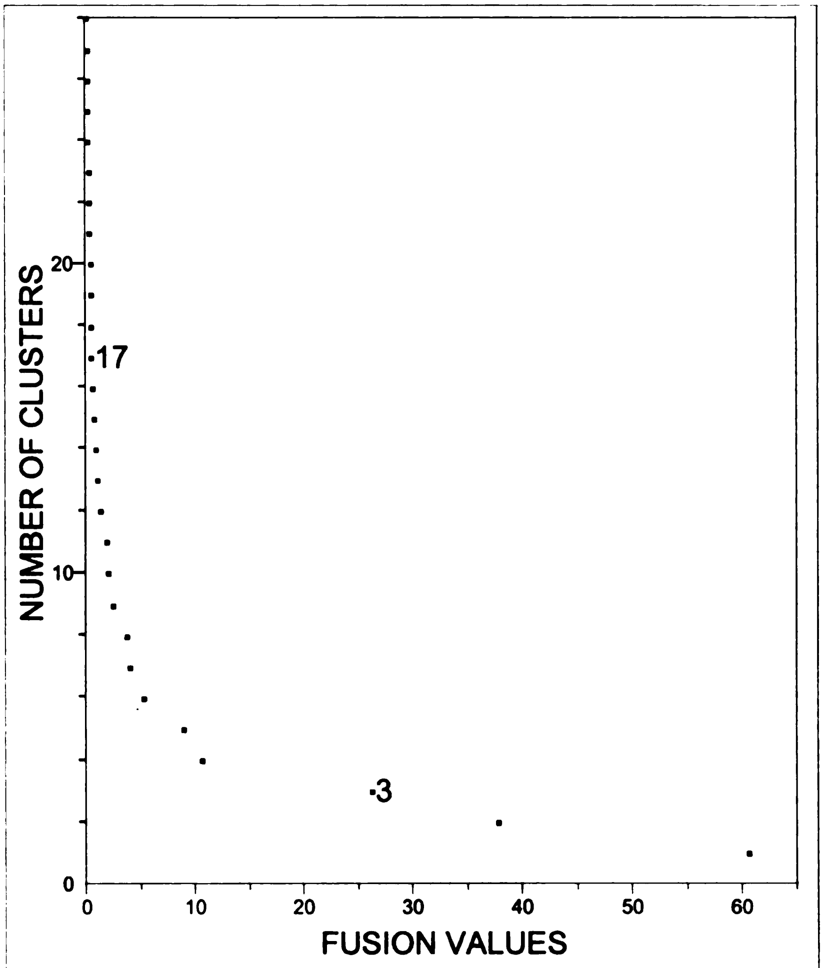


Figure A.24 Scree test showing two clusters for Jarácuaro phase body sherds with last 45 fusion coefficients shown (N=4719)

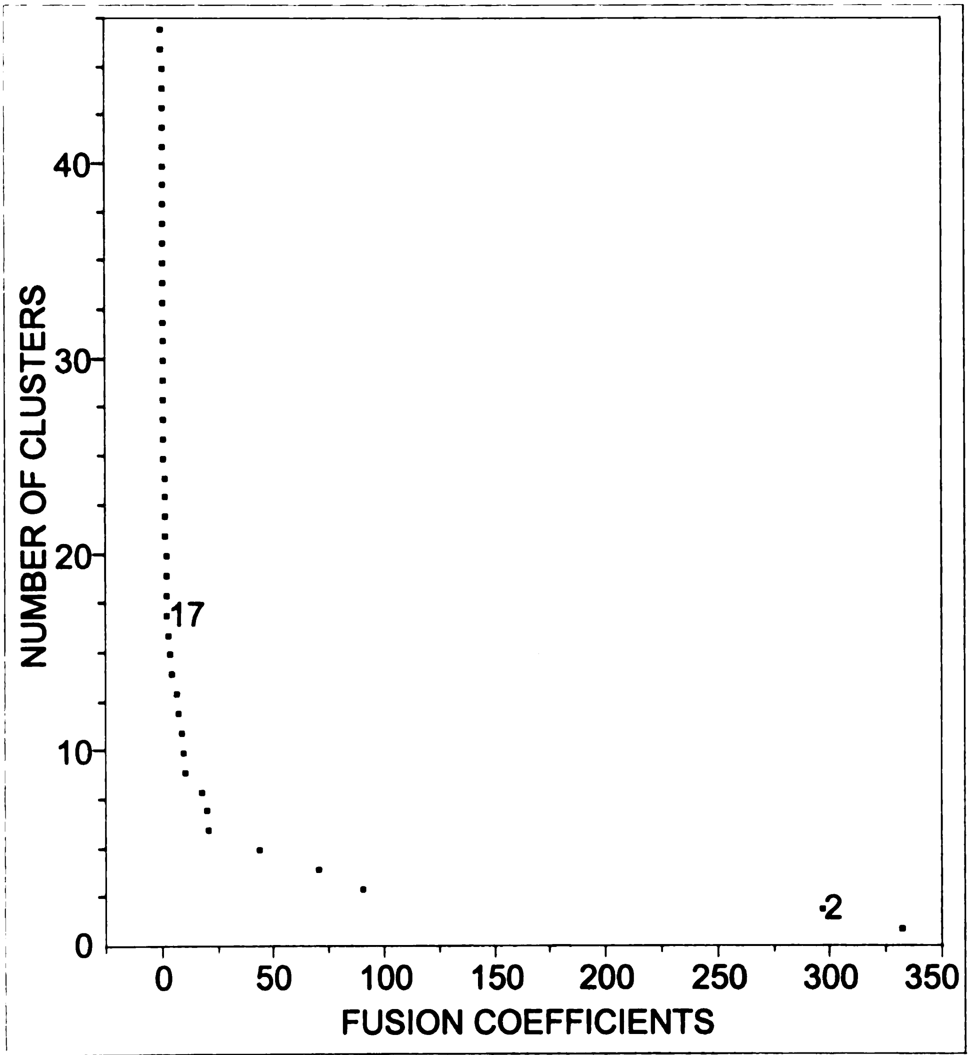


Figure A.25 Scree test showing three clusters for Lupe phase body sherds with last 65 fusion coefficients shown (N=7711)

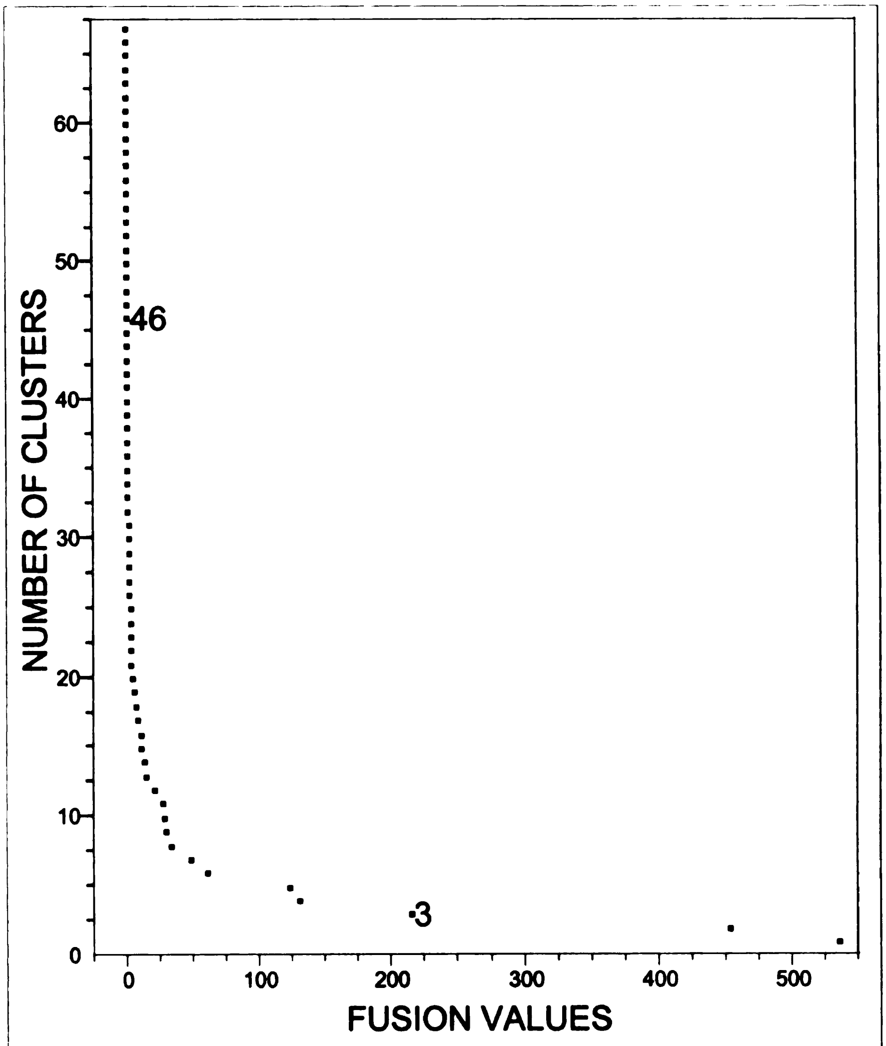


Figure A.26 Scree test showing two clusters for Early Urichu phase body sherds with last 65 fusion coefficients shown (N=8866)

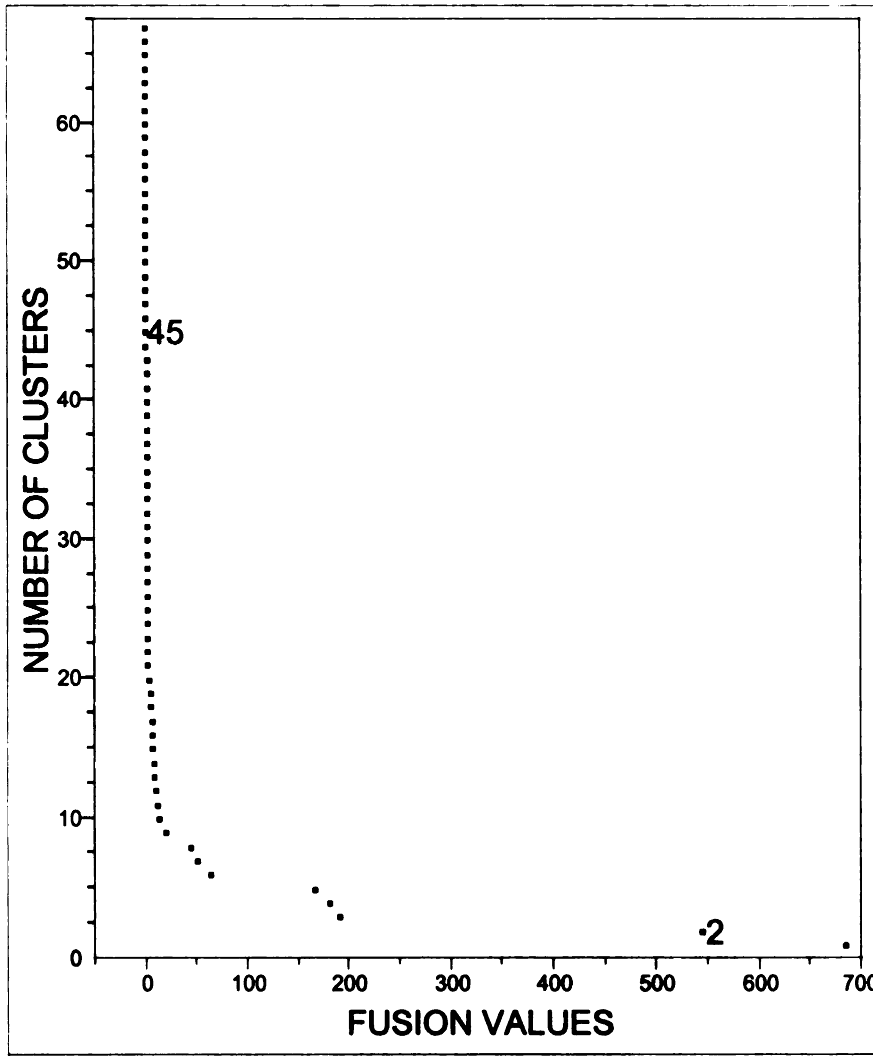


Figure A.27 Scree test showing three clusters for Late Urichu body sherds with last 35 fusion coefficients shown (N=535)

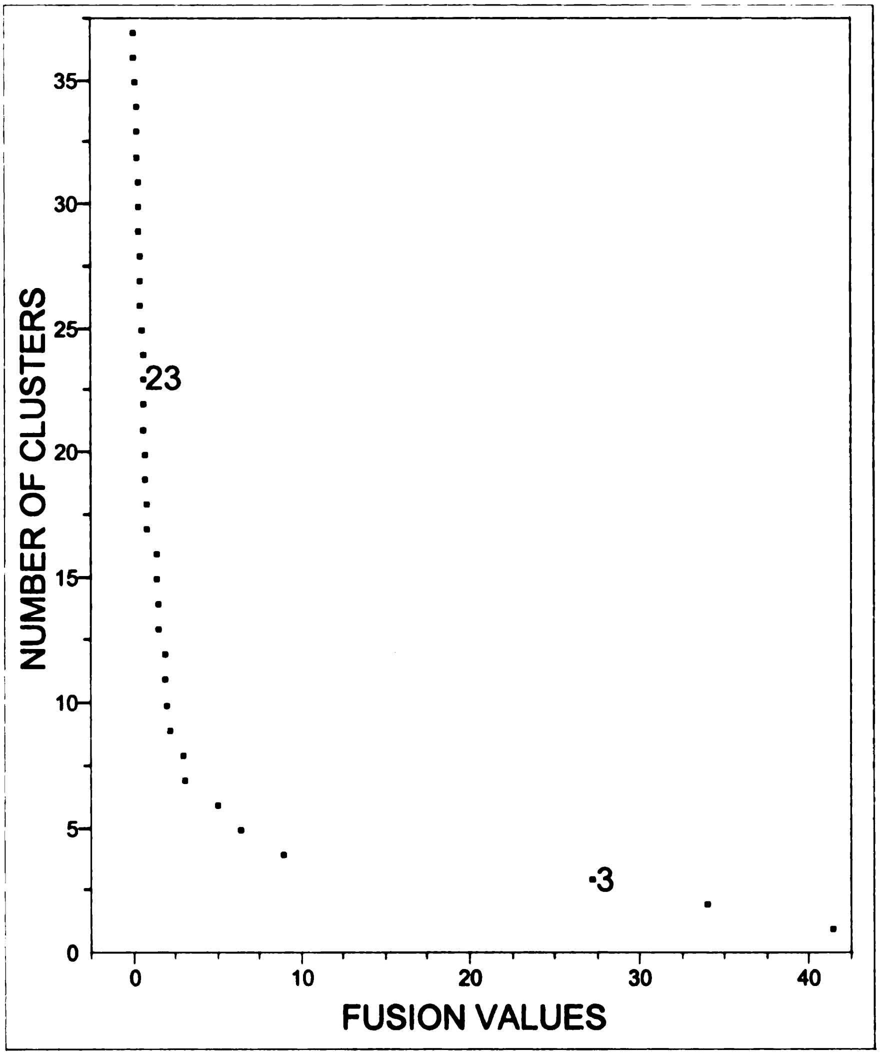


Figure A.28 Scree test showing three clusters for Tariacuri Area 1 phase body sherds with last 62 fusion coefficients shown (N=1434)

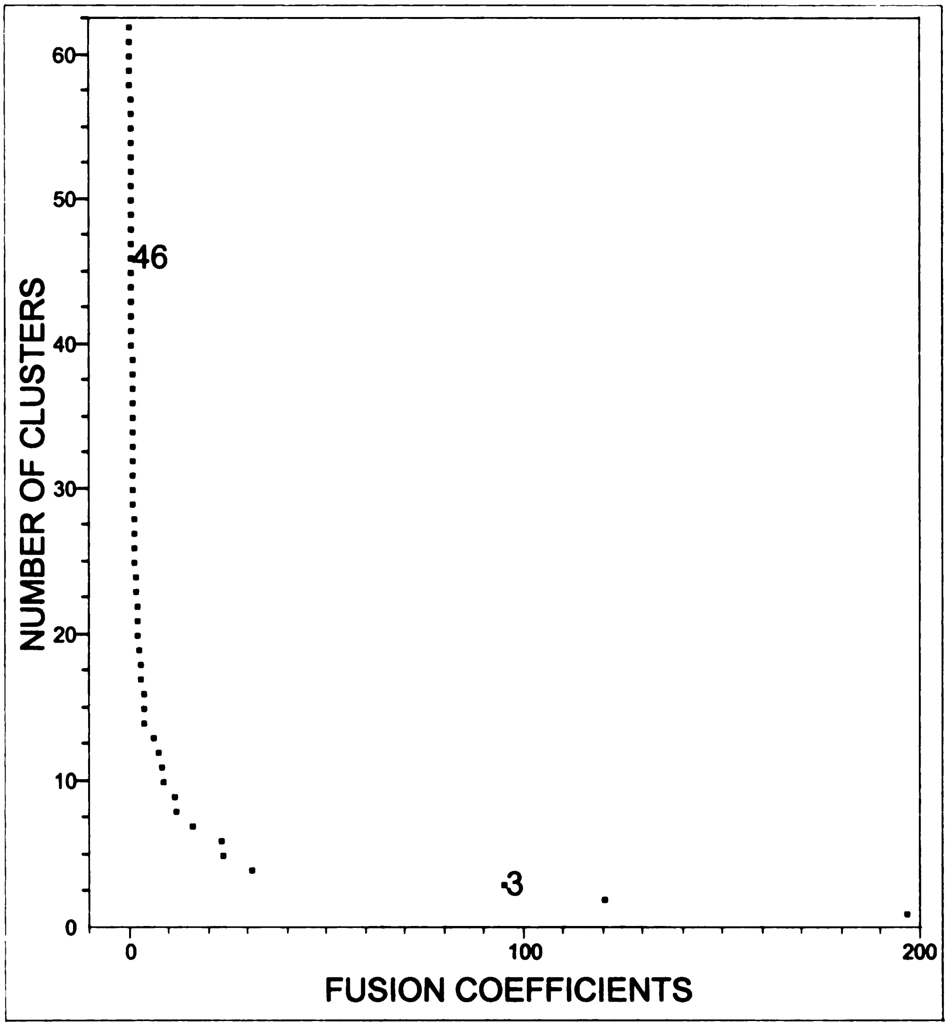


Figure A.29 Scree test showing four clusters for Tariacuri Area 2 phase body sherds with last 66 fusion coefficients shown (N=1434)

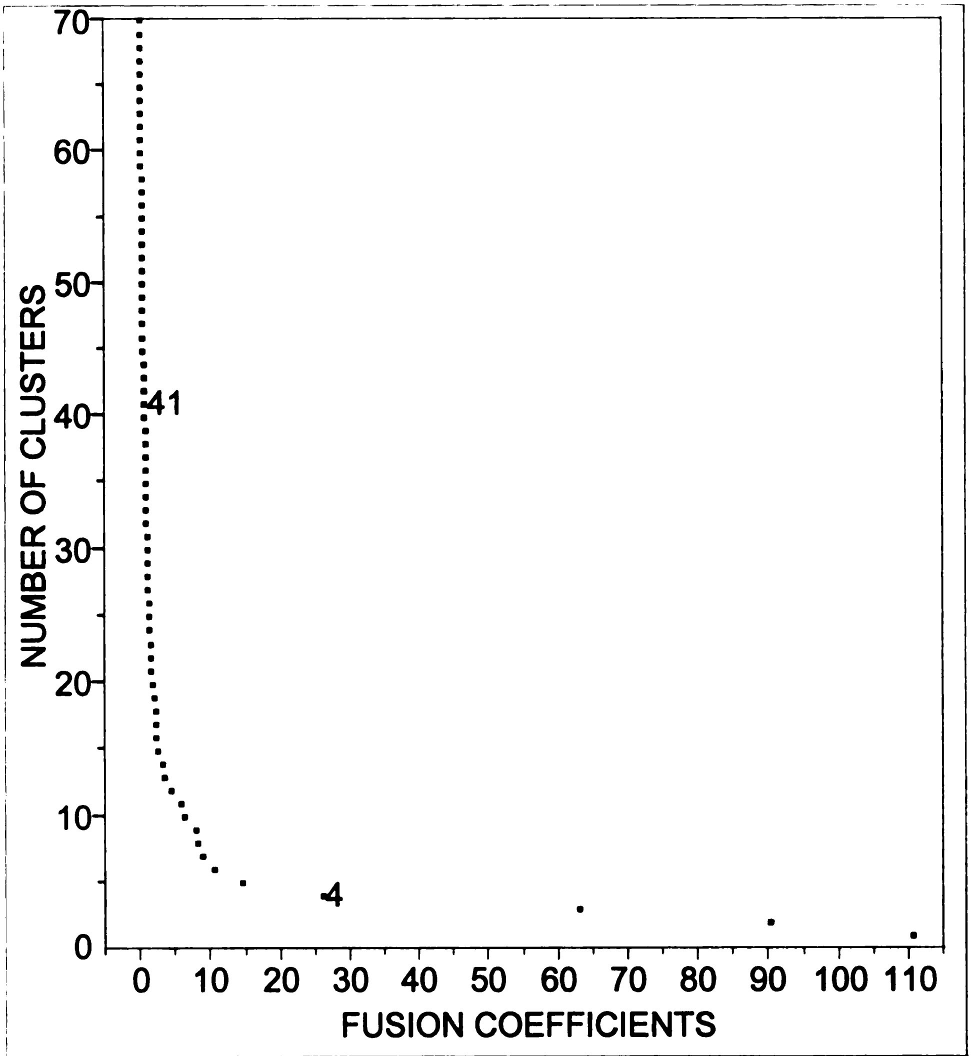
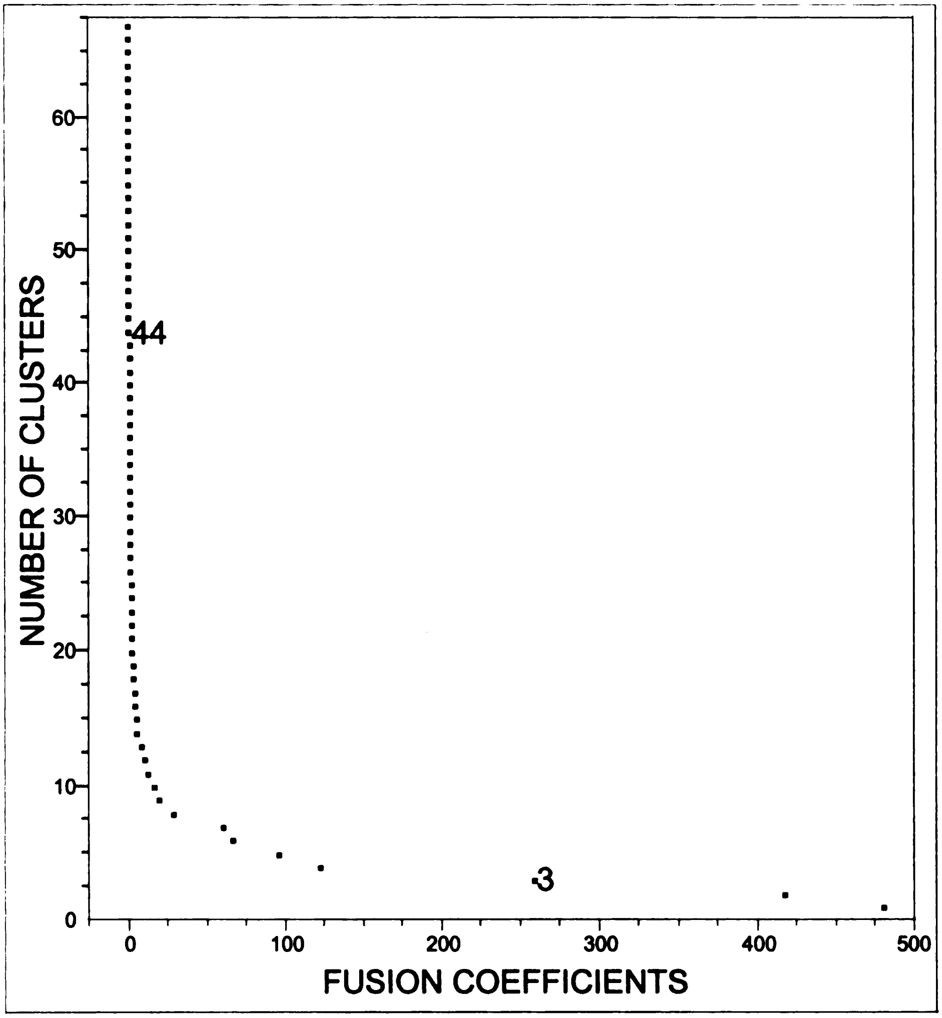


Figure A.30 Scree test showing three clusters for Tariacuri Area 5 phase body sherds with last 65 fusion coefficients shown (N=7315)



APPENDIX B:

TABLES OF CLUSTERS AND CLUSTER EXEMPLARS

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TABLES OF CLUSTERS AND CLUSTER EXEMPLARS

The tables in this appendix contain the description of the exemplar case for each cluster in a given phases' cluster solution. Any descriptive term in italics indicates multiple states for the variable in a given cluster, not including missing ("M") or indeterminate ("INDET") cases.

Table B.1 Loma Alta 3-Jarácuaro phase rim sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A	6	0.000	0.000	ROUNDED	INDET	INDET
2	A	3	0.032	0.000	ROUNDED	*INDET*	INDET
3	A	4	0.058	0.005	ROUNDED	CONVEX	OPEN
4	A	3	0.048	0.008	ROUNDED	STRAIGHT	OPEN
5	B	3	0.052	0.008	*TAPERED*	STRAIGHT	OPEN
6	B	3	0.048	0.008	*TAPERED*	EVERTED	CLOSED
7	B	7	0.238	0.010	*SQUARED*	*INDET*	INDET
8	C	5	0.173	0.007	ROUNDED	INDET	INDET
9	C	5	0.317	0.040	*ROUNDED*	*STRAIGHT*	*OPEN*
10	D	9	0.152	0.002	TAPERED	INCURVED	OPEN

Table B.1 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	6	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
2	A	3	SMOOTH	CREAM	ABSENT	ABSENT	MODELED
3	A	4	SMOOTH	*RED*	ABSENT	ABSENT	ABSENT
4	A	3	POLISH	*RED*	ABSENT	ABSENT	ABSENT
5	B	3	SMOOTH	RED	ABSENT	ABSENT	ABSENT
6	B	3	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
7	B	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
8	C	5	POLISH	CREAM	*RED*	*ABSENT*	ABSENT
9	C	5	SMOOTH	CREAM	*R/W*	ABSENT	ABSENT
10	D	9	*POLISH*	CREAM	ABSENT	ABSENT	*ABSENT*

Table B.2 Jarácuaro phase rim sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A	20	0.184	0.000	ROUNDED	*M*	M
2	A	4	0.158	0.007	*TAPERED*	EVERTED	CLOSED
3	A	3	0.077	0.013	ROUNDED	EVERTED	CLOSED
4	A	13	0.000	0.000	ROUNDED	M	M
5	B	5	0.182	0.000	ROUNDED	*M*	M
6	B	3	0.054	0.002	ROUNDED	CONVEX	OPEN
7	B	4	0.077	0.010	ROUNDED	CONVEX	OPEN
8	B	4	0.000	0.000	ROUNDED	STRAIGHT	OPEN
9	B	5	0.185	0.009	SQUARED	*STRAIGHT*	OPEN
10	B	7	0.087	0.017	SQUARED	*STRAIGHT*	OPEN
11	C(1)	4	0.074	0.000	TAPERED	STRAIGHT	OPEN
12	C(1)	5	0.000	0.000	TAPERED	STRAIGHT	OPEN
13	C(1)	3	0.115	0.010	TAPERED	*INCURVED*	OPEN
14	C(2)	9	0.063	0.015	ROUNDED	STRAIGHT	OPEN
15	C(2)	5	0.163	0.005	*ROUNDED*	STRAIGHT	OPEN
16	C(2)	6	0.090	0.008	*ROUNDED*	INCURVED	OPEN
17	C(2)	9	0.078	0.010	*ROUNDED*	CONVEX	OPEN
18	C(2)	6	0.167	0.018	ROUNDED	*CONVEX*	OPEN
19	C(2)	4	0.038	0.006	TAPERED	*STRAIGHT*	OPEN
20	C(2)	18	0.076	0.000	ROUNDED	STRAIGHT	OPEN

Table B.2 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	20	M	CREAM	ABSENT	ABSENT	ABSENT
2	A	4	SMOOTH	CREAM	*ABSENT*	ABSENT	ABSENT
3	A	3	POLISH	*CREAM*	*ABSENT*	ABSENT	ABSENT
4	A	13	M	RED	ABSENT	ABSENT	ABSENT
5	B	5	SMOOTH	CREAM	RED	ABSENT	ABSENT
6	B	3	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
7	B	4	POLISH	CREAM	*R/W*	ABSENT	ABSENT
8	B	4	POLISH	CREAM	RED	ABSENT	ABSENT
9	B	5	POLISH	*CREAM*	*RED*	ABSENT	ABSENT
10	B	7	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
11	C(1)	4	*SMOOTH*	CREAM	ABSENT	ABSENT	ABSENT
12	C(1)	5	SMOOTH	CREAM	RED	ABSENT	ABSENT
13	C(1)	3	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
14	C(2)	9	*POLISH*	CREAM	ABSENT	ABSENT	ABSENT
15	C(2)	5	POLISH	RED	ABSENT	*ABSENT*	ABSENT
16	C(2)	6	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
17	C(2)	9	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
18	C(2)	6	*POLISH*	CREAM	ABSENT	ABSENT	INCISED
19	C(2)	4	SMOOTH	CREAM	ABSENT	ABSENT	INCISED
20	C(2)	18	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT

Table B.2 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
21	D	7	0.000	0.000	ROUNDED	M	OPEN
22	D	13	0.077	0.013	ROUNDED	*EVERTED*	OPEN
23	D	8	0.000	0.000	ROUNDED	INCURVED	OPEN
24	D	25	0.000	0.000	ROUNDED	CONVEX	OPEN
25	E	3	0.000	0.000	SQUARED	M	M
26	E	5	0.059	0.002	SQUARED	STRAIGHT	OPEN
27	E	23	0.000	0.000	SQUARED	CONVEX	OPEN
28	E	7	0.000	0.000	SQUARED	CONVEX	OPEN
29	E	7	0.092	0.008	*TAPERED*	*EVERTED*	CLOSED
30	E	4	0.103	0.005	TAPERED	*CONVEX*	OPEN
31	E	5	0.062	0.001	TAPERED	STRAIGHT	OPEN

Table B.2 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
21	D	7	M	RED	ABSENT	ABSENT	ABSENT
22	D	13	SMOOTH	*RED*	ABSENT	ABSENT	ABSENT
23	D	8	SMOOTH	RED	ABSENT	ABSENT	ABSENT
24	D	25	SMOOTH	RED	ABSENT	ABSENT	ABSENT
25	E	3	M	RED	ABSENT	ABSENT	ABSENT
26	E	5	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT
27	E	23	SMOOTH	RED	ABSENT	ABSENT	ABSENT
28	E	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
29	E	7	SMOOTH	RED	ABSENT	ABSENT	ABSENT
30	E	4	*SMOOTH*	RED	ABSENT	ABSENT	ABSENT
31	E	5	SMOOTH	RED	*ABSENT*	ABSENT	ABSENT

Table B.3 Lupe phase rim sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A	9	0.020	0.000	TAPERED	M	M
2	A	6	0.102	0.004	TAPERED	EVERTED	*INDET*
3	A	27	0.000	0.000	TAPERED	STRAIGHT	INDET
4	A	11	0.087	0.000	TAPERED	STRAIGHT	*INDET*
5	A	17	0.000	0.000	TAPERED	M	M
6	A	5	0.072	0.008	TAPERED	EVERTED	*CLOSED*
7	A	3	0.018	0.000	TAPERED	BOLSTER	*INDET*
8	A	7	0.034	0.002	TAPERED	CONVEX	OPEN
9	B	6	0.000	0.000	SQUARED	EVERTED	CLOSED
10	B	5	0.056	0.007	SQUARED	BOLSTER	CLOSED
11	B	8	0.044	0.001	SQUARED	EVERTED	CLOSED
12	B	9	0.035	0.000	SQUARED	M	M
13	B	14	0.000	0.000	SQUARED	STRAIGHT	INDET
14	B	7	0.036	0.000	SQUARED	STRAIGHT	*INDET*
15	B	7	0.114	0.005	SQUARED	*STRAIGHT*	*OPEN*
16	C	4	0.089	0.022	ROUNDED	*STRAIGHT*	OPEN
17	C	5	0.091	0.009	*ROUNDED*	*STRAIGHT*	OPEN
18	C	4	0.081	0.014	*TAPERED*	EVERTED	CLOSED
19	C	10	0.084	0.001	TAPERED	CONVEX	*OPEN*
20	C	4	0.060	0.012	SQUARED	CONVEX	OPEN

Table B.3 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	9	*M*	M	ABSENT	ABSENT	ABSENT
2	A	6	*SMOOTH*	CREAM	*ABSENT*	ABSENT	ABSENT
3	A	27	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
4	A	11	POLISH	RED	ABSENT	*ABSENT*	ABSENT
5	A	17	M	RED	ABSENT	ABSENT	ABSENT
6	A	5	*SMOOTH*	RED	ABSENT	ABSENT	ABSENT
7	A	3	SMOOTH	RED	ABSENT	ABSENT	ABSENT
8	A	7	*SMOOTH*	RED	ABSENT	ABSENT	ABSENT
9	B	6	M	RED	ABSENT	ABSENT	ABSENT
10	B	5	SMOOTH	*RED*	ABSENT	ABSENT	ABSENT
11	B	8	SMOOTH	CREAM	*ABSENT*	ABSENT	ABSENT
12	B	9	*M*	CREAM	ABSENT	ABSENT	ABSENT
13	B	14	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
14	B	7	SMOOTH	RED	ABSENT	ABSENT	ABSENT
15	B	7	POLISH	RED	ABSENT	ABSENT	ABSENT
16	C	4	SMOOTH	*NONE*	ABSENT	ABSENT	ABSENT
17	C	5	WIPED	NONE	ABSENT	ABSENT	ABSENT
18	C	4	WIPED	*NONE*	ABSENT	ABSENT	ABSENT
19	C	10	*SMOOTH*	CREAM	ABSENT	ABSENT	ABSENT
20	C	4	*SMOOTH*	CREAM	ABSENT	ABSENT	*INCISED*

Table B.3 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
21	C	19	0.046	0.000	ROUNDED	CONVEX	OPEN
22	C	9	0.000	0.000	ROUNDED	INCURVED	OPEN
23	C	4	0.086	0.022	*SQUARED*	INCURVED	OPEN
24	C	7	0.053	0.002	ROUNDED	BOLSTER	*INDET*
25	C	5	0.054	0.003	ROUNDED	*STRAIGHT*	OPEN
26	C	3	0.054	0.009	ROUNDED	*CONVEX*	OPEN
27	C	22	0.000	0.000	ROUNDED	EVERTED	OPEN
28	C	17	0.064	0.001	ROUNDED	EVERTED	CLOSED
29	C	54	0.052	0.000	ROUNDED	STRAIGHT	OPEN
30	C	6	0.100	0.006	*ROUNDED*	STRAIGHT	CLOSED
31	C	9	0.039	0.001	ROUNDED	STRAIGHT	OPEN
32	D	25	0.044	0.000	ROUNDED	*M*	CLOSED
33	D	12	0.119	0.002	ROUNDED	BOLSTER	*INDET*
34	D	4	0.065	0.006	ROUNDED	*EVERTED*	OPEN
35	D	6	0.069	0.004	ROUNDED	CONVEX	OPEN
36	D	23	0.000	0.000	ROUNDED	M	OPEN
37	D	3	0.027	0.005	*ROUNDED*	STRAIGHT	OPEN
38	D	36	0.000	0.000	ROUNDED	STRAIGHT	OPEN
39	E	21	0.000	0.000	ROUNDED	M	M
40	E	8	0.079	0.002	ROUNDED	STRAIGHT	OPEN

Table B.3 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
21	C	19	*SMOOTH*	CREAM	ABSENT	ABSENT	ABSENT
22	C	9	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
23	C	4	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT
24	C	7	*SMOOTH*	CREAM	ABSENT	ABSENT	ABSENT
25	C	5	*SMOOTH*	CREAM	ABSENT	ABSENT	INCISED
26	C	3	POLISH	*RED*	ABSENT	ABSENT	INCISED
27	C	22	M	M	ABSENT	ABSENT	ABSENT
28	C	17	*SMOOTH*	CREAM	ABSENT	ABSENT	ABSENT
29	C	54	SMOOTH	CREAM	ABSENT	*ABSENT*	ABSENT
30	C	6	*SMOOTH*	CREAM	ABSENT	ABSENT	ABSENT
31	C	9	*POLISH*	CREAM	ABSENT	ABSENT	ABSENT
32	D	25	M	RED	ABSENT	ABSENT	ABSENT
33	D	12	*SMOOTH*	RED	ABSENT	ABSENT	ABSENT
34	D	4	M	RED	*ABSENT*	ABSENT	ABSENT
35	D	6	*POLISH*	RED	*ABSENT*	ABSENT	ABSENT
36	D	23	M	RED	ABSENT	ABSENT	ABSENT
37	D	3	SMOOTH	RED	WHITE	ABSENT	ABSENT
38	D	36	M	RED	ABSENT	ABSENT	ABSENT
39	E	21	M	CREAM	*RED*	ABSENT	ABSENT
40	E	8	*POLISH*	CREAM	R/W	*ABSENT*	ABSENT

Table B.3 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
41	E	24	0.099	0.000	ROUNDED	STRAIGHT	OPEN
42	E	4	0.034	0.003	ROUNDED	STRAIGHT	CLOSED
43	E	9	0.097	0.002	ROUNDED	EVERTED	*INDET*
44	E	5	0.000	0.000	ROUNDED	INCURVED	OPEN
45	E	4	0.041	0.003	ROUNDED	BOLSTER	INDET
46	E	2	0.000	0.000	ROUNDED	CONVEX	OPEN
47	E	11	0.063	0.003	ROUNDED	CONVEX	OPEN
48	E	5	0.000	0.000	TAPERED	INDET	INDET
49	E	8	0.024	0.000	TAPERED	STRAIGHT	OPEN
50	E	3	0.042	0.007	TAPERED	*CONVEX*	OPEN
51	E	6	0.035	0.006	SQUARED	CONVEX	OPEN
52	E	9	0.093	0.003	SQUARED	STRAIGHT	OPEN

Table B.3 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
41	E	24	SMOOTH	CREAM	*RED*	ABSENT	*ABSENT*
42	E	4	SMOOTH	CREAM	RED	ABSENT	*ABSENT*
43	E	9	*SMOOTH*	CREAM	*RED*	ABSENT	ABSENT
44	E	5	SMOOTH	CREAM	RED	ABSENT	ABSENT
45	E	4	SMOOTH	*CREAM*	RED	ABSENT	ABSENT
46	E	2	POLISH	CREAM	RED	RESIST	ABSENT
47	E	11	SMOOTH	CREAM	RED	ABSENT	ABSENT
48	E	5	POLISH	CREAM	RED	ABSENT	ABSENT
49	E	8	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
50	E	3	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
51	E	6	*SMOOTH*	CREAM	RED	ABSENT	ABSENT
52	E	9	*POLISH*	*CREAM*	RED	ABSENT	ABSENT

Table B.4 Early Urichu phase rim sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A	17	0.056	0.000	ROUNDED	EVERTED	M
2	A	11	0.144	0.001	ROUNDED	BOLSTER	*M*
3	A	6	0.096	0.000	ROUNDED	EVERTED	OPEN
4	A	12	0.042	0.000	ROUNDED	M	*M*
5	A	6	0.035	0.000	ROUNDED	*M*	M
6	A	3	0.049	0.016	ROUNDED	STRAIGHT	CLOSED
7	A	5	0.099	0.013	ROUNDED	STRAIGHT	OPEN
8	A	4	0.073	0.004	ROUNDED	*CONVEX*	OPEN
9	A	4	0.000	0.000	ROUNDED	CONVEX	OPEN
10	A	4	0.039	0.003	ROUNDED	STRAIGHT	OPEN
11	A	7	0.137	0.005	ROUNDED	*STRAIGHT*	OPEN
12	A	7	0.152	0.012	TAPERED	STRAIGHT	OPEN
13	A	55	0.000	0.000	ROUNDED	STRAIGHT	M
14	A	10	0.000	0.000	ROUNDED	EVERTED	OPEN
15	A	11	0.000	0.000	ROUNDED	INCURVED	OPEN
16	A	16	0.057	0.000	ROUNDED	*EVERTED*	CLOSED
17	A	6	0.086	0.005	*ROUNDED*	BOLSTER	OPEN
18	A	7	0.039	0.000	ROUNDED	BOLSTER	*M*
19	A	25	0.060	0.000	ROUNDED	CONVEX	OPEN
20	A	7	0.074	0.000	*M*	CONVEX	OPEN

Table B.4 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	17	M	M	ABSENT	ABSENT	ABSENT
2	A	11	SMOOTH	RED	ABSENT	ABSENT	*ABSENT*
3	A	6	*M*	*M*	ABSENT	ABSENT	ABSENT
4	A	12	M	RED	ABSENT	ABSENT	ABSENT
5	A	6	M	NONE	ABSENT	ABSENT	ABSENT
6	A	3	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT
7	A	5	WIPED	*CREAM*	ABSENT	ABSENT	ABSENT
8	A	4	WIPED	*M*	ABSENT	ABSENT	ABSENT
9	A	4	POLISH	RED	ABSENT	ABSENT	ABSENT
10	A	4	POLISH	RED	ABSENT	ABSENT	*ABSENT*
11	A	7	POLISH	CREAM	ABSENT	ABSENT	*ABSENT*
12	A	7	POLISH	RED	ABSENT	*ABSENT*	ABSENT
13	A	55	M	RED	ABSENT	ABSENT	ABSENT
14	A	10	M	CREAM	ABSENT	ABSENT	ABSENT
15	A	11	M	M	ABSENT	ABSENT	ABSENT
16	A	16	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
17	A	6	SMOOTH	CREAM	RED	ABSENT	ABSENT
18	A	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
19	A	25	SMOOTH	CREAM	ABSENT	ABSENT	*ABSENT*
20	A	7	SMOOTH	RED	ABSENT	ABSENT	ABSENT

Table B.4 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
21	A	13	0.000	0.000	ROUNDED	CONVEX	OPEN
22	A	2	0.026	0.011	*ROUNDED*	INCURVED	CLOSED
23	A	4	0.080	0.019	ROUNDED	STRAIGHT	OPEN
24	A	5	0.065	0.009	*ROUNDED*	STRAIGHT	OPEN
25	B	65	0.000	0.000	ROUNDED	STRAIGHT	OPEN
26	B	12	0.055	0.000	TAPERED	*EVERTED*	CLOSED
27	B	7	0.000	0.000	TAPERED	EVERTED	M
28	B	19	0.161	0.000	TAPERED	STRAIGHT	*M*
29	B	7	0.132	0.015	TAPERED	*BOLSTER*	M
30	B	13	0.000	0.000	TAPERED	M	OPEN
31	B	21	0.096	0.000	TAPERED	*M*	M
32	B	24	0.000	0.000	TAPERED	STRAIGHT	M
33	C	7	0.032	0.000	SQUARED	BOLSTER	*M*
34	C	3	0.037	0.008	SQUARED	M	M
35	C	4	0.000	0.000	SQUARED	CONVEX	OPEN
36	C	3	0.032	0.005	SQUARED	INCURVED	OPEN
37	C	8	0.000	0.000	SQUARED	EVERTED	M
38	C	3	0.099	0.016	SQUARED	EVERTED	CLOSED
39	C	27	0.167	0.000	SQUARED	STRAIGHT	*M*
40	C	9	0.000	0.000	SQUARED	M	OPEN

Table B.4 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
21	A	13	SMOOTH	RED	ABSENT	ABSENT	ABSENT
22	A	2	SMOOTH	CREAM	ABSENT	ABSENT	INCISED
23	A	4	SMOOTH	CREAM	ABSENT	ABSENT	*DRILLED*
24	A	5	SMOOTH	CREAM	ABSENT	ABSENT	INCISED
25	B	65	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
26	B	12	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
27	B	7	M	NONE	ABSENT	ABSENT	ABSENT
28	B	19	SMOOTH	CREAM	*ABSENT*	ABSENT	ABSENT
29	B	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
30	B	13	M	CREAM	ABSENT	ABSENT	ABSENT
31	B	21	*M*	RED	ABSENT	ABSENT	ABSENT
32	B	24	M	M	ABSENT	ABSENT	ABSENT
33	C	7	M	CREAM	ABSENT	ABSENT	ABSENT
34	C	3	M	*NONE*	ABSENT	ABSENT	ABSENT
35	C	4	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
36	C	3	SMOOTH	CREAM	*ABSENT*	ABSENT	ABSENT
37	C	8	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
38	C	3	*SMOOTH*	CREAM	*RED*	ABSENT	*ABSENT*
39	C	27	*M*	CREAM	ABSENT	ABSENT	ABSENT
40	C	9	M	CREAM	RED	ABSENT	ABSENT

Table B.4 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
41	C	2	0.054	0.027	SQUARED	STRAIGHT	OPEN
42	C	27	0.000	0.000	SQUARED	STRAIGHT	OPEN
43	C	4	0.081	0.004	SQUARED	*M*	M
44	C	8	0.000	0.000	SQUARED	BOLSTER	M
45	C	7	0.000	0.000	SQUARED	EVERTED	M
46	D	48	0.127	0.000	ROUNDED	STRAIGHT	OPEN
47	D	6	0.000	0.000	ROUNDED	STRAIGHT	M
48	D	27	0.000	0.000	TAPERED	STRAIGHT	OPEN
49	D	3	0.035	0.005	TAPERED	EVERTED	CLOSED
50	D	7	0.053	0.000	TAPERED	EVERTED	*M*
51	D	5	0.000	0.000	ROUNDED	EVERTED	OPEN
52	D	6	0.046	0.002	ROUNDED	*EVERTED*	CLOSED
53	D	4	0.032	0.000	ROUNDED	INCURVED	*M*
54	D	5	0.098	0.013	ROUNDED	*CONVEX*	OPEN
55	D	9	0.097	0.002	ROUNDED	STRAIGHT	OPEN
56	D	6	0.076	0.006	*TAPERED*	STRAIGHT	OPEN
57	D	23	0.000	0.000	ROUNDED	CONVEX	OPEN
58	D	6	0.074	0.006	TAPERED	CONVEX	OPEN
59	D	5	0.000	0.000	SQUARED	CONVEX	OPEN

Table B.4 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
41	C	2	SMOOTH	*CREAM*	*R/W*	ABSENT	*DRILLED*
42	C	27	M	RED	ABSENT	ABSENT	ABSENT
43	C	4	POLISH	RED	ABSENT	ABSENT	ABSENT
44	C	8	SMOOTH	RED	ABSENT	ABSENT	ABSENT
45	C	7	M	RED	ABSENT	ABSENT	ABSENT
46	D	48	SMOOTH	CREAM	RED	ABSENT	*ABSENT*
47	D	6	M	CREAM	R/W	ABSENT	ABSENT
48	D	27	M	CREAM	RED	ABSENT	ABSENT
49	D	3	POLISH	CREAM	RED	*ABSENT*	ABSENT
50	D	7	SMOOTH	CREAM	RED	ABSENT	ABSENT
51	D	5	M	CREAM	RED	ABSENT	ABSENT
52	D	6	SMOOTH	CREAM	RED	ABSENT	ABSENT
53	D	4	M	CREAM	RED	ABSENT	ABSENT
54	D	5	POLISH	CREAM	RED	ABSENT	ABSENT
55	D	9	POLISH	CREAM	*RED*	*ABSENT*	ABSENT
56	D	6	POLISH	CREAM	RED	ABSENT	ABSENT
57	D	23	SMOOTH	CREAM	RED	ABSENT	ABSENT
58	D	6	*SMOOTH*	CREAM	RED	ABSENT	ABSENT
59	D	5	SMOOTH	CREAM	RED	ABSENT	ABSENT

Table B.5 Late Urichu phase rim sherds cluster information

Cluster	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A	16	0.029	0.000	ROUNDED	*M*	OPEN
2	A	9	0.279	0.004	*ROUNDED*	EVERTED	CLOSED
3	B	18	0.175	0.000	ROUNDED	*M*	M
4	C	4	0.054	0.004	*TAPERED*	EVERTED	CLOSED
5	C	4	0.063	0.000	ROUNDED	*M*	*M*
6	C	9	0.051	0.000	TAPERED	M	OPEN
7	C	4	0.129	0.022	*TAPERED*	INCURVED	CLOSED
8	C	5	0.000	0.000	SQUARED	M	M
9	D	15	0.217	0.000	TAPERED	EVERTED	*M*
10	E	4	0.085	0.007	*ROUNDED*	EVERTED	OPEN
11	E	4	0.155	0.024	*ROUNDED*	BOLSTER	M
12	E	4	0.067	0.000	ROUNDED	*M*	CLOSED
13	E	2	0.042	0.021	ROUNDED	M	M
14	E	3	0.117	0.026	TAPERED	M	M
15	E	1	0.000	0.000	TAPERED	EVERTED	CLOSED
16	E	6	0.193	0.012	*TAPERED*	*STRAIGHT*	OPEN

Table B.5 (continued)

Cluster	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	16	M	RED	ABSENT	ABSENT	ABSENT
2	A	9	M	*RED*	*ABSENT*	ABSENT	*ABSENT*
3	B	18	M	CREAM	ABSENT	ABSENT	ABSENT
4	C	4	M	NONE	ABSENT	ABSENT	ABSENT
5	C	4	M	NONE	ABSENT	ABSENT	ABSENT
6	C	9	M	*INDET*	ABSENT	ABSENT	ABSENT
7	C	4	M	CREAM	ABSENT	ABSENT	*ABSENT*
8	C	5	M	CREAM	ABSENT	ABSENT	ABSENT
9	D	15	M	RED	*ABSENT*	ABSENT	ABSENT
10	E	4	M	CREAM	*RED*	ABSENT	ABSENT
11	E	4	M	*NONE*	RED	ABSENT	ABSENT
12	E	4	M	CREAM	RED	ABSENT	ABSENT
13	E	2	M	CREAM	*RED*	RESIST	ABSENT
14	E	3	M	*CREAM*	*WHITE*	RESIST	ABSENT
15	E	1	M	NONE	R/W	RESIST	ABSENT
16	E	6	M	CREAM	*RED*	ABSENT	ABSENT

Table B.6 Tariacuri Area 1 phase rim sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A(1)	5	0.043	0.005	TAPERED	EVERTED	OPEN
2	A(1)	5	0.126	0.006	*SQUARED*	STRAIGHT	OPEN
3	A(1)	7	0.184	0.007	*TAPERED*	STRAIGHT	OPEN
4	A(1)	6	0.048	0.002	TAPERED	STRAIGHT	OPEN
5	A(1)	13	0.000	0.000	TAPERED	EVERTED	M
6	A(1)	6	0.106	0.004	*TAPERED*	*INCURVED*	OPEN
7	A(1)	7	0.156	0.010	*SQUARED*	EVERTED	*M*
8	A(1)	6	0.107	0.003	SQUARED	EVERTED	*OPEN*
9	A(1)	5	0.074	0.000	SQUARED	*M*	OPEN
10	A(1)	10	0.050	0.000	SQUARED	STRAIGHT	*M*
11	A(2)	16	0.048	0.000	ROUNDED	EVERTED	CLOSED
12	A(2)	10	0.055	0.001	ROUNDED	STRAIGHT	OPEN
13	A(2)	7	0.089	0.000	ROUNDED	*M*	M
14	A(2)	2	0.022	0.011	ROUNDED	CONVEX	OPEN
15	A(2)	5	0.000	0.000	ROUNDED	CONVEX	OPEN
16	A(2)	4	0.043	0.003	TAPERED	*CONVEX*	OPEN
17	A(2)	4	0.056	0.013	*TAPERED*	BOLSTER	OPEN
18	A(3)	15	0.162	0.000	ROUNDED	*M*	OPEN
19	A(3)	11	0.168	0.001	ROUNDED	STRAIGHT	OPEN
20	A(3)	6	0.115	0.006	ROUNDED	*EVERTED*	OPEN

Table B.6 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A(1)	5	M	CREAM	*R/W*	ABSENT	ABSENT
2	A(1)	5	POLISH	*CREAM*	*WHITE*	ABSENT	ABSENT
3	A(1)	7	*M*	CREAM	*RED*	ABSENT	ABSENT
4	A(1)	6	SMOOTH	CREAM	*ABSENT*	ABSENT	ABSENT
5	A(1)	13	M	CREAM	ABSENT	ABSENT	ABSENT
6	A(1)	6	POLISH	CREAM	ABSENT	ABSENT	ABSENT
7	A(1)	7	M	RED	ABSENT	ABSENT	ABSENT
8	A(1)	6	SMOOTH	CREAM	*ABSENT*	ABSENT	ABSENT
9	A(1)	5	*M*	RED	ABSENT	ABSENT	ABSENT
10	A(1)	10	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
11	A(2)	16	*M*	CREAM	ABSENT	ABSENT	ABSENT
12	A(2)	10	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
13	A(2)	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
14	A(2)	2	SMOOTH	CREAM	ABSENT	ABSENT	MODELED
15	A(2)	5	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
16	A(2)	4	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
17	A(2)	4	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
18	A(3)	15	M	CREAM	RED	ABSENT	*ABSENT*
19	A(3)	11	*M*	CREAM	*R/W*	*ABSENT*	ABSENT
20	A(3)	6	M	CREAM	*R/W*	ABSENT	ABSENT

Table B.6 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
21	A(3)	6	0.277	0.029	*ROUNDED*	*STRAIGHT*	OPEN
22	A(4)	3	0.021	0.003	ROUNDED	*EVERTED*	CLOSED
23	A(4)	6	0.000	0.000	ROUNDED	EVERTED	CLOSED
24	A(4)	3	0.069	0.017	*TAPERED*	EVERTED	*CLOSED*
25	A(4)	5	0.053	0.003	TAPERED	EVERTED	M
26	A(4)	9	0.027	0.000	TAPERED	EVERTED	CLOSED
27	A(4)	5	0.038	0.005	SQUARED	EVERTED	CLOSED
28	B	20	0.000	0.000	ROUNDED	EVERTED	M
29	B	10	0.309	0.007	ROUNDED	*STRAIGHT*	*OPEN*
30	B	5	0.071	0.000	TAPERED	*M*	M
31	B	19	0.000	0.000	TAPERED	EVERTED	M

Table B.6 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
21	A(3)	6	M	CREAM	*R/W*	RESIST	ABSENT
22	A(4)	3	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
23	A(4)	6	M	NONE	RED	ABSENT	ABSENT
24	A(4)	3	WIPED	NONE	ABSENT	ABSENT	ABSENT
25	A(4)	5	M	*NONE*	RED	ABSENT	ABSENT
26	A(4)	9	SMOOTH	CREAM	RED	ABSENT	ABSENT
27	A(4)	5	M	CREAM	*R/W*	ABSENT	ABSENT
28	B	20	M	RED	ABSENT	ABSENT	ABSENT
29	B	10	SMOOTH	RED	*ABSENT*	ABSENT	ABSENT
30	B	5	SMOOTH	RED	ABSENT	ABSENT	ABSENT
31	B	19	M	RED	ABSENT	ABSENT	ABSENT

Table B.7 Tariacuri Area 2 phase rim sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A	15	0.000	0.000	SQUARED	EVERTED	CLOSED
2	A	12	0.051	0.000	SQUARED	*M*	OPEN
3	A	2	0.026	0.012	SQUARED	*CONVEX*	OPEN
4	A	32	0.000	0.000	TAPERED	M	M
5	A	8	0.291	0.003	TAPERED	*M*	OPEN
6	A	4	0.000	0.000	STRAIGHT	M	OPEN
7	A	22	0.273	0.000	TAPERED	*M*	M
8	A	5	0.068	0.000	TAPERED	*M*	*M*
9	B	5	0.100	0.004	ROUNDED	*INDET*	M
10	B	4	0.086	0.006	ROUNDED	EVERTED	CLOSED
11	B	15	0.107	0.001	ROUNDED	STRAIGHT	OPEN
12	B	4	0.065	0.004	ROUNDED	EVERTED	OPEN
13	B	4	0.050	0.004	ROUNDED	EVERTED	OPEN
14	B	5	0.158	0.011	*TAPERED*	EVERTED	CLOSED
15	B	13	0.142	0.000	TAPERED	*M*	OPEN
16	B	13	0.033	0.000	SQUARED	STRAIGHT	OPEN
17	B	2	0.046	0.019	SQUARED	STRAIGHT	OPEN
18	B	10	0.295	0.003	SQUARED	*M*	M
19	B	6	0.152	0.010	SQUARED	*EVERTED*	CLOSED
20	C	38	0.141	0.000	ROUNDED	*INDET*	M

Table B.7 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	15	M	RED	ABSENT	ABSENT	ABSENT
2	A	12	M	RED	ABSENT	ABSENT	ABSENT
3	A	2	POLISH	RED	ABSENT	RESIST	ABSENT
4	A	32	M	RED	ABSENT	ABSENT	ABSENT
5	A	8	*M*	RED	*ABSENT*	ABSENT	*ABSENT*
6	A	4	M	RED	ABSENT	ABSENT	ABSENT
7	A	22	*M*	CREAM	ABSENT	ABSENT	ABSENT
8	A	5	M	NONE	ABSENT	ABSENT	ABSENT
9	B	5	M	CREAM	*R/W*	ABSENT	ABSENT
10	B	4	SMOOTH	*CREAM*	*RED*	ABSENT	ABSENT
11	B	15	M	CREAM	*RED*	*ABSENT*	ABSENT
12	B	4	M	WHITE	RED	ABSENT	ABSENT
13	B	4	M	CREAM	*R/W*	RESIST	ABSENT
14	B	5	M	CREAM	*WHITE*	ABSENT	ABSENT
15	B	13	M	CREAM	*RED*	ABSENT	ABSENT
16	B	13	M	CREAM	*RED*	ABSENT	ABSENT
17	B	2	POLISH	*WHITE*	*R/W*	ABSENT	ABSENT
18	B	10	M	CREAM	ABSENT	ABSENT	*ABSENT*
19	B	6	M	*CREAM*	ABSENT	ABSENT	ABSENT
20	C	38	M	CREAM	ABSENT	ABSENT	ABSENT

Table B.7 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
21	C	9	0.162	0.000	ROUNDED	*M*	OPEN
22	C	11	0.028	0.000	ROUNDED	*M*	M
23	C	51	0.000	0.000	ROUNDED	INDET	M
24	D	20	0.547	0.016	ROUNDED	*STRAIGHT*	OPEN
25	D	34	0.144	0.000	ROUNDED	EVERTED	CLOSED

Table B.7 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
21	C	9	*M*	INDET	ABSENT	ABSENT	ABSENT
22	C	11	M	NONE	ABSENT	ABSENT	ABSENT
23	C	51	M	RED	ABSENT	ABSENT	ABSENT
24	D	20	M	RED	ABSENT	ABSENT	ABSENT
25	D	34	*M*	RED	*ABSENT*	ABSENT	ABSENT

Table B.8 Tariacuri Area 5 phase rim sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
1	A	72	0.122	0.000	ROUNDED	M	*M*
2	A	8	0.050	0.000	ROUNDED	*M*	OPEN
3	A	13	0.000	0.000	ROUNDED	BOLSTER	M
4	A	11	0.049	0.000	ROUNDED	EVERTED	CLOSED
5	B(1)	7	0.000	0.000	ROUNDED	EVERTED	OPEN
6	B(1)	35	0.052	0.000	ROUNDED	EVERTED	M
7	B(1)	110	0.000	0.000	ROUNDED	STRAIGHT	OPEN
8	B(1)	7	0.107	0.002	ROUNDED	STRAIGHT	CLOSED
9	B(1)	6	0.133	0.002	ROUNDED	*M*	M
10	B(1)	11	0.105	0.000	ROUNDED	INCURVED	*M*
11	B(1)	21	0.063	0.000	ROUNDED	CONVEX	OPEN
12	B(1)	18	0.139	0.000	ROUNDED	BOLSTER	*M*
13	B(2)	36	0.064	0.000	ROUNDED	EVERTED	CLOSED
14	C(1)	18	0.066	0.000	TAPERED	STRAIGHT	OPEN
15	C(1)	13	0.091	0.000	TAPERED	*M*	OPEN
16	C(1)	7	0.078	0.002	TAPERED	CONVEX	OPEN
17	C(1)	19	0.185	0.000	TAPERED	M	*M*
18	C(1)	9	0.138	0.000	TAPERED	*M*	OPEN
19	C(1)	6	0.000	0.000	TAPERED	CONVEX	OPEN
20	C(1)	3	0.071	0.011	SQUARED	STRAIGHT	OPEN

Table B.8 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	72	M	RED	ABSENT	ABSENT	ABSENT
2	A	8	M	RED	ABSENT	ABSENT	ABSENT
3	A	13	M	RED	ABSENT	ABSENT	ABSENT
4	A	11	*M*	RED	ABSENT	ABSENT	ABSENT
5	B(1)	7	M	RED	ABSENT	ABSENT	ABSENT
6	B(1)	35	*M*	CREAM	ABSENT	ABSENT	ABSENT
7	B(1)	110	M	CREAM	ABSENT	ABSENT	ABSENT
8	B(1)	7	SMOOTH	CREAM	*ABSENT*	ABSENT	*ABSENT*
9	B(1)	6	*POLISH*	CREAM	ABSENT	ABSENT	ABSENT
10	B(1)	11	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
11	B(1)	21	SMOOTH	CREAM	ABSENT	ABSENT	*ABSENT*
12	B(1)	18	M	CREAM	ABSENT	ABSENT	ABSENT
13	B(2)	36	*M*	CREAM	ABSENT	ABSENT	ABSENT
14	C(1)	18	SMOOTH	RED	*ABSENT*	ABSENT	ABSENT
15	C(1)	13	*M*	M	ABSENT	ABSENT	ABSENT
16	C(1)	7	SMOOTH	RED	*ABSENT*	ABSENT	ABSENT
17	C(1)	19	*M*	CREAM	ABSENT	ABSENT	ABSENT
18	C(1)	9	M	CREAM	ABSENT	ABSENT	ABSENT
19	C(1)	6	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
20	C(1)	3	SMOOTH	CREAM	ABSENT	ABSENT	*MODELED*

Table B.8 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
21	C(1)	4	0.177	0.031	ROUNDED	STRAIGHT	OPEN
22	C(1)	21	0.000	0.000	TAPERED	EVERTED	CLOSED
23	C(1)	15	0.049	0.000	TAPERED	EVERTED	CLOSED
24	C(1)	6	0.110	0.004	SQUARED	*BOLSTER*	M
25	C(1)	2	0.027	0.011	SQUARED	CONVEX	OPEN
26	C(1)	4	0.038	0.000	M	INCURVED	M
27	C(1)	10	0.000	0.000	SQUARED	M	M
28	C(1)	9	0.06	0.000	SQUARED	EVERTED	*M*
29	C(1)	7	0.182	0.010	SQUARED	*STRAIGHT*	M
30	C(1)	8	0.198	0.003	*SQUARED*	*M*	*M*
31	C(1)	11	0.100	0.000	ROUNDED	*M*	M
32	C(1)	5	0.046	0.002	ROUNDED	*STRAIGHT*	OPEN
33	C(1)	2	0.024	0.011	*ROUNDED*	STRAIGHT	OPEN
34	C(1)	5	0.109	0.007	TAPERED	*EVERTED*	*M*
35	C(1)	3	0.039	0.006	*TAPERED*	EVERTED	CLOSED
36	C(1)	4	0.098	0.017	ROUNDED	*STRAIGHT*	OPEN
37	C(2)	6	0.058	0.000	TAPERED	EVERTED	CLOSED
38	C(2)	13	0.096	0.000	TAPERED	*M*	M
39	C(2)	17	0.118	0.000	TAPERED	CONVEX	OPEN
40	C(2)	3	0.000	0.000	TAPERED	STRAIGHT	OPEN

Table B.8 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
21	C(1)	4	*SMOOTH*	*CREAM*	ABSENT	ABSENT	INCISED
22	C(1)	21	M	CREAM	ABSENT	ABSENT	ABSENT
23	C(1)	15	*M*	RED	ABSENT	ABSENT	ABSENT
24	C(1)	6	SMOOTH	RED	*ABSENT*	ABSENT	ABSENT
25	C(1)	2	*SMOOTH*	RED	ABSENT	ABSENT	INCISED
26	C(1)	4	SMOOTH	RED	ABSENT	ABSENT	ABSENT
27	C(1)	10	M	RED	ABSENT	ABSENT	ABSENT
28	C(1)	9	M	RED	ABSENT	ABSENT	ABSENT
29	C(1)	7	SMOOTH	*NONE*	ABSENT	ABSENT	ABSENT
30	C(1)	8	WIPED	*NONE*	ABSENT	ABSENT	ABSENT
31	C(1)	11	M	NONE	ABSENT	ABSENT	ABSENT
32	C(1)	5	SMOOTH	NONE	ABSENT	ABSENT	ABSENT
33	C(1)	2	SMOOTH	SELF	ABSENT	ABSENT	ABSENT
34	C(1)	5	*M*	NONE	ABSENT	ABSENT	ABSENT
35	C(1)	3	SMOOTH	NONE	RED	ABSENT	ABSENT
36	C(1)	4	*SMOOTH*	NONE	RED	ABSENT	ABSENT
37	C(2)	6	*M*	M	*M*	M	M
38	C(2)	13	M	*CREAM*	RED	ABSENT	ABSENT
39	C(2)	17	M	M	M	M	M
40	C(2)	3	M	CREAM	RED	ABSENT	ABSENT

Table B.8 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	LIP FORM	RIM FORM	CONSTRICTION
41	C(2)	3	0.069	0.011	TAPERED	CONVEX	OPEN
42	C(2)	27	0.124	0.000	TAPERED	STRAIGHT	*M*
43	C(3)	25	0.000	0.000	SQUARED	M	OPEN
44	C(3)	4	0.046	0.004	*SQUARED*	EVERTED	OPEN
45	C(3)	9	0.193	0.013	SQUARED	*INCURVED*	OPEN
46	C(3)	5	0.000	0.000	SQUARED	M	M
47	C(3)	5	0.023	0.001	SQUARED	CONVEX	OPEN
48	C(3)	6	0.000	0.000	SQUARED	EVERTED	CLOSED
49	C(3)	4	0.097	0.017	*ROUNDED*	INCURVED	CLOSED
50	C(3)	6	0.050	0.002	SQUARED	*EVERTED*	CLOSED
51	C(3)	15	0.000	0.000	SQUARED	STRAIGHT	OPEN
52	D	18	0.206	0.000	ROUNDED	EVERTED	*M*
53	D	21	0.000	0.000	ROUNDED	M	OPEN
54	D	8	0.055	0.000	ROUNDED	BOLSTER	*M*
55	D	29	0.090	0.000	ROUNDED	CONVEX	OPEN
56	D	3	0.039	0.008	ROUNDED	M	M
57	D	5	0.044	0.000	ROUNDED	STRAIGHT	M
58	D	10	0.107	0.000	ROUNDED	*M*	M
59	D	4	0.034	0.000	ROUNDED	*M*	M
60	D	8	0.059	0.004	ROUNDED	STRAIGHT	OPEN
61	D	66	0.000	0.000	ROUNDED	STRAIGHT	OPEN

Table B.8 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
41	C(2)	3	POLISH	*CREAM*	*RED*	ABSENT	ABSENT
42	C(2)	27	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
43	C(3)	25	M	CREAM	ABSENT	ABSENT	ABSENT
44	C(3)	4	M	CREAM	WHITE	ABSENT	ABSENT
45	C(3)	9	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
46	C(3)	5	M	CREAM	RED	ABSENT	ABSENT
47	C(3)	5	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
48	C(3)	6	M	CREAM	RED	ABSENT	ABSENT
49	C(3)	4	*SMOOTH*	CREAM	RED	ABSENT	ABSENT
50	C(3)	6	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
51	C(3)	15	SMOOTH	CREAM	RED	ABSENT	ABSENT
52	D	18	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
53	D	21	M	CREAM	RED	ABSENT	ABSENT
54	D	8	SMOOTH	CREAM	RED	ABSENT	ABSENT
55	D	29	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
56	D	3	POLISH	RED	*RED*	ABSENT	ABSENT
57	D	5	M	M	M	M	M
58	D	10	POLISH	CREAM	RED	ABSENT	ABSENT
59	D	4	M	CREAM	R/W	RESIST	ABSENT
60	D	8	SMOOTH	CREAM	*R/W*	ABSENT	ABSENT
61	D	66	SMOOTH	CREAM	RED	ABSENT	ABSENT

Table B.9 Loma-Alta 3-Jarácuaro phase support sherds (all cases)

FILL	FORM	CONSTRICTION	FINISH	SLIP	PAINT	RESIST	PLASTIC
N/A	CIRCULAR	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
SOLID	CONICAL	INDET	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
SOLID	CONICAL	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
N/A	BASE	CLOSED	SMOOTH	CREAM	PINK	ABSENT	ABSENT

Table B.10 Jarácuaro phase support sherds (all cases)

FILL	FORM	CONSTRICTION	FINISH	SLIP	PAINT	RESIST	PLASTIC
SOLID	NUBBIN	OPEN	M	CREAM	ABSENT	ABSENT	ABSENT
N/A	ANULAR BASE	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
N/A	ANULAR BASE	INDET	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
SOLID	INDET	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
SOLID	CONICAL	OPEN	POLISH	CREAM	RED	ABSENT	PUNCTATE
N/A	ANULAR BASE	M	POLISH	RED	ABSENT	ABSENT	ABSENT
SOLID	CONICAL	M	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT

Table B.11 Lupe phase support sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	FILL	FORM	CONSTRICTION
1	A	5	0.095	0.012	N/A	ANULAR BASE	OPEN
2	A	2	0.056	0.027	SOLID	*FLATTENED*	INDET
3	A	5	0.184	0.008	HOLLOW	*INDET*	OPEN
4	A	12	0.567	0.003	SOLID	*M*	OPEN
5	B	7	0.265	0.013	*HOLLOW*	*INDET*	OPEN
6	C	12	0.247	0.001	HOLLOW	*INDET*	OPEN

Table B.11 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	5	SMOOTH	RED	ABSENT	ABSENT	*ABSENT*
2	A	2	WIPED	*CREAM*	ABSENT	ABSENT	ABSENT
3	A	5	*POLISH*	*CREAM*	ABSENT	ABSENT	ABSENT
4	A	12	SMOOTH	CREAM	*ABSENT*	*ABSENT*	ABSENT
5	B	7	POLISH	CREAM	RED	ABSENT	*ABSENT*
6	C	12	SMOOTH	*CREAM*	RED	ABSENT	ABSENT

Table B.12 Early Urichu phase support sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	FILL	FORM	CONSTRICTION
1	A	11	0.116	0.000	SOLID	INDET	OPEN
2	A	2	0.026	0.000	HOLLOW	INDET	OPEN
3	A	7	0.416	0.033	SOLID	CONICAL	OPEN
4	A	7	0.212	0.014	HOLLOW	INDET	OPEN
5	B	7	0.259	0.002	SOLID	INDET	INDET
6	B	8	0.000	0.000	SOLID	CONICAL	OPEN
7	B	7	0.029	0.000	HOLLOW	INDET	M
8	B	3	0.000	0.000	HOLLOW	INDET	OPEN
9	B	3	0.156	0.000	HOLLOW	INDET	OPEN
10	B	7	0.000	0.000	HOLLOW	MAMIFORM	M

Table B.12 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	11	SMOOTH	CREAM	M	M	ABSENT
2	A	2	SMOOTH	CREAM	RED	ABSENT	ABSENT
3	A	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
4	A	7	POLISH	CREAM	RED	ABSENT	ABSENT
5	B	7	SMOOTH	NONE	ABSENT	ABSENT	ABSENT
6	B	8	WIPED	NONE	ABSENT	ABSENT	ABSENT
7	B	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT
8	B	3	SMOOTH	CREAM	WHITE	ABSENT	ABSENT
9	B	3	SMOOTH	RED	ABSENT	ABSENT	ABSENT
10	B	7	POLISH	RED	ABSENT	ABSENT	ABSENT

Table B.13 Late Urichu phase support sherds (all cases)

FILL	FORM	CONSTRICTION	FINISH	SLIP	PAINT	RESIST	PLASTIC
SOLID	M	INDET	M	CREAM	ABSENT	ABSENT	ABSENT
N/A	BASE	OPEN	M	CREAM	RED	RESIST	ABSENT
HOLLOW	M	M	M	CREAM	WHITE	ABSENT	ABSENT
SOLID	CYLINDRICAL	M	M	CREAM	RED	ABSENT	ABSENT
SOLID	NUBBIN	OPEN	M	CREAM	ABSENT	ABSENT	ABSENT

Table B.14 Tariacuri Area 1 phase support sherds (all cases)

FILL	FORM	CONSTRICTION	FINISH	SLIP	PAINT	RESIST	PLASTIC
SOLID	NUBBIN	M	M	CREAM	RED	ABSENT	ABSENT
SOLID	CONICAL	OPEN	M	CREAM	ABSENT	ABSENT	ABSENT
M	M	CLOSED	M	CREAM	R/W	ABSENT	ABSENT
SOLID	M	M	M	CREAM	ABSENT	ABSENT	ABSENT
SOLID	M	M	M	CREAM	ABSENT	ABSENT	ABSENT
M	INDET	M	M	CREAM	WHITE	ABSENT	ABSENT
N/A	BASE	OPEN	M	CREAM	WHITE	ABSENT	ABSENT
N/A	BASE	M	M	RED	WHITE	ABSENT	ABSENT
HOLLOW	M	M	M	RED	ABSENT	ABSENT	ABSENT
INDET	INDET	M	M	NONE	ABSENT	ABSENT	ABSENT
INDET	INDET	OPEN	M	CREAM	R/W	RESIST	ABSENT
N/A	BASE	OPEN	M	RED	ABSENT	ABSENT	ABSENT
N/A	CIRCULAR	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	PUNCTATE
N/A	CIRCULAR	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	PUNCTATE
INDET	INDET	OPEN	POLISH	CREAM	R/W	ABSENT	ABSENT
HOLLOW	INDET	OPEN	SMOOTH	RED	R/W	ABSENT	ABSENT
HOLLOW	INDET	OPEN	SMOOTH	CREAM	R/W	ABSENT	ABSENT

Table B.15 Tariacuri Area 2 phase support sherds (all cases)

FILL	FORM	CONSTRICTION	FINISH	SLIP	PAINT	RESIST	PLASTIC
SOLID	SLAB	INDET	SMOOTH	NONE	RED	ABSENT	ABSENT
N/A	ANULAR BASE	M	M	RED	ABSENT	ABSENT	ABSENT
N/A	BASE	OPEN	M	CREAM	WHITE	ABSENT	ABSENT
HOLLOW	M	OPEN	M	CREAM	R/W	ABSENT	ABSENT
INDET	INDET	OPEN	M	RED	ABSENT	ABSENT	ABSENT
INDET	INDET	M	M	RED	ABSENT	ABSENT	ABSENT
SOLID	ALMENA	M	M	CREAM	RED	ABSENT	ABSENT
SOLID	CONICAL	OPEN	M	CREAM	ABSENT	ABSENT	ABSENT
SOLID	CYLINDRICAL	M	WIPED	RED	ABSENT	ABSENT	ABSENT
HOLLOW	M	M	M	RED	RED	ABSENT	ABSENT
INDET	INDET	OPEN	M	CREAM	ABSENT	ABSENT	PUNCTATE
HOLLOW	M	M	M	INDET	ABSENT	ABSENT	ABSENT
N/A	BASE	OPEN	M	CREAM	RED	ABSENT	ABSENT
SOLID	MAMIFORM	OPEN	M	NONE	ABSENT	ABSENT	PUNCTATE
N/A	CIRCULAR	M	M	INDET	ABSENT	ABSENT	ABSENT
HOLLOW	M	INDET	SMOOTH	NONE	ABSENT	ABSENT	ABSENT
N/A	CIRCULAR	OPEN	SMOOTH	RED	ABSENT	ABSENT	ABSENT
N/A	CIRCULAR	OPEN	SMOOTH	RED	ABSENT	ABSENT	ABSENT
N/A	CIRCULAR	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	PUNCTATE
SOLID	NUBBIN	OPEN	SMOOTH	CREAM	ABSENT	ABSENT	PUNCTATE
HOLLOW	CYLINDRICAL	INDET	POLISH	WHITE	RED	ABSENT	ABSENT

Table B.16 Tariacuri Area 5 phase support sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	FILL	FORM	CONSTRICTION
1	A	5	0.063	0.000	INDET	*INDET*	OPEN
2	A	4	0.044	0.004	SOLID	*NUBBIN*	OPEN
3	A	4	0.026	0.000	HOLLOW	*INDET*	OPEN
4	A	6	0.095	0.002	SOLID	*CONICAL*	OPEN
5	A	5	0.062	0.004	HOLLOW	*INDET*	OPEN
6	A	8	0.137	0.000	SOLID	*M*	OPEN
7	A	5	0.000	0.000	SOLID	NUBBIN	INDET
8	A	9	0.153	0.001	N/A	ANULAR BASE	*M*
9	A	4	0.116	0.014	SOLID	*BULBOUS*	OPEN
10	A	10	0.059	0.001	SOLID	CONICAL	OPEN
11	B	23	0.308	0.000	HOLLOW	*INDET*	*M*
12	B	3	0.106	0.016	N/A	BASE	OPEN

Table B.16 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC
1	A	5	SMOOTH	NONE	ABSENT	ABSENT	ABSENT
2	A	4	WIPED	NONE	ABSENT	ABSENT	ABSENT
3	A	4	M	RED	ABSENT	ABSENT	ABSENT
4	A	6	*M*	RED	ABSENT	ABSENT	ABSENT
5	A	5	POLISH	CREAM	ABSENT	ABSENT	ABSENT
6	A	8	M	CREAM	ABSENT	ABSENT	ABSENT
7	A	5	*M*	CREAM	ABSENT	ABSENT	ABSENT
8	A	9	SMOOTH	CREAM	ABSENT	ABSENT	*ABSENT*
9	A	4	SMOOTH	CREAM	ABSENT	ABSENT	*PUNCTATE*
10	A	10	SMOOTH	CREAM	*ABSENT*	ABSENT	ABSENT
11	B	23	SMOOTH	CREAM	*RED*	ABSENT	ABSENT
12	B	3	*POLISH*	CREAM	*R/W*	*ABSENT*	ABSENT

Table B.17 Loma Alta 3-Jarácuaro phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A	398	0.000	0.000	*CLOSED*
2	B	150	0.123	0.000	*OPEN*
3	B	3	0.125	0.021	*OPEN*
4	C	12	0.212	0.002	*CLOSED*
5	C	2	0.042	0.021	*CLOSED*
6	C	1	0.000	0.000	CLOSED
7	C	8	0.049	0.001	*OPEN*
8	C	15	0.000	0.000	*OPEN*
9	C	6	0.089	0.003	*OPEN*
10	C	3	0.063	0.010	*OPEN*
11	C	10	0.000	0.000	*OPEN*
12	C	3	0.031	0.005	OPEN
13	C	1	0.000	0.000	CLOSED
14	C	14	0.000	0.000	*CLOSED*
15	C	12	0.000	0.000	*CLOSED*
16	C	59	0.000	0.000	*CLOSED*
17	C	11	0.000	0.000	*OPEN*

Table B.17 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
1	A	398	*SMOOTH*	*CREAM*	*ABSENT*	*ABSENT*	*ABSENT*	ABSENT
2	B	150	*SMOOTH*	*CREAM*	*ABSENT*	*ABSENT*	ABSENT	ABSENT
3	B	3	SMOOTH	*CREAM*	ABSENT	ABSENT	INCISED	ABSENT
4	C	12	SMOOTH	*CREAM*	*RED*	ABSENT	ABSENT	ABSENT
5	C	2	SMOOTH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
6	C	1	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
7	C	8	*SMOOTH*	*CREAM*	*RED*	*ABSENT*	ABSENT	ABSENT
8	C	15	*POLISH*	*CREAM*	*ABSENT*	ABSENT	*ABSENT*	ABSENT
9	C	6	*POLISH*	*CREAM*	*WHITE*	ABSENT	ABSENT	ABSENT
10	C	3	POLISH	*CREAM*	R/W	ABSENT	ABSENT	ABSENT
11	C	10	*POLISH*	*CREAM*	*RED*	ABSENT	ABSENT	ABSENT
12	C	3	POLISH	CREAM	RED	RESIST	ABSENT	ABSENT
13	C	1	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
14	C	14	*POLISH*	*CREAM*	*ABSENT*	ABSENT	ABSENT	ABSENT
15	C	12	*POLISH*	*RED*	ABSENT	ABSENT	ABSENT	ABSENT
16	C	59	SMOOTH	*RED*	ABSENT	ABSENT	ABSENT	ABSENT
17	C	11	*SMOOTH*	*RED*	ABSENT	ABSENT	ABSENT	ABSENT

Table B.18 Jarácuaro phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A	2640	0.000	0.000	CLOSED
2	B	2	0.000	0.000	CLOSED
3	B	3	0.000	0.000	CLOSED
4	B	25	0.000	0.000	CLOSED
5	B	18	0.000	0.000	CLOSED
6	B	4	0.053	0.004	OPEN
7	B	8	0.000	0.000	OPEN
8	B	2	0.000	0.000	OPEN
9	B	14	0.000	0.000	OPEN
10	B	33	0.000	0.000	OPEN
11	B	17	0.000	0.000	M
12	B	19	0.072	0.000	OPEN
13	B	1	0.000	0.000	OPEN
14	B	60	0.000	0.000	CLOSED
15	B	18	0.000	0.000	CLOSED
16	B	69	0.000	0.000	OPEN
17	B	24	0.000	0.000	CLOSED
18	B	3	0.000	0.000	CLOSED
19	B	54	0.039	0.000	CLOSED
20	B	181	0.000	0.000	OPEN

Table B. 18 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
1	A	2640	M	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
2	B	2	M	CREAM	ABSENT	ABSENT	APPLIQUE	ABSENT
3	B	3	SMOOTH	CREAM	ABSENT	ABSENT	INCISED	ABSENT
4	B	25	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT
5	B	18	SMOOTH	NONE	ABSENT	ABSENT	ABSENT	ABSENT
6	B	4	POLISH	CREAM	*WHITE*	ABSENT	ABSENT	ABSENT
7	B	8	POLISH	CREAM	R/W	ABSENT	ABSENT	ABSENT
8	B	2	POLISH	CREAM	R/W	RESIST	ABSENT	ABSENT
9	B	14	M	CREAM	RED	ABSENT	ABSENT	ABSENT
10	B	33	M	*CREAM*	ABSENT	ABSENT	ABSENT	ABSENT
11	B	17	M	RED	ABSENT	ABSENT	ABSENT	ABSENT
12	B	19	POLISH	*RED*	ABSENT	ABSENT	ABSENT	ABSENT
13	B	1	POLISH	RED	ABSENT	RESIST	ABSENT	ABSENT
14	B	60	POLISH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
15	B	18	WIPED	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
16	B	69	SMOOTH	*CREAM*	RED	ABSENT	ABSENT	ABSENT
17	B	24	POLISH	CREAM	RED	ABSENT	ABSENT	ABSENT
18	B	3	POLISH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
19	B	54	SMOOTH	CREAM	*RED*	ABSENT	ABSENT	ABSENT
20	B	181	M	RED	ABSENT	ABSENT	ABSENT	ABSENT

Table B. 18 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
21	B	572	0.000	0.000	OPEN
22	B	3	0.060	0.020	OPEN
23	B	3	0.000	0.000	OPEN
24	B	2	0.027	0.013	OPEN
25	B	4	0.000	0.000	OPEN
26	B	7	0.000	0.000	OPEN
27	B	2	0.000	0.000	OPEN
28	B	8	0.053	0.002	OPEN
29	B	2	0.027	0.013	*OPEN*
30	B	4	0.000	0.000	OPEN
31	B	2	0.000	0.000	OPEN
32	B	2	0.027	0.013	*CLOSED*
33	B	3	0.042	0.007	M
34	B	2	0.027	0.013	OPEN
35	B	908	0.000	0.000	CLOSED

Table B. 18 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
21	B	572	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
22	B	3	SMOOTH	CREAM	ABSENT	ABSENT	*MODELED*	ABSENT
23	B	3	SMOOTH	CREAM	ABSENT	ABSENT	GRABADO	ABSENT
24	B	2	*POLISH*	CREAM	RED	ABSENT	PUNCTATE	ABSENT
25	B	4	SMOOTH	CREAM	ABSENT	ABSENT	PUNCTATE	ABSENT
26	B	7	SMOOTH	CREAM	ABSENT	ABSENT	INCISED	ABSENT
27	B	2	POLISH	CREAM	ABSENT	ABSENT	INCISED	ABSENT
28	B	8	SMOOTH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
29	B	2	SMOOTH	RED	RED	ABSENT	ABSENT	ABSENT
30	B	4	SMOOTH	*RED*	WHITE	ABSENT	ABSENT	ABSENT
31	B	2	SMOOTH	RED	ABSENT	ABSENT	INCISED	ABSENT
32	B	2	SMOOTH	RED	ABSENT	ABSENT	RAISED	ABSENT
33	B	3	SMOOTH	NONE	ABSENT	ABSENT	ABSENT	*OVAL*
34	B	2	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	LUG
35	B	908	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT

Table B.19 Lupe phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A(1)	120	0.000	0.000	M
2	A(1)	64	0.000	0.000	M
3	A(1)	1	0.000	0.000	OPEN
4	A(1)	67	0.000	0.000	OPEN
5	A(1)	7	0.000	0.000	OPEN
6	A(1)	2	0.028	0.013	OPEN
7	A(1)	3	0.000	0.000	CLOSED
8	A(1)	5	0.041	0.005	OPEN
9	A(1)	2	0.000	0.000	CLOSED
10	A(1)	4	0.049	0.004	CLOSED
11	A(1)	4	0.096	0.024	CLOSED
12	A(1)	8	0.031	0.001	CLOSED
13	A(1)	9	0.064	0.001	*CLOSED*
14	A(1)	13	0.060	0.000	CLOSED
15	A(1)	2	0.000	0.000	CLOSED
16	A(1)	5	0.000	0.000	M
17	A(1)	7	0.040	0.000	M
18	A(1)	14	0.000	0.000	OPEN
19	A(1)	5	0.000	0.000	OPEN
20	A(1)	4	0.000	0.000	OPEN

Table B.19 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
1	A(1)	120	M	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
2	A(1)	64	M	RED	ABSENT	ABSENT	ABSENT	ABSENT
3	A(1)	1	POLISH	RED	ABSENT	ABSENT	PUNCTATE	ABSENT
4	A(1)	67	POLISH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
5	A(1)	7	WIPED	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
6	A(1)	2	SMOOTH	CREAM	RED	RESIST	ABSENT	ABSENT
7	A(1)	3	POLISH	CREAM	ABSENT	RESIST	ABSENT	ABSENT
8	A(1)	5	POLISH	*CREAM*	WHITE	ABSENT	ABSENT	ABSENT
9	A(1)	2	POLISH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
10	A(1)	4	SMOOTH	*CREAM*	ABSENT	ABSENT	INCISED	ABSENT
11	A(1)	4	SMOOTH	CREAM	ABSENT	ABSENT	*APPLIQUE*	ABSENT
12	A(1)	8	SMOOTH	*CREAM*	WHITE	ABSENT	ABSENT	ABSENT
13	A(1)	9	SMOOTH	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
14	A(1)	13	WIPED	*INDET*	ABSENT	ABSENT	ABSENT	ABSENT
15	A(1)	2	SMOOTH	RED	ABSENT	ABSENT	ABSENT	*LUG*
16	A(1)	5	SMOOTH	NONE	ABSENT	ABSENT	ABSENT	*OVAL*
17	A(1)	7	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	*CIRCULAR*
18	A(1)	14	SMOOTH	CREAM	ABSENT	ABSENT	INCISED	ABSENT
19	A(1)	5	SMOOTH	CREAM	ABSENT	ABSENT	PUNCTATE	ABSENT
20	A(1)	4	SMOOTH	CREAM	ABSENT	ABSENT	RAISED	ABSENT

Table B.19 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
21	A(1)	3	0.040	0.007	OPEN
22	A(1)	8	0.000	0.000	OPEN
23	A(1)	138	0.000	0.000	CLOSED
24	A(1)	62	0.000	0.000	OPEN
25	A(1)	1	0.000	0.000	OPEN
26	A(1)	70	0.077	0.000	CLOSED
27	A(1)	59	0.000	0.000	CLOSED
28	A(1)	61	0.000	0.000	CLOSED
29	A(1)	98	0.000	0.000	OPEN
30	A(1)	1	0.000	0.000	OPEN
31	A(1)	2	0.027	0.013	OPEN
32	A(1)	2	0.000	0.000	OPEN
33	A(1)	11	0.000	0.000	OPEN
34	A(1)	6	0.000	0.000	OPEN
35	A(1)	39	0.000	0.000	CLOSED
36	A(1)	42	0.000	0.000	OPEN
37	A(1)	3	0.080	0.013	*OPEN*
38	A(1)	139	0.000	0.000	CLOSED
39	A(1)	1	0.000	0.000	CLOSED
40	A(2)	4	0.082	0.012	OPEN

Table B.19 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
21	A(1)	3	SMOOTH	CREAM	ABSENT	ABSENT	*ENGRAVED*	*LUG*
22	A(1)	8	POLISH	CREAM	ABSENT	ABSENT	INCISED	ABSENT
23	A(1)	138	M	RED	ABSENT	ABSENT	ABSENT	ABSENT
24	A(1)	62	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT
25	A(1)	1	M	NONE	ABSENT	ABSENT	APPLIQUE	ABSENT
26	A(1)	70	*M*	NONE	ABSENT	ABSENT	ABSENT	ABSENT
27	A(1)	59	WIPED	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
28	A(1)	61	WIPED	NONE	ABSENT	ABSENT	ABSENT	ABSENT
29	A(1)	98	M	*CREAM*	RED	ABSENT	ABSENT	ABSENT
30	A(1)	1	SMOOTH	CREAM	RED	ABSENT	ABSENT	LUG
31	A(1)	2	*POLISH*	CREAM	RED	ABSENT	RAISED	ABSENT
32	A(1)	2	SMOOTH	CREAM	RED	ABSENT	FLANGE	ABSENT
33	A(1)	11	SMOOTH	CREAM	R/W	ABSENT	ABSENT	ABSENT
34	A(1)	6	SMOOTH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
35	A(1)	39	POLISH	CREAM	RED	ABSENT	ABSENT	ABSENT
36	A(1)	42	POLISH	CREAM	RED	ABSENT	ABSENT	ABSENT
37	A(1)	3	POLISH	*WHITE*	RED	ABSENT	ABSENT	ABSENT
38	A(1)	139	SMOOTH	CREAM	RED	ABSENT	ABSENT	ABSENT
39	A(1)	1	SMOOTH	RED	RED	ABSENT	ABSENT	ABSENT
40	A(2)	4	SMOOTH	RED	ABSENT	ABSENT	*INCISED*	ABSENT

Table B.19 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
41	A(2)	4	0.048	0.004	OPEN
42	A(2)	5	0.054	0.003	OPEN
43	A(2)	354	0.000	0.000	OPEN
44	A(3)	1033	0.000	0.000	OPEN
45	B	1449	0.000	0.000	CLOSED
46	C	3770	0.000	0.000	CLOSED

Table B.19 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
41	A(2)	4	SMOOTH	*RED*	ABSENT	ABSENT	RAISED	ABSENT
42	A(2)	5	SMOOTH	RED	WHITE	ABSENT	ABSENT	ABSENT
43	A(2)	354	SMOOTH	*RED*	ABSENT	ABSENT	ABSENT	ABSENT
44	A(3)	1033	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
45	B	1449	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT
46	C	3770	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT

Table B.20 Early Urichu phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A(1)	4328	0.000	0.000	CLOSED
2	A(1)	1	0.000	0.000	CLOSED
3	A(2)	79	0.000	0.000	OPEN
4	A(2)	2	0.000	0.000	OPEN
5	A(2)	2	0.028	0.014	OPEN
6	A(2)	2	0.000	0.000	OPEN
7	A(2)	4	0.083	0.013	OPEN
8	A(2)	47	0.000	0.000	OPEN
9	A(2)	2	0.028	0.014	OPEN
10	A(2)	11	0.000	0.000	OPEN
11	A(2)	3	0.086	0.014	CLOSED
12	A(2)	5	0.056	0.003	OPEN
13	A(2)	4	0.000	0.000	M
14	A(2)	3	0.000	0.000	M
15	A(2)	3	0.046	0.007	OPEN
16	A(2)	5	0.000	0.000	M
17	A(2)	12	0.000	0.000	CLOSED
18	A(2)	8	0.069	0.005	CLOSED
19	A(2)	28	0.000	0.000	CLOSED
20	A(2)	27	0.088	0.000	CLOSED

Table B.20 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
1	A(1)	4328	M	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
2	A(1)	1	SMOOTH	CREAM	ABSENT	RESIST	ABSENT	ABSENT
3	A(2)	79	M	*CREAM*	ABSENT	ABSENT	ABSENT	ABSENT
4	A(2)	2	M	RED	ABSENT	ABSENT	INCISED	ABSENT
5	A(2)	2	POLISH	RED	ABSENT	ABSENT	PUNCTATE	ABSENT
6	A(2)	2	POLISH	RED	ABSENT	ABSENT	RAISED	ABSENT
7	A(2)	4	POLISH	CREAM	ABSENT	ABSENT	*INCISED*	ABSENT
8	A(2)	47	M	RED	ABSENT	ABSENT	ABSENT	ABSENT
9	A(2)	2	*POLISH*	RED	ABSENT	RESIST	ABSENT	ABSENT
10	A(2)	11	M	CREAM	ABSENT	ABSENT	INCISED	ABSENT
11	A(2)	3	SMOOTH	*CREAM*	ABSENT	ABSENT	*RAISED*	ABSENT
12	A(2)	5	SMOOTH	CREAM	ABSENT	ABSENT	*PUNCTATE*	ABSENT
13	A(2)	4	M	RED	ABSENT	ABSENT	ABSENT	*INDET*
14	A(2)	3	M	NONE	ABSENT	ABSENT	ABSENT	*OVAL*
15	A(2)	3	*SMOOTH*	*NONE*	ABSENT	ABSENT	ABSENT	*LUG*
16	A(2)	5	M	CREAM	ABSENT	ABSENT	ABSENT	*CIRCULAR*
17	A(2)	12	M	CREAM	RED	ABSENT	ABSENT	ABSENT
18	A(2)	8	POLISH	CREAM	*R/W*	ABSENT	ABSENT	ABSENT
19	A(2)	28	POLISH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
20	A(2)	27	WIPED	*CREAM*	ABSENT	ABSENT	ABSENT	ABSENT

Table B.20 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
21	A(2)	1416	0.000	0.000	OPEN
22	A(3)	30	0.000	0.000	OPEN
23	A(3)	3	0.000	0.000	OPEN
24	A(3)	3	0.083	0.014	*OPEN*
25	A(3)	1	0.000	0.000	OPEN
26	A(3)	4	0.050	0.004	OPEN
27	A(3)	8	0.065	0.001	*OPEN*
28	A(3)	3	0.042	0.007	OPEN
29	A(3)	3	0.000	0.000	CLOSED
30	A(3)	6	0.054	0.009	OPEN
31	A(3)	9	0.000	0.000	OPEN
32	A(3)	8	0.000	0.000	OPEN
33	A(3)	6	0.171	0.008	OPEN
34	A(3)	3	0.042	0.007	*CLOSED*
35	A(3)	9	0.000	0.000	CLOSED
36	A(3)	3	0.000	0.000	CLOSED
37	A(3)	192	0.000	0.000	OPEN
38	A(3)	197	0.000	0.000	CLOSED
39	A(3)	262	0.000	0.000	M
40	B(1)	5	0.000	0.000	OPEN

Table B.20 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
21	A(2)	1416	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT	ABSENT
22	A(3)	30	POLISH	CREAM	RED	ABSENT	ABSENT	ABSENT
23	A(3)	3	POLISH	CREAM	R/W	ABSENT	ABSENT	ABSENT
24	A(3)	3	POLISH	CREAM	RED	ABSENT	*PUNCTATE*	ABSENT
25	A(3)	1	POLISH	CREAM	RED	ABSENT	FLANGE	FLANGE
26	A(3)	4	SMOOTH	CREAM	RED	ABSENT	*RAISED*	ABSENT
27	A(3)	8	SMOOTH	CREAM	RED	ABSENT	FLANGE	ABSENT
28	A(3)	3	POLISH	CREAM	*R/W*	RESIST	ABSENT	ABSENT
29	A(3)	3	POLISH	CREAM	R/W	RESIST	ABSENT	ABSENT
30	A(3)	6	SMOOTH	CREAM	*RED*	RESIST	ABSENT	ABSENT
31	A(3)	9	SMOOTH	CREAM	R/W	ABSENT	ABSENT	ABSENT
32	A(3)	8	SMOOTH	*CREAM*	WHITE	ABSENT	ABSENT	ABSENT
33	A(3)	6	*SMOOTH*	RED	*WHITE*	ABSENT	ABSENT	ABSENT
34	A(3)	3	SMOOTH	CREAM	*BROWN*	ABSENT	ABSENT	ABSENT
35	A(3)	9	SMOOTH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
36	A(3)	3	SMOOTH	CREAM	R/W	ABSENT	ABSENT	ABSENT
37	A(3)	192	SMOOTH	CREAM	RED	ABSENT	ABSENT	ABSENT
38	A(3)	197	SMOOTH	CREAM	RED	ABSENT	ABSENT	ABSENT
39	A(3)	262	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT
40	B(1)	5	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT

Table B.20 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
41	B(1)	12	0.000	0.000	OPEN
42	B(1)	150	0.000	0.000	CLOSED
43	B(2)	63	0.000	0.000	CLOSED
44	B(2)	1485	0.000	0.000	CLOSED
45	B(2)	409	0.000	0.000	OPEN

Table B.20 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
41	B(1)	12	WIPED	NONE	ABSENT	ABSENT	ABSENT	ABSENT
42	B(1)	150	WIPED	NONE	ABSENT	ABSENT	ABSENT	ABSENT
43	B(2)	63	M	RED	ABSENT	ABSENT	ABSENT	ABSENT
44	B(2)	1485	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT
45	B(2)	409	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT

Table B.21 Late Urichu phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A	211	0.000	0.000	M
2	A	30	0.000	0.000	OPEN
3	A	1	0.000	0.000	M
4	A	4	0.000	0.000	CLOSED
5	A	4	0.063	0.005	CLOSED
6	A	15	0.000	0.000	M
7	A	7	0.079	0.002	OPEN
8	A	14	0.000	0.000	OPEN
9	A	4	0.000	0.000	M
10	A	4	0.000	0.000	M
11	A	1	0.000	0.000	CLOSED
12	A	4	0.087	0.011	*OPEN*
13	A	2	0.035	0.018	OPEN
14	B	72	0.000	0.000	OPEN
15	B	25	0.097	0.000	CLOSED
16	B	4	0.063	0.005	CLOSED
17	B	2	0.037	0.018	OPEN
18	B	3	0.059	0.010	M
19	C	101	0.000	0.000	CLOSED
20	C	19	0.140	0.000	OPEN

Table B.21 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
1	A	211	M	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
2	A	30	M	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
3	A	1	M	CREAM	ABSENT	ABSENT	PUNCTATE	ABSENT
4	A	4	M	CREAM	R/W	ABSENT	ABSENT	ABSENT
5	A	4	M	CREAM	*WHITE*	ABSENT	ABSENT	ABSENT
6	A	15	M	CREAM	RED	ABSENT	ABSENT	ABSENT
7	A	7	M	CREAM	*R/W*	ABSENT	ABSENT	ABSENT
8	A	14	M	CREAM	RED	ABSENT	ABSENT	ABSENT
9	A	4	M	WHITE	RED	ABSENT	ABSENT	ABSENT
10	A	4	M	WHITE	RED	RESIST	ABSENT	ABSENT
11	A	1	M	WHITE	ABSENT	RESIST	ABSENT	ABSENT
12	A	4	M	CREAM	*RED*	RESIST	ABSENT	ABSENT
13	A	2	M	*RED*	WHITE	RESIST	ABSENT	ABSENT
14	B	72	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT
15	B	25	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT
16	B	4	M	NONE	RED	ABSENT	ABSENT	ABSENT
17	B	2	M	NONE	*RED*	ABSENT	ABSENT	ABSENT
18	B	3	M	NONE	ABSENT	ABSENT	*ABSENT*	OVAL
19	C	101	M	RED	ABSENT	ABSENT	ABSENT	ABSENT
20	C	19	*M*	RED	ABSENT	ABSENT	ABSENT	ABSENT

Table B.21 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
21	C	3	0.000	0.000	OPEN
22	C	2	0.000	0.000	M
23	C	3	0.035	0.000	*M*

Table B.21 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESIST	PLASTIC	HANDLE
21	C	3	M	RED	ABSENT	RESIST	ABSENT	ABSENT
22	C	2	M	RED	BLACK	ABSENT	ABSENT	ABSENT
23	C	3	M	RED	WHITE	ABSENT	ABSENT	ABSENT

Table B.22 Tariacuri Area 1 phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A	185	0.000	0.000	CLOSED
2	A	15	0.000	0.000	CLOSED
3	A	2	0.000	0.000	CLOSED
4	A	3	0.000	0.000	CLOSED
5	A	1085	0.000	0.000	CLOSED
6	B	130	0.346	0.000	OPEN
7	B	1	0.000	0.000	OPEN
8	B	606	0.000	0.000	OPEN
9	C	64	0.173	0.000	CLOSED
10	C	9	0.000	0.000	OPEN
11	C	50	0.000	0.000	CLOSED
12	C	77	0.000	0.000	CLOSED
13	C	4	0.044	0.004	OPEN
14	C	111	0.000	0.000	OPEN
15	C	50	0.000	0.000	CLOSED
16	C	14	0.000	0.000	CLOSED
17	C	12	0.070	0.000	CLOSED
18	C	25	0.000	0.000	CLOSED
19	C	2	0.000	0.000	CLOSED
20	C	2	0.000	0.000	CLOSED

Table B.22 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	PLASTIC	RESIST	HANDLE	SPOUT
1	A	185	M	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
2	A	15	WIPED	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
3	A	2	M	RED	ABSENT	ABSENT	ABSENT	ABSENT	SPOUT
4	A	3	M	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	SPOUT
5	A	1085	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
6	B	130	*M*	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
7	B	1	POLISH	CREAM	ABSENT	MODELED	ABSENT	ABSENT	ABSENT
8	B	606	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
9	C	64	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
10	C	9	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
11	C	50	M	RED	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
12	C	77	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
13	C	4	POLISH	RED	ABSENT	ABSENT	*ABSENT*	ABSENT	ABSENT
14	C	111	M	RED	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
15	C	50	M	CREAM	R/W	ABSENT	ABSENT	ABSENT	ABSENT
16	C	14	M	CREAM	RED	ABSENT	ABSENT	ABSENT	ABSENT
17	C	12	POLISH	CREAM	R/W	ABSENT	ABSENT	ABSENT	*ABSENT*
18	C	25	M	CREAM	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
19	C	2	M	CREAM	BLACK	ABSENT	ABSENT	ABSENT	ABSENT
20	C	2	POLISH	CREAM	PINK	ABSENT	ABSENT	ABSENT	ABSENT

Table B.22 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
21	C	3	0.000	0.000	OPEN
22	C	3	0.061	0.009	CLOSED
23	C	2	0.013	0.006	OPEN
24	C	3	0.042	0.007	CLOSED
25	C	14	0.000	0.000	CLOSED
26	C	39	0.000	0.000	CLOSED
27	C	3	0.042	0.007	CLOSED
28	C	3	0.041	0.006	CLOSED
29	C	4	0.000	0.000	M
30	C	3	0.037	0.006	*OPEN*
31	C	3	0.037	0.006	CLOSED
32	C	2	0.025	0.012	OPEN
33	C	3	0.000	0.000	M
34	C	3	0.062	0.007	*M*
35	C	22	0.000	0.000	OPEN
36	C	16	0.000	0.000	OPEN
37	C	19	0.033	0.000	OPEN
38	C	12	0.000	0.000	OPEN
39	C	8	0.000	0.000	OPEN
40	C	35	0.000	0.000	OPEN

Table B.22 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	PLASTIC	RESIST	HANDLE	SPOUT
21	C	3	M	CREAM	BLACK	ABSENT	ABSENT	ABSENT	ABSENT
22	C	3	POLISH	NONE	*RED*	ABSENT	ABSENT	ABSENT	ABSENT
23	C	2	POLISH	RED	*R/W*	ABSENT	ABSENT	ABSENT	ABSENT
24	C	3	M	RED	WHITE	ABSENT	*ABSENT*	ABSENT	ABSENT
25	C	14	POLISH	CREAM	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
26	C	39	SMOOTH	CREAM	RED	ABSENT	ABSENT	ABSENT	ABSENT
27	C	3	M	NONE	ABSENT	*APPLIQUE*	ABSENT	ABSENT	ABSENT
28	C	3	SMOOTH	*CREAM*	ABSENT	APPLIQUE	ABSENT	ABSENT	ABSENT
29	C	4	M	CREAM	ABSENT	INCISED	ABSENT	ABSENT	ABSENT
30	C	3	SMOOTH	CREAM	ABSENT	PUNCTATE	ABSENT	ABSENT	ABSENT
31	C	3	SMOOTH	CREAM	RED	*PUNCTATE*	ABSENT	ABSENT	ABSENT
32	C	2	SMOOTH	CREAM	RED	*PUNCTATE*	ABSENT	ABSENT	ABSENT
33	C	3	M	CREAM	RED	ABSENT	ABSENT	*OVAI*	ABSENT
34	C	3	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	*STRAP*	ABSENT
35	C	22	M	CREAM	R/W	ABSENT	ABSENT	ABSENT	ABSENT
36	C	16	M	CREAM	RED	ABSENT	ABSENT	ABSENT	ABSENT
37	C	19	POLISH	CREAM	*R/W*	ABSENT	ABSENT	ABSENT	ABSENT
38	C	12	M	CREAM	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
39	C	8	SMOOTH	CREAM	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
40	C	35	SMOOTH	CREAM	RED	ABSENT	ABSENT	ABSENT	ABSENT

Table B.22 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
41	C	5	0.025	0.001	CLOSED
42	C	5	0.000	0.000	CLOSED
43	C	1	0.000	0.000	OPEN
44	C	2	0.000	0.000	CLOSED
45	C	1	0.000	0.000	CLOSED
46	C	18	0.037	0.000	OPEN

Table B.22 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	PLASTIC	RESIST	HANDLE	SPOUT
41	C	5	POLISH	CREAM	*WHITE*	ABSENT	RESIST	ABSENT	ABSENT
42	C	5	M	CREAM	R/W	ABSENT	RESIST	ABSENT	ABSENT
43	C	1	M	WHITE	RED	ABSENT	RESIST	ABSENT	ABSENT
44	C	2	M	CREAM	ABSENT	ABSENT	RESIST	ABSENT	ABSENT
45	C	1	M	WHITE	ABSENT	ABSENT	RESIST	ABSENT	SPOUT
46	C	18	POLISH	CREAM	*R/W*	ABSENT	RESIST	ABSENT	ABSENT

Table B.23 Tariacuri Area 2 phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A	220	0.123	0.000	OPEN
2	A	52	0.000	0.000	OPEN
3	A	5	0.041	0.000	OPEN
4	A	4	0.050	0.004	M
5	A	2	0.000	0.000	OPEN
6	A	4	0.049	0.004	OPEN
7	A	5	0.125	0.018	M
8	A	4	0.055	0.005	M
9	A	4	0.053	0.004	OPEN
10	A	122	0.296	0.000	CLOSED
11	A	105	0.000	0.000	CLOSED
12	B	4	0.050	0.004	OPEN
13	B	3	0.040	0.008	M
14	B	3	0.042	0.007	OPEN
15	B	9	0.000	0.000	M
16	B	4	0.068	0.017	CLOSED
17	B	3	0.000	0.000	OPEN
18	B	4	0.000	0.000	CLOSED
19	B	4	0.000	0.000	CLOSED
20	B	7	0.080	0.004	OPEN

Table B.23 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	PLASTIC	RESIST	HANDLE	SPOUT
1	A	220	*M*	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
2	A	52	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
3	A	5	M	*M*	ABSENT	INCISED	ABSENT	ABSENT	ABSENT
4	A	4	POLISH	CREAM	ABSENT	*INCISED*	ABSENT	ABSENT	ABSENT
5	A	2	M	M	ABSENT	EXCISED	ABSENT	ABSENT	ABSENT
6	A	4	SMOOTH	*CREAM*	ABSENT	PUNCTATE	ABSENT	ABSENT	ABSENT
7	A	5	M	NONE	ABSENT	*INCISED*	ABSENT	ABSENT	ABSENT
8	A	4	M	NONE	ABSENT	*ABSENT*	ABSENT	*CIRCULAR*	ABSENT
9	A	4	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT	*CIRCULAR*	ABSENT
10	A	122	*M*	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
11	A	105	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
12	B	4	M	RED	*WHITE*	ABSENT	ABSENT	ABSENT	ABSENT
13	B	3	M	NONE	*WHITE*	ABSENT	ABSENT	ABSENT	ABSENT
14	B	3	M	CREAM	WHITE	*ABSENT*	ABSENT	ABSENT	ABSENT
15	B	9	M	CREAM	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
16	B	4	M	RED	*ABSENT*	ABSENT	RESIST	ABSENT	ABSENT
17	B	3	M	RED	WHITE	ABSENT	RESIST	ABSENT	ABSENT
18	B	4	M	RED	RED	ABSENT	ABSENT	ABSENT	ABSENT
19	B	4	M	RED	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
20	B	7	M	CREAM	*R/W*	ABSENT	ABSENT	ABSENT	ABSENT

Table B.23 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
21	B	35	0.039	0.000	CLOSED
22	B	15	0.070	0.000	OPEN
23	B	7	0.063	0.007	CLOSED
24	B	5	0.000	0.000	M
25	B	43	0.000	0.000	M
26	B	8	0.000	0.000	CLOSED
27	B	3	0.000	0.000	CLOSED
28	B	2	0.027	0.012	OPEN
29	B	2	0.030	0.015	M
30	B	6	0.060	0.002	CLOSED
31	B	18	0.000	0.000	OPEN
32	B	9	0.054	0.000	*M*
33	B	6	0.000	0.000	OPEN
34	B	2	0.028	0.014	CLOSED
35	C	270	0.000	0.000	M
36	C	12	0.000	0.000	OPEN
37	D	283	0.214	0.000	M
38	D	74	0.000	0.000	CLOSED
39	D	37	0.000	0.000	OPEN
40	D	27	0.000	0.000	OPEN
41	D	2	0.000	0.000	M

Table B.23 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	PLASTIC	RESIST	HANDLE	SPOUT
21	B	35	POLISH	CREAM	*R/W*	ABSENT	ABSENT	ABSENT	ABSENT
22	B	15	*M*	CREAM	*R/W*	ABSENT	RESIST	ABSENT	ABSENT
23	B	7	M	CREAM	*WHITE*	ABSENT	RESIST	ABSENT	ABSENT
24	B	5	M	CREAM	RED	ABSENT	RESIST	ABSENT	ABSENT
25	B	43	M	*CREAM*	RED	ABSENT	ABSENT	ABSENT	ABSENT
26	B	8	POLISH	CREAM	RED	ABSENT	ABSENT	ABSENT	ABSENT
27	B	3	M	CREAM	RED	INCISED	ABSENT	ABSENT	ABSENT
28	B	2	SMOOTH	CREAM	RED	*GRABADO*	ABSENT	ABSENT	ABSENT
29	B	2	M	CREAM	R/W	*ABSENT*	ABSENT	INDET	ABSENT
30	B	6	M	WHITE	*RED*	ABSENT	ABSENT	ABSENT	ABSENT
31	B	18	M	WHITE	RED	ABSENT	ABSENT	ABSENT	ABSENT
32	B	9	M	WHITE	ABSENT	ABSENT	RESIST	ABSENT	ABSENT
33	B	6	M	WHITE	RED	ABSENT	RESIST	ABSENT	ABSENT
34	B	2	M	WHITE	RED	ABSENT	RESIST	ABSENT	*ABSENT*
35	C	270	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
36	C	12	M	NONE	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
37	D	283	M	RED	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
38	D	74	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
39	D	37	M	RED	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
40	D	27	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT	ABSENT
41	D	2	M	WHITE	ABSENT	ABSENT	ABSENT	ABSENT	SPOUT

Table B.24 Tariacuri Area 5 phase body sherds cluster information

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
1	A(1)	267	0.000	0.000	M
2	A(1)	3	0.038	0.006	OPEN
3	A(1)	2	0.000	0.000	OPEN
4	A(1)	4	0.046	0.004	OPEN
5	A(1)	6	0.085	0.002	*M*
6	A(1)	14	0.000	0.000	OPEN
7	A(1)	9	0.000	0.000	M
8	A(1)	10	0.000	0.000	CLOSED
9	A(1)	13	0.000	0.000	M
10	A(1)	4	0.000	0.000	M
11	A(1)	5	0.026	0.001	CLOSED
12	A(1)	2	0.026	0.013	OPEN
13	A(1)	3	0.000	0.000	CLOSED
14	A(1)	5	0.026	0.001	OPEN
15	A(1)	5	0.064	0.006	CLOSED
16	A(1)	4	0.000	0.000	CLOSED
17	A(1)	5	0.000	0.000	CLOSED
18	A(1)	17	0.000	0.000	CLOSED
19	A(1)	5	0.090	0.008	OPEN
20	A(1)	11	0.000	0.000	OPEN

Table B.24 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESISTN	PLASTIC	HANDLE
1	A(1)	267	SMOOTH	CREAM	RED	ABSENT	ABSENT	ABSENT
2	A(1)	3	SMOOTH	CREAM	RED	ABSENT	*PUNCTATE*	ABSENT
3	A(1)	2	SMOOTH	CREAM	RED	ABSENT	FLANGE	ABSENT
4	A(1)	4	SMOOTH	RED	*WHITE*	ABSENT	ABSENT	ABSENT
5	A(1)	6	SMOOTH	RED	*RED*	ABSENT	ABSENT	ABSENT
6	A(1)	14	M	CREAM	R/W	ABSENT	ABSENT	ABSENT
7	A(1)	9	SMOOTH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
8	A(1)	10	SMOOTH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
9	A(1)	13	SMOOTH	CREAM	R/W	ABSENT	ABSENT	ABSENT
10	A(1)	4	SMOOTH	CREAM	WHITE	RESIST	ABSENT	ABSENT
11	A(1)	5	SMOOTH	CREAM	*R/W*	RESIST	ABSENT	ABSENT
12	A(1)	2	SMOOTH	*CREAM*	ABSENT	RESIST	ABSENT	ABSENT
13	A(1)	3	SMOOTH	CREAM	ABSENT	RESIST	ABSENT	ABSENT
14	A(1)	5	POLISH	CREAM	*WHITE*	RESIST	ABSENT	ABSENT
15	A(1)	5	POLISH	CREAM	*R/W*	RESIST	ABSENT	ABSENT
16	A(1)	4	POLISH	CREAM	WHITE	ABSENT	ABSENT	ABSENT
17	A(1)	5	POLISH	CREAM	R/W	ABSENT	ABSENT	ABSENT
18	A(1)	17	POLISH	CREAM	RED	ABSENT	ABSENT	ABSENT
19	A(1)	5	*POLISH*	CREAM	*R/W*	ABSENT	ABSENT	ABSENT
20	A(1)	11	POLISH	CREAM	RED	ABSENT	ABSENT	ABSENT

Table B.24 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
21	A(1)	184	0.000	0.000	M
22	A(1)	59	0.000	0.000	OPEN
23	A(1)	56	0.000	0.000	M
24	A(1)	359	0.000	0.000	CLOSED
25	A(2)	9	0.000	0.000	M
26	A(2)	2	0.026	0.013	OPEN
27	A(2)	4	0.077	0.012	OPEN
28	A(2)	3	0.000	0.000	OPEN
29	A(2)	4	0.000	0.000	OPEN
30	A(2)	3	0.043	0.006	CLOSED
31	A(2)	2	0.000	0.000	OPEN
32	A(2)	4	0.085	0.013	M
33	A(2)	4	0.095	0.023	CLOSED
34	A(2)	5	0.000	0.000	CLOSED
35	A(2)	1319	0.000	0.000	M
36	B	3427	0.000	0.000	CLOSED
37	C(1)	2	0.027	0.013	OPEN
38	C(1)	1	0.000	0.000	M
39	C(1)	921	0.000	0.000	M
40	C(1)	294	0.000	0.000	OPEN

Table B.24 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESISTN	PLASTIC	HANDLE
21	A(1)	184	POLISH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
22	A(1)	59	POLISH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
23	A(1)	56	WIPED	INDET	ABSENT	ABSENT	ABSENT	ABSENT
24	A(1)	359	SMOOTH	CREAM	RED	ABSENT	ABSENT	ABSENT
25	A(2)	9	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	*CIRCULAR*
26	A(2)	2	SMOOTH	CREAM	ABSENT	ABSENT	APPLIQUE	*LUG*
27	A(2)	4	SMOOTH	CREAM	ABSENT	ABSENT	*MODELED*	ABSENT
28	A(2)	3	SMOOTH	CREAM	ABSENT	ABSENT	INCISED	ABSENT
29	A(2)	4	SMOOTH	CREAM	ABSENT	ABSENT	PUNCTATE	ABSENT
30	A(2)	3	SMOOTH	RED	ABSENT	ABSENT	APPLIQUE	ABSENT
31	A(2)	2	SMOOTH	RED	ABSENT	ABSENT	FLANGE	ABSENT
32	A(2)	4	SMOOTH	NONE	ABSENT	ABSENT	*INCISED*	ABSENT
33	A(2)	4	SMOOTH	CREAM	ABSENT	ABSENT	*RAISED*	ABSENT
34	A(2)	5	SMOOTH	CREAM	ABSENT	ABSENT	INCISED	ABSENT
35	A(2)	1319	SMOOTH	CREAM	ABSENT	ABSENT	ABSENT	ABSENT
36	B	3427	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT	ABSENT
37	C(1)	2	SMOOTH	*CREAM*	ABSENT	ABSENT	ABSENT	LUG
38	C(1)	1	SMOOTH	WHITE	ABSENT	ABSENT	ABSENT	ABSENT
39	C(1)	921	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT
40	C(1)	294	SMOOTH	RED	ABSENT	ABSENT	ABSENT	ABSENT

Table B.24 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	ESS	EXEMPLAR DISTANCE	CONSTRICTION
41	C(1)	4	0.000	0.000	M
42	C(2)	152	0.000	0.000	M
43	C(2)	98	0.000	0.000	M
44	C(2)	5	0.000	0.000	M

Table B.24 (continued)

CLUSTER	SCREE GROUP	CASES IN CLUSTER	FINISH	SLIP	PAINT	RESISTN	PLASTIC	HANDLE
41	C(1)	4	POLISH	RED	ABSENT	ABSENT	ABSENT	ABSENT
42	C(2)	152	WIPED	NONE	ABSENT	ABSENT	ABSENT	ABSENT
43	C(2)	98	SMOOTH	NONE	ABSENT	ABSENT	ABSENT	ABSENT
44	C(2)	5	POLISH	NONE	ABSENT	ABSENT	ABSENT	ABSENT

BIBLIOGRAPHY

Acheson, James

1995 Coase Among the Purepechas: Transaction Costs and Institutional Change in a Mexican Indian Pueblo. *Journal of Institutional and Theoretical Economics* 151(2):358-372.

Adams, William Y.

1979 On the Argument from Ceramics to History: A Challenge Based on Evidence from Medieval Nubia. *Current Anthropology* 20(4):727-744.

Adams, William Y., and Ernest W. Adams

1991 *Archaeological Typology and Practical Reality: A Dialectical Approach to Artifact Classification and Sorting.* Cambridge University Press, Cambridge.

Aldenderfer, Mark S., and Roger K. Blashfield

1978 Cluster Analysis and Archaeological Classification. *American Antiquity* 43(3): 502-505.

1984 *Cluster Analysis.* Sage University Paper Series on Quantitative Applications in the Social Sciences, series No. 07-044. Sage Publications, Beverly Hills.

Armillas, Pedro

1948 A Sequence of Cultural Development in Mesoamerica. In *A Reappraisal of Peruvian Archaeology,* edited by W. Bennett. SAA Memoir 13(4):105-111.

Arnauld, Marie Charlotte, Patricia Carot, and Marie-France Fauvet-Berthelot

1993 *Arqueología de las Lomas en la cuenca lacustre de Zacapu, Michoacán, México.* Cuadernos de Reconocimientos Michoacanos 5, Centre d'Etudes Mexicaines et Centraméricaines, Mexico.

Arnold, Dean E.

1980 Localized Exchange: an Ethnoarchaeological Perspective. In *Models and Methods in Regional Exchange*, edited by Robert E. Fry, pp. 147-150. SAA Papers No. 1. Society for American Archaeology, Washington, D. C.

1981 A Model For The identification Of Non-Local Ceramic Distribution: A View From The Present. In *Production and Distribution: A Ceramic Viewpoint*, edited by H. Howard and E.L. Morris, pp. 31-44. BAR International Series No. 120, Oxford, England.

1983 Design Structure and Community Organization in Quinua, Peru. In *Structure and Cognition in Art*, edited by Dorothy Washburn, pp 56-73. Cambridge University Press, Cambridge.

1984 Social Interaction and Ceramic Design: Community-wide Correlations in Quinua, Peru. In *Pots and Potters: Current Approaches in Ceramics Archaeology,* edited by Prudence M. Rice, pp. 133-161. Monograph XXIV, Institute of Archaeology, University of California, Los Angeles.

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

1991 Ethnoarchaeology and Investigations of Ceramic Production and Exchange: Can We Go Beyond Cautionary Tales? In *The Ceramic Legacy of Anna O. Shepard*, edited by Ronald L. Bishop and Frederick W. Lange, pp. 321-345. University Press of Colorado, Niwot, Colorado.

2000 Does The Standardization Of Ceramic Pastes Really Mean Specialization? *Journal of Archaeological Method and Theory* 7(4):333-375.

Arnold, Dean E., Hector Neff, and Ronald L. Bishop
1991 Compositional Analysis and "Sources" of Pottery: An Ethnoarchaeological Approach. *American Anthropologist* 93(1):70-90.

Arnold, Dean E., Hector Neff, Ronald L. Bishop, and Michael D. Glascock
1999 Testing Interpretative Assumptions of Neutron Activation Analysis. Contemporary Pottery In Yucatán, 1964-1994. In *Material Meanings: Critical Approcahes to the Interpretation of Material Culture,* edited by Elizabeth S. Chilton, pp. 61-84. The University of Utah Press, Salt Lake City.

Arnold, Dean E., Hector Neff, and M.D. Glascock
2000 Testing Assumptions of Neutron Activation Analysis: Communities, Workshops and Paste Preparation in Yucatán, Mexico. *Archaeometry* 42(2):301-316.

Arnold, Dean E., and A. L. Nieves
1992 Factors Affecting Ceramic Standardization. In *Ceramic Production and Distribution: An Integrated Approach*, edited by George J. Bey III and Christopher A. Pool, pp. 113-214. Westview Press, Boulder, Colorado.

Arnold, Phillip J., III

1991 Dimensional Standardization and Production Scale in Mesoamerican Ceramics. *Latin American Antiquity* 2:363-370.

1999 On Typologies, Selection and Ethnoarchaeology in Ceramic Production Studies. In *Material Meanings: Critical Approaches to the Interpretation of Material Culture*, edited by Elizabeth S. Chilton, pp. 103-117. The University of Utah Press, Salt Lake City.

Balfet, Héléne

1965 Ethnographical Observations in North Africa and Archaeological Interpretation: The Pottery of the Maghreb. In *Ceramics and Man*, edited by Frederick R. Matson. Viking Fund Publications in Anthropology No. 41. Werner-Gren Foundation for Anthropological Research Incorporated, New York.

Balkansky, Andrew K., Gary M. Feinman, and Linda M. Nicholas

1997 Pottery Kilns of Ancient Ejutla, Oaxaca, Mexico. *Journal of Field Archaeology* 24:139-160.

Barrera-Bassols, N.

1988 Etnoedafología P'urhepecha: conocimiento y uso de los suelos en la cuenca de Pátzcuaro. *México Indíqena 24:47-52.*

Baxter, M.J.

1994 *Exploratory Multivariate Analysis in Archaeology*. Edinburgh University Press, Edinburgh.

2001 Methodological Issues in the Study of Assemblage Diversity. *American Antiquity* 66(4):715-725.

Bayman, James M.

1999 Craft economies in the North American Southwest. *Journal of Archaeological Research* 7(3):249-299.

Beltrán, Ulises

1982 Tarascan State and Society in Prehispanic Times: An Ethnohistorical Inquiry. Ph.D. Dissertation, University of Chicago. University Microfilms, Ann Arbor.

Benco, Nancy

1987 *The Early Medieval Pottery Industry at al-Basra, Morocco*. BAR International Series 341. Oxford, England.

1988 Morphological standardization: an approach to the study of craft specialization. In *A Pot For All Reasons: Ceramic Ecology Revisited*, edited by C. Kolb and L. Lackey, pp. 157-172. Laboratory of Anthropology, Temple University, Philadelphia.

Berdan, Frances F.
1982 *The Aztecs of Central Mexico: An Imperial Society*. Holt, Rinehart, and Winston, New York.

Bishop, Ronald L., Veletta Canouts, Patricia L. Crown, and Suzanne P. DeAtley
1990 Sensitivity, Precision and Accuracy: Their roles in Ceramic Compositional Data Bases. *American Antiquity* 55(3):537-546.

Blackman, M. J., G. J. Stein, and P. B. Vandiver
1993 The Standardization Hypothesis and Ceramic Mass Production: Technological, Compositional and Metric Indexes of Craft Specialization at Tell Leilan, Syria. *American Antiquity* 58:60-80.

Blanton, Richard E., and Gary M. Feinman
1984 The Mesoamerican World System. *American Anthropologist* 86:673-692.

Blanton, Richard E., Stephen A. Kowalewski, Gary M. Feinman, and Jill Appel
1982 *Monte Alban's Hinterland, Part 1: The Prehispanic Settlement Patterns of the Central and Southern Parts of the Valley of Oaxaco*. Memoirs of the Museum of Anthropology, No. 15. University of Michigan, Ann Arbor.

Braniff, Beatriz
1998 *Morales, Guanajuato y la tradiciĆ³n ChupĆcuaro*. ColecciĆ³n Cientiffica, Serie ArqueologĆa, INAH, MĆ©xico, D.F.

Braun, David P.
1985 Ceramic Decorative Diversity and Illinois Woodland Integration. In *Decoding Prehistoric Ceramics*, edited by Ben A. Nelson, pp. 128-153. Southern Illinois University Press, Carbondale.

Brumfiel, Elizabeth M.
1980 Specialization, Market Exchange, and the Aztec State: A View from Huexotla. *Current Anthropology 21(4):459-478.*

1987a Consumption and Politics at Aztec Huexotla. *American Anthropologist* 89(3):676-686.

1987b Elite and Utilitarian Crafts in the Aztec State. In *Specialization, Exchange, and complex Societies*, edited by Elizabeth Brumfiel and Timothy K. Earle, pp. 102-118. Cambridge University Press, Cambridge.

1996 The Quality of Tribute Cloth: The Place of Evidence in Archaeological Argument. *American Antiquity* 61(3):453-462.

Brumfiel, Elizabeth M., and Timothy K. Earle

1987 Specialization, Exchange, and Complex Societies: An Introduction. In *Specialization, Exchange and Complex Societies*, edited by Elizabeth M. Brumfiel and Timothy K. Earle, pp. 1-9. Cambridge University Press, Cambridge.

Burton, James H., and Arleyn W. Simon

1993 Reports: Acid Extractions as a Simple and Inexpensive Method for Compositional Characterization of Archaeological Ceramics. *American Antiquity 58(1):45-59.*

Cabrera Castro, Rubén

1996 Cerámica suntuaria de Tzintzuntzan, Michoacán. *Tiempo y territorio en arqueología. El centro norte de México*, coordinadores A. M. Crespo y C. Viramontes, pp. 37-58. INAH, México.

Cárdenas García, Efraín

1990 Fases de Ocupación en la Cuenca de Pátzcuaro. *Anales Del Museo Michoacano*, Tercera Época, 2:25-43, Morelia.

Carrasco, Pedro

1982 The Political Economy of the Aztec and Inca States. In *The Inca and Aztec States: 1400-1800,* edited by G. Collier, R. Rosaldo, and J. Wirth, pp. 23-40. Academic Press, New York.

1983 Some Theoretical Considerations About the Role of the Market in Ancient Mexico. In *Economic Anthropology: Topics and Theories,* edited by Sutti Ortiz, pp. 67-82. Monographs in Economic Anthropology, No. 1. University Press of America, Lanham.

Caso, Alfonso

1930 Informe preliminar de las exploraciones realizadas en Michoacán. *Anales del Museo Nacional de Arqueología, Historia y Etnográfia* 6(2):446-452.

Castro-Leal, Marcia

1986 *Tzintzuntzan, Capital de los Tarascos.* Gobierno del Estado de Michoacán, Morelia, Mexico.

Chacón Torres, Arturo

1993a Ecosistema Lacustre. In *Plan Pázcuaro 2000: Investigatión Multidisciplinaria Para el Dessarrollo Sostenido*, edited by V.M. Toledo, P. Alverez-Icaza and P. Avila, pp. 37-70. Friedrich Ebert Stiftung, Morelia, Mexico.

1993b Pátzcuaro un lago Amenazado: Bosquejo Limnológico. Universididad Michoacana de San Nicolás de Hidalgo, Morelia Mexico.

Charlton, Cynthia Otis, Thomas H. Charlton, and Deborah L. Nichols

1993 Aztec Household-Based Craft Production: Archaeological Evidence From the City-State of Otumba, Mexico. In *Prehispanic Domestic Units in Western Mesoamerica*, edited by Robert S. Santley and Kenneth G. Hirth, pp. 147-171. CRC Press, Boca Raton, Florida.

Charlton, Thomas H., Deborah L. Nichols, and Cynthia Otis Charlton

1991 Aztec Craft Production and Specialization: Archaeological Evidence From the City-State of Otumba, Mexico. *World Archaeology 23(1).*

Childe, V. Gordon

1951 *Social Evolution.* Watts, London.

Chilton, Elizabeth S.

1999 One Size Fits All: Typology and Alternatives for Ceramic Research. In *Material Meanings: Critical Approaches to the Interpretation of Material Culture*, edited by Elizabeth S. Chilton, pp. 44-60. The University of Utah Press, Salt Lake City.

Christenson, Andrew L., and Dwight W. Read

1977 Numerical Taxonomy, R-mode Factor Analysis, and Archaeological Classification. *American Antiquity* 42(3):163-179.

1978 Comments on "Cluster Analysis and Archaeological Classification." *American Antiquity* 43(3):505-506.

Clarke, David L.

1968 *Analytical Archaeology.* Methuen and Co., Ltd., London.

Clark, John E., and William J. Parry

1990 Craft Specialization and Cultural Complexity. *Research in Economic Anthropology 12:289-346.*

Clifford, H. T., and W. Stephenson

1975 *An Introduction to Numerical Classification.* Academic Press, New York.

Cobean, Robert H.
1990 *La Cerámica de Tula, Hidalgo*. INAH, Serie Arqueología 215, Mexico.

Corter, James E.
1996 *Tree Models of Similarity and Association.* Sage University Paper Series on Quantitative Applications in the Social Sciences, series No. 07-12. Sage Publications, Thousand Oaks, California.

Costin, Cathy L.
1986 From Chiefdom to Empire State: Ceramic Economy Among the Prehispanic Wanka of Highland Peru. Ph.D. Dissertation, University of California, Los Angeles. University Microfilms, Ann Arbor.

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

Costin, Cathy L., and Melissa B. Hagstrum
1995 Standardization, Labor Investment, Skill, and the Organization of Ceramic Production in Late Prehispanic Highland Peru. *American Antiquity* 60(4):619-639.

Cowgill, George L.
1968 Archaeological Applications of Factor, Cluster, and Proximity Analysis. *American Antiquity* 33(3):367-375.

1972 Models, Methods and Techniques for Seriation. In *Models in Archaeology*, edited by David L. Clarke, pp. 381-424. Methuen and Co., Ltd., London.

1989 The Concept of Diversity in Archaeological Theory. *Quantifying Diversity in Archeology*, edited by Robert D. Leonard and George T. Jones, pp. 131-141. Cambridge University Press, Cambridge.

Curet, L. Antonio
1997 Technological Changes in Prehistoric Ceramics from Eastern Puerto Rico: An Exploratory Study. *Journal of Archaeological Science* 24:497-504.

Crown, Patricia L.
1995 The Production of the Salado Polychromes in the American Southwest. *Ceramic Production in the American Southwest*, edited by Barbara J. Mills and Patricia L. Crown, pp. 142-166. The University of Arizona Press, Tucson.

DeBoer, Warren R., and James A. Moore
1982 The Measurement and Meaning of Stylistic Diversity. *Nawpa Pacha* 20:147-162.

Dickens, Roy S., Jr.,
1980 Ceramic Diversity as an Indicator of Cultural Dynamics in the Woodland Period. *Tennessee Anthropologist* 5:34-46.

Drennan, Richard
1976 A Refinement of Chronological Seriation Using Nonmetric MDS. *American Antiquity 41:290-302.*

Duff, Andrew I.
1996 Ceramic Micro-seriation: Types or Attributes? *American Antiquity* 61(1):89-101.

Dunnell, Robert C.
1971 *Systematics in Prehistory.* The Free Press, New York.

1989 Diversity in Archaeology: A Group of Measures in Search of Application. In *Quantifying Diversity in Archeology*, edited by Robert D. Leonard and George T. Jones, pp. 142-149. Cambridge University Press, Cambridge.

Eerkens, Jelmer W., and Robert L. Bettinger
2001 Techniques For Assessing Standardization in Artifact Assemblages: Can We Scale Material Variability? *American Antiquity* 66(3):493-504.

Everitt, Brian
1980 *Cluster Analysis*, second edition. Halsted Press, New York.

Faugère-Kalfon, Brigitte
1996 *Entre Zacapu y Río Lerma: Culturas en una Zona Fronteriza.* Cuadernos de Reconocimientos Michoacanos 7, Centre d'Etudes Mexicaines et Centraméricanies, Mexico.

Feinman, Gary M.
1980 The Relationship Between Administrative Organization and Ceramic Production in the Valley of Oaxaca, Mexico. Ph.D Dissertation, City University of New York. University Microfilms, Ann Arbor.

1999 Rethinking Our Assumptions: Economic Specialization at the Household Scale in Ancient Ejutla, Oaxaca, Mexico. In *Pottery and People: A Dynamic Interaction,* pp. 81-98. The University of Utah Press, Salt Lake City.

Feinman, Gary M., and Stephen A. Kowaleski, and R. E. Blanton
1984 Modeling Archaeological Ceramic Production and Organizational Change in the Prehispanic Valley of Oaxaca. In *The Many Dimensions of Pottery: Ceramics in Archaeology and Anthropology,* edited by S.W. vander Leeuw and A. A. Pritchard, pp. 295-334. University of Amsterdam, Amsterdam.

Feinman, Gary M., S. Upham, and K. G. Lightfoot
1981 The Production Step Measure: An Ordinal Index of Labor Input in Ceramic Manufacture. *American Antiquity* 46:871-884.

Fisher, Christopher
n.d. Compositional analysis of archaeological ceramic samples from the Lake Pátzcuaro Basin, Michoacán. Mss.

Fisher, Christopher, Helen Perlstein Pollard, and Charles Frederick
1999 Landscape Change and Socio-political Development Within the Lake Pátzcuaro Basin. *Antiquity* 73(281):642-649.

Fisher, Christopher T., Helen P. Pollard, Isabel Israde, Victor H. Garduño-Monroy, and Subir K. Banerjee.
2003 A reexamination of human-induced environmental change within the Lake Pátzcuaro Basin, Michoacán, Mexico. *Proceedings of the National Academy of Sciences* 100:4957-4962.

Flannery, Kent V.
1972 The Cultural Evolutionary Civilizations. *The Annual Review of Ecology and Systematics* 3:399-426.

Foster, George M.
1948a *Empire's Children: The People of Tzintzuntzan*. Institute of Social Anthropology 6. Smithsonian Institution, Washington, D.C.

1948b Some Implications of Modern Mexican Mold-Made Pottery. *Southwestern Journal of Anthropology* 4(4):356-370.

1960a *Culture and Conquest: America's Spanish Heritage*. Viking Fund Publications in Anthropology, No 27, New York.

1960b Life-Expectancy of Utilitarian Pottery in Tzintzuntzan, Michoacán, Mexico. *American Antiquity* 25(4):606-609

1976 Contemporary Pottery Techniques in Southern and Central Mexico. *Studies in Middle American Anthropology*, No 22, Middle American Research Institute, Tulane University, New Orleans.

1979 *Tzintzuntzan: Mexican Peasants in a Changing World*, revised edition. Elsevier, New York.

Fried, Morton H.
1967 *The Evolution of Political Society: An Essay in Political Anthropology*. Random House, New York.

Fry, Robert E.
1979 The Economics of Pottery at Tikal, Guatemala: Models of Exchange for Serving Vessels. *American Antiquity* 44(3):494-512.

1980 Models of Exchange for Major Shape Classes of Lowland Maya Pottery. In *Models and Methods in Regional Exchange,* edited by Robert E. Fry, pp. 3-18. SAA Papers No. 1, Washington, D.C.

Fry, Robert E., and Scott C. Cox
1974 The Structure of Ceramic Exchange at Tikal, Guatemala. *World Archaeology 6(2):*209-225.

Gifford, James C.
1960 The Type-Variety Method of Ceramic Classification as an Indicator of Cultural Phenomena. *American Antiquity* 25(3):341-347.

Glascock, Michael D.
1992 Neutron Activation Analysis. *Chemical Characterization of Ceramic Pastes in Archaeology*, edited by Hector Neff, pp. 11-26. Monographs in World Archaeology No. 7. Prehistory Press, Madison, Wisconsin.

Gorenstein, Shirley
1985 *Acambaro on the Tarascan-Aztec Frontier*. Vanderbilt University Publications in Anthropology 32, Nashville.

Gorenstein, Shirley, and Helen Perlstein Pollard
1980 *The Development of the Protohistoric Tarascan State*. Submitted to the National Science Foundation and the National Endowment for the Humanities.

1983 *The Tarascan Civilization: A Late Prehispanic Cultural System*. Vanderbilt University Publications in Anthropology 28, Nashville.

Gortaire Iturralde, Alfonso
1971 *Santa Fe: Presencia Etnologica de un Pueblo Hospital*. Universidad iberoamericana A.C., Mexico.

Gower, J. C.
1967 A Comparison of Some Methods of Cluster Analysis. *Biometrics* 23(4):623-637.

1971 A General Coefficient of Similarity and Some of its Properties. *Biometrics* 27:857-872.

Hagstrum, Melissa B.
1985 Measuring Prehistoric Ceramic Craft Specialization: a Test Case in the American Southwest. *Journal of Field Archaeology* 12:65-75.

Harbottle, Garmon
1976 Activation Analysis in Archaeology. In *Radiochemistry*, Volume 3, edited by G.W.A. Newton, pp. 33-72. The Chemical Society, London.

Hart, F. Alan, Jeremy M.V. Storey, Stuart J. Adams, Robin P. Symonds, and J. Nicholas Walsh
1987 An Analytical Study, Using Inductively Coupled Plasma (ICP) Spectrometry, of Samian and Colour-Coated Wares from the Roman Town at Colchester together with Related Continental Samian Wares. *Journal of Archaeological Science 14:577-598.*

Hill, J.N., and R.K. Evans
1972 A Model for Classification and Typology. In *Models in Archaeology*, edited by David L. Clarke, pp. 231-273. Methuen and Co., Ltd., London.

Hirshman, Amy, Helen Perlstein Pollard, Hector Neff, and Michael D. Glascock
1999 Ceramic Production and Distribution and the Emergence of the Tarascan State: Chemical Characterization of Urichu Finewares and Pátzcuaro Basin Clays. Paper presented at the 64th Annual Meeting of the Society for American Archaeology, Chicago, Illinois.

Hodge, Mary G., Hector Neff, M. James Blackman, and Leah D. Minc
1992 A Compositional Perspective on Ceramic Production in the Aztec Empire. In *Chemical Characterization of Ceramic Pastes in Archaeology,* edited by Hector Neff, pp. 203-220. Monographs in World Archaeology No. 7. Prehistory Press, Madison, Wisconsin.

Hodson, F.R.
1969 Searching for Structure Within Multivariate Archaeological Data. *World Archaeology* 1(1):90-105.

1970 Cluster Analysis and Archaeology: Some New Developments and Applications. *World Archaeology* 1(3):299-320.

Hosler, Dorothy
1988a Ancient West Mexican Metallurgy: A Technological Chronology. *Journal of Field Archaeology* 15:191-217.

1988b Ancient West Mexican Metallurgy: South and Central American Origins and West Mexican Transformations. *American Anthropologist* 90:832-855.

Jiménez Moreno, Wigberto
1966 Mexico Before the Toltecs. In *Ancient Oaxaca*, edited by J. Paddock. Stanford University Press, pp. 1-82.

Johnson, Allen W., and Timothy Earle
1987 *The Evolution of Human Societies*. Stanford University Press, Stanford, California.

Johnson, LeRoy Jr.
1971 Interdependent Data, Cluster Analysis and Archaeology. *Proceedings of the Prehistoric Society* 37(1):251-3.

1972 Introduction to Imaginary Models for Archaeological Scaling and Clustering. In *Models in Archaeology*, edited by David L. Clarke, pp. 309-379. Methuen and Co., Ltd., London.

Kaplan, Flora S.
1994 *A Mexican Folk Pottery Tradition: Cognition and Style in Material Culture in the Valley of Puebla*, revised edition. Southern Illinois University Press, Carbondale.

1985 The Measuring, Mapping, and Meaning of Pots. *American Anthropologist* 87(2):357-364.

Kaplan, Flora S., and David M. Levine
1981 Cognitive Mapping of a Folk Taxonomy of Mexican Potter: A Multivariate Approach. *American Anthropologist* 83(3):868-884.

Kelly, Isabel
1947 Excavations at Apatzingan, Michoacán. Viking Fund Publications in Anthropology, No. 7, New York.

Kramer, Carol
1985 Ceramic Production and Specialization. *Paléorient*, 11/2:117-119.

Kruskal, Joseph B., and Myron Wish
1987 *Multidimensional Scaling*. Sage University Paper Series on Quantitative Applications in the Social Sciences, series No. 07-011. Sage Publications, Beverly Hills.

Kvamme, Kenneth L., Miriam T. Stark, and William A. Longacre
1996 Alternative Procedures for Assessing Standardization in Ceramic Assemblages. *American Antiquity* 61(1):116-126.

Lebart, Ludovic
1994 Complementary Use of Correspondence Analysis and Cluster Analysis. In *Correspondence Analysis in the Social Sciences,* edited by Michael Greenacre and Jörg Blasius, pp. 162-178. Academic Press, London.

Lister, Robert
1949 *Excavations at Cojumatlan, Michoacán*, Mexico. University of New Mexico Publications in Anthropology 5, Albuquerque.

London, Gloria Anne
1991 Standardization and Variation in the Work of Craft Specialists. In *Ceramic Ethnoarchaeology*, edited by William A. Longacre, pp. 182-204. The University of Arizona Press, Tucson.

Longacre, William A.
1991 Ceramic Ethnoarchaeology: An Introduction. In *Ceramic Ethnoarchaeology*, edited by William A. Longacre, pp. 1-10. The University of Arizona Press, Tucson.

1999 Standardization and Specialization: What's the Link? In *Pottery and People: A Dynamic Interaction,* edited by James M. Skibo and Gary M. Feinman, pp. 44-58. The University of Utah Press, Salt Lake City.

Longacre, William A., Kenneth Kvamme, and M. Kobayashi
1988 Southwestern Pottery Standardization: An Ethnoarchaeological View From the Philippines. *Kiva* 53:101-112.

Longacre, William A., and James M. Skibo
1994 *Kalinga Ethnoarchaeology: Expanding Archaeological Method and Theory*. Smithsonian Institution Press, Washington.

Lovis, William A.
1973 Late Woodland Cultural Dynamics in the Northern Lower Peninsula of Michigan. Ph.D. Dissertation, Department of Anthropology, Michigan State University.

Macías Goytia, Angelina
1990 *Huandacareo: Lugar de Juicios, Tibunal.* Colección Científica 222, INAH, Mexico.

Mallory, Leanne M. Greenough, and John D. Greenough
1998 New Data for Old Pots: Trace-Element Characterization of Ancient Egyptian Pottery Using ICP-MS. *Journal of Archaeological Science 25:85-97.*

Manzanilla López, R.
1988 Salvamento arqueológico en Loma Santa María, Morelia, Michoacán. In *Primera Reunion Sobre las Sociedades Prehispánicas en el Centro-Occidente de México, Memoria*, edited by R. Brambila and A. M. Crespo, pp. 151-160. Cuaderno de Trabajo 1, Centro Regional de Querétaro, INAH, Mexico.

McKeown, Bruce, and Dean Thomas
1988 *Q Methodology*. Sage University Paper Series on Quantitative Applications in the Social Sciences, series No. 07-066. Sage Publication, Newbury Park, California.

Meara, Kevin, Frédéric Robin, and Stephen G. Sireci
2000 Using Multidimensional Scaling to Assess the Dimensionality of Dichotomous Items Data. *Multivariate Behavioral Research* 35(2):229-259.

Michelet, Dominique (coordinator)
1992 *El Proyecto Michoacán 1983-1987 Medio ambiente e intoducción a los trabajos arqueológicos*. Collection Etudes Mésoaméricaines 11-12, Cuadernos de Reconocimientos Michoacanos 4, CEMCA, Mexico.

Michelet, Dominique, Marie Charlotte Arnauld, and M. F. Fauvet Merthelot,
1989 El Proyecto del CEMCA en Michoacán. Etapa 1: Un balance. *Trace* 16:70-87, CEMCA, Mexico.

Michelet, Dominique, A. Ichon, and G. Migeon
1985 Residencias, barrios y sitios posclásicos en el Malpaís de Zacapu. *Actas de la Primera reunión sobre las sociedades prehispánicas en el Centro-Occidente de México, Querétaro.*

Minc, Leah D.
1994 Political Economy and Market Economy Under Aztec Rule: A Regional Perspective Based on Decorated Ceramic Production and Distribution Systems in the Valley of Mexico. PhD. Dissertation, Department of Anthropology, University of Michigan. University Microfilms, Ann Arbor.

Moedano, Hugo
1941 Estudio preliminar de la cerámica de Tzintzuntzan. Temporada III. *Revista Mexicana de Estudios Antopológicos* 5(1):21-42.

1946 La cerámica de Zinapécuaro, Michoacán. *Anales del Museo Michoacáno* 2:439-49.

Moguel Cos, Ma. Antonieta
1987 Trabajos de Salvamento Arqueológico en las Cuencas de Cuitzeo, Pátzcuaro y Zirahuén: Un Intento de Interpretación Cultural. Tesis para Licenciado en Arqueología. Escuela Nacional de Antropoligía e Historia (ENAH), INAH, Mexico.

Mojena, R.
1977 Hierarchical Grouping Methods and Stopping Rules: An Evaluation. *Computer Journal* 20(4):359-363.

Mojena, R., and D. Wishart
1980 Stopping Rules for Ward's Clustering Method. Pp. 426-432. *Compstate 1980 Proceedings*. Physica Verlaq, Wurzburg.

Morgan, Lewis Henry
1877(1985) *Ancient Society*. University of Arizona Press, Tucson.

Munsell Soil Color Charts
1971 Munsell Color Company, Inc., Baltimore.

Neff, Hector
1992 Introduction. In *Chemical Characterization of Ceramic Pastes in Archaeology*, edited by Hector Neff, pp. 1-10. Monographs in World Archaeology, No. 7. Prehistory Press, Madison, Wisconsin.

Neff, Hector, Ronald L. Bishop, and Dean E. Arnold
1988 Reconstructing Ceramic Production from Ceramic Compositional Data: An Example From Guatemala. *Journal of Field Archaeology* 15(3):339-348.

Neff, Hector, and Michael D. Glascock
1999 Compositional Analysis of Ceramics and Raw Materials From the Lake Patzcuaro Basin, Mexico. Manuscript in the possession of the author.

Noguera, Eduardo
1931 Exploraciones arqueológicas en las regiones de Zamora y Pátzcuaro, estado de Michoacán. *Anales del Museo Nacional de México* 4(7):88-104.

1965 La cermámica arqueológia de Mesoamérica. *Instituto de Investigaciones Historicas 86*. Universidad Nacional Autónoma de México, Mexico.

O'Hara, Sarah
1993 Historical Evidence of Fluctuations in the Level of Lake Pátzcuaro, Michoacán, México over the last 600 years. *The Geographical Journal* 159(1):51-62.

Palerm, Angel, and Eric Wolf
1957 Ecological Potential and Cultural Development in Mesoamerica. *Pan American Union Social Science Monograph* 3:1-37.

Paredes Martinez, Carolos
1984 El tribute indìgena el la region del Lagode Pátzcuaro. In *Michoacán en el siglio XVI*, Carlos S. Paredes Martinez, Marcela Irais Pinon Flores et al, Michoacanan el Siglio XVI, pp. 21-104. Colección Estodios Michoanas VII, Fimax Oulicistas, Morelia, Michoacán.

Payne, William O.
1982 Kilns and Ceramic Technology of Ancient Mesoamerica. *Archaeological Ceramics*, edited by Jacqueline S. Olin and Alan D. Franklin, pp. 189-192. Smithsonian Institution Press, Washington, D.C.

Peacock, D. S.
1982 *Pottery in the Roman World: An Ethnoarchaeological Approach.* Longman, London.

Pereira, Grégory
1999 *Potrero de Guadalupe. Anthropologie funéraire d'une communauté prétarasque du nord du Michoacán, Mexique.* Paris Monographs in American Archaeology 5, BAR International Series 816, UK.

Pielou, E. C.
1977 *Mathematical Ecology.* John Wiley & Sons, New York.

Piña Chan, Román and Kuniaki Oí
1982 *Exploraciones Arqueológicas en Tingambato, Michoacán.* INAH, Mexico.

Pfaffenberger, Bryan
1992 Social Anthropology of Technology. *Annual Review of Anthropology* 21:491-516.

Pollard, Helen Perlstein
1972 Prehispanic Urbanism at Tzintzuntzan, Michoacán. PhD. Dissertation, Columbia University. University Microfilms, Ann Arbor.

1980 Central Places and Cities: A Consideration of the Protohistoric Tarascan State. *American Antiquity 45(4):677-696.*

1982a Ecological Variation and Economic Exchange in the Tarascan State. *American Ethnologist* 9(2):250-268.

1982b Water and Politics: Paleoecology and the Centralization of the Tarascan State. Paper presented at symposium on Paleoecology and Man in Central Mexico, 44th Congress of Americanists, Manchester.

1987 The Political Economy of Prehispanic Tarascan Metallurgy. *American Antiquity* 52(4):741-752.

1991 The Construction of Ideology in the Emergence of the Prehispanic Tarascan State. *Ancient Mesoamerica* 2:167-179.

1993 *Taríacuri's Legacy: The Prehispanic Tarascan State.* University of Oklahoma Press, Norman.

1994 Ethnicity and Political Control in a Complex Society: the Tarascan State of Prehispanic Mexico. In *Factional Competition and Political Development in the New World*, edited by Elizabeth M. Brumfiel and J. W. Fox, pp. 79-88. Cambridge University Press, Cambridge.

1995 The Transformation of Regional Elites in Central Michoacan. Paper presented for symposium "The Classic to Postclassic Transition in Western Mexico, 60th Annual Meeting of the Society for American, Minneapolis.

1996 *Proyecto desarollo del estado Tarasco: los senorios Urichu, Xaracuaro, y Pareo: registro de piezas arqueologicas entregados al Museo Michoacáno del Centro del INAH – Michoacán.* Submted to the Consejo de Arqueología, Instituto Nacional de Antropología e Historia.

1997 Recent research in West Mexico archaeology. Journal of Archaeological Research 5(4):345-384.

2000a *Informe Final.* Submitted to the Consejo de Arqueología, Instituto Nacional de Antropología e Historia.

2000b Tarascans and Their Ancestors: Prehistory of Michoacán. In *Greater Mesoamerica: The Archaeology of West and Northwest Mexico*, edited by Michael S. Foster and Shirley Gorenstein, pp.59-70. The University of Utah Press, Salt Lake City.

2000c Tarascan External Relationships. In *Greater Mesoamerica: The Archaeology of West and Northwest Mexico*, edited by Michael S. Foster and Shirley Gorenstein, pp. 71-80. The University of Utah Press, Salt Lake City.

2001a From Core Region to Colony: the Tarascan Empire in a Spanish Colonial World. Paper presented for symposium "The Late Postclassic to Spanish-era Transition in Mesoamerica: Archaeological Perspectives," 66th Annual Meetings of the Society for American Archaeology, New Orleans.

2001b *Informe Final, Tomo 3: La Ceramica.* Submitted to the Consejo de Arqueología, Instituto Nacional de Antropología e Historia.

2002 Michoacán en el mundo mesoamericano prehispanico: Erongarícuaro, Michaocán y los estados teotihuanco y tarasco. Paper presented at the Symposide Arqueología: El Occidente de México y el Mundo Mesoamericano, Guadalajaro.

Pollard, Helen Perlstein, and Laura Cahue
1999 Mortuary Patterns of Regional Elites in the Lake Pátzcuaro Basin of Western Mexico. *Latin American Antiquity* 10(3):259-280.

Pollard, Helen Perlstein, and Shirley Gorenstein
1980 Agrarian Potential, Population and the Tarascan State. *Science* 209(4453):274-277.

Pollard, Helen Perlstein, Amy Hirshman, Hector Neff, and Michael D. Glascock
2001 Las elites el intercambio de bienes y el surgimiento del area nuclear tarasca: análisis de la cerámica de la cuenca de Pátzcuaro. In *Estudios Cerámicos en el Occidente y Norte de México*, edited by Eduardo Williams and Phil C. Weigand, pp. 289-310. El Colegio de Michoacán.

Pollard, Helen Perlstein, and Thomas Vogel
1993 Late Postclassic Imperial Expansion and Economic Exchange Within the Tarascan Domain. In *Economics and Politics in the Aztec Realm*, edited by Michael Smith and Mary Hodge, pp. 447-470. University of Texas Press, Austin.

Pool, Christopher
1992 Interpreting Ceramic Production and Distribution. In *Ceramic Production and Distribution: An Integrated Approach,* edited by G. J. Bey III and C. A. Pool, pp. 275-314. Westview Press, Boulder, Colorado.

Porter, Muriel Noé
1956 Excavacation at Chupìcuraro, Guanajuator, Mexico. *Transaction of the American Philosophical Society,* No. 46. The American Philosophical Society, Philadelphia.

Price, Barbara F.
1977 Shifts in Production and Organization: A Cluster-Interaction Model. *Current Anthropology* 18(2):209-233.

Rathje, William L.
1975 The Last Tango in Mayapán: A Tentative Trajectory of Production-Distribution Systems. In *Ancient Civilization and Trade*, edited by Jeremy A. Sabloff and C. C. Lamberg-Karlovsky, pp. 409-448. University of New Mexico Press, Albuquerque.

Relación, de Michoacán (1541) (RM)
1956 *Relación de las Ceremonias y Ritos y Población y Gobierno de Michoacán*. Reproducción Facsimilar del Ms IV de El Escorial, Madrid. Aguilar Publicistas, Madrid.

1980 *La Relación de Michoacán*. Versión Paleográfica, Separación de Textos, Ordenación Coloquial, Reconocimiento Preliminar Y Notas de F. Miranda. Estudios Michoacanos V. Fimax, Morelia, Michoacán, Mexico.

Relaciones Geográficas
1985 *Relacciones y memorias de la provincia de Michoacán*, 1579-1581, edited by Alvaro Ochoa S. and Gerardo Sánchez D. Universidad Michoacána, Ayutamiento de Morelia.

Reynolds, H.T.
1984 *Analysis of Nominal Data*, second edition. Sage University Paper Series on Quantitative Applications in the Social Sciences, series No. 07-007. Sage Publications, Beverly Hills, California.

Rice, Prudence
1976 Comment: Rethinking the Ware Concept. *American Antiquity* 41(4):538-543.

1981 Evolution of Specialized Pottery Production: A Trial Model. *Current Anthropology* 22(3):219-240.

1982 Pottery production, pottery classification, and the role of physicochemical analyses. In *Archaeological Ceramics,* edited by Jacqueline S. Olin and Alan D. Franklin, pp. 47-56. Smithsonian Institution Press, Washington, D.C.

1987 *Pottery Analysis: A Sourcebook*. The University of Chicago Press, Chicago.

1989 Ceramic Diversity, Production, and Use. In *Quantifying Diversity in Archeology*, edited by Robert D. Leonard and George T. Jones, pp. 109-117. Cambridge University Press, Cambridge.

1991 Specialization, Standardization, and Diversity: A Retrospective. In *The Ceramic Legacy of Anna O. Shepard,* edited by R. L. Bishop and F. W. Lange, pp. 257-279. University Press of Colorado, Boulder.

1996 Recent Ceramic Analysis: 2. Composition, Production, and Theory. *Journal of Archaelogical Research* 4(3):165-202.

Rice, Prudence M., and Marian E. Saffer
1982 Cluster Analysis of Mixed-level Data: Pottery Provenience as an Example. *Journal of Archaeological Science* 9:395-409.

Rouse, Irving
1960 The Classification of Artifacts in Archaeology. *American Antiquity* 25(3):313-323.

Rubín de la Borbolla, Daniel F.
1939 Antropología Tzintzuntzan-Ihuatzio: Temporadas I y II. *Revista Mexicana de Estudios Antropológicas* 3(2):99-121.

1948 Arqueología Tarasca en *El Occidente de México 4ª. Mesa Redonda de la S.M.A., pp. 30-35. México.*

Sabloff, Jeremy A.
1994 *The New Archaeology and the Ancient Maya*. Scientific American Library, New York.

Sabloff, Jeremy A., and Robert E. Smith
1969 The Importance of Both Analytic and Taxonomic Classification in the Type-Variety System. *American Antiquity* 34(3):278-285.

Sanders, William T.
1957 The Central Mexican Symbiotic Region: A Study in Prehistoric Settlement Patters. *Viking Fund Publications in Anthropology* 23: 115-127.

Sanders, William T., Jeffrey R. Parsons, and Robert S. Santley
1979 *The Basin of Mexico: Ecological Processes in the Evolution of a Civilization*. Academic Press, New York.

Sanders, William T., and Barbara J. Price
1968 *Mesoamerica: The Evolution of a Civilization*. Random House, New York.

Santley, Robert S., Philip J. Arnold III, and Christopher A. Pool
1989 The Ceramics Production System at Matacapan, Veracruz, Mexico. *Journal of Field Archaeology* 16(1):107-132.

Service, Elam R.
1971 *Primitive Social Organization: An Evolutionary Perspective*. Random House, New York.

1975 Origins of the State and Civilization: The Process of Cultural Evolution. Norton, New York.

Shafer, H.J., and T.R. Hester
1983 Ancient Maya Chert Workshops in Northern Belize, Central America. *American Antiquity* 48:519-543.

1986 Maya Stone-Tool Craft Specialization and Production at Colha, Belize: Reply to Mallory. *American Antiquity* 5:158-166.

1991 Lithic Craft Specialization and Product Distribution at the Maya Site of Colha, Belize. *World Archaeology* 23:79-97.

Shott, Michael
1996 Mortal Pots: on Use Life and Vessel Size in the Formation of Ceramic Assemblages. *American Antiquity* 61(3):463-482.

Shott, Michael and Eduardo Williams
2001 Datos censales sobre la vida útil de la cerámica: estudio etnoarqueológico. In *Estudios Cerámicas en el Occidente y Norte de México*, Eduardo Williams and Phil C. Weigand, eds, pp. 97-125. El Colegio de Michoacán, Zamora and Instituto Michoacano de Cultura, Morelia, Mexico.

Sinopoli, Carla
1988 The Organization of Craft Production at Vijayanagara, South India. *American Anthropologist* 90:580-597.

Smith, Robert E., Gordon R. Willey, and James C. Gifford
1960 The Type-Variety Concept as a Basis for the Analysis of Maya Pottery. *American Antiquity* 25(3):330-340.

Sneath, Peter H. A., and Robert R. Sokal
1973 *Numerical Taxonomy: The Principles and Practice of Numerical Classification.* W. H. Freeman and Company, San Fransisco.

Spaulding, Albert C.
1953 Statistical Techniques for the Discovery of Artifact Types. *American Antiquity* 18(4):305-313.

Spence, Michael W.
1967 The Obsidian Industry of Teotihuacan. *American Antiquity* 32:507-514.

1981 Obsidian Production and the State in Teotihuacan. *American Antiquity* 46:769-788.

Stalans, Loretta J.
1995 Multidimensional Scaling. In *Reading and Understanding Multivariate Statistics*, edited by Laurence G. Grimm and Paul R. Yarnold, pp. 137-168. American Psychological Association, Washington, DC.

Stark, Barbara L.
1985 Archaeological Identification of Pottery Production Locations: Ethnoarchaeology and Archaeological Data from Mesoamerica. In *Decoding Prehistoric Ceramics*, edited by B.A. Nelson, pp. 158-194. Southern Illinois University Press, Carbondale.

Stark, Barbara L. and Joseph T. Hepworth
1982 A Diversity Index Approach to Analysis of Standardization in Prehistoric Pottery. In *Computer Application in Archaeology: 1982 Conference Proceedings*, pp. 87-104. University of Birmingham, England.

Steponaitis, Vincas
1982 *Ceramics, Chronology, and Community Patterns: An Archaeological Study of Moundville*. Academic Press, New York.

Steward, Julian H.
1955 Development of Complex Societies: Cultural Causality and Law: A Trial Formulation of the Development of Early Civilizations. In *Theory of Culture Change: The Methodology of Multilinear Evolution*, edited by Julian H. Steward, pp. 178-209. University of Illinois Press, Urbana.

Thompson, Bruce
1951 *Canonical Correlation Analysis: Uses and Interpretation*. Sage University Paper Series on Quantitative Application in the Social Sciences, series No. 07-047. Sage Publications, Beverly Hills.

Thorndike, R.L.
1953 Who Belongs in the Family? *Psychometrika* 18:267.276.

Toledo, Victor M.
1991 Pátzcuaro's Lesson: Nature, Production, and Culture in an Indigenous Region of Mexico, edited by Margery L. Oldfield and Janis B. Alcorn, pp. 147-171. In *Biodiversity: Culture, Conservation, and Ecodevelopment.* Westview Press, Boulder.

Toledo, Victor M., and Arturo Argueta
1993 Cultura indigena y ecologia. In *Plan Patzcuaro 2000: Investigación Multidisciplinaria para el desarrollo sostenido, edited by V.M. Toledo, P. Alvarez-Icaza and P. Avilla, pp. 219-238.* Friedrich Ebert Stiftung, Morelia, Mexico.

Tommasi de Magrelli, Wanda
1978 *La cerámica funeraria de Teotenango*. Biblioteca Enciclopedia del Estado de Mexico, Mexico.

Trigger, Bruce G.
1989 *A History of Archaeological Thought*. Cambridge University Press, Cambridge.

van der Leeuw, Sander
1976 Towards a Study of the Economics of Pottery Making. In *Ex Horreo*, edited by B. L. van Beek, R. W. Brandt and W. Groenman-van Waateringe, pp. 68-76. Institute of Pre- and Proto-History, University of Amsterdam, The Netherlands.

Van Zantwijk, R. A. M.
1967 Servant of the Saints: The Social and Cultural Identity of a Tarascan Community in Mexico. Van Gorcum & Comp., Assen.

Versluis, Vincent
1994 The Iconography of the Protohistoric Tarascan State of Western Mexico: The Material Expression of the State Ideology. M.A. Thesis, Department of Anthropology, Michigan State University, East Lansing, Michigan.

Weaver, Muriel Porter
1993 *The Aztecs, Maya, and Their Predecessors: Archaeology of Mesoamerica,* 3rd edition. Academic Press, San Diego.

Warren, J. Benedict
1985 *The Conquest of Michoacán*. The Spanish Domination of the Tarascan Kingdom in Western Mexico, 1521-1530. University of Oklahoma Press, Norman.

Wattenmaker, Patricia
1998 *Household and State in Upper Mesopotamia: Specialized Economy and the Social Uses of Goods in an Early Complex Society.* Smithsonian Institution Press, Washington.

Weigand, P.C., G. Harbottle, and E. V. Sayre
1977 Turquoise Sources and Source Analysis: Mesoamerica and the Southwestern U. S. A. In *Exchange Systems in Prehistory*, edited by T. K. Earle and J. E. Ericson, pp. 15-34. Academic Press, New York.

Wenke, Robert J.
1999 *Patterns in Prehistory: Humankind's First Three Million Years*, Fourth Edition. Oxford University Press, New York.

West, Robert
1948 *Cultural Geography of the Modern Tarascan Area.* Institute of Social Anthropology No. 7. Smithsonian Institution, Washington, D.C.

Whallon, Robert
1984 Unconstrained Clustering for the Analysis of Spatial Distributions in Archaeology. In *Intrasite Spatial Analysis in Archaeology,* edited by Harold J. Hietala, pp. 242-277. Cambridge University Press, Cambridge.

Whallon, Robert, and James A. Brown
1982 *Essays on Archaeological Typology*. Center for American Archaeology Press, Evanston, Illinois.

Wheat, Joe Ben, James C. Gifford, and William Wasley
1958 Ceramic Variety, Type Cluster, and Ceramic System in Southwestern Pottery Analysis. *American Antiquity* 24(1):34-37.

Willey, Gordon R.
1957 Prehistoric Settlement Patterns in the New World. *Viking Fund Publication in Anthropology* 23:107-114.

Willey, Gordon R., and Jeremy A. Sabloff
1980 *A History of American Archaeology*, second edition. W.H. Freeman and Company, San Francisco.

Williams, Eduardo
1994 Organizaci6n del espacio doméstico y prodducci6n cerámica en Huáncito, Michoacán. In *Contribuciones a la Arquelogía y Etnohistoria del Occidente de Méxiao*, edited by Eduardo Williams, pp. 189-225. El Colegio de Michoacán, Zamora.

Wishart, David
1999 *ClustanGraphics Primer: A Guide to Cluster Analysis.* Clustan Limited, Edinburgh.

Wolf, Eric
1959 *Sons of the Shaking Earth.* The University of Chicago Press, Chicago.

Young, Forrest W.
1987 History. In *Multidimensional Scaling: History, Theory, and Applications*, edited by Robert J. Hamer, pp. 3-40. Lawrence Erlbaum Associates, Publishers, Hillsdale, New Jersey.

Zorita, Alonso de
1941 Breve y Sumaria Relaciόn de los Senores y Maneras y Diferencias que Había de Ellos en la Nueva Espana. In *Nueva Colecciόn de Documentos para la Historia de México*, edited by J. Garcia Icazbalceta, pp. 67-205. Salvado Chávez Haycoe, Mèxico.