

AUSTRONESIAN COLONISATION OF THE MARIANA ISLANDS: THE PALAEOENVIRONMENTAL EVIDENCE

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ABSTRACT

Palaeoenvironmental records from a Guam coastal wetland and a Saipan sinkhole document the Holocene environmental history of the Marianas archipelago of the western Pacific. Disturbance indicators, including charcoal particles and pollen of various plant taxa, attest to the arrival of human settlers in the Mariana Islands by the middle fifth millennium BP, one thousand years earlier than suggested by accepted archaeological data. This finding, corroborating other records in the Mariana Islands and mirroring similar records obtained from Palau to the south, argues for a significantly earlier date for initial expansion of Austronesians out of island Southeast Asia and into the Pacific.

Understanding the Austronesian expansion is important because it represents one of the world's largest population movements of the last 6,000 years (Diamond 1998:336). This expansion, named after the Austronesian language family, describes an ethnic and geographic distribution of closely related languages whose speakers traditionally shared certain broad cultural traits throughout an enormous region that includes Taiwan, Malaysia, the Philippines, Indonesia, inland southern Vietnam, Madagascar, and much of the tropical and subtropical Pacific stretching to Hawaii, New Zealand and Easter Island (Bellwood 1991:90).

That there was an Austronesian expansion is accepted by almost all investigators. However, there remains controversy as to whether the Austronesian homeland was centered in island Southeast Asia (Oppenheimer and Richards 2001), whether Taiwan was the homeland from which expansion occurred (Bellwood 1997), or whether the

historical cross currents of linguistic, population, genetic, and ethnic factors were much more complicated than the dichotomous models usually propounded for at least the eastward expansion of island Southeast Asian Austronesians into Oceania (Terrell *et al.* 2001).

Whatever the homeland or origins of Austronesian speakers, it seems clear that tropical horticulturalists began to emerge in island Southeast Asia during the middle Holocene, and that these peoples were likely in some sense Austronesians. Firm archaeological dates for when this happened are still elusive, but it seems to have occurred by about 4500 years ago (see Kirch 2000:91 for Philippine dates; also Bellwood 1997). Nevertheless, the possible precocious role of New Guinea and other nearby large Melanesian islands in the development of tropical horticulture and domestication cannot be ignored as a potentially significant factor in this process (Denham *et al.* 2003, see also Swadling 1997). Terrell (2002) has cogently argued just this point citing various lines of evidence.

Whatever the origin (or multiple origins) of Pacific agriculture, the expansion of Austronesian horticulturalists out of island Southeast Asia and into the Pacific is thought to be signaled by the highly diagnostic Lapita pottery, first appearing about 3500 years ago in the Bismark Archipelago (Kirch 2000:88). Close variants of this pottery are known from the Philippines and are likely about the same age (see Solheim 1968; Van Heekeren 1972; Spoehr 1973; Bellwood 1979:282; Thiel 1989; Aoyagi *et al.* 1993; Kirch 2000:91, 171). From the Bismarck Archipelago the Austronesians spread rapidly to the east where they eventually completed one of the world's great exploration feats by finding and colonising the remote Micronesian, Melanesian, and Polynesian archipelagos and other islands of the Western, Central, and South Pacific.¹

In this paper we wish to consider the implications of our recent palaeoenvironmental investigations for Austronesian colonisation of the previously uninhabited Mariana archipelago in the western Pacific (Figure 1). Our results suggest significantly earlier colonisation than has heretofore been accepted for human settlement. We believe this not only has interesting implications for the archaeology of the Mariana Islands, but it broadens our understanding of the process of Austronesian expansion, including the role of the Lapita phenomenon as the engine driving voyaging and settlement into the remote Pacific.

The methodology of palaeoenvironmental investigations and the use of these studies for archaeological inferences have been dealt with elsewhere (Athens and Ward 2004a). Suffice it to say that the great utility of palaeoenvironmental investigations for archaeological studies has been demonstrated beyond question in the Pacific and other areas of the world, though we recognise that limitations exist. Unfortunately, practitioners sometimes have found themselves doing work and using data beyond the limits of their abilities, evoking occasional criticisms of the methodology that are clearly misplaced. Hopefully that will not be a concern in the studies we are about to present.

We will begin our discussion with a very brief synopsis of archaeological information relating to the early settlement of the Mariana Islands. This will be followed by a summary of our palaeoenvironmental findings. Finally, we will return to the topic of the implication of these findings for the process of Austronesian expansion and the resulting expectations for the archaeological record in the Mariana Islands.

EARLY SETTLEMENT OF THE MARIANA ISLANDS

Recent archaeological investigations support Spoehr's (1957) original radiocarbon determination that the Mariana Islands were settled about 3500 years ago (Moore *et al.* 1992; Rainbird 1994:298; Butler 1994, 1995; Hunter-Anderson and Butler 1995; Russell 1998). The earliest reasonably secure radiocarbon dates are from the Achugao and Chalan Piao sites on Saipan, and Unai Chulu on Tinian. Linguistic and physical anthropological data and material-culture similarities indicate that these early migrants were originally from insular southeast Asia, most likely the Philippines, and that they were the ancestors of the present day Chamorro people (see Craib 1993:131, 1996; Butler 1994:33; Rainbird 1994:298).

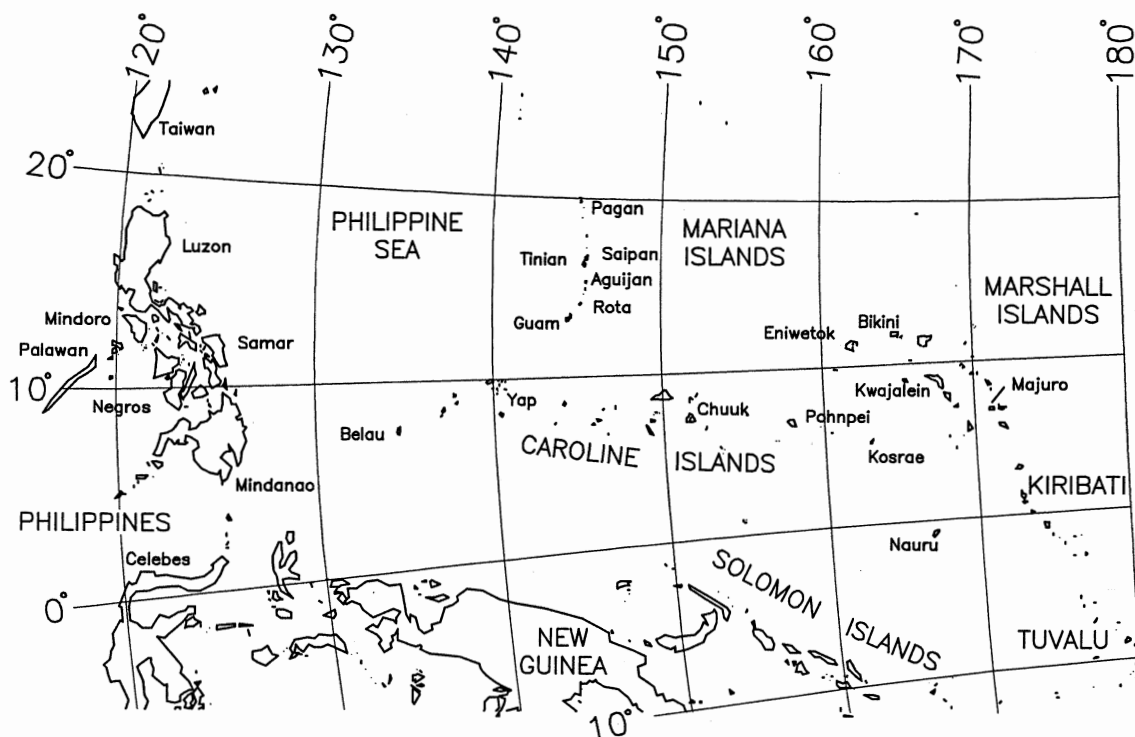


Figure 1: The Mariana Islands in western Micronesia, with Guam and Saipan.

The early period of human occupation of the Mariana Islands is designated the Early Pre-Latte Period (c. 1500 BC to 500 BC; see Hunter-Anderson and Butler 1995:26; also Moore 2002 for an up-to-date discussion of ceramic periods with finer divisions). Pre-Latte ceramic assemblages are characterised by calcareous sand temper, red slip, well-polished or burnished exterior surfaces, and a wide variety of vessel forms, including small jars with everted or constricted rims and shallow bowls, some with carinated shoulders. Rims are usually unthickened or narrow. Sherds decorated with complex designs of lime-filled incisions and dentate stamping are a particularly distinctive characteristic of this period. Butler (1994) distinguishes two styles: Achugao and San Roque Incised. The Achugao style consists of 'complex, predominantly rectilinear incised patterns with the zones between the major elements packed with tiny, delicate punctations'; the San Roque Incised style consists of 'bands of curvilinear garlands made by linking incised arches (half circles) with small stamped circles or large punctations placed at the junctions of the arch segments' (Butler 1994:27). The San Roque type may have persisted for a longer time than the Achugao type. A later bold incised and stamped style (such as predominates at the Chalan Piao site on Saipan), which has been reported from many early sites, dates to the later part of the Early Pre-Latte period and extends into the Intermediate Pre-Latte period.

According to Butler (1994:32), the fine dentate technique is reminiscent of the famous Lapita ware of Melanesia. Butler (1994) and Craib (1993:131), however, caution that the two pottery types are not specifically related, though they believe that the Mariana ware may ultimately share the same or similar Austronesian heritage from island Southeast Asia (see also Kirch (2000:171).

PALAEOENVIRONMENTAL EVIDENCE

The relevant palaeoenvironmental findings primarily derive from two recent investigations. One concerns a 28 m long core recovered from the Laguas wetland on Guam, designated here as the IARII Laguas core to distinguish it from the MARS Laguas core. The other is a study of sedimentary deposits in a large sinkhole on the Kagman Peninsula of Saipan. Other relevant palaeoenvironmental studies in the Mariana Islands are summarised in Table 1. In regard to these other studies, both the Pago core from Guam (Ward 1994) and the recent Lake Susupe core from Saipan (Athens and Ward 2004b) produced results similar to the findings presented here. Unfortunately, however, the data from these two cores have limitations, including too few radiocarbon dates for the Pago core, and the apparent lack of fine depositional resolution in the critical Layer III of the Lake Susupe core. The other cores (Tipalao/Orote, MARS Laguas,

and Lake Hagoi) are not directly relevant for consideration of the question of initial Austronesian colonisation.²

The Laguas Core, Guam

The relevant points for the present discussion concerning the IARII Laguas core may be summarised as follows (for details see Athens and Ward 1999, 2004a).

1. The core location is a small coastal wetland on the west side of Guam in the southern geological province of the island. It is near the mouth of a small drainage basin that descends from the dissected and weathered volcanic uplands (Figure 2).
2. The chronology of the Laguas core is defined by 10 radiocarbon determinations, all of which are in proper chrono-stratigraphic order (Figure 3). Sedimentary deposition has been continuous at this location for the past 9300 years.
3. A total of 45 pollen samples were processed; all sample intervals yielded abundant pollen.
4. From 9300 years to about 4300 years cal. BP the pollen record indicates an entirely forested landscape. Disturbance indicators – savanna and grassland pollen types – are virtually absent from the record during this period. At about 4300 cal. BP they start to slowly increase. The absence of microscopic charcoal particles prior to 4300 cal. BP indicates that there were no natural fires on Guam for at least the preceding 5000 years (Figure 4).
5. At 4300 cal. BP charcoal particles first begin to appear in the Laguas record, and they remain in the record thereafter. At first they are found in very low concentrations, but begin increasing in quantity by c. 3550 cal. BP. It is also at 3550 cal. BP that grass and fern pollen begin increasing significantly, though there are signs of increase as early as 3900 cal. BP (Figure 4).

It is our contention that there is no other reasonable explanation for the advent of charcoal particles on the landscape beginning at 4300 cal. BP other than the arrival of humans. A natural origin on Guam does not make sense because this implies severe drought of a type that had not occurred during the preceding 5000 years. Had such a drought occurred, leading to the natural ignition of vegetation, it should have been accompanied by a simultaneous and significant increase in pollen and spores of types indicative of aridity and disturbance to natural habitats. This is clearly not the case in the IARII Laguas core, where there is a significant lag in the appearance of disturbance indicators (at least 400 to 500 years).

If we continue to play the devils advocate, another potential explanation for the natural appearance of charcoal particles concerns their atmospheric transport from distant sources of natural or anthropogenic fires. With respect to

Table 1: Summary Data from Previous Palaeoenvironmental Cores in the Mariana Islands

| Characteristics | Tipalao/Orote | Pago | Laguas (MARS) | Lake Hagoi | Lake Susupe |
|---|---------------|-----------|---------------|------------|-------------|
| LOCATION | Guam | Guam | Guam | Tinian | Saipan |
| REFERENCES | A | B | C | D | E |
| Depth, m | 4.98 | 33.8 | 41.8 | 6.8 | 6.0 |
| Date; base of core* | 7924 | 10,453 | >9100** | >7632** | 7820 |
| No. ¹⁴ C dates | 5 | 4 | 6 | 10 | 8 |
| No. Pollen Samples | 26 | 17 | 14 | 46 | 23 |
| Date; Earliest Charcoal | 3561 | 4857 | 3602 | 3444 | 4860 |
| Date; Earliest <i>Cocos</i> | 4600 | 4328 | >9100** | 3289 | 7821 |
| Date; Earliest <i>Areca</i> (betel) | 5638 | 4857 | 9080 | - | 4168 |
| Date; Earliest significant grass | 1399 | 3222 | 2225 | 3289 | 4168 |
| Date; Earliest significant <i>Gleichenia</i> | - | 3222 | 2761 | - | - |
| Date; Earliest significant <i>Lycopodium</i> | - | 4857 | 2761 | - | - |
| Date; Earliest significant decline of <i>Pandanus</i> | 2145 | 4328 | 1957 | 1448 | 2148 |
| Date; Earliest significant decline in forest types | 2450 | 4857-4328 | 2225 | 1448 | 1797 |

References: A) Athens and Ward 1995; B) Ward 1994; C) Ward 1995; D) Athens and Ward 1998; E) Athens and Ward 2004b.

* Dates are based on age/depth interpolations derived from calibrated radiocarbon determinations.

** Dates extrapolated below the lowest radiocarbon determination cannot be regarded as reliable without further radiocarbon determinations; dates below this depth, therefore, are designated as >xxxx cal. BP, with xxxx indicating the value of the lowest radiocarbon determination.

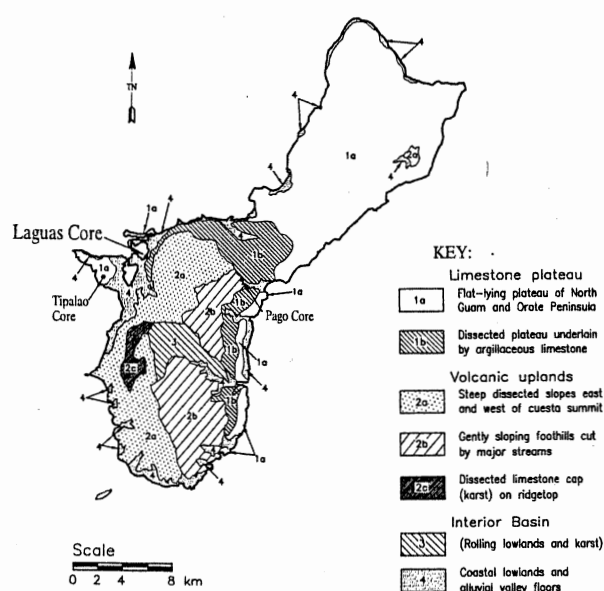


Figure 2: Map of Guam showing major physiographic divisions (redrafted from Tracey et al. [1964:A63] and location of Laguas and other palaeoenvironmental cores).

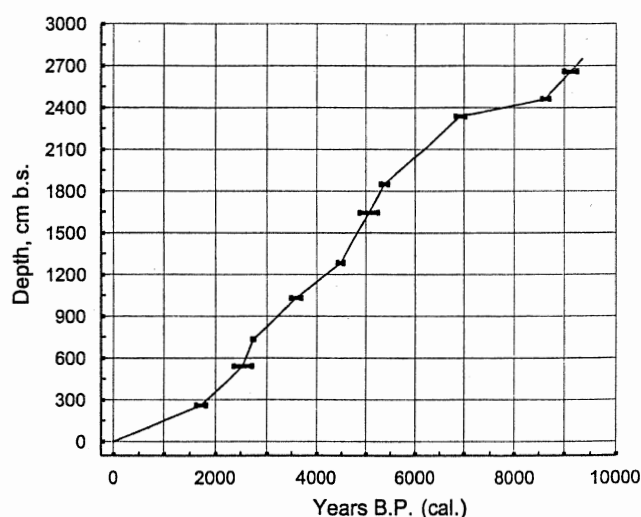


Figure 3: Depth-age distribution of calibrated radiocarbon determinations (1 sigma range) for Laguas core.

natural fires, this seems implausible simply because it had never happened during the previous 5000 years. As for anthropogenic fires, one argument might be that Austronesians in the Philippines began to undertake a significant amount of burning to clear forests for their gardens, and therefore this could be the source of the early charcoal particles we see in Guam. However, the prevailing winds blow in the opposite direction for this to be considered a reasonable possibility (the prevailing winds blow from the northeast, which would also preclude a natural origin of charcoal from the Philippines or other areas of island southeast Asia).

The final point for considering alternative explanations for the source of charcoal particles in the IARII Laguas record concerns the question as to whether the Laguas results might be somehow aberrant either because of dating error (i.e., that the date of the charcoal particles is in reality significantly later) or other unknown reasons. That the IARII Laguas record is secure, however, and not somehow misleading for Guam is suggested by similar findings in the Pago core (Ward 1994), another long Holocene record from the interior of southern Guam (location indicated in Figure 1). Although the Pago record suffers from not having the sample resolution of the IARII Laguas record, it clearly

supports the notion that a significant change occurred in Guam during the 5th millennium BP. The 10,000 year old Pago record displays an absence of charcoal particles and disturbance indicators until about 4800 cal. BP, after which time their concentrations dramatically increase (see Ward 1994; Athens and Ward 2004a).

In view of these considerations, we suggest that the appearance of charcoal particles in the IARII Laguas core provides a reliable signal documenting the arrival of Austronesians in the Mariana Islands during the mid 5th millennium BP.

The Kagman Sinkhole, Saipan

The sinkhole depression of the Kagman site on Saipan, located on the large Kagman Peninsula on the east side of the island, formed a natural sediment trap. The apparently much higher water table of the area during prehistoric and prehuman times created a wetland inside the sinkhole for much of its history. The earliest of six radiocarbon determinations (see Figure 5) indicate that the accumulation of alluvially/colluvially-deposited clay, silt, and loam sediments along with organic remains originating from inside the sink itself began about 7900 cal. BP. The latest

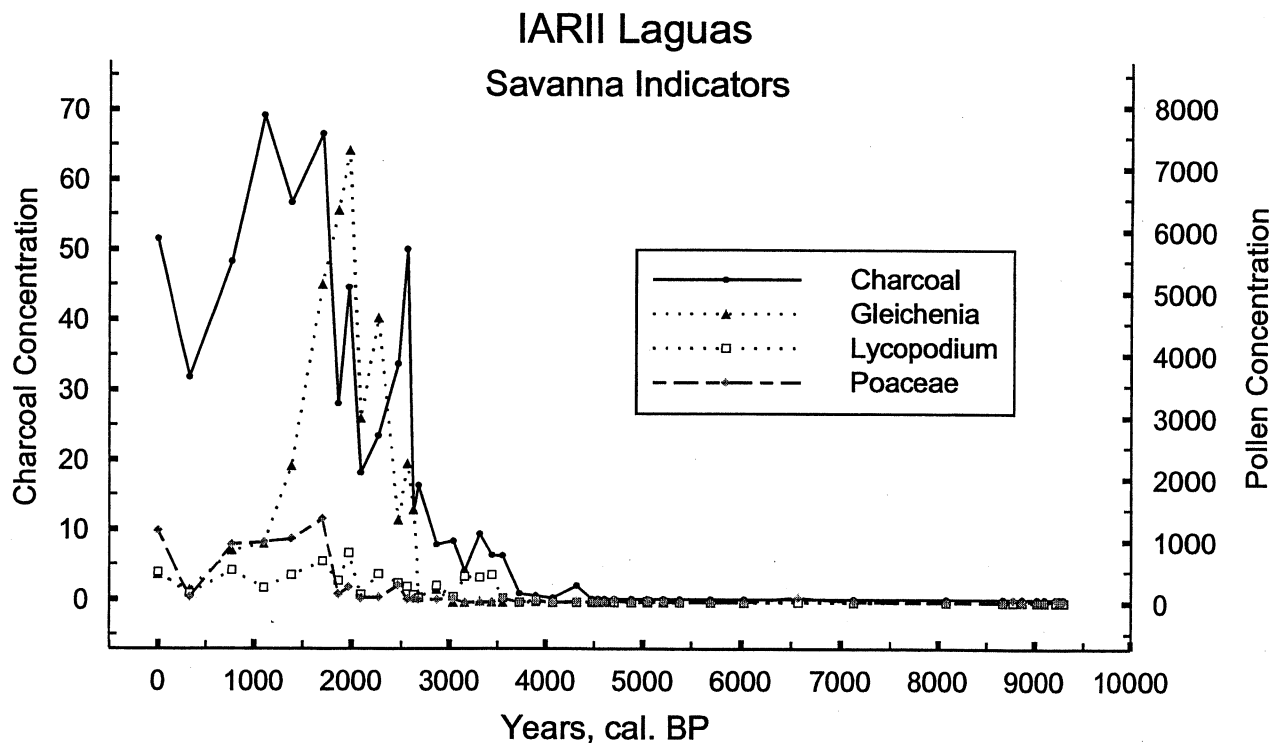


Figure 4: Graph of charcoal particle concentrations and pollen concentrations of main savanna pollen indicators for Laguas core.

determination demonstrates that sediment continued to accumulate in the sink until sometime after about 700 cal. BP. Because the sinkhole in modern times is dry, it is difficult to be certain that sediment accumulation always has been regular, though the depth-age curve suggests no major irregularities (with the exception that the 146-154 cm date appears to be too young – see Dega and Cleghorn 2001 for a complete discussion).

Two different sets of pollen data are available, each prepared by different analysts. One consists of 33 samples (analyst L. S. Cummings), and the other just five samples (analyst: J. V. Ward). Samples of the larger set were processed at regular intervals throughout the sinkhole sediment column, though unfortunately information and counts concerning charcoal particles, as well as identifications to genera and species level of some potentially significant indicator plants, were not provided. The other set includes five samples processed from intervals having interpolated dates between 4122 and 4485 cal. BP. Importantly, these interpolated ages are constrained immediately above and below by radiocarbon determinations of 4129 - 3933 and 4863 - 4653 cal. BP (1 sigma ranges). We therefore feel the chronology of these particular sample intervals have a high degree of reliability. The results of the two pollen sample suites indicate the following:

1. In the full sample suite (Figure 6), a very distinct vegetation change occurs about 4520 cal. BP. It appears that prior to this time the area was characterised by mixed grassland and forest, though afterwards the forest disappears and grasslands predominate. At the point of transition forest ferns almost completely disappear while the disturbance fern, *Lycopodium cernuum*, begins a steep ascent in the pollen curve.
2. In the suite of five samples (Figure 7), dating between 4122 and 4485 cal. BP, all contained charcoal particles. The specific concentrations, from bottom to top, were 1.1, 0.4, 0.5, 0.6, and 1.1 mm²/cc. These values, interestingly, are comparable to those documented in the Lake Susupe core between about 4560 and 4860 cal. BP. Though deeper samples demonstrating the absence of charcoal particles in obviously prehuman times are not available for the Kagman record (charcoal particles were not counted in the larger samples suite), the nearby Lake Susupe core does indicate the absence of charcoal particles before 4860 cal. BP (it is also notable that charcoal particle concentrations increase in this core in the intervals just above 4560 cal. BP – see Athens and Ward 2004b). The charcoal particles in the Kagman samples, therefore, appear to be anthropogenic.
3. In the five sample suite (Figure 7), pollen of taro (*Colocasia esculenta*), an important prehistoric root crop, was present in the 4122 cal. BP interval. *Colocasia*

is not native to the Mariana Islands, would have been introduced by the Austronesian colonists. Unfortunately, it is necessary to be cautious about the association of this pollen – just a single grain – with the date. This is because in the full sample suite a few historically-introduced *Leucaena* pollen grains were present to a significant depth. Thus, judgment about the significance of the finding of *Colocasia* pollen should be reserved until further studies confirm its presence on Saipan during the early 5th millennium.

As with the IARII Laguas record, we feel that the Kagman investigations provide substantive results indicating the high likelihood of Austronesian presence in the Mariana Islands during the mid-5th millennium BP. The significant changes in vegetation that occurred during the latter part of the 5th millennium, coupled with the presence of charcoal particles, provide an undeniable signature for the presence of humans. As to the reliability of the radiocarbon dating evidence, we believe that the proper chrono-stratigraphic order of the two relevant dating samples should be noted, as should the fact that they are from relatively closely spaced intervals (separated by just 70 cm) that bracket the time period of greatest interest. These factors provide a relatively high degree of assurance for the dating. Of course, the coincidence of the Laguas and Kagman results as well as their conformity with the Pago and Lake Susupe results further adds to our confidence in the data.

IMPLICATIONS

The possibility that humans might have been present in the Mariana Islands by the mid-5th millennium BP (800 to 1000 years earlier than previously thought) is probably not an idea that has been seriously considered by most archaeologists working in the region. However, this possibility, clearly indicated by two good palaeoenvironmental records from different islands (and two other supplemental records), now should be regarded as very probable. Our findings have two main implications for understanding both the Austronesian expansion and the archaeology of the Mariana Islands. These are:

1. The Austronesians began their thrust into the Pacific well before the advent of Lapita times in the Bismark Archipelago. They presumably would have arrived in the Mariana Islands from island Southeast Asia, bringing with them tropical root and tree crops. Our reading of the archaeological literature suggests that they must have colonised the Mariana Islands relatively quickly after their appearance in island Southeast Asia. Following landfalls and settlement in the Mariana Islands and the other archipelagos of western Micronesia (we have similar results in Palau [see Athens and Ward 2002] and there is highly suggestive evidence for

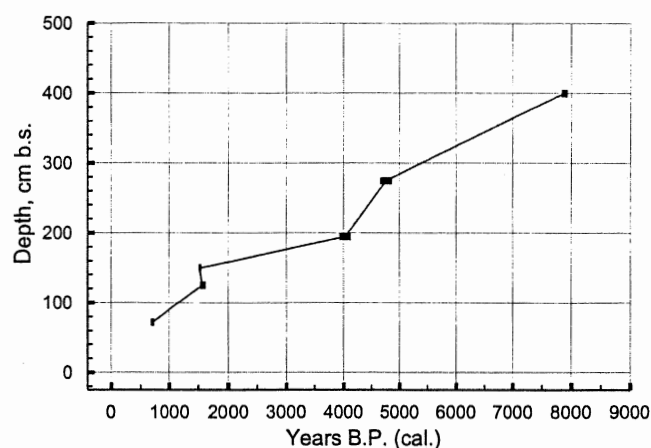


Figure 5: Depth-age distribution of calibrated radiocarbon determinations (1 sigma range) for Kagman sinkhole.

Yap [Dodson and Intoh 1999]), there was a pause, evidently lasting something on the order of 1,000 years, before Austronesian people again embarked from island southeast Asia, this time on their easterly journey to the Bismarck Archipelago and beyond (see Diamond 1998; Kirch 2000).

2. Incised and dentate stamped pottery is the hallmark of Lapita sites in the Pacific, though the occurrence of this pottery is always at a low frequency. Chronologically, it first appears about 3500 cal. BP in the Bismarck Archipelago (Kirch 2000). We believe it is no coincidence that a similar (but not identical) pottery, also occurring in low frequency, is present in the Mariana Islands at this same time. However, it seems to us highly unlikely that Austronesians arrived in the Mariana Islands from island southeast Asia in the mid-5th millennium BP with this distinctive pottery. It seems to us too unusual for such an elaborate pottery style to be so long-lived. This inference suggests that the earliest sites in the Mariana Islands will *not* have incised and dentate stamped pottery, but possibly a more generalised and functional pottery, perhaps a red ware or perhaps not. We argue, therefore, that archaeologists must change their concept of what the earliest sites might look like in the Mariana Islands if they are to recognise them. Joyce Bath may have discovered just such a site in Guam, as suggested by her 4419-4150 cal. BP radiocarbon date in pottery-bearing deposits containing a hearth feature (see Bath 1986:41)³. Unfortunately, however, the deposits associated with the hearth feature that was dated were never adequately described and charcoal from the dating sample was never identified, so we are left wondering what might have been.

NOTES

1. A synopsis of the Austronesian expansion, including an interesting discussion of its causes, is provided by Diamond (1998:334). Bellwood (1997) and Bellwood *et al.* (1995) provide detailed academic accounts, as does Kirch (2000:85). For linguistic treatments see Pawley and Ross (1993, 1995) and Blust (1995, 1996). Genetic studies are presented in Lum and Cann (1998), Lum *et al.* (1998), Martinson (1996), Su *et al.* (2000) and Oppenheimer and Richards (2001).
2. These cores do not have evidence for charcoal particles that is early enough. For Tiplao/Orote this could be due to the wetland's location on an isolated peninsula away from Guam's main land mass. For the MARS Laguas core, this may be a result of non-quantitative observations by the analyst (essentially a qualitative judgment was made of the relative abundance of charcoal particles). For the Lake Hagoi core, there was poor or no preservation of pollen and charcoal particles in the sampling intervals immediately below the earliest documented charcoal particles at 3444 cal. BP (good preservation was not obtained again until an interval at 7262 cal. BP).
3. The charcoal sample was derived from '... a dense firepit deposit, and thus of cultural origin' (Bath 1986:41).

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REFERENCES

- Aoyagi, Yoji, Melchor L. Aguilera, Jr., Hidefumi Ogawa, and Kazuhiko Tanaka. 1993. Excavation of hill top site, Magapit Shell Midden in Lal-lo Shell Middens, Northern Luzon, Philippines. *Man and Culture in Oceania* 9:127-155.
- Athens, J. Stephen and Jerome V. Ward. 1995. Paleoenvironment of the Orote Peninsula, Guam. *Micronesica* 28(1):51-76.
- Athens, J. Stephen and Jerome V. Ward. 1998. *Paleoenvironment and Prehistoric Landscape Change: A Sediment Core Record from Lake Hagoi, Tinian, CNMI*. Report prepared for Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i, under contract to Belt Collins Hawaii, Honolulu. Honolulu: International Archaeological Research Institute, Inc.
- Athens, J. Stephen and Jerome V. Ward. 1999. Paleoclimate, vegetation, and landscape change on Guam: the Laguas Core. Chapter V in *Archaeological Inventory Survey of the Sasa Valley and Tenjo Vista Fuel Tank Farms, Piti District, Territory of Guam, Mariana Islands*, by Boyd Dixon, J. Stephen

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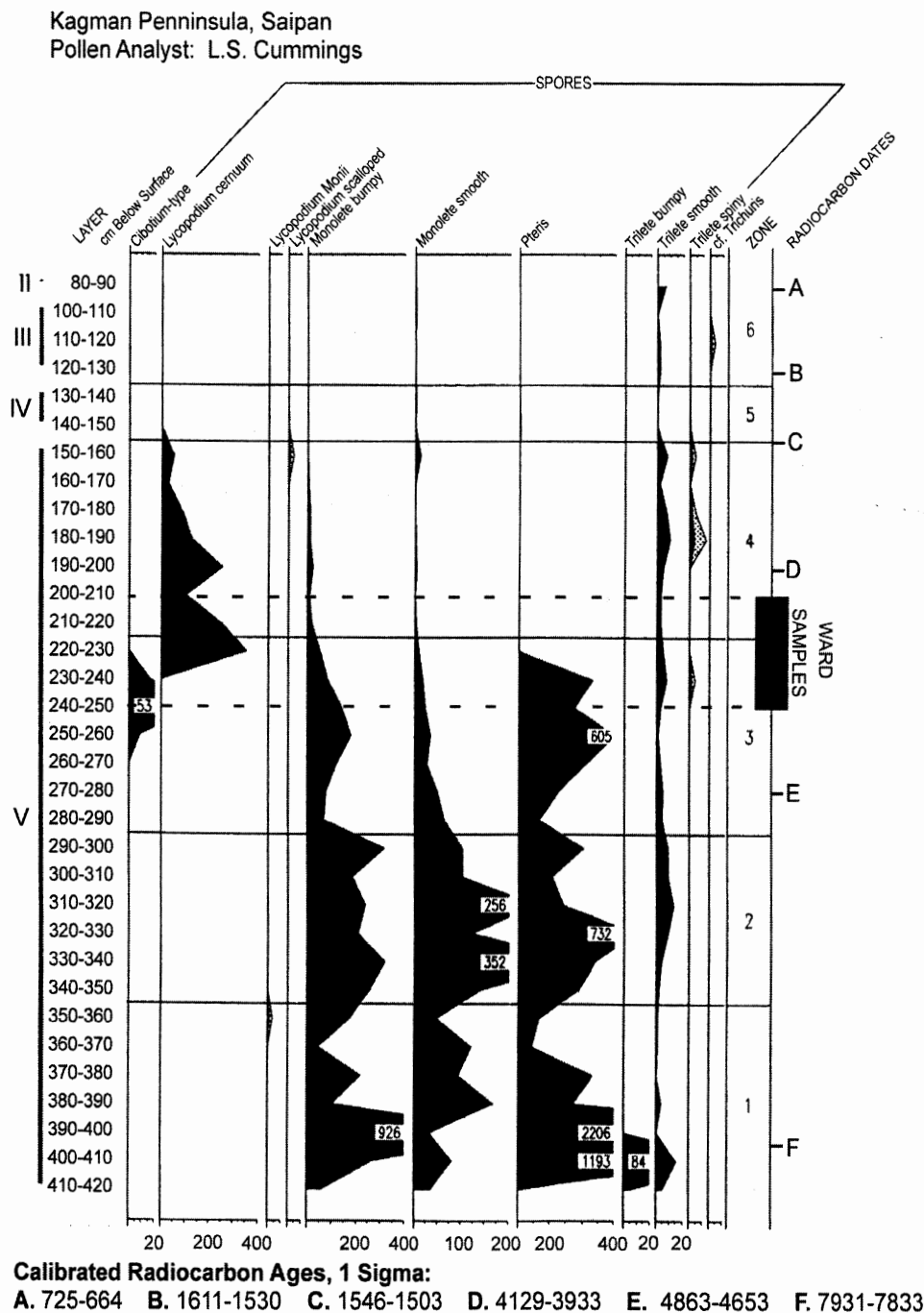


Figure 6: Portion of the pollen diagram for Kagman sinkhole showing spore counts, large sample suite.
Pollen Analyst: L.S. Cummings.

Athens, Jerome V. Ward, Tina Mangieri, and Timothy Rieth, pp. 121-51. Report prepared for Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i. International Archaeological Research Institute, Inc., Honolulu.

Athens, J. Stephen and Jerome V. Ward. 2002. Paleo-environmental evidence for early human settlement in Palau: The Ngerchau Core. *Pacific 2000: Proceedings of the Fifth International Congress on Easter Island and the Pacific* (eds), C.M. Stevenson, G. Lee and F.J. Morin, pp. 165-77. Los Osos, California Easter Island Foundation.

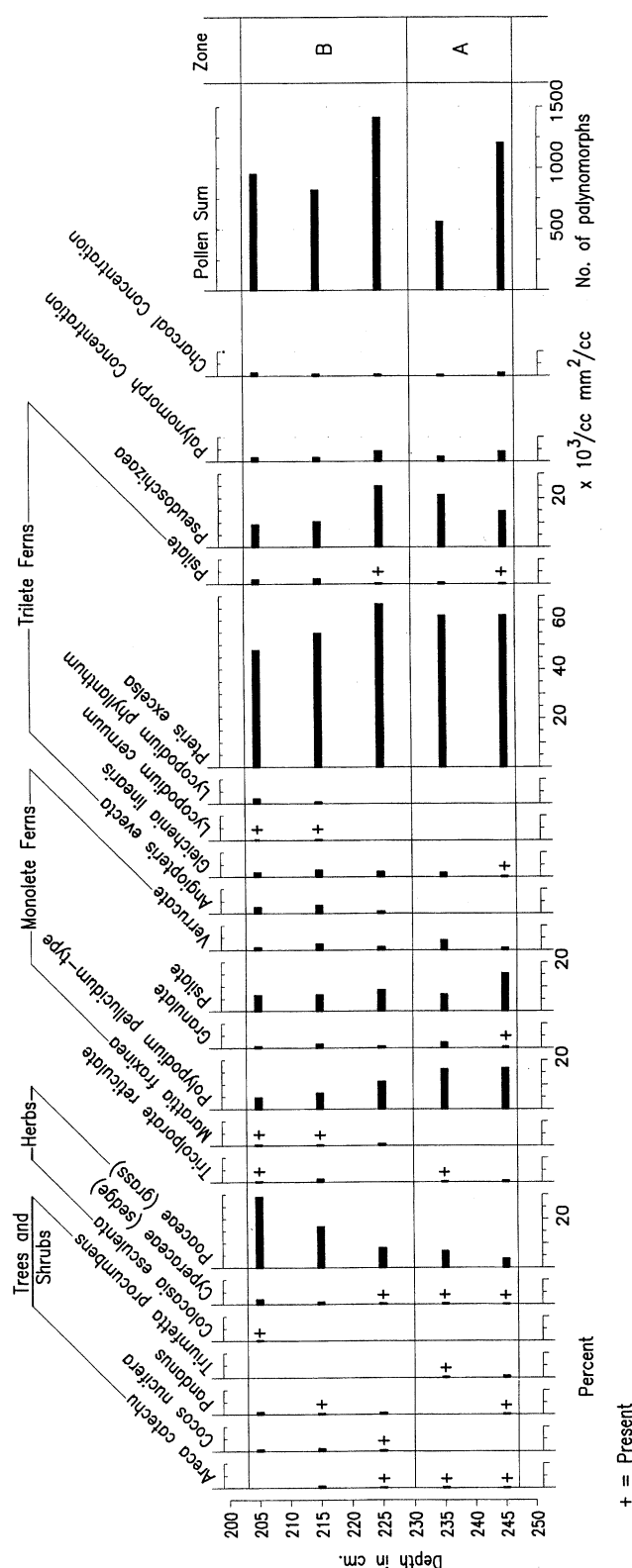


Figure 7. Pollen diagram (histogram style) with charcoal particle concentrations for Kagman sinkhole, small sample suite. Pollen Analyst: Jerome V. Ward.

Athens, J.S. and J.V. Ward. 2004a. Holocene vegetation, savanna origins and human settlement of Guam. In V. Attenbrow and R. Fullagar (eds), *A Pacific Odyssey: Archaeology and Anthropology in the Western Pacific: Papers in Honour of Jim Specht*. Sydney: Records of the Australian Museum, Supplement 29.

Athens, J.S. and J.V. Ward. 2004b. *Holocene Paleo-environment of Saipan: Analysis of a Core from Lake Susupe*. Report prepared for Division of Historic Preservation, Department of Community and Cultural Affairs, CNMI, Saipan. International Archaeological Research Institute, Inc., Honolulu.

Bath, J.E. 1986. *The San Vitores Road Project, Part 1: Final Report*. Prepared for Maeda Pacific Corporation and Maeda Road Construction Co., Ltd., A Joint Venture. Copy of volume in library at International Archaeological Research Institute, Inc., Honolulu.

Bellwood, P. 1979. *Man's Conquest of the Pacific*. Oxford University Press, New York.

Bellwood, P. 1991. The Austronesian dispersal and the origin of languages. *Scientific American* 265(1):88-93.

Bellwood, P. 1997. *Prehistory of the Indo-Malaysian Archipelago* (rev. ed.). Honolulu: University of Hawaii Press.

Bellwood, P., J. Fox and D. Tryon (eds). 1995. *The Austronesians: Historical and Comparative Perspectives*. Canberra: Australian National University.

Blust, R. 1995. The prehistory of the Austronesian-speaking peoples: A View from Language. *Journal of World Prehistory* 9:453-510.

Blust, R. 1996. Austronesian culture history: the windows of Language. In W. H. Goodenough (ed.), *Prehistoric Settlement of the Pacific*, pp. 28-35. *Transactions of the American Philosophical Society* 86(5).

Butler, B.M. 1994. Early prehistoric settlement in the Mariana Islands: new evidence from Saipan. *Man and Culture in Oceania* 10:15-38.

Butler, B.M. 1995. *Archaeological Investigations in the Achugao and Matansa Areas of Saipan, Mariana Islands*. Micronesian Archaeological Survey Report, No. 30. Division of Historic Preservation, Department of Community and Cultural Affairs, Saipan, CNMI.

Craib, J.L. 1993. Early occupation at Unai Chulu, Tinian, Commonwealth of the Northern Mariana Islands. *BIPPA* 13:116-134.

Dega, M.F. and P. Cleghorn. 2001. *Anthropogenic Landscape Change on Saipan: The Sedimentary and Pollen Record from Kagman Peninsula, Saipan, CNMI*. Report prepared for US Army Corps of Engineers, Pacific Ocean Division, Building 252, Fort Shafter, Hawaii'i.

Denham, T. P., S.G. Haberle, C. Lentfer, R. Fullagar, J. Field, M. Therin, N. Porch, B. Winsborough. 2003. Origins of agriculture at Kuk Swamp in the Highlands of New Guinea. 2003. *Science* 301:189-93.

- Diamond, J. 1998. *Guns, Germs and Steel: A Short History of Everybody for the Last 13,000 Years*. London: Vintage, The Random House Group, Ltd (originally published 1997).
- Dodson, J.R. and M. Intoh. 1999. Prehistory and palaeoecology of Yap, Federated States of Micronesia. *Quaternary International* 59:17-26.
- Hunter-Anderson, R.L. and B.M. Butler. 1995. *An Overview of Northern Marianas Prehistory*. Micronesian Archaeological Survey Report, No. 31. Division of Historic Preservation, Department of Community and Cultural Affairs, Saipan, CNMI.
- Kirch, P.V. 2000. *On the Road of the Winds: An Archaeological History of the Pacific Islands Before European Contact*. Berkeley: University of California Press.
- Lum, J.K. and R.L. Cann. 1998. mtDNA and language support a common origin of Micronesians and Polynesians in Island Southeast Asia. *American Journal of Physical Anthropology* 105:109-19.
- Lum, J.K., R.L. Cann, J.J. Martinson, and L.B. Jorde. 1998. Mitochondrial and nuclear genetic relationships among Pacific Island and Asian populations. *American Journal of Human Genetics* 63:613-24.
- Martinson, J.J. 1995. Molecular perspectives on the colonisation of the Pacific. In A.J. Boyce and C.G.N. Mascie-Taylor (eds), *Molecular Biology and Human Diversity*, pp. 171-95. Cambridge: Cambridge University Press.
- Moore, D.R. 2002. *Guam's Prehistoric Pottery and Its Chronological Sequence*. Report prepared for Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, under contract to International Archaeological Research Institute, Inc., Honolulu.
- Moore, D.R., R.L. Hunter-Anderson, J.R. Amesbury and E.F. Wells. 1992. *Archaeology at Chalan Piao, Saipan*. Report prepared for Jose Cabrera and Historic Preservation Division, Department of Community and Cultural Affairs, Saipan, CNMI. Micronesian Archaeological Research Services, Mangilao, Guam.
- Oppenheimer, S. and M. Richards. 2001. Fast trains, slow boats, and the ancestry of the Polynesian Islanders. *Science Progress* 84(3):157-81.
- Pawley, A.K. and M. Ross. 1993. Austronesian historical linguistics and culture history. *Annual Review of Anthropology* 22:425-59.
- Pawley, A.K. and M. Ross. 1995. The prehistory of Oceanic languages: a current view. In P. Bellwood, J.J. Box and D. Tryon (eds), *The Austronesians: Historical and Comparative Perspectives*, pp. 39-74. Canberra: The Australian National University.
- Rainbird, P. 1994. Prehistory in the northwest tropical Pacific: the Caroline, Mariana, and Marshall Islands. *Journal of World Prehistory* 8(3):293-349.
- Russell, S. 1998. *Tiempon I Manmofo'na: Ancient Chamorro Culture and History of the Northern Mariana Islands*. Saipan: Division of Historic Preservation, Commonwealth of the Northern Mariana Islands, *Micronesian Archaeological Survey Report* No. 32.
- Solheim, W.G., II. 1968. The Batungan Cave sites, Masbate, Philippines. *Asian and Pacific Archaeology Series* 2:21-62.
- Spoehr, A. 1957. Marianas prehistory: archaeological survey and excavations on Saipan, Tinian and Rota. *Fieldiana: Anthropology* 48.
- Spoehr, A. 1973. *Zamboanga and Sulu: An Archaeological Approach to Ethnic Diversity*. Pittsburgh: University of Pittsburgh, Department of Anthropology, *Ethnology Monographs* No. 1.
- Su, B., Li J., P. Underhill, J. Martinson, N. Saha, S.T. McGarvey, M.D. Shriver, J. Chu, P. Oefner, R. Chakraborty and R. Deka. 1999. Polynesian origins: insights from the Y chromosome. *Proceedings of the National Academy of Sciences of the United States* 97(15):8225-8.
- Swadling, P. 1997. Changing shorelines and cultural orientations in the Sepik-Ramu, Papua New Guinea: Implications for Pacific prehistory. *World Archaeology* 29(1):1-14.
- Terrell, J.E. 2002. Tropical agroforestry, coastal lagoons, and Holocene prehistory in Greater Near Oceania. In Shuji Yoshida and P. Matthews (eds), *Vegetation in Eastern Asia and Oceania*, pp. 195-216. Osaka: Japan Centre for Area Studies, *Symposium Series* No. 16.
- Terrell, J.E., K.M. Kelly and P. Rainbird. 2001. Foregone conclusions? In search of 'Papuans' and 'Austronesians'. *Current Anthropology* 42(1):97-124.
- Thiel, B. 1989. Excavations at the Lal-lo shell middens, Northern Luzon, Philippines. *Asian Perspectives* 27(1):71-94.
- Tracey, J.I., Jr., S.O. Schlanger, J.T. Stark, D.B. Doan and H.G. May. 1964. *General Geology of Guam*. Washington, DC: US Government Printing Office, *Geological Survey Professional Paper* 403-A.
- Van Heekeren, H.R. 1972. *The Stone Age of Indonesia*. The Hague: Verhandeligen van het Koninklijk Instituut voor Taal-, Land, en Volkenkunde 61.
- Ward, J.V. 1994. A Holocene pollen record from the Pago River Valley, Guam. In R.L. Hunter-Anderson (ed.), *Archaeology in Manenggon Hills, Yona, Guam, vol. III, results of analyses*. Chapter 9.B, pp. 9.34-9.52. Guam: Micronesian Archaeological Research Services, Report prepared for MDI Guam Corporation, Yona, Guam.
- Ward, J.V. 1995. A Holocene Pollen Record From Laguas River, Guam. Appendix B In E.F. Wells, U.K. Prasad and R. Hunter-Anderson (eds), *Archaeology in the Marine Drive Corridor from Agana to Agat, Guam*, pp. 203-224. Guam: Micronesian Archaeological Research Services, Report prepared for the Guam Department of Public Works, Agana, Guam.