Ceramic Production in the Mariana Islands: Explaining Change and Diversity in Prehistoric Interaction and Exchange

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THE TRADITIONAL APPROACH employed to describe the history and prehistory of the Mariana Islands has emphasized the cultural and linguistic homogeneity of the indigenous population, the Chamorros. Consequently, archaeologists have devoted little attention to spatial variabililty across the archipelago or to research domains that may articulate with such variability—for example, the exchange of commodities or social transactions and the extent of inter-community and inter-island interaction. Interestingly, this approach has produced an inconsistency between archaeological method and the study of culture history in Mariana Islands prehistory. For with few exceptions, artifacts recovered from archaeological sites have been treated as if they were produced and used within the confines of a single community. Yet at the same time, the material culture assemblage for each time period, spanning an array of communities, is thought to have been relatively homogeneous. Such a view can only be maintained by postulating high rates of prehistoric interaction coupled with low rates of exchange. This hypothesis has not been explicitly evaluated by Micronesian archaeologists, in terms of its methodological, theoretical, or substantive adequacy.

The completion of a number of archaeological projects over the past 15 years in the Mariana Islands now makes it possible to ask, how homogeneous and similar are material culture assemblages across the archipelago at different points in time? Pottery lends itself well to this kind of questioning, because it occurs in large numbers at virtually all sites in the Mariana Islands, and its variability across a number of dimen-

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sions can be described. Traditionally in Micronesia pottery analyses have focused on the description of easily observed characteristics of sherds, such as temper inclusions or surface treatment. While such observations have proved useful and will continue to structure archaeological systematics in the Mariana Islands, other, less easily observed characteristics of pottery can also be of analytical use. In particular, the combination of compositional and traditional analyses of Micronesian pottery may prove to be a powerful tool in resolving alternative hypotheses regarding community interaction and exchange, as we hope to show here.

Ultimately our goal is to link ceramic variation through time and space in the Mariana Islands to a more general model incorporating aspects of interaction, exchange, and social complexity. The evidence from our pottery analyses is congruent with hypotheses that link variability in inter-island interaction and exchange to (1) the varying conditions associated with first establishing human settlements under conditions of low population density, and then to (2) the conditions that prevailed as the numbers and size of settlements increased and as the Chamorros became socially differentiated within and between communities and islands.

CERAMIC VARIATION IN THE MARIANA ISLANDS: ITS DIMENSIONS AND IMPLICATIONS

The practice of modern ceramic analysis in much of the Mariana Islands and Micronesia was largely adapted from traditional approaches in the American Southwest, where ceramic assemblages were intuitively grouped into named types or series, which were then presumed to have temporal and cultural significance. In the Mariana Islands, the ceramic typology devised by Alexander Spoehr (1957) and still in use today reflects this orientation. Spoehr worked in the American Southwest before his research in the Mariana Islands. He also assumed, based on his understanding of the traditional ethnic unity of the Islands reported by the early Spanish missionaries (see L. Thompson 1945), that ceramic assemblages would be relatively similar between sites dating to contemporaneous time periods. In other words, he suggested that a single ethnic group was responsible for the two series of pottery, Marianas Redware and Marianas Plainware, recovered throughout the archipelago. The difference between these ceramic series was temporal: Redware preceded Plainware, and was later replaced by it. Chronologically, Marianas Redware is associated with the Pre-latte period, from ca. 1200–1500 B.C. until A.D. 1000–1200. Marianas Plainware occurred in both the Pre-latte period and the Latte period, but it predominates in later assemblages. Subsequent work has been conducted within this same framework, although substantive differences have emerged regarding both the timing of change from Redware to Plainware and the criteria used to distinguish among the types (Ray 1981; Reinman 1977; Takayama and Intoh 1976).

These conclusions have recently been challenged, both methodologically and substantively. First, Moore (1983) has demonstrated the polythetic (and sometimes inconsistent) nature of previous typological definitions. Because both Marianas Redware and Plainware represent intuitive and implicit classifications (in fact, these are groups not classes), the criteria that define each series (or the types within each series) have had to be reconstructed after the fact. There is considerable overlap in the criteria and the attributes that have been employed to assign a given sherd to either of the two series. Consequently, the assignment of some pieces of pottery to either of the series can sometimes be ambiguous.

Rather than produce yet another typology, Moore (1983) used an attribute-based analysis for the entire collection of pottery from Tarague Beach, on the northern coast of Guam. This site is one of the oldest known prehistoric settlements in Micronesia, with early occupation dates reaching back to at least 1000 B.C. (Athens 1986; Kurashina et al. 1981; Kurashina and Clayshulte 1983). Moore's results demonstrated considerable variation within each of the traditionally named series, as well as some overlap or sharing of attributes between the series. When variation in the pottery collection from Tarague was arranged by time—based on stratigraphic relations and matching sets of radiocarbon dates—much of the variability was continuous and incremental over the duration of the prehistoric occupation. Moore (1983) concluded that the two series were part of a single but evolving ceramic manufacturing tradition. Changes in the tradition over three millennia showed a variable yet coherent ceramic industry for the Mariana Islands.

Spoehr's inference that spatial homogeneity characterized relatively contemporaneous prehistoric pottery assemblages in the Mariana Islands has continued to structure much of the region's culture history (Graves and Moore 1990). Two factors, in addition to the historically based assumption of cultural homogeneity, bolstered this inference. First, in the Mariana Islands archaeologists tended to work on a single site, a single island, or on nearby islands in the archipelago. Even when a large-scale survey was conducted, as for instance by Spoehr (1957) or Reinman (1977), the analysis of pottery assemblages was limited to only a few sites. Consequently, archaeological research was not sufficiently sensitive to the possibility of geographic variation in pottery manufacture because of the nature of the field research undertaken in the region. Second, the process by which pottery from the Mariana Islands was grouped or classified into types or series also contributed to this orientation, since many aspects of pottery variation were subsumed by the placement of sherds into relatively few polythetic categories. Although archaeologists (e.g., Reinman 1977) were occasionally surprised by the lack of congruence between the pottery found on Guam and the pottery recovered from either Saipan or Tinian, no attempt was made to determine if there was a geographic basis for this variation. Instead, most attention was focused on refining or altering the classificatory system.

The recovery of ceramic assemblages from Saipan and Guam as a result of recent archaeological projects, combined with the application of attribute-based ceramic classification, now makes it possible to assess the question of geographic variation in Mariana Islands pottery. We begin with a discussion of the sites included in this analysis, and then draw upon the ceramics from these sites to illustrate geographical variation across certain attributes of pottery manufacture. Other sites in the Mariana Islands exhibit patterns of ceramic variability similar to those discussed here, and where relevant, we will use these assemblages to illustrate our hypothesis.

The best-documented ceramic assemblages come from late prehistoric residential occupations, often associated with *latte* remnants (*latte* are megalithic stone foundations). Typically, these assemblages are assigned to the Latte period, although it should be noted that there is some uncertainty about how this period is defined (Graves 1986). A map of the Mariana Islands (Fig. 1) shows the location of the sites for assemblages that were analyzed. In general, these assemblages date to A.D. 1000–

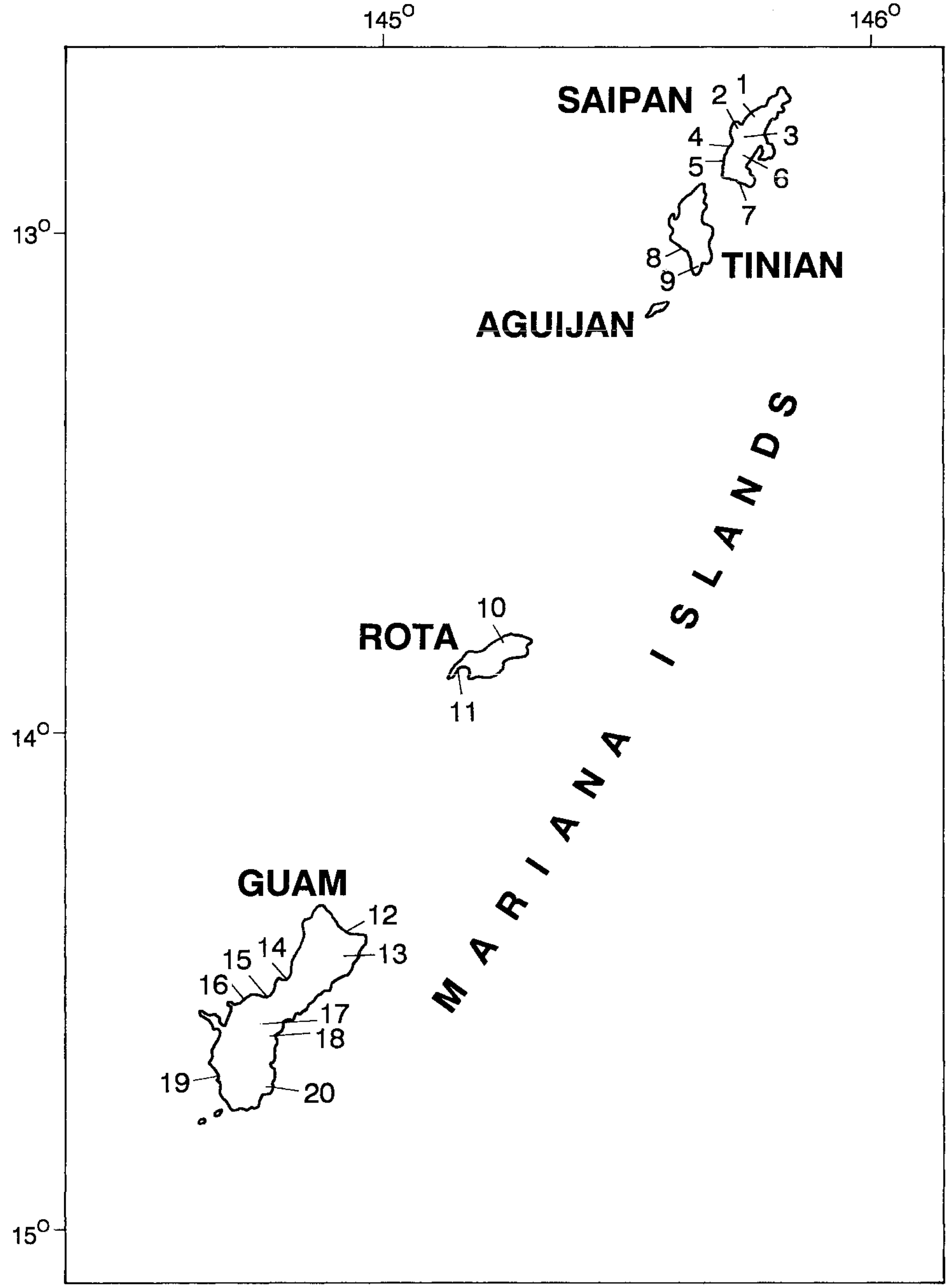

Fig. 1. Map of the Mariana Islands showing locations of major archaeological sites and clay sources. Legend: 1. Tanapag; 2. Garapan; 3. Chalan Galaide; 4. Oleai and Chalan Kija; 5. Chalan Piao; 6. LauLau Bay (including LauLau *latte* set and Bapot Rockshelter); 7. Objan; 8. Taga; 9. Tachonga (also known as the Blue Site); 10. Mochong; 11. SongSong; 12. Tarague; 13. Mt. Santa Rosa; 14. Tumon Bay (including Ypao Beach, Matapang Beach, Tumon Beach, Gongna Beach); 15. Agana Bay: 16. Asan; 17. Pulantat; 18. Ylig Bay; 19. Fouha Bay; 20. Nomna Bay.

1200 or thereafter. The ceramic assemblages associated with this time span are generally found in the upper layer of archaeological sites in the Mariana Islands, such as at Tarague Beach (Layer 1) or at Matapang Beach (Layer 1 and possibly Layer 2) in Tumon Bay. Because of the temporal trend towards coastal progradation on Guam, and presumably Saipan, *latte* components are not always underlaid by earlier occupations, such as was the case at Oleai, Tanapag (D. Thompson 1979), and Objan (Spoehr 1957) on Saipan, and near the edge of the beach at Matapang (Moore 1986) on Guam. Similarly, one of the sites included in this study, Chalan Galaide on Saipan (Graves and Moore 1990), is a single-component late prehistoric (or Latte period) to early historic site in an inland location. Similar sites have been recorded on Guam, at Pulantat (Reinman 1977), Chochogo (Cordy and Allen 1986), and near Fena Reservoir (L. Thompson 1932). The site at Asan on the west central coast of Guam represents perhaps the most complex depositional environment among the sites included here, with coastal progradation attributable to both marine and terrigenous sources (Graves and Moore 1986). Nonetheless, the upper near-beach deposits at Asan contain classic Latte period deposits dating to at least the fifteenth century. Many beach locations in the Mariana Islands contain deeply stratified deposits of prehistoric material remains. Perhaps the best-known site is at Tarague Beach on Guam (Athens 1986; Kurashina and Clayshulte 1983; Moore 1983), yet similar stratified deposits are known from elsewhere on Guam (Graves and Moore 1985; Leidemann 1980; Reinman 1977), Rota (Butler 1988; Takayama and Egami 1971; Takayama and Intoh 1976), Tinian (Pellet and Spoehr 1961; Spoehr 1957), and Saipan (Butler 1988; Spoehr 1957). Although most of these stratified sites contain Latte period deposits, they may also contain Pre-latte deposits of varying age and depositional integrity.

Late prehistoric or Latte period assemblages can be identified by their stratigraphic position, radiocarbon dates, and ceramic characteristics. These assemblages are widely distributed in the Mariana Islands, yet systematic inter-assemblage descriptions are largely lacking, especially for sites on different islands. Are the ceramic products contained within the Latte period deposits across the Mariana Islands relatively similar or not? We consider this question in relation to several dimensions of ceramic variability.

The distribution of inclusions or tempering materials in Latte period ceramics shows great variation, with most assemblages comprising several temper classes, such as volcanic sands, calcareous sands, mixed sands, or no temper. Thus far, there is little geographic consistency with respect to the kinds of temper used. For instance, at Chalan Galaide the commonest temper group was a mixed volcanic and calcareous sand, while at Oleai Beach volcanic sands were commonly employed. At Tarague Beach, calcareous sand inclusions were commonest in the upper (Latte period) deposit of the site. Untempered pottery was the most abundant group at Matapang Beach in Tumon Bay. Some of this variability may be due to differences in the manner in which different temper classes are defined or identified, although in the cases described here this seems unlikely since a single person identified the temper groups in all four cases. Nor is there much geographic variation in the diversity of temper groups employed in late prehistoric contexts in the Mariana Islands. Matapang Beach on Guam and Oleai Beach on Saipan have the most homogeneous distribution of temper classes. Perhaps the best criterion that might be used to distinguish pottery inclusions on a geographic basis would be the presence or absence

TABLE 1. PERCENTAGE DISTRIBUTION OF SURFACE TREATMENT CATEGORIES FOR 4 SITES ON GUAM AND SAIPAN

	SURFACE TREATMENT						
SITE	BURNISHED/ POLISHED	PLAIN	WIPED/ BRUSHED	COMBED/ TRAILED	IMPRESSED/ INCISED	LIME PLASTER	N
Chalan Galaide, Saipan	3.3	94.3	0.5	—	0.5	1.4	211
Oleai, Saipan	2.2	94.1	0.3	1.2	0.6	1.4	1,297
Matapang, Guam[a]	0.2	23.5	69.1	6.8	0.4	0.0	796
Matapang, Guam[a]	0.0	18.9	51.2	29.0	0.0	0.4	248
Tarague	6.8	44.1	44.4	1.0	0.6	2.2	3,437

Note: All assemblages assigned to Latte period.
[a] Matapang assemblages were derived from two separate deposits. The first comes from the edge of the beach; the second was in direct association with a *latte* set located in the inner beach.

of quartz sand or crystals. These inclusions occur in the well-documented Latte period assemblages from Oleai Beach (Moore 1989), Chalan Galaide (Graves and Moore 1986), and LauLau Bay (Kennaston 1988) in Saipan in proportions of between 10 percent and 20 percent of the total collection. They have not been observed in assemblages from Guam thus far. The occurrence of these distinctive light-colored mineral (as opposed to calcareous) sands on Saipan may indicate geographically restricted rock units. Quartzose sandstones have been identified in the Denysinyama bedrock formations on Saipan (Cloud et al. 1956), and these or similar materials may have been incorporated into clay deposits or pastes used to make pottery on the island.

A variety of exterior surface treatments have been recognized on late prehistoric pottery in the Mariana Islands; these can be separated into six attributes (Table 1) ranging from burnished or polished surfaces to various forms of combing, incising, or plastering. The distribution of the different attributes of exterior surface treatment shows considerable and consistent geographic variation across the Mariana Islands. The two assemblages from Saipan included in Table 1 contained over 90 percent unmodified and scraped (here labeled as plain) exterior surfaces. Assemblages from Guam exhibit a more heterogeneous array of surface treatments, with wiped or brushed surfaces making up the dominant category. This finding is consistent with Spoehr's (1957:108–120) description of Marianas Plain, Marianas Cord-marked, and Marianas Trailed Pottery. Marianas Plain, which is equivalent to the plain category in Table 1, was the predominant type of pottery recovered from the late prehistoric deposits at Objan, LauLau, and Oleai on Saipan, and the sites of Tachonga (of Blue I) and Taga on Tinian. None of these sites has appreciable quantities of the other forms of surface treatment. Thus, late prehistoric ceramic production on Saipan and Tinian appears to have placed little emphasis on finishing exterior

TABLE 2. MEAN VESSEL WALL THICKNESS FOR BODY SHERDS FROM 5 SITES ON GUAM AND SAIPAN

SITE	MEAN VESSEL WALL THICKNESS
Chalan Galaide, Saipan	9.3–11.5 mm
Oleai, Saipan	12.7–13.2 mm
Matapang, Guam	8.7–8.9 mm
Tarague, Guam	8.2–9.5 mm
Asan, Guam	7.6–9.1 mm

Note: All assemblages assigned to the Latte period.

surfaces of vessels beyond smoothing and scraping. On Guam, and perhaps Rota (see Sant and Lebetski 1988:249), alternative forms of surface finish are represented in greater proportions than on Saipan and Tinian. In particular, the ceramic assemblage from Matapang on Guam contained between 50 percent and 70 percent wiped or brushed surface treatment. Not only are different forms of exterior surface treatment emphasized on Guam, the assemblages are more heterogeneous across the array of exterior surface treatment attributes. This increase in heterogeneity is unrelated to sample size effects. Latte period ceramics from the Mariana Islands are thus differentiated by exterior surface treatment into at least two geographical groups: a northern variety and a southern variety. It is also possible that within Guam there is additional geographic variation in the relative frequency of wiped or brushed surface treatments as indicated by the respective proportions of this attribute within the assemblages from Matapang and Tarague.

Beginning with Spoehr (1957), archaeologists have suggested that prehistoric ceramics in the Mariana Islands were chronologically distinguished by the thickness of body sherds. The direction of change—whether body sherd thickness increased or decreased—has been the subject of some dispute (see Moore 1983). An analysis of late prehistoric ceramic assemblages from Saipan and Guam suggests why this should be so (Table 2). Mean body sherd thickness is significantly greater in the assemblages from Saipan than in the collections from Guam. Again, this conclusion is consistent with previous research. In Spoehr's (1957:110–111) original description of Marianas Plainware collected from sites on Saipan and Tinian, he noted a "relatively large number of sherds measuring more than 12 mm. in thickness." No average thickness values are provided, and his collection of Marianas Plainware includes some sherds from Pre-latte contexts. Nonetheless, the thickness of body sherds on Marianas Plainware from Saipan and Tinian is similar to the better documented Latte period assemblages from Saipan. On Guam, Reinman (1977:74) provided mean thickness values from five sites. Again, some of these sites contain Pre-latte components. Nonetheless, the mean values for all sites are between 7.50 and 8.50 mm, and this is comparable to the values recorded from Latte period contexts at Matapang, Tarague, and Asan on Guam. Interestingly, mean thickness values on body sherds of between 7 and 9 mm are reported from late prehistoric contexts on Rota (Sant and Lebetski 1988:232–233), making these assemblages more similar to Guam than to the Saipan or Tinian collections.

One of the hallmarks of the change from the Pre-latte to Latte period in the Mariana Islands is a shift from relatively narrow or unthickened vessel rims to rims

TABLE 3. PERCENTAGE DISTRIBUTION OF RIM CATEGORIES FOR 9 SITES ON SAIPAN AND TINIAN

	RIM FORM		
SITE	UNTHICKENED	THICKENED	N
Chalan Kija, Saipan	67	33	605
Tanapag, Saipan	58	42	255
Oleai, Saipan	39	61	89
Objan, Saipan	39	61	359
Chalan Galaide, Saipan	36	64	14
LauLau, Saipan	22	78	153
Tarague, Guam	29	71	85
Asan, Guam	4	96	26
Matapang, Guam	2	98	208

Note: All assemblages assigned to the Latte period.

that are thicker than their associated vessel walls (Spoehr 1957:124–126). Again, Moore (1983) has documented this change in rim form at the well-stratified site of Tarague on Guam. Thickened rims predominate in the very latest stratigraphic levels of the site, and this is generally the case throughout the Mariana Islands, including Saipan and Tinian. However, the extent to which thickened rims predominate in Latte period deposits does show some variability (Table 3). On Guam, thickened rims occur in proportions in excess of 70 percent within the upper occupational levels at virtually all sites. This finding is substantiated by two of the Latte period sites studied by Reinman (1977:75), and several sites on Rota (Sant and Lebestski 1988:251). In contrast, late prehistoric sites on Saipan are characterized by a greater proportion of unthickened rims, and in the case of both Chalan Kija (Spoehr 1957:125) and Tanapag (D. Thompson 1977), this type of rim form predominates in the assemblage. Rim form data for Tinian are more ambiguous. The upper stratigraphic levels at the Taga site (Spoehr 1957:126) contained over 50 percent unthickened rims, yet at Tachogna (the Blue Site), approximately 80 percent of the rims were thickened (Spoehr 1957:125). The geographical patterning is relatively robust, with several sites on Saipan and Guam exhibiting strong differentiation in the proportion of thickened to unthickened rim forms within late prehistoric assemblages. Sites on Rota, northern Guam, and a few sites on Tinian and Saipan fall between these extremes.

Within the class of thickened rims, there is additional geographic variation when measured by the ratio of the maximum thickness of the rim to the thickness of body sherds (Table 4). At Oleai and Chalan Galaide on Saipan this ratio varies between 0.65 and 0.80, and on Guam, between 0.20 and 0.50. The larger the ratio, the less difference there is between the thickness of the rim and the thickness of the vessel wall. On Saipan, thickened rims are associated with relatively thick vessel walls. On Guam, the rims of vessels are much thicker, often two or three times the thickness of vessel walls. In a number of cases, rim thickness on Latte period ceramics from Guam is in excess of 25–30 mm. Such elaborately thickened rims are rare on Saipan and Tinian. Again, there are few data available for Rota. However, excavations at Songsong (Sant and Lebetski 1988:197) on Rota produced Latte period assemblages with mean rim-to-body thickness ratios of between 0.50 and 0.65.

TABLE 4. RATIO OF VESSEL WALL THICKNESS FOR MAXIMUM RIM THICKNESS FOR 4 SITES ON GUAM AND SAIPAN

SITE	RANGE OF RATIO
Oleai, Saipan	0.64–0.78
Chalan Galaide, Saipan	0.76–0.80
Asan, Guam	0.49–0.50
Matapang, Guam	0.20–0.30

Note: Only thickened rims are represented from Latte period assemblages.

Another characteristic that distinguishes late prehistoric pottery production on Saipan from the production of ceramics on Guam is a greater frequency of decorations (incisions, thumb or finger impressions) on the unthickened rims of vessels from Saipan. This form of decoration is uncommon or absent on Latte period pottery from Guam.

A variety of dimensions, thus, distinguishes Latte period pottery manufacture based on geographic location. In the north, quartz sand inclusions are occasionally found in the paste of sherds. This kind of sand does not occur in pottery from Guam. The preparation and elaboration of the exterior vessels is more homogeneous in ceramic assemblages from Saipan and Tinian, compared to those from Guam. Most body sherds from Saipan show minimal surface treatment, beyond simple smoothing and scraping of the exterior. Accompanying this, pottery assemblages from Saipan and Tinian are characterized by thicker walled vessels, especially when compared to the maximum thickness of vessel rims. Body sherds from Guam and Rota exhibit smaller mean thicknesses and are associated with relatively thick vessel rims. Rim forms are more homogeneous on Guam during the late prehistoric period, with the vast majority of rims consisting of thickened and incurved edges. Unthickened rims persist on Saipan and Tinian during the same time, and they are occasionally associated with various forms of decoration.

Does earlier—that is, Pre-latte—pottery exhibit similar patterns of regional variation in the Mariana Islands? A definitive answer to this question is not yet possible, although we summarize here the results of previous research. First, however, an important analytical problem must be acknowledged. The Pre-latte period in the Mariana Islands spans at least two thousand years, from approximately 1000 B.C. (and possibly as much as five hundred years earlier) to A.D. 1000 (and likely two to three hundred years later). The Latte period, in contrast, spans only about five to six hundred years. Thus, there is considerably greater potential for temporal variation within Pre-latte ceramic assemblages. Moreover, attempts to compare Pre-latte assemblages are hampered by difficulties in establishing relative contemporaneity between collections. And finally, compared to Latte ceramic assemblages, the number of Pre-latte sherds from most sites is small, and most are small in size as well. Given these analytical problems, the evidence we marshal to indicate geographical variability in Pre-latte pottery production will be necessarily anecdotal.

That Pre-latte pottery from the Mariana Islands does *not* show geographical patterning comparable to that described for Latte pottery is best indicated by the relative ease with which archaeologists have identified this kind of pottery at sites on Guam, Rota, Tinian, and Saipan. In other words, Pre-latte pottery—especially its earliest forms dating between 1200 B.C. and 100 B.C.—represents a relatively homogeneous collection regardless of its collection locale in the region. Substantial proportions of Pre-latte pottery are tempered with or have inclusions of calcareous beach sands. Spoehr (1957:117–120) identified calcareous sands temper in Marianas Redware and Lime-Filled Impressed Tradeware from Pre-latte components at LauLau Rockshelter and Chalan Piao on Saipan. Similar observations have been made on Guam by Reinman (1977), Moore (1983), and Graves and Moore (1985, 1986) and on Rota by Takayama and Intoh (1976). Spoehr (1957:118) defined Marianas Redware by the presence of a reddish slip applied to the exterior surface. Although sherds conforming to this definition occur in virtually all Pre-latte assemblages from throughout the Mariana Islands, not all Pre-latte vessels were slipped. However, most sherds are either well polished or burnished on their exterior surface. Again, this characteristic has wide geographic distribution in the Mariana Islands.

Virtually all of the published Pre-latte assemblages contain a wide array of vessel forms, including small jars with everted or constricted rims, and shallow bowls of various sizes, some with carinated shoulders. The vast majority of these vessels have unthickened or narrow rims. Average measures of wall thickness for body sherds range from 6 to 12 mm for Pre-latte pottery from Tarague (Moore 1983:92), and this most likely reflects the wide array of vessel sizes that were produced throughout this time period.

Most sites that have produced assemblages of Marianas Redware (or its unslipped but well-polished or burnished variety) have also produced pieces of what Spoehr labeled Lime-Filled Impressed Trade Ware. Sites from which this kind of pottery has been recovered include: Chalan Piao, LauLau Cave, and Bapot Cave on Saipan; Tachonga on Tinian; Mochong on Rota; and Tarague, Tumon Bay, Asan, Nomna Bay, and Ypao Beach on Guam. There are no indications that the distribution of this form of pottery is weighted geographically in the Mariana Islands. The number of pieces of this distinctive form of pottery represented in Pre-latte assemblages is usually a function of total sample size or the area of the site excavated.

Compared with the late prehistoric pottery assemblages from the Mariana Islands, earlier assemblages do not yet provide any evidence of differential geographic distribution. A relatively diverse set of vessels is found at most Pre-latte sites in the Mariana Islands. Thus, Pre-latte occupations are relatively similar in terms of the kinds of vessel forms and sizes represented. There is no indication that some vessel forms are found in greater proportion on Saipan and Tinian than on Guam or Rota. Within each Pre-latte assemblage, characteristics of temper, surface treatment and finish, and rim form show substantial homogeneity, and there is relatively high inter-site similarity between assemblages on different islands. Unfortunately, we cannot yet quantify this proposition in a manner comparable to Latte period ceramic assemblages.

Chronologically, then, an early prehistoric ceramic production tradition in the Mariana Islands was altered into at least two regional subtraditions, one based on Saipan and Tinian, the other situated on Guam and possibly Rota. The timing of this geographic divergence in pottery making occurred at least by A.D. 1000, and it may well have begun earlier.

COMPOSITIONAL ANALYSES OF POTTERY FROM THE MARIANA ISLANDS

Analyses of macroscopic ceramic attributes (e.g., surface treatment) provide important evidence regarding the geographic distribution of various pottery characteristics at the time these vessels or sherds were incorporated into archaeological deposits. Unfortunately, these kinds of analyses have only limited or indirect efficacy in determining if Marianas pottery was transported through exchange from one settlement to another or if characteristics were diffused between settlements and islands through the process of interaction. Fortunately, compositional analysis of ceramics can provide more direct information relative to the question of pottery exchange.

A sample of 34 sherds from a variety of sites on Saipan, Guam, and Aguijan and 2 clay sources (Table 5) were selected for compositional analyses using a two-step strategy (Hunt 1989:119): (1) sherds were identified by type (Latte, Pre-latte), and (2) they were then subjected to elemental microanalysis of the clay portion of the paste using an energy-dispersive spectrometer (EDS) integrated with a scanning electron microscope (SEM). This form of compositional analysis was first used in Oceania by Anson (1983) to study Lapita pottery from the Bismarck Archipelago. Hunt (1989) has extended such analyses to the well-documented assemblages from the Mussau Islands (Kirch 1987, 1988). The compositional analyses of elemental concentrations reported here were conducted by Hunt at the University of Washington.

The combined use of the SEM and EDS makes it possible not only to pinpoint and view very small portions of the clay matrix within any given sherd, but also to detect X rays emitted from the clay. These X rays, in turn, reflect the relative abundance of different elements that make up the clay. X-ray emissions are converted to quantitative elemental data by the standard ZAF correction method carried out on a microcomputer integrated with the SEM and EDS (see Goldstein et al. 1981:275–392). The resulting values represent quantities of elements (by elemental weight percent) present in the sample, and these values are assessed against a theoretically derived standard by means of a chi-square test (Goldstein et al. 1981:411–412; see also Hunt 1989 for specific analytical protocols).

Sherds selected for compositional analysis were impregnated under vacuum conditions with ordinary casting resin. The small round blocks of hardened resin containing the sherds were cut into thick sections (ca. 5 mm) with a diamond wafering blade. The surface to be mounted for analysis was polished using increasingly fine wet silicon carbide cloth, stopping at 600 grit size (12.5–17 microns). Specimens were washed with distilled water and wiped with alcohol following preparation (Pye and Krinsley 1984). The relatively small effort invested in attempting to achieve a microscopically flat surface was compensated for by tests of rotation to check for bias resulting from topography (McHardy and Birnie 1987:198; Hunt 1989).

The thick sections were mounted on aluminum SEM stubs with double-sided cellophane tape. Contact between the stub and the specimen was enhanced with the application of colloidal graphite around the specimen's edges. The mounted thick sections were left uncoated so as not to complicate compositional analyses. The specimens were sufficiently conductive (i.e., charging was minimal) to allow normal

TABLE 5. List of Pottery Samples Used in Compositional Analysis

SPECIMEN NUMBER	PROVENIENCE	SITE	LOCATION	ISLAND	POTTERY TYPE
1	None	None	Tumon Bay	Guam	Latte
2	None	None	Tumon Bay	Guam	Pre-latte
3	None	None	Tumon Bay	Guam	Latte
4	None	None	Tumon Bay	Guam	Latte
5	None	None	Tumon Bay	Guam	Latte
6	None	None	Tumon Bay	Guam	Pre-latte
7	None	None	Tumon Bay	Guam	Latte
8	TP 1, 110–115 cm	Bapot Rockshelter	LauLau Bay	Saipan	Pre-latte
9	TP 1, 110–115 cm	Bapot Rockshelter	LauLau Bay	Saipan	Pre-latte
10	Surface	Bapot Rockshelter	LauLau Bay	Saipan	Latte
11	Surface	Bapot Rockshelter	LauLau Bay	Saipan	Latte
12	TP 1, 70–90 cm	Bapot Rockshelter	LauLau Bay	Saipan	Pre-latte
13	TP 1, 70–90 cm	Bapot Rockshelter	LauLau Bay	Saipan	Pre-latte
14	TP 1, 20–30 cm	Bapot Rockshelter	LauLau Bay	Saipan	Latte
15	TP 1, 80–90 cm	Bapot Rockshelter	LauLau Bay	Saipan	Pre-latte
16	TP 1, 50–60 cm	Bapot Rockshelter	LauLau Bay	Saipan	Pre-latte
17	TP 1, 70–80 cm	Bapot Rockshelter	LauLau Bay	Saipan	Pre-latte
18	Row B, 114 cm	Baseball Field Tumon Beach	Tumon Bay	Guam	Pre-latte
19	Row B, 110–120 cm	Baseball Field Tumon Beach	Tumon Bay	Guam	Pre-latte
20	Surface	None	None	Aguijan	Latte
21	Surface	None	None	Aguijan	Latte
22	TP 4, 10–30 cm	Oleai Beach		Saipan	Latte
23	Surface	East Agana	Agana Bay	Guam	Latte
24	Surface	East Agana	Agana Bay	Guam	Latte
25	80–105 cm	Ylig	Ylig Bay	Guam	Latte
26	Surface	Gongna	Tumon Bay	Guam	Latte
27	Surface	Gongna	Tumon Bay	Guam	Latte
28	Surface		Mt. Santa Rosa	Guam	clay
29	None	Chalan Piao		Saipan	Pre-latte lime-impressed
30	None	Chalan Piao		Saipan	Pre-latte lime-impressed
31	None	Chalan Piao		Saipan	Pre-latte
32	None	Chalan Piao		Saipan	Pre-latte
33	T.P. 1, Layer 4b	Garapan		Saipan	Pre-latte
34	T.P. 1, Layer 4b	Garapan		Saipan	Pre-latte
35	S.T. 25, Layer 5	Pac. Isl. Club Ypao Beach	Tumon Bay	Guam	Latte
36		Garapan		Saipan	clay

scanning electron imaging as well as X-ray microanalysis (Hunt 1989; cf. McHardy and Birnie 1987:198). The reasonably stable behavior of the uncoated specimens was enhanced by the use of a relatively low accelerating voltage (10 kV, see McHardy and Birnie 1987:177).

Sherd cross-sections were viewed on the cathode-ray tube of the SEM while simultaneously undergoing X-ray analysis. Points of the sherd cross-section were isolated for analysis by a step-wise increase in the magnification, allowing careful inspection of the region for inclusions (e.g., temper grains in the fabric) or other anomalies. High magnification (ca. 5000X) was used to inspect the area of characteristic clay particle structure. Areas that were clay matrix alone were chosen for analysis, and X rays were collected with the SEM magnification at 1200X, with the area of interest in complete view. X-ray collection time was minimally 100 seconds, which proved sufficient for achieving an adequate goodness-of-fit as measured by low chi-square values (Goldstein et al. 1981:411).

Twelve elements (Na, Mg, Al, Si, P, Cl, K, Ca, Ti, Cr, Mn, and Fe) that are detectable by this technique were selected for identification. These are relatively common elements within clay, and they occur in sufficient concentrations to be quantified as a proportion of the total weight of the clay composition. Using the proportion of each of these elements for each sherd as data, a series of cluster analyses was performed on the 34 sherds and 2 clay specimens. The objective of these analyses was to determine if the sherds and clay samples could be grouped into consistent clusters, which then could be inferred to represent products of the same (or highly similar) clay sources. An additional goal was to inspect the distribution of each compositionally determined group of sherds (or clays) recovered from more than one site, locality, or island.

Two different clustering algorithms were employed: average linkage between groups, and complete linkage between groups (see Shennan 1988:212–215). These are hierarchical algorithms that use agglomerative techniques to build groups from a series of individuals (in this case, sherds). As one means to define group consistency, both algorithms were employed on the pottery and clay elemental data from the Mariana Islands. Consistency was defined by redundant clustering of sherds and clay into the same group when both algorithms were employed. In other words, compositional groups were identified when the same specimens were grouped together using both clustering algorithms (Sokal and Sneath 1963). Cluster analyses using the two algorithms were performed first on data sets including all 12 elements, and then on data sets with only 8 elements represented. The 4 elements removed from the data in the second set of analyses were Na, Cl, P, and Ca. Hunt (1989:182–184) has found that the occurrence of these elements may be a function of conditions other than the composition of the clay source. In particular, the combination Na and Cl may occur in Oceanic pottery because of saltwater contamination in beach locations. Calcium was removed because it can be leached into or out of materials in contact with groundwater. In addition, calcareous sand, used as a tempering agent in some of the Pre-latte pottery from the Mariana Islands, can undergo chemical weathering and diffuse into the surrounding sherd matrix. Phosphorus is a common residue produced on pottery that has been used for cooking or storage. It is also a constituent of the sediments at many archaeological sites. Lacking control on either of these conditions, we chose to eliminate this element from the second set of cluster analyses (see Dunnell and Hunt 1990).

In general, there was high consistency in the assignment of the sherds and clay samples to different groups by the two clustering algorithms. Similar groups were also produced when both 8 and 12 elements were employed as data sets. Table 6 shows the sherd and clay samples that were grouped consistently by the two clustering algorithms for the 8-element data set. In this analysis only three specimens (02, 17, and 33) were inconsistently allocated. Specimen 17 was placed into Group 1 by the average linkage method and into Group 3 by the complete linkage algorithm. Specimens 02 and 33 were grouped together by both methods but were marginally placed into Group 2 by the average linkage method and into Group 1 by the complete linkage algorithm. Neither specimen 15 nor 36 was placed into any of the four groups; both were consistently placed at the extreme edge of the cluster diagram, with little similarity to any of the other specimens or to each other.

The four groups represented in Table 6 show strong geographic patterning. Each of the groups is dominated by sherds (or in the case of Group 4, a clay specimen) from sites on a single island, either Guam or Saipan. Out of the 31 sherds placed into the 4 groups, only 4 (13 percent) were recovered from a different island than the majority of other sherds represented in the group. Two sherds from Aguijan Island were grouped with a series of Latte period sherds from several sites on Guam in Group 1. Morphologically, these two sherds are similar to those from Guam; the rims are extensively thickened, especially in relation to body thickness. The compositional data support the macroscopic evidence that these two sherds come from vessels manufactured on Guam. The Group 3 cluster comprises mostly sherds from the Bapot Rockshelter in LauLau Bay on Saipan, with the exception of two Latte period sherds from Guam. Group 2 consists of sherds all from several different sites on Saipan. Group 4 comprises sherds from several different sites within Tumon Bay on Guam, and these sherds are compositionally similar to a clay specimen from Mt. Santa Rosa in northeast Guam. We surmise that in the sample of sherds analyzed for the elemental composition of their paste, there are at least four clay sources represented that were used to make pottery. One of these is almost certainly from Mt. Santa Rosa clay. It is unclear if potters from Tumon Bay had direct access to Mt. Santa Rosa or if this clay source is generally distributed across the upland northern plateau of Guam. The sources of the clay for the other groups are unknown, although we infer that they are likely to be on the island where most of the sherds from each group were derived. Thus, there would have been 2 clay sources represented on Guam, and 2 on Saipan, and these sources were exploited for most of the pottery represented in the 10 sites included in the elemental analysis.

Three of the compositional groups contained pottery from both Latte and Prelatte contexts. The geographical clustering of clay sources thus had substantial time depth in the Mariana Islands, with the same or very similar clay sources being used by the same community (or group of communities) over a substantial period of time. This suggests that the organization of pottery production was geographically based at a relatively early date in the Mariana Islands, and that this form of production continued throughout the prehistoric period.

Four sherds and one specimen of clay either could not be consistently grouped or were not placed into one of the groups by the cluster analyses. The clay source from Garapan on Saipan is unlike any of the sherds from the site at Garapan or from any of the other sites on Saipan. On current evidence, it seems unlikely to have been used for pottery making. The ungrouped sherds were from sites on both Saipan and

TABLE 6. GROUPS PRODUCED BY CLUSTER ANALYSIS OF 8 ELEMENTS FOR SHERDS LISTED IN TABLE 5

AVERAGE LINKAGE ALGORITHM	GROUP	COMPLETE LINKAGE ALGORITHM	ISLAND	SITE	POTTERY TYPE
20	1	20	Aguijan	—	Latte
21	1	21	Aguijan	—	Latte
1	1	1	Guam	Tumon	Latte
3	1	3	Guam	Tumon	Latte
7	1	7	Guam	Tumon	Latte
23	1	23	Guam	Agana	Latte
25	1	25	Guam	Ylig	Latte
35	1	35	Guam	Ypao	Latte
(17)	—				
12	2	12	Saipan	LauLau	Pre-latte
31	2	31	Saipan	Chalan Piao	Pre-latte
29	2	29	Saipan	Chalan Piao	Pre-latte
32	2	32	Saipan	Chalan Piao	Pre-latte
11	2	11	Saipan	LauLau	Latte
30	2	30	Saipan	Chalan Piao	Pre-latte
9	2	9	Saipan	LauLau	Pre-latte
34	2	34	Saipan	Garapan	Pre-latte
16	2	16	Saipan	LauLau	Pre-latte
(2)	—	(2)	Guam	Tumon	Pre-latte
(33)	—	(33)	Saipan	Garapan	Pre-latte
8	3	8	Saipan	LauLau	Pre-latte
14	3	14	Saipan	LauLau	Latte
10	3	10	Saipan	LauLau	Latte
24	3	24	Guam	Agana	Latte
13	3	13	Saipan	LauLau	Pre-latte
4	3	4	Guam	Tumon	Latte
22	3	22	Saipan	Oleai	Latte
	—	17	Saipan	LauLau	Pre-latte
5	4	5	Guam	Tumon	Latte
28	4	28	Guam	Mt. S. Rosa	clay
6	4	6	Guam	Tumon	Pre-latte
26	4	26	Guam	Gongna	Latte
18	4	18	Guam	Tumon	Pre-latte
27	4	27	Guam	Gongna	Latte
19	4	19	Guam	Tumon	Pre-latte
(15)	—		Saipan	LauLau	Pre-latte
(36)	—		Saipan	Garapan	clay

Guam, but all are classified as Pre-latte materials. No Latte period ceramics were ungrouped by the cluster analyses. If sampling error is not a factor here, this suggests that early prehistoric pottery production in the Mariana Islands involved a greater array of clays than late prehistoric pottery production. Such experimentation with a variety of clays might be expected among founder populations. It may also indicate that pottery manufacture was more widespread at a number of settlements during the Pre-latte period.

In only two cases do we have a good sample size of compositionally characterized sherds from a site or set of geographically related sites. The first of these is the Bapot Rockshelter site in LauLau Bay on the southeast coast of Saipan. The sherds all come from a single test excavation within the rockshelter. One of the clusters, Group 3, comprises sherds recovered largely from the Bapot Rockshelter. Two sherds from Guam and one from Oleai Beach on Saipan also fall into this group. Morphologically, the sherds from Guam that fall into Group 3 are similar to Latte period pottery from Saipan. Rims are relatively unthickened, the ratio of rim to wall thickness is approximately 0.5, and there are quartz sand inclusions in the fabric of the paste. The second compositional group that contains sherds from Bapot Rockshelter is Group 2. This group also includes sherds from Garapan and Chalan Piao on Saipan. Although it is difficult to identify the settlements associated with the production of pottery from this group, it seems unlikely that pottery was made at all three of these settlements from a single clay source. All of the Chalan Piao sherds fall into Group 2, and it is possible that this settlement is the source for the production of this group, especially during the Pre-latte period. There is thus some indication for both intra-island and inter-island exchange of pottery involving the settlement at Bapot in LauLau Bay on Saipan. Interestingly, evidence for inter-island exchange is available only for the Latte period ceramics from Bapot Rockshelter.

Pottery is also represented from a series of prehistoric settlements in Tumon Bay on Guam. These include materials from Ypao Beach, Tumon Beach, and Gongna Beach. At the time of Spanish contact, each of these beaches was associated with a distinct settlement (Graves 1990*b*; Graves and Moore 1985). Sherds from Tumon were assigned to two groups. As mentioned above, Group 4 consists of sherds from Tumon Bay (specifically, Gongna Beach, Tumon Beach, and possibly Ypao Beach) and a clay sample from Mt. Santa Rosa. No other sites outside of Tumon Bay were placed into this group. Group 1 includes sherds from Ypao Beach and possibly Tumon Beach. Two sherds from Aguijan Island were also placed into this group, as well as sherds from Ylig Bay and East Agana. The sherds from Aguijan are almost certainly the result of exchange. Because both Agana Bay and Tumon Bay are contiguous to each other on the west coast of Guam, the use of a single clay source by settlements in each locality seems possible. However, the sherd from Ylig Bay on the east coast of Guam that has been placed in this group is likely to represent the outcome of pottery exchange from a settlement on the west coast. Again, there is evidence of inter-island and intra-island exchange of pottery, with the best documentation for inter-island exchange during the Latte period.

The cluster analyses of sherd elemental data from the Mariana Islands support the earlier inferences based on morphological characteristics about geographical clustering of ceramic production in the Mariana Islands. In the sample of pottery from the Mariana Islands included for elemental characterization, there are at least two clay sources represented for both Guam and Saipan. One of the groups can be associated with a known clay source; the other groups can be tentatively assigned geographic localities where either the clays occur or the pottery was produced. There are probably other clays represented, as indicated by the sherds that could not be placed into the four groups. Out of the 30 sherds placed into 1 of the 4 groups, at least 10 (or 33 percent) are likely to represent the products of exchange. Most of these exotic sherds are assigned to the Latte period, and our best evidence for inter-island exchange comes from this period, as well.

INTEGRATING COMPOSITIONAL AND MACROSCOPIC CERAMIC EVIDENCE

The compositional and macroscopic analyses of pottery from the Mariana Islands have each produced distinctive kinds of information relative to the question of variation in prehistoric ceramic production over time. It would be unrealistic to expect these analyses to be completely congruent since they monitor somewhat different phenomena. The macroscopic analyses provide information on the manufacture of pottery, including the following processes: (1) preparing clay for manipulation, (2) shaping the vessel, and (3) finishing the rim and the exterior surface before firing. Data pertaining to the shape of vessels and their surface finish in different pottery assemblages may be used to infer aspects of interaction (e.g., rate and degree) between settlements. Compositional data, on the other hand, can indicate the number and, in some cases, the source areas of clays used in the production of particular pieces of pottery. In addition, it is possible to infer the exchange of pottery (or less likely, clays) when pottery assigned to a known clay source is found at a distant location. Less reliable but still useful is the inference of exchange of pottery when, in a group of ceramics with similar compositional characteristics, there are pieces from a variety of distant settlements.

The macroscopic analyses of Latte period pottery from the Mariana Islands suggested a strong distinction between the pottery recovered from sites on Guam and the pottery found on Saipan and Tinian. We have argued that this geographic pattern is a result of differences in the production of pottery, which separates communities on Saipan and Tinian from those on Guam, and possibly Rota. Geographic variation in the production of pottery during the Pre-latte period has not yet been detected, and the available evidence suggests that there are relatively few typological differences between Pre-latte pottery assemblages found on Guam, Tinian, Rota, or Saipan, especially when the duration of this period is taken into account.

The compositional analyses support the inference of geographically localized production of pottery during the late prehistoric period. Four groups were identified, two on Saipan and two on Guam. These groups were probably further localized by district or settlement on these islands. This suggests that local clay sources were exploited by potters from a given settlement or set of linked settlements. The production of pottery (i.e., shaping and finishing the vessel) varied geographically, but our best evidence is for variation at the scale of entire islands (e.g., Guam) or closely spaced islands (e.g., Saipan and Tinian). There is a production boundary that, at minimum, separates Saipan and Tinian from Guam, and possibly Rota. The presence of this boundary suggests that interaction between potters or the diffusion of pottery-making techniques was somehow limited during the Latte period.

The compositional analyses also suggest that the exploitation of local clay sources began during the early prehistoric period. However, Pre-latte sherds were more likely not to be assigned to one of the four groups than Latte sherds. Thus, in contrast to the Latte pottery sherds, we do not appear to have identified all of the clay sources for the Pre-latte pottery. One hypothesis consistent with this inference is that Pre-latte pottery was more widely produced from a greater variety of clays than Latte pottery. Also, in contrast to Latte pottery there is no good indicator of geographic variation in Pre-latte pottery. It is not entirely clear if this is due to the nature of the samples that have been recovered so far or if such clear-cut variation is nonexistent during this period. If the latter, then this would imply relatively high interaction and exchange of ideas regarding the production of pottery across a variety of settlements where potters drew upon a number of clay sources.

Evidence pertaining to the physical movement of pottery from one settlement to another was derived from the compositional analyses. Again, we must be careful about the reliability of the sample of sherds submitted for compositional analyses. Nonetheless, several points emerge from our analyses. First, the exchange of pottery does characterize both early and late prehistoric pottery groups. The proportion of the sample that was inferred to represent the outcome of exchange, either inter-island or inter-settlement, on a single island, was relatively high, about 30 percent. Second, in the sample represented here, Latte pottery was more often exchanged between islands than was Pre-latte pottery, although additional analyses are necessary to confirm these observations. If correct, this suggests that early prehistoric pottery was made in a number of settlements out of a variety of clays, some of which continued to be used throughout the prehistoric period. High interaction between potters maintained geographic homogeneity in the production of pottery, even between islands. Exchange of Pre-latte pottery was localized, between settlements on the same island or nearby islands. During the Latte period, exploitation of clays continued to be localized, and variation in the production of pottery depended on location. Traditionally, this would imply less interaction between potters, yet this is anomalous in light of the relatively high rate of inter-island exchange represented. Communities were in contact, but they were also producing more distinctive forms of pottery. We hypothesize that the nature of ceramic changes in surface treatment and morphology, leading to the late prehistoric geographical divergence noted above, was not simply due to isochrestic (Sackett 1982) stylistic variation. Rather these changes produced quite visible alterations to the ceramic assemblages in the settlements of Guam, and these alterations were distinguishable from comparable assemblages on Saipan and Tinian. In other words, the late prehistoric divergence in pottery production that we have documented for the Mariana Islands may be the outcome of conscious efforts to produce and maintain geographically based social distinctions.

EXPLAINING CHANGE AND DIVERGENCE IN THE MARIANA ISLANDS

Traditionally, archaeologists have explained change in the Mariana Islands as the result of population replacement or migration (L. Thompson 1932; Ray 1981) or the consequence of development change (Spoehr 1957). Both interpretations, of course, are tied to a typological metaphysic that equated pottery types or series with ethnic or social groups. For those who held the first of these views, the replacement of Marianas Redware by Marianas Plainware was the material replica of the replacement of one social group by a more dominant one during the later prehistory of the islands. Spoehr's interpretation, while more sophisticated in some respects, saw pottery variation only in temporal terms. The cases for change are rarely invoked, except to allude to developmental or historic diffusionary processes. Our analyses of pottery and other forms of material culture now make either scenario very unlikely.

If, instead, we adopt a materialistic perspective, we may ask, under what conditions is it advantageous for individuals to interact widely with others, either through the exchange of resources or the transfer of information? And then, what are the conditions under which it would no longer be advantageous to continue any one of these forms of interaction? Our analyses of pottery variation can thus become explicable, both over time and across the region.

When population size is small and populations are widely dispersed, or both, the chance of extinction is relatively high (Cashdan 1985). This can occur through a variety of random, accidental, or catastrophic events, including reproductive outcomes, loss of food reserves, boating or voyaging accidents, or severe storms. By maintaining widespread contacts, such vulnerable populations are more likely to survive during periods of stress or resource depletion. The dispersal of the population throughout the major islands of the Mariana archipelago is also advantageous in a region that receives major storm damage on the average of once every five years. The transfer of information involved in the production of pottery in the early prehistoric period of the Mariana Islands can be viewed within the context of low population density among colonizing inhabitants. It thus accounts for the similarity across the region in the production of pottery, despite the distances between some of the islands. Rates of interaction were high, within the context of only moderate exchange of pottery.

It is not until the late prehistoric period, however, that we begin to detect significantly different social conditions. With larger and contiguous settlement areas, with increased population size, and with the occupation of more environmental zones on individual islands, including inland valleys and elevated limestone terraces, the context for maintaining interaction had changed. Rather than looking to communities on other islands in the archipelago, people could find support within a larger community or between socially linked settlements. This, of course, is consistent with the diversification of the pottery tradition between Guam and the islands of Saipan and Tinian. With reduced inter-island interaction and exchange of personnel between communities on the different islands, pottery-making techniques would have varied in response to stochastic or historical processes of change. Innovation would not have been carried as frequently from Guam to Saipan, or in the opposite direction. Yet, this was not all.

Increased population density throughout the Mariana Islands during the late prehistoric period is associated with the occurrence of megalithic house foundations, known locally as *latte*. These features, varying in size and height, are manifestations of the institutionalization of hierarchical social relations within kin-based corporate groups (Graves 1986). From their initial appearance about A.D. 1200, the construction of megalithic foundations spread rapidly throughout the island, and these structures are found in virtually all prehistoric communities. Recent analyses of their social context (Graves 1986, 1990*b*) suggest that these structures were residential features for high-ranking members of various kin-based social groups. As such, they were very likely the physical manifestations of estates, conceptualized here as the living areas and productive resources controlled by each group.

Hierarchical social organization and exclusive rights to resources require mechanisms for determining the affiliation of different members of the community. The subregional divergence of pottery making, based on fairly visible aspects of vessel morphology and surface treatment, is consonant with social (and possibly political) mechanisms for demonstrating one's kin-group affiliation and identification. This is not an argument for creating social boundaries with material objects (e.g., Plog 1980), although these may have existed. It simply recognizes that with increasing social complexity, members of a community are under greater pressure to demonstrate their respective (and sometimes overlapping) social affiliations. It is this condition that we believe will account for the appearance of geographical variation in pottery production during the late prehistoric period, and which distinguishes it from an earlier period of relative similarity in pottery-making techniques across the Mariana Islands.

That the exchange of pottery also characterizes the late prehistoric period may at first appear to be inexplicable, given the evidence for geographical variation in pottery production. Exchange of commodities, however, can coexist with geographic differentiation (see Graves 1990*a*). Among the Kalinga of the Philippines, pottery produced for exchange provides an alternative means to gain access to resources among certain households whose land holdings are insufficient in relation to total food consumption. For the Kalinga, this pattern of pottery exchange is linked to relatively high population density, and the organization of communities into endogamous regions. Materially, the pottery produced in each region is unambiguously distinctive in terms of decorative attributes placed on the exterior of each vessel. Exchange is, therefore, a weak form of specialization that can be maintained in areas where there is increasing competition for resources and additional pressure to identify with one's social group. We hypothesize that these conditions prevailed during the late prehistoric period in the Mariana Islands.

This analysis of pottery manufacture throughout the Mariana Islands has identified both temporal and spatial variability. This variability, in turn, has been linked with variable environmental conditions under which prehistoric Chamorro populations first colonized and then established themselves on these islands. The pattern of dispersed settlements and relatively similar pottery-making practices during the early prehistory of the region can be explained as the outcome of individual decisions to minimize the potential impact of environmental variability. While rates of interaction were relatively high, there is only limited evidence for extensive pottery exchange. This, of course, is in marked contrast to the pattern that has been identified for early Lapita ceramic assemblages (Hunt 1989), where exchange of pottery in some cases was widespread. For the Mariana Islands, the late prehistoric period combines evidence of geographic differentiation (as expressed through different vessel morphologies and surface treatments) and integration (as indicated by the exchange of Latte pottery between sites and different islands). The context for the production of pottery had changed by this time to include relatively high population density, numerous aggregated settlements, and hierarchically organized social groups. These are conditions that tend to be associated with heightened competition between and within settlements. Georaphically distinctive forms of pottery are consistent with such competition. The exchange of pottery might be seen as the outcome of competition within social units over access to resources (in a manner comparable to the Kalinga), or alternatively, exchange might have been employed as a mechanism for creating alliances between social units in competition with other groups.

Methodologically, combining compositional and traditional approaches to pottery analysis in the Mariana Islands should produce more useful descriptions of assemblage variability. As we have attempted to demonstrate here, there is considerably more spatial variability than has heretofore been recognized in the Mariana Islands. More important, the explanation of spatial and temporal variability cannot be accommodated by traditional frameworks, which emphasized typological and inter-assemblage homogeneity, localized production and distribution, and stylistic change. We have suggested tentative hypotheses regarding the production of pottery under varying social and natural environmental conditions at different times in the Mariana Islands. In so doing, we have moved the study of pottery from its traditional focus of typology to the systemic role pottery making played in articulating prehistoric Chamorro populations with one another and to their island environment.

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