CULTURAL ADAPTATIONS AND LATE HOLOCENE SEA LEVEL CHANGE IN THE MARIANAS: RECENT EXCAVATIONS AT CHALAN PIAO, SAIPAN, MICRONESIA

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ABSTRACT

Recent salvage excavations at Chalan Piao, Saipan (a Pre-Latte site) are reported. Chalan Piao was one of the earliest settlements in the Marianas, first occupied c.1731-1226 BC. The physical setting then was a shallow marine embayment with sand bars upon which people were encamped. The area eventually became a sandy beach with a brackish marsh behind it and the Pre-Latte deposits were buried by more recent prehistoric deposits of the Latte Phase. A wide range of artifacts (redware pottery, Conus *shell beads and other ornaments/valuables and stone tools) was retrieved from the Pre-Latte layer. From the lower to upper parts of this layer the ceramic decorations and vessel forms become simpler; shell ornaments/valuables (rings, circlets, bracelets) decline in frequency and beads decline in average size. These changes may reflect directional social processes related to environmental changes enabling larger populations to live in the islands; specifically, an increase in strand areas useful for planting and collecting. Marine shell evidence of inshore habitat change, related to seaward progradation, from Chalan Piao and other sites in southwestern Saipan during the prehistoric period is presented.*

INTRODUCTION

In the early months of 1989, commercial sand mining was about to destroy the Chalan Piao archaeological site on Saipan's west coast (Figs 1, 2), where Spoehr (1957) had found statistically useful quantities of pottery to first define Marianas Red Ware, a hallmark of the Pre-Latte Phase of the Marianas prehistoric occupational sequence. Although containing some of the earliest cultural deposits in the Marianas, Chalan Piao saw little additional research until our salvage excavations. For two weeks in June 1989, Micronesian Archaeological Research Services (MARS) excavated 4.5 cubic metres within the remnant deposits, retrieving a diverse assemblage of marine food shells, pottery, lithics and shell artifacts, mainly beads (Moore *et al.* 1992). The intact Pre-Latte layer, Layer II, began approximately 21 cm below the disturbed surface, beneath a layer which we termed Layer I, which contained a mixture of Pre-Latte and Latte Phase materials. Layer II extends at least to the base of the five excavation units at c.100 cm. At this depth, the sand was so concreted that cultural materials could not be removed without severe breakage and time had run out.

All the artifacts from Layer II, which was divided into upper and lower segments at 61cm below surface, are referable to the Pre-Latte Phase, now understood to span the period c.3500 to 2000 BP.[1] No intact features were found in Layer II. However, dispersed charcoal occurred in both upper (IIa) and lower (IIb) segments, which proved adequate for two radiocarbon dates. The sample from Layer IIb (61-100 cm) yielded a calendar date range of 1731-1226 BC and the sample from Layer IIa (31-61 cm) dated to 1396-865 BC (Table 1). These dates are composites and thus do not bracket the upper and lower limits of the excavated portion of Layer II. Nonetheless, they provide independent evidence that the deposits are likely to be as old as the original radiocarbon date[2] obtained by Spoehr for the site, 1527±200 BC (Libby 1952; Spoehr 1957).

We calibrated the charcoal dates using the Calib program (Rev. 3.0) of Stuiver and Reimer (1993) and found that they are consistent with the stratigraphic sequence at Chalan Piao (Table 1). The new dates indicate that the site was occupied from the mid-2nd millennium BC to

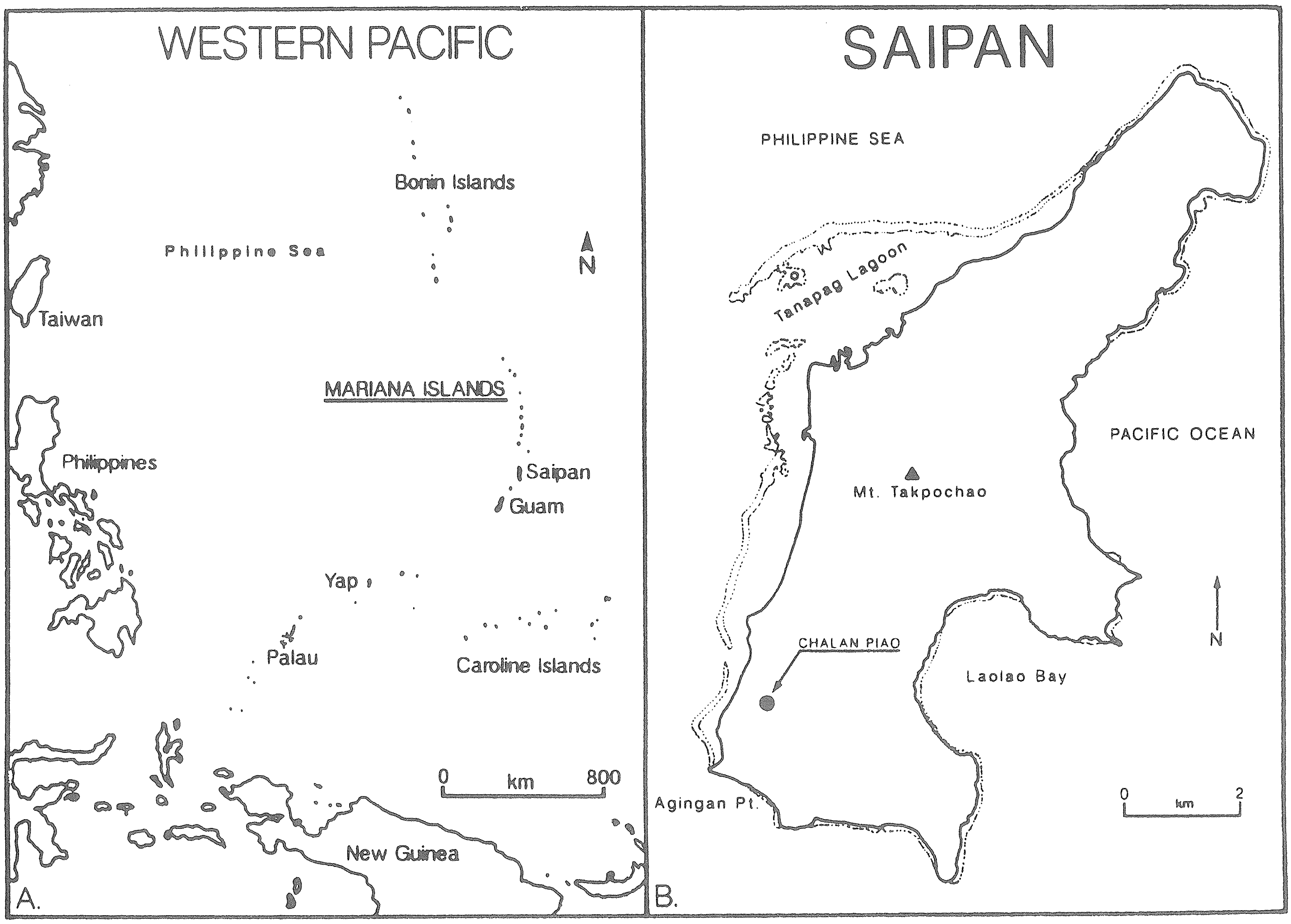


Figure 1: Map of the Marianas in the western Pacific (a) and Saipan (b).

the early part of the first millennium BC. The much younger date reported by Cloud *et al.* in 1956 may indeed date the top of Layer II, but when a marine reservoir effect correction factor of 450±35 yrs (after Bonhomme and Craib 1987) is applied, the date appears too young for its position in the layer, given the associated artifacts.

The MARS salvage excavations sampled a very small part of a much larger area that had contained Pre-Latte materials prior to modern disturbances. The purpose here is to summarise what we learned from this limited investigation, including new information about changes in the late Holocene environment in southwestern Saipan. In addition, we make some comparisons with Lapita pottery and other artifacts from a similar period in the early human settlement of Melanesia and Polynesia (Bellwood 1979).

GEOGRAPHICAL AND CULTURAL ADAPTIVE CONTEXTS OF CHALAN PIAO

Under significantly higher sea stands than today, as high as +2 m until about 3000 yrs BP (see below), the Marianas coastlines were mostly steep limestone escarpments and terraces, the result of millions of years of uplift and downfaulting in this seismically active zone of the western Pacific. On the west coast of Saipan, the present wide sandy shorelines had not yet formed. The Chalan Piao site was located on what was once a sand bar or spit of land on the seaward edge of a large marine lagoon,

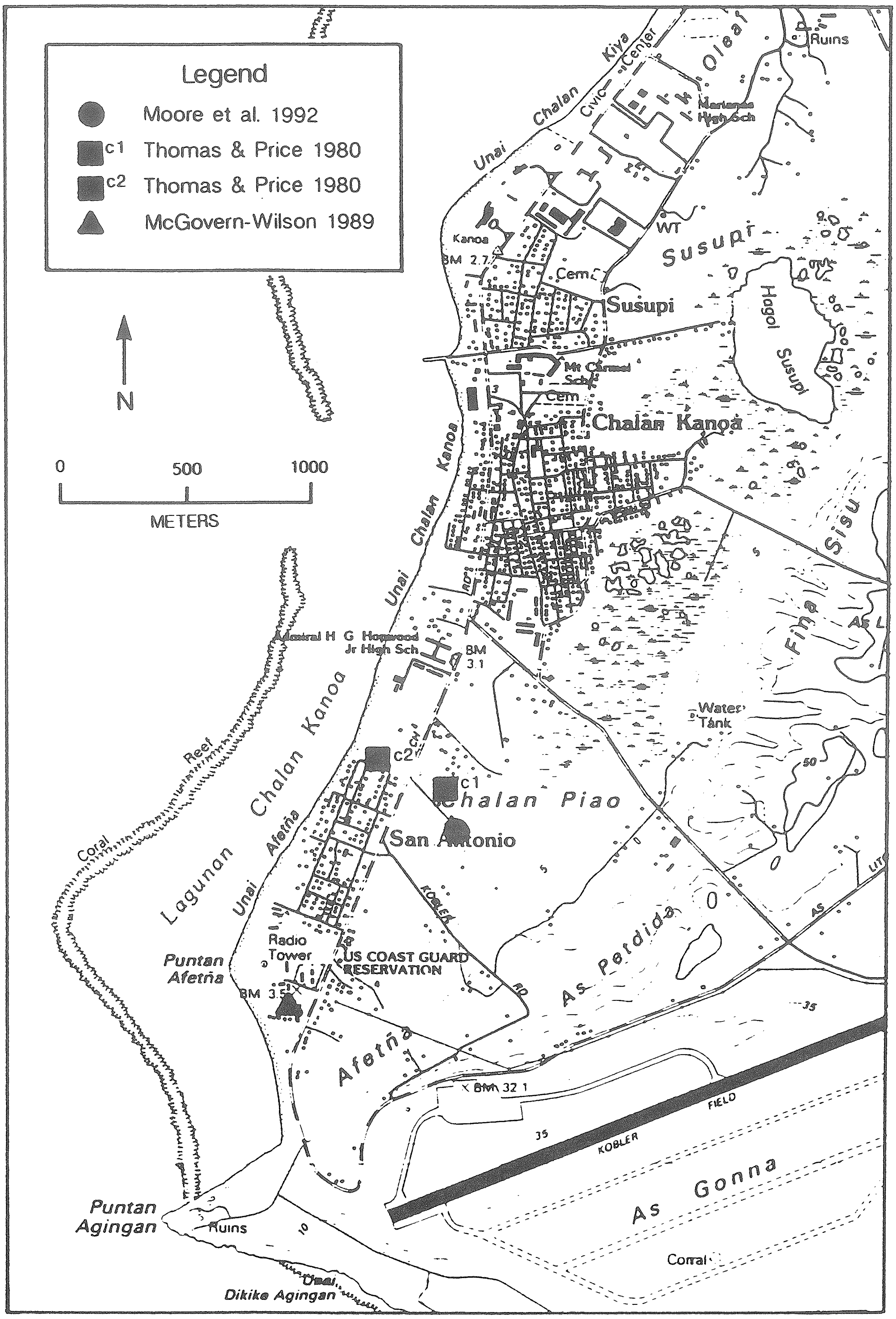


Figure 2: The Chalan Piao site and environs, southwestern Saipan.

Lab/ Sample No.	Provenience	Material	C-14 Years BP	Calendar Date[2] Range, 1 σ	Calendar Date[2] Range, 2 σ	Sources
U. Chicago 669	45cmbs	oyster[1] shell	3479 +/- 200	1079 - 649 BC	1366 - 357 BC	a
"	"	"	1730 +/- 450[5]	AD 676 - 1486	AD 184 - 1950[6]	b
Beta 33390	31-61cmbs[4]	dispersed charcoal	2930 +/- 90	1262 - 993 BC	1396 - 865 BC	c
Beta 33391	61-100cmbs[4]	dispersed charcoal	3210 +/-100	1597 - 1396 BC	1731 - 1226 BC	c
Geochron GX-15327	B.T. 1	Porites[1] coral	4125 +/-115[3]	1753 - 1477 BC	1921 - 1364 BC	c
NZA 614	30-40cmbs Unit K5:4	Tridacna[1] shell	1750 +/-100	AD 1015 - 1236	AD 901 - 1307	d
NZA 615	70-80cmbs Unit K5:8	Tridacna[1] shell	1835 +/-74	AD 963 - 1099	AD 868 - 1213	d
NZA 616	110-120cmbs Unit K5:12	Tridacna[1] shell	1950 +/-110	AD 784 - 1029	AD 676 - 1161	d

1 marine reservoir correction of -450 +/-35 applied during calibration, after Bonhomme and Craib 1987
2 according to Stuiver and Reimer 1993, Calib Program
3 C-13 Isotopic correction (1.9%) applied by Geochron Labs
4 composite sample from Units 1-A through 4-B
5 Kulp's recalculation
6 Calib could not calibrate due to bomb C-14

Sources:
a = Libby 1952, Spoehr 1957
b = Cloud et al. 1957
c = Moore et al. 1992
d = McGovern-Wilson 1989

Table 1: Radiocarbon Dates from Chalan Piao and Afetna, Saipan.

whose remnants are the Susupe marsh system (Fig. 2). The lagoon was fed fresh water on its eastern side by small streams draining the low volcanic hills of south-central Saipan. Facing the lagoon on the inland side was a low, narrow sloping limestone terrace which may have supported Pre-Latte encampments; this area remains unexplored.

On the sea side of the sand bar, people would have had access to pelagic and reef fish, shellfish and other invertebrates; the lagoon would have yielded other reef fish and shellfish. Some of the shellfish found in our excavations suggest that mangroves were present in the vicinity of the site. Inland, the moist, organically enriched soils bordering the lagoon may have been planted with salt-tolerant aroids and this large body of water may have attracted migratory and resident birds. Farther inland, forested slopes may have been used for seasonal swidden gardening.

Early Pre-Latte populations appear to have been small, judging from the low density of artifacts found at the few sites known and from the rarity of these settlements. Some Pre-Latte sites probably still lie buried beneath later prehistoric deposits in coastal settings, while perhaps others, on inland slopes, have eroded away. Another factor contributing to small population size may have been a greater subsistence emphasis on marine protein and less upon agriculture and gathering than later populations. The lack of emphasis upon plant foods is suggested by the paucity of grinding and pounding implements, especially compared to Latte Phase assemblages. Bayliss-Smith (1975) has demonstrated that relatively intensive coral reef exploitation alone cannot sustain very large populations; he estimates that to support a fisher-gatherer community of 30 persons would require, at minimum, some 17 km of productive coastal zone. The effective ceiling on human carrying capacity in the Pre-Latte may have been the small amount of alluvial lowlands available for crops (see Hunter-Anderson and Zan 1985).

Drought and typhoons would have limited the payoff for agriculture as well. Paleoclimatic studies (Pisias 1978, 1979) suggest that El Niño/Southern Oscillation events were numerous and severe during early Pre-Latte times. During typhoons, crops growing at the inland marsh margins would be subject to tidal surges and salt-laden winds, compromising reliability. During droughts, rain-fed tree crops would be vulnerable, as would low-land plantings. Distance from the sea-land ecotone would be the chief disadvantage of inland gardens, a disadvantage that would be amplified with intensification. Thus a negative feedback relationship may have existed between horticultural dependence and coastal settlement with marine-estuarine resource dependence.

A semi-mobile, Carolinian-type adaptive system (Alkire 1965, 1978), but with a less significant agricultural component, is a possible model for this early time in the Marianas. Alkire has argued that the Carolinians in the northern tropical Pacific typhoon belt maintain inter-island socio-economic ties as an adaptive strategy for survival under periodic subsistence stress conditions related to typhoons, droughts and small island size. Pre-Latte peoples of the Marianas, also subject to typhoons and droughts and occupying spatially limited locales, would have maintained inter-island socio-economic ties, involving inter-island visiting, intermarriage and frequent residential moves. Like the Carolinians, Pre-Latte peoples probably shared a common social organisation, language and socio-symbolic system, e.g., as expressed in the ceramic tradition, in personal ornamentation and in the design and use of valuables. As will be shown below, these speculations are not contradicted by the archaeological record at Chalan Piao nor at other Pre-Latte sites.

Site Formation at Chalan Piao

To help establish the approximate time the Chalan Piao area was still a marine embayment, we radiocarbon-dated a piece of unaltered aragonite from the top of a mound of massive *Porites* coral heads. This colony once grew just below the former low tide level and then was buried by emergent limesands. The fossil coral heads were exposed by a backhoe digging under the direction of R. Randall, retired from the Marine Laboratory at the University of Guam. The *Porites* exposure was close to the deepest part of the sand-mined area about 2 m below the lowest exposed part of the cultural deposit. The fossil coral dates to 2410 to 2050 BC (Table 1). Based on these and other considerations, including widespread geological evidence for a mid-Holocene +2 m higher sea stand at Saipan, Randall has proposed a site formation scenario for Chalan Piao (Randall 1992). To summarise Randall's scenario:

About 6,000 years ago, a relatively wide bench of downfaulted Tanapag limestone that forms the site's underlying terrace was flooded by a transgressing sea to a level about 2 m higher than present. The Chalan Piao area was most likely a shallow lagoon behind a barrier reef, or a shallow reef flat platform, if the present barrier reef did not develop upward at about the same rate as the rising sea. The high sea stand lasted until around 3,000 years ago, when there was a relatively rapid sea level decline to the present level and the beach continued to prograde westward.

The recent 2 m regression exposed much of the calcareous sediment that had earlier accumulated on the platform. As the sea retreated, some beach and storm-deposited materials may have been 'veneered' on to the lagoon platform sediments. Deeper parts of the old platform became marshes and open ponds of brackish water became separated from the sea by bars of emergent limesands. The Susupe marsh system, a segment of which abuts the Chalan Piao site on the east, probably formed during this time (Fig. 2).

The low limesand bars and margins of the lagoon, which were forming as sea level was dropping, were most likely used for encampments by the early island inhabitants. Some of the primary cultural deposits resulting from these encampments, such as Chalan Piao, have been reworked by wave action. Meanwhile, terrestrial infilling of the lagoon, from stream runoff in the hills on its eastern margin, contributed to the transformation of this feature into a brackish marsh system. Infilling of the old barred-off platform areas has continued to the present day and the beach has prograded almost half a mile westward. Upon this recently prograded beach, later prehistoric occupations are evidenced by prehistoric deposits of the Latte Phase (*c.* AD 1150 to 1521) on and near the surface. Beneath these later deposits are culturally sterile Late Holocene limesands.

If Randall's scenario is substantially correct, then the early Chalan Piao environmental setting was a sea-land ecotone that would have yielded the site occupants marine protein from the ocean and lagoon sides and plants and animals in the ponds and marshes on the inland side of the sand bars. Just how this settlement location functioned within the Pre-Latte cultural adaptive system is

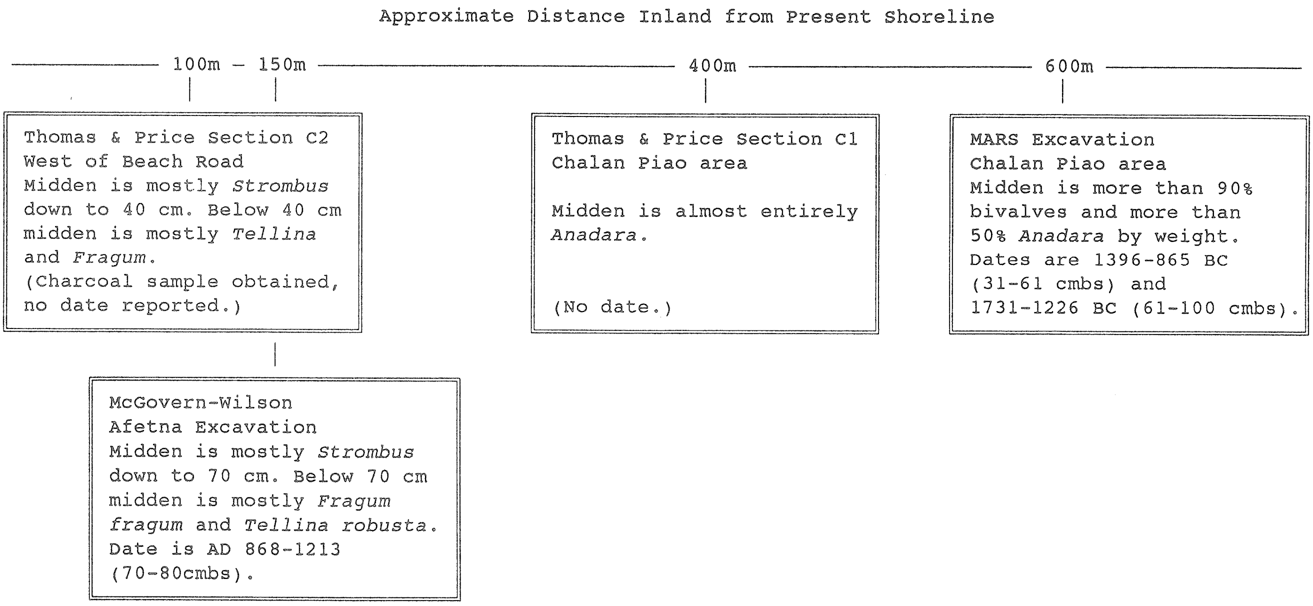


Figure 3: Comparison of marine shell genera from four excavations in southwest Saipan, showing changes correlated with distance inland from the present shoreline.

unclear. However, judging from the composition of the food shell assemblages in the deposits (by weight more than 90% bivalves and more than 50% of the total *Anadara*) and from the large quantities of (mainly *Conus*) shell beads, bead blanks and sea urchin spine bead manufacturing tools, site activities were directly related to the procurement and processing of nearby marine resources. Fish bones from only small individuals were present in Layer II, but in such fragmentary condition that identification has proved difficult; so far only a stingray spine has been recognised and 117 pieces remain unidentified. Unlike in Saipan's Latte Phase coastal sites, where Scaridae (parrot fish) remains are usually abundant, no mouth parts (most diagnostic of this fish) were found in Layer II.

Marine Shell Variability and Sea Level Change

The marine food shells at the site are mostly bivalves, dominated by *Anadara*; their prevalence suggests a silty marine habitat, possibly mangroves. In the sample of 14 kg from two of the excavation units, more than 90% by weight of the shells are bivalves. Three species comprise more than 85% of the weight of analysed shell: *Anadara* cf. *antiquata, Gafrarium pectinatum* and *Tellina (Quidnipagus) palatam. Anadara* alone makes up more than 50% of the shell weight.

Changes are discernible in the shell midden from the lower levels of the deposit to the upper levels. Bivalves comprise 93% of the shell weight in Layer IIb, but decline slightly to 92% in Layer IIa and to 90% in Layer I. However, *Anadara* drops more rapidly from 60% of the shell weight in Layer IIb to 54% in Layer IIa and 38% in Layer I.

Summarised below, a comparative analysis of the marine shells from Chalan Piao and nearby archaeological sites suggests that relative sea level fell after initial human occupation of southwestern Saipan. This helps to explain the marine shell changes within the Chalan Piao deposits (Fig. 3).

The Thomas and Price Survey

An archaeological survey by Thomas and Price (1980) identified three loci of prehistoric material in the Susupe-Chalan Kanoa flood control study area (Fig. 2). Test excavations were done in Locus C, which was divided into two sections. Section C1, which contained the Chalan Piao site, was characterised by *Anadara* shell midden and potsherds of both Marianas Plain and Marianas Red.

Anadara was the most numerous shell in every level of the test excavation in Section C1.

Section C2, to the west (closer to the present shoreline), was characterised by *Strombus* shell midden and Marianas Plain pottery. At the test excavation in Section C2, *Strombus* was the most numerous shell in the top 40 cm. Below 40 cm, an unidentified species "*Tellina* (?)" was the most numerous shell in all but the 80-90 cm level, where *Fragum* was the most numerous. No radiocarbon dates were reported for the Thomas and Price Section C1 and C2 excavations.

The Afetna Project

South of the Chalan Piao area, the Afetna site excavated by McGovern-Wilson (1989) (Fig. 2) yielded the following information on the shell midden content. In the uppermost spits (to 70 cm below surface), *Strombus* was the genus with the highest minimum number of individuals (MNI); while in the lowest spits (100-150 cm), the species with the highest MNI were two bivalves, *Fragum fragum* and *Tellina robusta*. In Spits 8-10 (70-100 cm), *Fragum fragum* outnumbered *Strombus*, but *Strombus* outnumbered *Tellina robusta*, so that the two most numerous genera were *Fragum* and *Strombus*. The change from a majority of bivalves to a majority of gastropods occurred at 70 cm.

McGovern-Wilson obtained three radiocarbon dates from small *Tridacna* shells. He applied a marine reservoir correction of 450±35 years, after Bonhomme and Craib (1987: 99) and calibrated the dates according to Stuiver and Pearson (1986). Corrected and calibrated in this way, the calendar date for Spit 8 (70-80 cm) is AD 604-681 (McGovern-Wilson 1989: 70). We have recalibrated McGovern-Wilson's dates according to Stuiver and Reimer (1993). The revised dates are a few hundred years later (Table 1) and indicate that the change from a majority of bivalves to a majority of gastropods took place around AD 1000.

Aligning the four excavations discussed according to their distance inland from the present shoreline (Fig. 3), we can see that the two excavations farthest inland (the MARS Chalan Piao excavation at about 600 m and the Thomas and Price Section C1 excavation at about 400 m) yielded shell middens dominated by *Anadara*. The two excavations closest to the present shoreline (Afetna at approximately 150 m and the Thomas and Price Section C2 excavation at about 100 m) had shell middens dominated by smaller bivalves (*Tellina* and *Fragum*) in the lower levels and by *Strombus* in the upper levels.

If the shoreline has been advancing seaward, then we can assume that the older material is farther inland and the more recent material is seaward. The radiocarbon dates obtained by MARS and McGovern-Wilson support this idea. It appears, then, that there has been a shift in mollusc species collected through time in this area of Saipan from *Anadara* to smaller bivalves to gastropods, especially *Strombus*. A similar shift has been documented for the Tumon Bay area of Guam (Moore *et al.* 1990; Moore *et al.* 1993).

If the prehistoric people were collecting the most abundant shellfish in rough proportion to their natural occurrence, then it appears that there was a marked change in the environment of the mollusc communities, which ceased favouring *Anadara* and instead favoured gastropods, especially *Strombus*.

Alternatively, it is possible the prehistoric people preferred *Anadara*, but over-exploited them until they were forced to collect smaller bivalves and finally, gastropods. We asked G. Paulay of the University of Guam Marine Laboratory to comment on which of these two processes is most likely.

According to Paulay (1992), the taxonomy of *Anadara* in the central Pacific is not well established, but the problems may be resolved soon by M. Yamaguchi of the University of the Ryukyus. All known *Anadara* from the Mariana Islands belongs to the *Anadara antiquata* complex. However, the *A. antiquata* complex in the central Pacific may be made up of three species and the identity of the Marianas *Anadara* with respect to these three forms has not been determined.

The identification of the species present is important, because the three forms in the *A. antiquata* complex occupy different habitats. The species common in Tungaru (Kiribati) atoll lagoons prefers sea grass beds, while another species, common in Fiji, is limited to silty sand beds adjacent to mangrove flats. On Guam, *Anadara* is rare; B. Smith of the UOG Marine Laboratory has seen it only in inner Apra Harbor where it inhabits silty sand seaward of a mangrove fringe, a habitat suggestive of the common Fijian form. In both Fiji and Guam, *Anadara* is not found in localities with clearer waters and fringing reefs. According to Paulay (1992), this species may depend in part on detrital food resources generated in mangrove ecosystems. As mangroves are especially sensitive to sea level change (Woodroffe *et al.* 1985), a drop in sea level would have reduced or eliminated the habitat for *Anadara*.

Arguing against over-harvesting as the cause of a reduction in *Anadara* is the survival of this clam, in spite of very intensive harvesting, at Tarawa atoll (Kiribati), Fiji and Tonga. The Holocene extinction of *Anadara* on Aitutaki in the Cook Islands and the changes in abundance of *Anadara* in Tonga (Spennemann 1987) are hypothesised to have resulted from changes in the environment. The apparent ability of *Anadara* populations in other parts of the Pacific to bear heavy harvesting pressure, combined with the limited distribution of *Anadara* at Guam, cause Paulay to favour the environmental change hypothesis for the disappearance of *Anadara* from the archaeological record in southwestern Saipan.

An environmental shift from deep to shallow sand habitats, which would favour *Strombus*, might also be caused by a drop in sea level. The lowered sea level would have the effect of killing off large areas of reef which, when overlain by shallow sands (as Randall has suggested), would provide good habitat for *Strombus*.

To simplify, it appears that the earliest inhabitants of southwestern Saipan collected large quantities of bivalves, principally *Anadara* cf. *antiquata*. As relative sea level fell and the coastal mangrove fringe gradually disappeared, *Anadara* declined in abundance and smaller bivalves (*Tellina* and *Fragum*) were the most commonly collected molluscs. The falling sea levels would have eventually stranded and killed large tracts of reef, which, covered by shallow seas and sands, provided the habitat for *Strombus* to flourish. By the Latte Phase, *Strombus* was the most commonly collected mollusc.

COMPARISON WITH LAPITA SITES

Nagaoka (1988) has summarized molluscan data for ten Lapita sites. She concluded that there was no marked preference for certain families of shells across Lapita sites and that availability of shells was a greater factor than selection for certain shells. However, we note that at Tongatapu Site To-2 (Poulsen 1968), the two categories of shell quantified (*Anadara antiquata* and *Gafrarium* spp.) are also the two most abundant categories at Chalan Piao.

A comparison of shell density is possible between Chalan Piao and three Lapita sites of the Mussau Island group, Bismarck Archipelago (Kirch 1987). There, density of marine molluscs collected with 5 mm mesh ranged from 14.5 to 32.6 kilograms per cubic meter. At Chalan Piao, density of marine shells collected with 1/4" mesh (estimated from the 10% samples) varied from 48.0 to 86.8 kg per cubic meter depending on layer (Table 2). Kirch (1987: 176) observed that a high density of marine shell is characteristic of virtually all Lapita sites; in that respect Chalan Piao is similar to Lapita sites.

Two arguments in the Lapita literature for human over-exploitation of molluscs were reviewed by Nagaoka (1988). One argument, presented by Best (1984), involved a shift in shell frequencies similar to that seen in southwestern Saipan. The shift at the Lakeba Site 101/7/197 in Fiji was from exploitation of the Neritidae in the Lapita layers to the Mytilidae in the post-Lapita layers. Best interpreted this to be a result of over-exploitation of the Neritidae, but Nagaoka pointed out that it may have been a result of environmental change, in particular, the silting of the marine environment.

The other argument, presented by Swadling (1986), involves a decrease in size of three common species (*Trochus niloticus*, *Tectus pyramis* and *Anadara antiquata*) from the sites of the Reef/Santa Cruz Islands, Southeast Solomons. Swadling suggested that the decrease in size was caused by human predation. However, Nagaoka pointed out that the differences in shell size should be tested to determine if they are statistically significant and maintained that environmental factors should be discounted before human exploitation can be considered causal. We note that Ford (1989) has discussed several factors which differentially affect the size-frequency distributions of shells from archaeological deposits. These include the characteristics of the source population, the method of collection and transport, the environment of deposition and post-depositional processes.

It is possible that the shift in mollusc collecting in southwestern Saipan from *Anadara* during the Pre-Latte Phase to *Strombus* during the Latte Phase was caused by human over-harvesting. However, the relative drop in sea level appears to be a more economical explanation.

CHALAN PIAO CERAMICS: GENERAL ATTRIBUTES AND A COMPARISON WITH THE CONTEMPORARY LAPITA POTTERY TRADITION

The Chalan Piao excavation yielded 2,493 pottery sherds from Layer IIa and 2,615 from Layer IIb. In the laboratory, each sherd was examined and sorted according to its size and condition. Sherds with a long axis in excess of 2 cm and with intact exterior and interior surfaces were retained for the analysis. Excepting small decorated sherds which were retained in spite of their size, sherds not meeting these criteria were rejected. More than two-thirds of the sherds were eliminated, leaving a group of 1,611 sherds (consisting of 1,455 undecorated body sherds, 94 undecorated rims, 38 undecorated wall/base junctures and 24 decorated sherds) which were analysed using the following attributes: temper type, surface treatment, thickness values, rim form, rim orientation and shape and orifice diameter.

These Pre-Latte sherds from Layer II can be classified as redware (initially designated Marianas Red by Spoehr 1957), a thin-walled, often red-slipped or painted, cal-

	Layer I	Layer IIA	Layer IIB
Pottery[1] (Grams per Cubic Meter)	3865.3	3219.9	2673.6
Pottery (Sherds per Cubic Meter)	1068.5	1440.2	1502.9
Pottery (Grams per Sherd)	3.62	2.24	1.78
Shell Beads[2] (Number of Beads per Cubic Meter)	51.6	118.4	107.1
Shell Midden[3] (Kilograms per Cubic Meter)	48.0	86.8	70.0

[1] Pottery referred to is the pottery picked from the 1/8" screen at all units. Total weight of pottery recovered in this way is 15.0 kg. This does not include the pottery recovered in the 10% midden samples.

[2] Shell beads include the beads picked from the 1/8" screen, as well as those recovered in the 10% midden samples, from all units. Number of beads collected in this way is 419.

[3] Shell referred to is the marine shell from the 10% midden samples of Units 1A and 2A only. The shell from those midden samples was screened with 1/4" screen. This is the shell which was analyzed. Total weight of analyzed marine shell is 14.0 kg.

Shell density was calculated by multiplying the weight of analyzed marine shell by 10 in order to obtain the estimated total weight of marine shell which could have been collected with 1/4" screen. Then that weight was divided by cubic meters excavated from Units 1A and 2A. This density does not include shell artifacts, land snails, or shells too small to be collected with 1/4" screen.

Table 2: Pottery, marine shell and bead densities in Layers I and II at Chalan Piao.

careous sand-tempered pottery. A small number of these sherds, decorated with impressed, stamped, or incised designs filled with lime, were designated by Spoehr (1957) as Trade Ware, a term no longer used since the decorated sherds also appear to have been manufactured locally.

At least three vessel forms are represented in the analysed group of sherds from Layer II; rounded jars, shallow, open bowls and carinated bowls. The most common shape is a well-made globular jar with relatively thin walls, a restricted orifice with an everted or flared, unthickened rim and a rounded base. Most of these undecorated jars have a red slip or wash on their exterior surface. Wall thicknesses range from 2.5 mm to 14 mm. Orifice diameters range from 14 cm to 24 cm, suggesting that more than one size of jar was produced. Although information about height and maximum girth is lacking, some jars may have been quite large.

The second shape is a shallow bowl with nearly vertical walls, flat or slightly rounded bases and simple, unthickened rims. Both large and small versions of this shape are present. The large version has robust walls and flat bases, which can be more than 2 cm thick and orifice diameters which range from 30 cm to 40 cm. Although height estimates for this form were not obtained from the Chalan Piao collection, other Mariana pottery collections indicate that it can be 15 cm tall (Moore 1983). The robust version is unslipped and undecorated. The thinner-walled, smaller version can have simple impressed decorations on the rim lip and its exterior surface is sometimes polished or burnished.

The third shape in this collection is a small, well-made bowl with sharply carinated shoulders, incurving upper walls, everted or flaring rims and rounded bases. Surface treatments include red or brown slips, or a plain, unslipped finish. The upper walls and rims of some of these bowls are decorated with incised and/or impressed designs. One large rim/shoulder section from one of these bowls was estimated to have a diameter of 16 cm at its shoulder.

The distribution of the analysed rim and wall/base sherds from Layer II indicates that the percentage of the different vessel forms changes from the bottom to the top of the layer. The relative number of globular jars and carinated bowls decreases over time while the relative number of open bowls increases.

The 24 decorated sherds from Layer II are small and do not provide much information about vessel size or form. Decorative elements include impressed or incised dots, dashes, semi-circles, circles, straight and curved lines. Individual elements are repeated or combined to create a simple motif which generally appears as an encircling band on the vessel. The most common designs consist of one or two elements. The designs are placed on the exterior surfaces of the small carinated bowls, near the rim or on the upper wall between the rim and the shoulder. Sometimes the interior side of the flared rim is also decorated.

The designs in this collection can be separated into three types, fine-line (Achugao Incised of Butler 1994), bold-line (San Roque Incised of Butler 1994 and bold incised) and other (Fig. 4). The features which distinguish the first two types are partially the width and depth of the elements, but also the design patterns. The elements of the fine-line designs are characterised by shallow, narrow incisions which form rectilinear or curvilinear patterns. Tiny dots or dashes, formed individually or with a dentate stamp, fill spaces between the lines. These finely executed motifs are usually lime-filled. Body

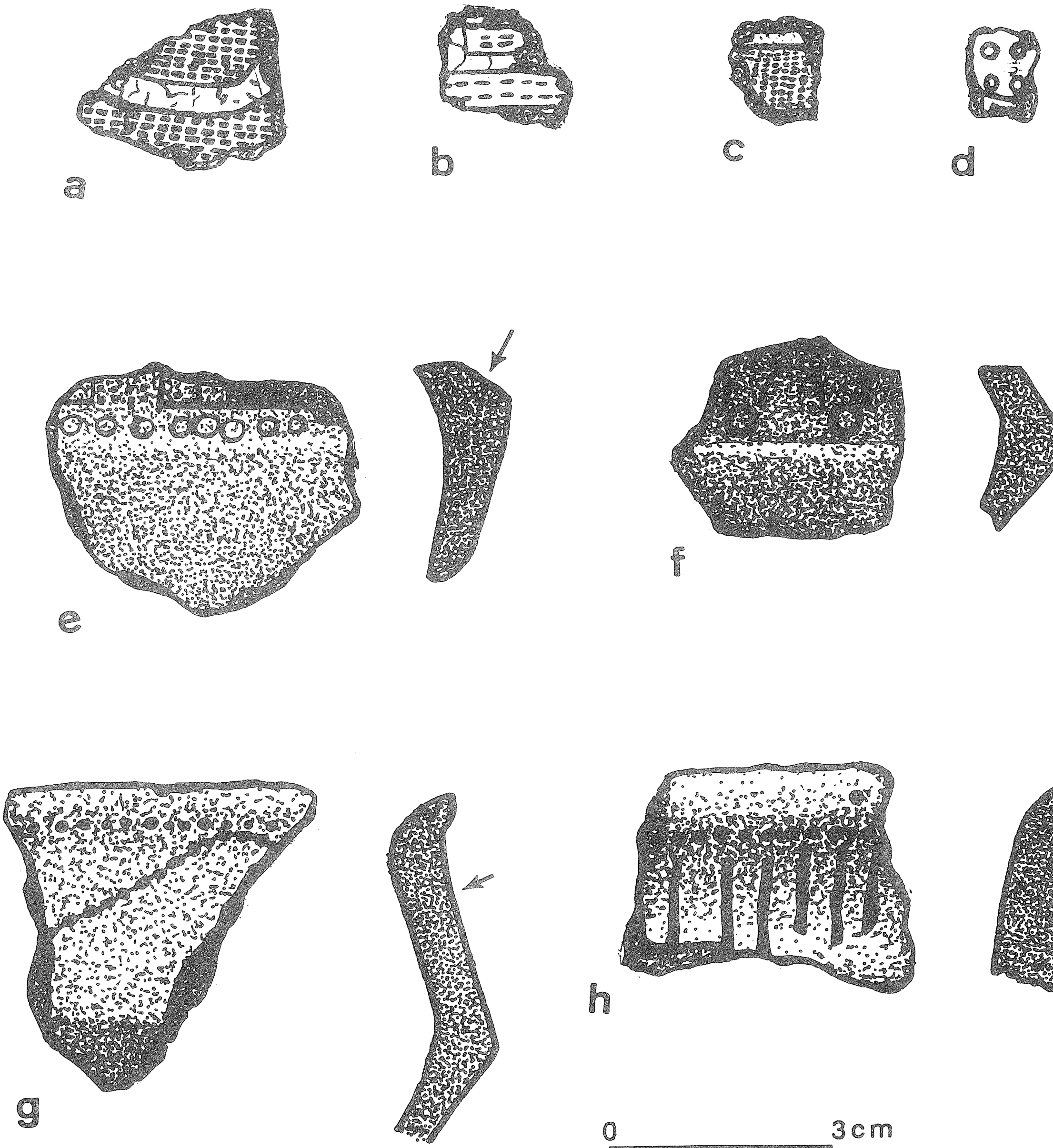


Figure 4: Decorated pottery sherds from Layer II, Chalan Piao, Saipan. a-e are examples of fine-line designs (also designated Achugao Incised by Butler 1994). f-h are examples of bold-line designs (f has been designated San Roque Incised by Butler 1994). Arrows show location of decoration on sherd exterior.

sherds with fine-line designs have a mean thickness of 5.67 mm.

The elements of the bold-line designs are deeper and wider and the motifs consist primarily of lines, circles and semi-circles which have been stamped or impressed into the vessel surface. Although small dots and dashes are sometimes arranged linearly, they are not used to fill spaces between solid lines. Bold-line encircling bands are often, but not always, filled with lime. Body sherds with bold-line designs have a mean thickness of 7.95 mm.

The other type of decoration includes five sherds with surface treatments which do not readily fit either the fine- or bold-line categories. Included among these are design bands comprised of a single incised or dashed line, impressions (made with a stylus and possibly a twisted fibre) and a sherd with a corrugated surface.

The vertical distribution of the fine- and bold-line decorated sherds at Chalan Piao suggests that design patterns changed over time. From Layer II to Layer I, a decrease in the percentage of sherds with fine-line designs is matched by an increase in the percentage of sherds with bold-line and other designs. No sherds with fine-line designs were recovered from Layer I. Since the fine-line designs are the most complex, this distribution suggests design simplification over time, a trend which has been noted for Pre-Latte pottery from Achugao, Saipan (Butler 1995). Some of the Chalan Piao Layer II designs appear identical to those found on Pre-Latte pottery from Achugao and other sites in the Marianas such as Laulau (Spoehr 1957), Saipan; Taga (Pellet and Spoehr 1961) and Unai Chulu (Craib 1993), Tinian; Songsong (Moore 1989) and Mochong (Craib 1990), Rota; and Tarague (Ray 1981) and Ypao (Leidemann 1980), Guam.

Comparisons with Lapita Pottery

Similarities have been noted between Marianas Early Pre-Latte pottery and the roughly contemporary Lapita wares, prompting the suggestion that they share a common cultural heritage (see Spoehr 1957; Solheim 1968; Bellwood 1979). Similarities include the utilisation of calcareous sand to temper the clay, the filling of designs with lime and the decoration of vessels with more complex shapes. Like the Pre-Latte sequence, the Lapita tradition also tends toward the simplification of decorative designs over time (Kirch 1990: 121). In the Marianas this simplification seems to occur between 3000-2000 B.P. (Butler 1994: 32).

The immediately evident differences between the Lapita and Pre-Latte ceramic traditions include the actual designs, the placement of the designs on the vessels and the vessel shapes (see Butler 1994: 34). Generally, the Lapita dentate designs are more complex and cover more of the vessel's surface than do the Chalan Piao designs (see Kirch 1987: 169; White *et al.* 1988). Some Lapita collections have higher percentages of decorated sherds than does the Chalan Piao collection. For example, Kirch (1987: 169) reports the percentage of decorated sherds ranges from three to 16 at sites in the Mussau Islands, Bismarck Archipelago. It is not clear whether these higher percentages are due to the more spatially extensive designs on single vessels, or to the greater number of decorated vessels in a given Lapita assemblage.

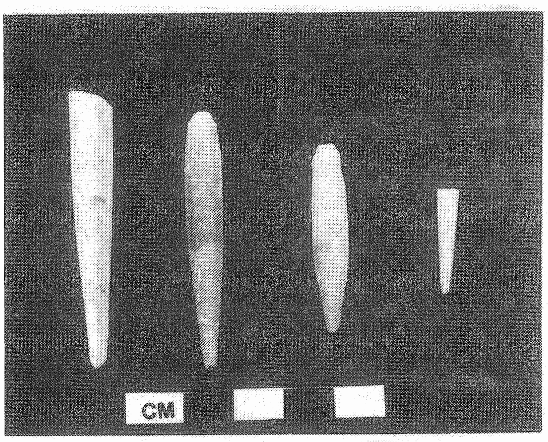
Although both traditions appear to share similar vessel shapes, some of the Lapita assemblages contain a greater variety of shapes than does the Chalan Piao assemblage. For example, seven different vessel forms have been described for the early pottery from Fiji (Mead *et al.* 1975). Lapita collections also contain ring-type pot stands (Kirch 1987: 169). As yet, pot stands have not been positively identified in the Marianas, although a possible fragment was recovered from Chalan Piao.

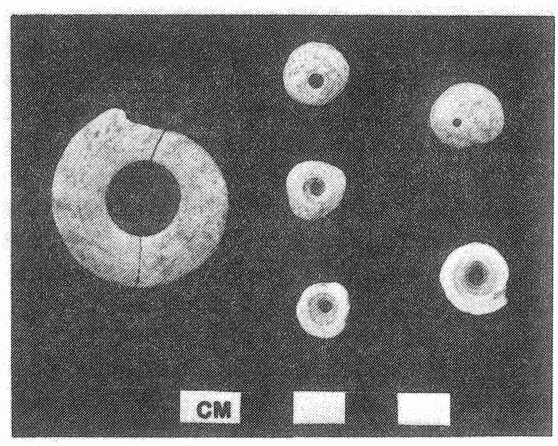
All of the Pre-Latte pottery from Chalan Piao appears to be made from materials which are locally available on Saipan; no exotic clay nor tempering materials were identified. However, the fact that many of the sherds contained quartz grains, which are not found in the Chalan Piao beach sands, suggests that the potters either had access to clay and temper resources elsewhere on Saipan, or pottery made elsewhere on Saipan was brought to Chalan Piao.

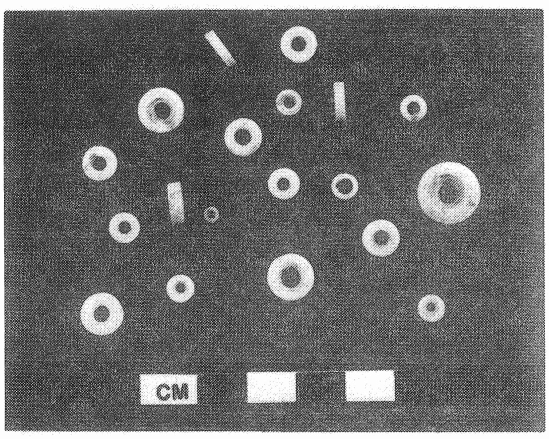
THE BEADS AND OTHER SHELL ARTIFACTS

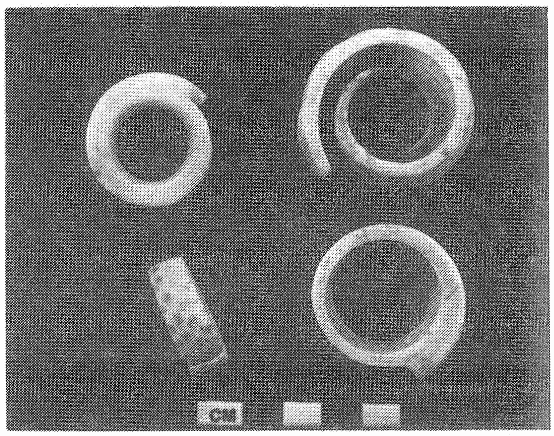
Conus beads were the most common shell artifact at Chalan Piao. In Layer IIa there were 205 whole beads and in Layer IIb, 150. As with pottery within Layer II, the beads in the lower portion of the layer differ from those in the upper portion. In Layer IIa the average diameter is 6.84 mm, as compared with an average bead diameter of 7.21 mm in Layer IIb,3 and bead density increases from lower Layer II to upper (Table 2). Thus it seems that while the size of beads diminished over time within Layer II, the quantity produced or used increased. Unfinished beads and bead-making tools, such as sea urchin spines used as drills and files, were also found throughout Layer II. Figs. 5-10 illustrate some of the shell artifacts and sea urchin files from Layer II. Another trend in shell artifacts is a decline in diversity and frequency of what could be considered ornaments and/or valuables: Layer IIa yielded four such items in three categories (*Cypraea* beads, *Conus* bracelets and *Conus* circlets), while Layer IIb yielded 11 items in these three categories as well as a pendant (possibly *Lambis*).

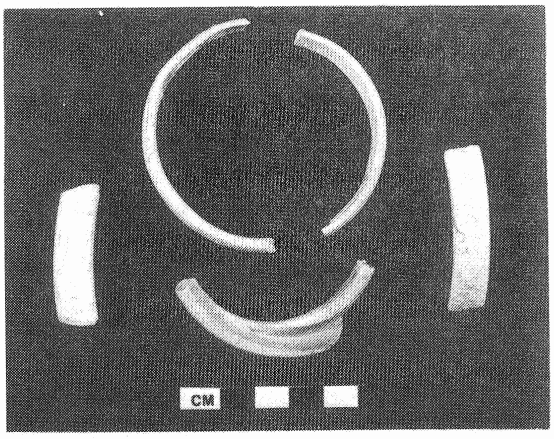
Tridacna shell adzes (made on the outer portion of the valve) are common at Saipan Latte Phase coastal sites, but this type of artifact is rare at Pre-Latte sites.[4] At Chalan Piao, the only adzes recovered were from the surface: a large one of highly polished limestone and











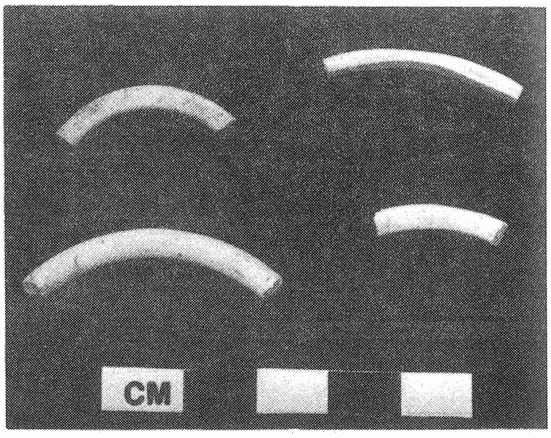


Figure 5 (top left): Sea urchin spine drills, Layer II.
Figure 6 (top right): Conus *disk (surface) and unfinished beads (Layers I, II).*
Figure 7 (middle left): Conus *beads, Layer Iib.*
Figure 8 (middle right): Conus *circlets, upper left Layer IIa, remainder unprovenanced.*
Figure 9 (lower left): Conus *wide band bracelet fragments, two in upper center unprovenanced, three lower from Layer II.*
Figure 10 (lower right): Conus *narrow band bracelet fragments, upper right unprovenanced, remainder from Layer II.*

three smaller *Tridacna* adze fragments, all made on the outer portion of the shell. Rare unworked pieces of *Tridacna* were retrieved from Layers I and II. While it is possible that some of the surface finds came from Layer II, the preponderance of *Tridacna* in Latte Phase sites generally and its minor presence at Pre-Latte sites suggest a relatively late consistent use of *Tridacna* for tools and food. This, in turn, may relate to habitat change, as with the decline in silt-loving molluscs used for food.

Whereas in the Saipan Latte Phase coastal sites, hooks and gorges made from *Isognomon* are common, at Chalan Piao fishing gear was rare. Butler (1994) noted the paucity of fishing gear at Achugao (Saipan) as did Moore (1983) in the Tarague (Guam) Pre-Latte deposits. Along with the relative scarcity of large fish bones in Pre-Latte sites, this suggests that early fishing techniques in the southern Marianas were different from those used during the Latte Phase, possibly due to marine habitat differences.

In island Melanesia, parallel shifts in artifact types and mollusks occur during the time period covered by the Pre-Latte to the Latte Phase. We have noted the simplification of designs over time in both Pre-Latte and Lapita ceramics. Other changes involve the addition and deletion of various artifact types. For example, *Terebra* and *Tridacna* adzes made on dorsal margins appear late in the prehistoric record in Mussau (Kirch *et al.* 1991), paralleling the Latte Phase emphasis on *Tridacna*. Pre-Latte shell ornaments or valuables, particularly *Conus* beads and rings, resemble those at Mussau Lapita sites; according to Kirch *et al.* (1991: 152-53), the "consistent Lapita artefact assemblage" in Mussau includes "a wide variety of rings, disks, beads and pendants from several genera of molluscs." Kirch has argued (1988, 1990; Kirch *et al.* 1991) that these items figured in long-distance exchanges with other island areas, from which obsidian and other exotics were obtained and that such long-distance exchanges were part of a colonisation strategy which required that the colonisers kept in touch with source areas until stable colonies were established. Post-Lapita assemblages lack these exotics and show a marked increase in pig bones, assumed to have been locally produced. Kirch suggests these changes mark a shift toward "an internally focussed system based on competitive production and exchange of pigs" (Kirch *et al.* 1991: 154) replacing the externally focussed systems of earlier times.

Evidence is lacking for Chalan Piao's being a specialised "production center," exporting beads and receiving exotics from elsewhere in the Marianas or outside the archipelago, in the sense proposed by Kirch *et al.* (1991). Pre-Latte pottery, lithics and marine shell artifacts were locally manufactured and it appears that inter-island assemblage variability is low. Although bead manufacturing is evident at other Pre-Latte sites, Chalan Piao is the only Pre-Latte site which has yielded so many beads (finished and partially made), as well as bead-making tools. From lower to upper Layer II, the decline in non-bead shell ornaments, the increase in the number of beads but decrease in average bead size and, during the Latte Phase throughout the Marianas, a shift away from *Conus* to *Spondylus* beads and to relatively high inter-island variation in pottery assemblages (Graves *et al.* 1991), all suggest cultural-adaptive changes related to local environmental and social conditions.

ENVIRONMENTAL CHANGE, POPULATION INCREASE AND SOCIAL PROCESSES

The subtle shifts in the kinds and amounts of cultural remains detected within Layer II at Chalan Piao correlate with a decline in relative sea level and progradation of the shoreline. These environmental changes, if broadly indicative of trends in the southern Marianas, could signify the beginning of human population growth and with it, changes in the ways people used the land and sea and in turn, how they related to one another socially.

The notion that population growth and widening shorelines were related in the Marianas derives from the assumption that if more land became available to support wild and domestic crops, people would have utilised it for these purposes. In small islands, security for human populations is a function of land area because of higher food yields (see Alkire 1978); hence, increased acreage of land crops is expected to result in a larger population, other things equal. Direct support for this hypothesis in the Marianas archaeological record is lacking; however, indirect support comes from a study by Hunter-Anderson and Zan (1985), in which a strong correlation was found between island population size and amount of alluvial soil distributed along island perimeters in the Hawaiian Islands.

In the Marianas case, a greater emphasis on strand and backstrand horticulture and gathering may have raised the "population ceiling" and fostered new social forms, eventually replacing those characteristic of the earliest Pre-Latte times. For example, a high rate of inter-island residential mobility and small settlements may have given way to fewer inter-island residential moves and larger, less mobile communities using larger geographic ranges, at least within the larger islands. These changes, in turn, may have affected the context for production of decorated pottery and the use and exchange of shell ornaments and valuables. As personal sociopolitical orientations shifted and came to reflect affiliations with larger groups using more definite territories, perhaps the need for decorated pottery declined and the items involved in symbolic exchanges changed.[5]

More archaeological investigations and more detailed hypotheses are needed to determine the goodness of fit of these tentative suggestions and then to test them independently. Two recent excavations at Pre-Latte sites, Unai Chulu, Tinian (Craib 1993; Haun pers. comm. 1995) and Huchunao, Guam (Moore *et al.* 1988; Dilli and Haun in prep.) promise to yield new information about Pre-Latte cultural adaptations. Also needed are paleoenvironmental studies to help characterise late Holocene marine and terrestrial habitat changes in the southern Marianas. Paleosediment coring work toward this end has begun (for Guam, see Athens and Ward 1993; Hunter-Anderson 1994a, 1994b; Ward 1995; for Tinian, Athens pers. comm. 1995); an obvious candidate for a future study is the Susupe marsh system (Fig. 2).

CONCLUSION

The recent work at Chalan Piao has enabled us to ask some general questions about the early period in Marianas prehistory but not to answer them satisfactorily. For example, we would like to know more about the settlement and subsistence practices of these early islanders and more about the environmental settings in which they lived. The reworked deposits at the site, the lack of features, the fragmentary fish remains and the lack of preserved plant parts preclude obtaining more information on these topics.

We have confirmed that Chalan Piao was one of the earliest of the Pre-Latte settlements, its locale was probably a marine embayment and through time this area became a sandy beach with a brackish marsh behind it. Within the Pre-Latte layer over time the redware pottery decorations and vessel forms became simpler and shell ornaments/valuables (rings, circlets, bracelets) declined in frequency and beads in average size. These changes may reflect directional social processes about which we can only speculate at present but which could relate to environmental changes enabling larger populations to live in the islands. It is hoped that additional excavations at Pre-Latte sites and new data from paleoenvironmental studies will indicate whether what we have discovered at Chalan Piao merits further investigation.

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NOTES

1. As chronological control of the Marianas ceramic sequence has improved, the Pre-Latte Phase has been expanded and refined; see discussions in Moore (1983), Craib (1990), Butler (1994) and Hunter-Anderson and Butler (1995).

2. Doubts were raised by Kurashina and Clayshulte (1983) as to the correctness of this date, which was from an oyster shell (*Ostrea cucullata* L.) which Spoehr had excavated at 45 cm. The shell date was first reported by W. Libby in 1952 and then by Spoehr in *Marianas Prehistory* (1957), which became the authority among archaeologists and the standard reference for those writing overviews of Pacific prehistory (e.g., Bellwood 1979). L. Kulp revised the Chalan Piao shell date to 1730±450 yrs BP (AD 220±450) using a "new conversion factor, recalculated from data on radiocarbon activity of modern coral specimens;" Kulp reported the revision in the General Geology of Saipan (Cloud *et al.* 1956: 87), but this younger date was virtually ignored by archaeologists until noted by Marck (1980: 39) and later Kurashina and Clayshulte.

3. The *Conus* bead diameters from Layer II from all units (n = 355) were analysed in two groups, Layer IIa (n = 205) and Layer IIb (n = 150). The difference between their group means is statistically significant at the .05 level of confidence (2-sample t-test; one-way ANOVA with 2 samples).

4. Two specimens made from the hinge portion of the valve are reported: from Achugao (Butler 1994: 33) and from Tarague (Moore 1983: Fig. 34A,a; Kurashina and Clayshulte 1983: 117-118). Kirch *et al.* (1991: 154) note the late prehistoric shift in Melanesian sequences from Tridacna adzes made from the hinge portion to those made on the dorsal margin.

5. While pigs were introduced into the Marianas during Spanish times (1521-1898) and hence were not part of aboriginal exchanges (Intoh 1986), food exchanges between higher and lower ranking persons (fish for land produce, respectively) were observed at Rota and Guam by early European visitors (Driver 1989).

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