

THE EARLY AUSTRONESIAN MIGRATION TO LUZON: PERSPECTIVES FROM THE PEÑABLANCA CAVE SITES

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ABSTRACT

In the northern Philippines, interaction between the foragers of the Peñablanca cave sites and the early Austronesian farmers of the Cagayan Valley (northern Luzon) was established by at least 3500 years ago. Farmers exchanged earthenware pottery, clay earrings, spindle whorls and shell beads with foragers, possibly for forest products. This exchange, however, did not, on present evidence, include cereal-based foods such as rice. The botanical evidence from the cave sites shows a heavy reliance on wild and arboreal food sources.

INTRODUCTION

In the broad rift basin of the Cagayan River in northeastern Luzon, archaeological exploration and excavation since the 1970s has led to the discovery of a number of Paleolithic and Neolithic assemblages. Fossils of Middle Pleistocene mammals have been found along the western side of the Valley (Fox 1971). Pebble tools, such as those of the Cabalwanian pebble tool industry, and flake tool workshops, have been found in some of these open air valley sites (Fox and Peralta 1974), although taphonomic issues over their antiquity are not yet resolved. The western slopes of the Sierra Madre have limestone caves that contain both Palaeolithic and Neolithic assemblages. About nine of these caves have been systematically excavated, including those discussed in this paper (Mijares 2002; Ronquillo and Santiago 1977; Thiel 1980).

Shell midden sites up to 3 meters deep occur close to the channel of the Cagayan River itself. These shell middens are mainly of Iron Age date, after 2500 BP, and have produced polished black incised and impressed pottery. Some are stratified above non-midden habitation layers that contain an older type of red-slipped pottery (Tsang et al. 2001). One shell midden at Magapit, near Lallo township, has this type of red-slipped pottery throughout, some with dentate-stamped decoration (Thiel 1980). Recent excavation in the clay layer beneath the Nagsabaran shell midden has yielded a water buffalo skull possibly dating to c.3500 BP, associated with red slipped pottery and trapezoidal-sectioned adzes (Tsang and Santiago 2001). There is evidence of rice with red-slipped pottery at the Andarayan site by 3700 BP (Snow et al.

1986). These sites also contain spindle whorls, clay *lingling-o* ear ornaments, shell and stone beads, and polished stone adzes (Aoyagi et al. 1993, 1997; Ogawa 2000).

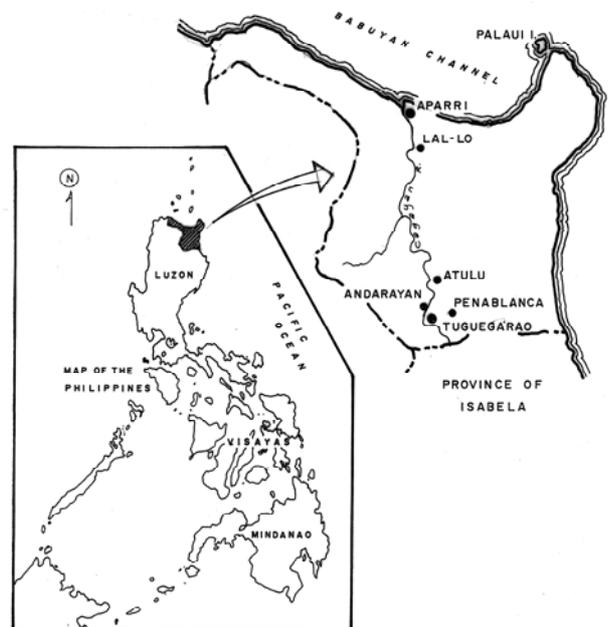


Figure 1. Neolithic sites in northeastern Luzon, Philippines

This paper will present the relationships in material culture and economy during the mid to late Holocene period, since about 4000 BP, between the cave sites in the Callao limestone formation in Peñablanca, immediately east of the Cagayan Valley near Tuguegarao, and the open sites along the Cagayan Valley itself (Fig. 1). In terms of overall chronological sequence, it is clear from the caves that hunting and gathering groups continued to exploit the forest and alluvial plain resources of the valley into the mid-Holocene (Mijares 2005a). Around 4000 to 3500 years ago, a different group of people with a different subsistence economy and a Neolithic technology arrived. In linguistic terms, these were the first speakers of Malayo-Polynesian languages within the Austronesian family to reach the Philippines (Ross 2005; Pawley 2002; Blust 1985). The Malayo-Polynesian linguistic subgroup itself was formed by innovations that occurred after departure from Taiwan (Ross 2005). Both the linguistic

and the archaeological evidence suggest that these people migrated southwards from the islands of Formosa (including Luda and Lanyu). As a result of contacts with them, the populations of indigenous hunters and gatherers soon adopted Austronesian languages, to the extent that only a few lexical traces of their former languages remain, according to Reid (1994; Headland and Reid 1989).

The Austronesians brought with them a suite of cultural materials that included pottery and polished adzes (Bellwood 2005; 1997), cultural markers now used widely to demarcate this new period, for which there had been no previous occurrences in the Philippines. The introduction of ground and polished adze technology was particularly significant. Roger Duff (1970) recognised the clear relationships between Taiwan and Philippine adzes, with the latter being regarded as an elaboration of the former. The quadrangular-sectioned adzes of Duff's Type 2A are the most common form in Southeast Asia, and occur both in Luzon and Taiwan. Duff's types 1A and 1B, with quadrangular cross-sections and stepped and shouldered butts respectively, are also found in both Taiwan and Luzon. In the Cagayan Valley, such stone adzes are found associated with both the red-slipped and the black pottery. In the Peñablanca Cave sites, only Arku Cave, excavated by Barbara Thiel (1990), has yielded any stone adzes, all apparently in burial contexts.

Bellwood (1997; 2005) and Hung (2004; 2005), in correlating pottery dating between 4000 and 3000 BP from Taiwan, the Batanes Islands and Luzon, point to great affinity in form, surface finish and decoration. Of particular interest is the red-slipped surface finish that they trace to southeastern Taiwan, the region that may have been the immediate source-area for the ancestral Malayo-Polynesian movements. Red-slipped pottery has been found in many sites in the Cagayan alluvial floodplain, dating possibly from 4850-3650 cal. BP (Gak-17967) at Pamittan (Tanaka and Orogo 2000), although this is a single isolated determination and all other Cagayan dates for this phase are closer to 3600 cal. BP. The Cagayan red-slipped pottery corresponds well with that from the newly discovered red-slipped pottery site at Chaoliaqiao in southeastern Taiwan, dating to c.4200 BP (Hung 2005).

Hidefume Ogawa (2000; 2002a, b, c) has hypothesized that there are four chronological phases of pottery development in Cagayan Valley prehistory. The first contained red-slipped pottery, some with stamped decoration as found at Magapit. The second contained undecorated red-slipped pottery, such as that stratified below the shell midden levels in many of the alluvial open sites, such as Irigayen. The third contained black pottery with incised decoration, of the type excavated from the lower shell midden layers at Bangag and Catugan. The final phase had undecorated black pottery, found in most upper shell midden layers.

I cannot agree entirely with this general chronology for the Cagayan Valley pottery sequence (Mijares 2005a). The recent excavation of Nagsabaran (Hung pers. comm. 2004), and the archaeological inventory records for

Bangag, Catugan and Irigayen, provide a different story. The red-slipped and black pottery styles occur together in the basal silty clay layers in these sites. Although the red-slipped pottery tends to be more frequent in this early stratigraphic context, some black pottery is already present. Thus, the black pottery does not only appear in the shell midden layer. The possibility that the black pottery found in the early non-midden layers was redeposited from above is unlikely. The soil micromorphological analysis of Nagsabaran (Mijares 2005b) reveals that there was minimal bioturbation, and there was also a 20 cm stratigraphic hiatus between the shell midden above and the red-slipped/black pottery assemblage below.

THE PEÑABLANCA CAVE SITES

In 2003, I undertook the excavation of three caves in the Callao Limestone Formation, in Peñablanca. These are Callao, Eme and Dalan Serkot (Fig. 2). Most cave sites in Peñablanca contain two cultural horizons - a lower with flaked lithic tools, shells and animal bones, and a similar upper assemblage with the addition of pottery sherds.

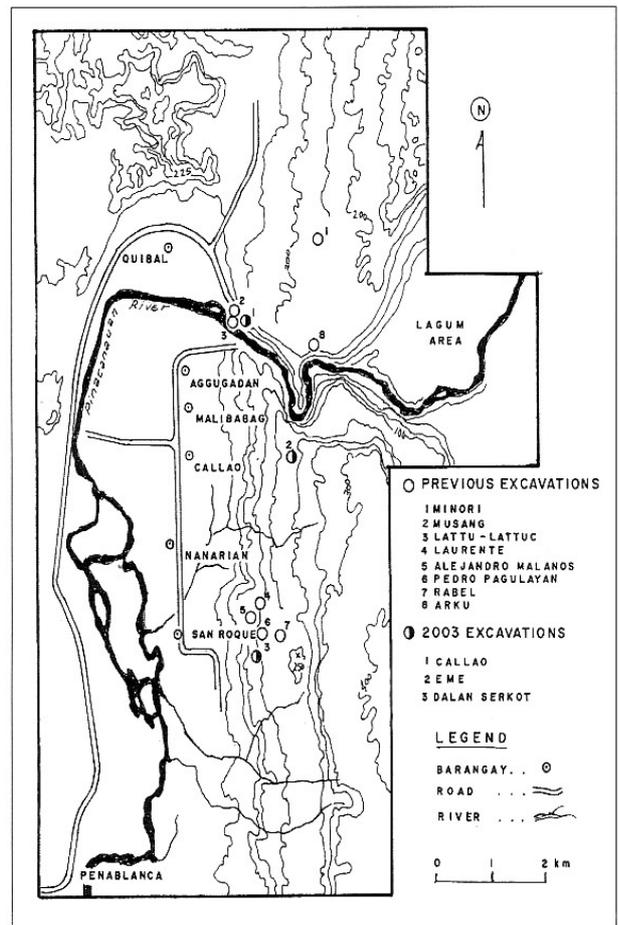


Figure 2. Cave sites excavated in the Peñablanca area

Callao Cave

The ceramic period in Callao Cave contains andesite and chert flake tools; shell beads; clay *lingling-o* earrings; and brown, red-slipped (Fig. 3) and black earthenware sherds. Faunal remains include deer teeth, wild boar tusks and other pig teeth, bat bones, and riverine and landsnail shells. This layer is dated to 3335 ± 34 uncal. BP or 3650-3470 cal. BP (Wk-17010, Oxcal Calibration software) by an AMS radiocarbon determination on charcoal.

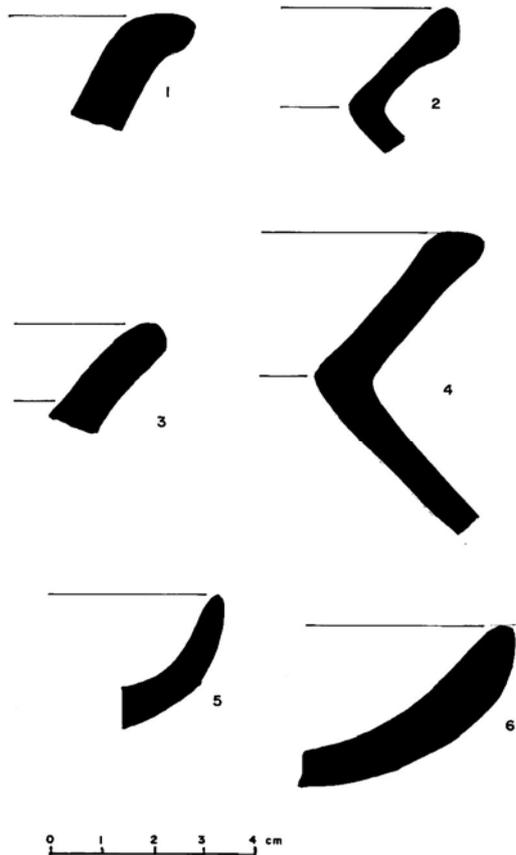


Figure 3. Callao Cave red-slipped pottery rim forms

Maharlika Cuevas' (1980) excavation in Callao Cave recovered a spindle whorl from this level, analysed by Judith Cameron (Cameron and Mijares forthcoming) as similar in size and shape to some found by Chang (1969) in the Fengpitou Neolithic site in southwestern Taiwan.

Macrobotanical remains identified by Victor Paz and Jane Carlos (2005) include wild ramie seeds (*Boehmeria* cf. *platanifolia*), parenchymatous tissues, charred wood, charred nuts and seeds. The wild ramie *Boehmeria* cf. *platanifolia* is a relative of *Boehmeria nivea* (Chinese ramie), which is cultivated for its fibre. Microbotanical remains identified by Jeff Parr (2005) include phytoliths of grasses (*Poaceae*), sedges (*Cyperaceae*), palms (*Arecaceae*) and bamboo.

Of the palm phytoliths found in the preceramic layer, some are identical to *Metroxylon sagu* and some resemble

coconut (*Cocos nucifera*) (Parr 2005). Although Luzon is outside the current known distribution of *Metroxylon sagu* (Ruddle *et al.* 1978), there are other palms used for sago making in Luzon. These include *Arenga*, *Corypha* and *Caryota*. *Caryota cumingi*, a sago-like palm, is abundant in the Sierra Madre and is still gathered by Agta foragers (Griffin 1984, 1985; Griffin and Estioko-Griffin 1978).

Dalan Serkot Cave

The Dalan Serkot ceramic horizon contained earthenware sherds (mixed red-slipped, black and brown), human teeth and phalanges, human skull fragments and a few stone flakes. Some black sherds had incised designs on their rims and carinations. Landsnail shells, deer and pig teeth were also recovered. This layer has an AMS radiocarbon determination on charcoal of 3530 ± 34 uncal. BP or 3900-3690 cal. BP. (Wk-15648).

Dalan Serkot had the fewest botanical remains of the excavated sites. The upper ceramic period horizon contained fragments of parenchymatous tissue, and a single mineralized *Boehmeria* seed. No phytoliths were observed in the samples analysed by Jeff Parr.

Eme Cave

The Eme Cave ceramic horizon contains chert, andesite and basalt flakes, lithic debris, land snails and riverine (*Thiara* sp.) shells, and animal bones. The sherds are mostly black in finish, but there is also some plain brown pottery. A large number of probably mineralised *Boehmeria* cf. *platanifolia* seeds were identified. Charred parenchymatous tissues, charred pieces of nut, and wood fragments were also identified. This layer has a radiocarbon determination on charcoal of 1908 ± 74 uncal. BP or 2010-1690 cal. BP (Wk-14882).

POTTERY ANALYSIS

The sherds retrieved from the cave sites come from small restricted vessels, mostly with everted rims, unrestricted vessels, and large restricted jars. There are no stratigraphic changes in form that can be recognized in the cave sequences. Morphological analysis shows correlations with the pottery found in the Cagayan valley open sites, including the shell middens. Most rim forms are paralleled in the typology formulated by Ogawa for the Irigayen and Conciso valley floor sites (Ogawa 2002b, 2002c). Even some of the brown pottery rim forms from the Peñablanca Cave sites fit within the rim form classification for the Cagayan Valley.

These correlations are further supported by petrographic analyses (Mijares 2006). The inclusions in the cave sherds are derived from the igneous mineral-rich alluvial deposits that occur in the banks and along the flood plain of the Cagayan River. Further comparison with the modern pottery industry in the village of Atulu, in the Cagayan Valley, confirms this inference. We are not able to pinpoint sources precisely, but we can be sure that the pottery was not made in the Peñablanca caves themselves or in their immediate vicinities. There is some site-by-site variation in terms of the types and amounts of

mineral inclusions, but all were derived from sediments weathered from igneous rocks.

MACROBOTANICAL ANALYSIS

Victor Paz and Jane Carlos (2005) subjected three parenchymatous tissue samples from the Eme ceramic layer and one from Dalan Serkot to SEM analysis. The cell dimensions were measured, and compared with reference samples of *Colocasia* sp. (taro), *Dioscorea alata* (Greater yam), *Ipomea batatas* (sweet potato) and *Manihot esculenta* (manioc), the last two of postcolonial American origin. However, there was no overlap with any of these species in terms of cell size, and the Eme cell dimensions were all smaller. Paz and Carlos (2005) surmised that these parenchymatous tissues might have belonged to wild plants with relatively small cell sizes.

LITHIC ANALYSIS

Around 6000 BP, there was a change in the Cagayan Valley to using both chert and volcanic rocks, particularly andesite (Fig. 4), for lithic tools. Previously, only chert was used. The Pinacanauan de Tuguegarao River, which bisects the Callao Limestone Formation, carries many cobble-sized volcanic rocks from outcrops in the Sierra Madre. Most of the flakes, especially those of andesite, carry varying amounts of cortex, and most flakes have cortexed striking platforms. The use of volcanic rocks might have been due to diminishing access to chert raw materials in the area.

All of the flakes from the three caves studied lack intentional retouch between 6000 and 3500 BP. This signifies a lack of interest in the curation of flakes, and indicates the users had sufficient raw material simply to knock off a new flake rather than retouch one that had become blunt or dull from usage. Though there are a few blade-like flakes from this period, they are very few and show no further modification. The more 'formal' stone implements from the previous Late Pleistocene layer in Callao Cave seem to have given way to a simpler and more expedient lithic technology (Mijares 2001, 2002).

The same raw materials and the same simple hard hammer percussion technique persisted, even after the introduction of pottery into these cave sites from the Cagayan Valley, about 3500 years ago. At Eme Cave, flake tools were still associated with earthenware pottery at around 1900 BP.

Use-wear analysis of flakes from both the preceramic and the ceramic horizons shows that about half were used on hard contact materials, possibly bamboo, palm and rattan, which are ubiquitous in the region (Mijares 2005a). These activities might have included the manufacture of spears, bamboo knives, traps, or the making of mats. Some flakes were used in meat processing, as they exhibit soft contact use wear attributes. Bones of pig (*Sus*) and deer (*Cervus*) were associated with the assemblages.

The flake tools from Peñablanca were manufactured using a simple percussion technique. The aim was to produce a good working edge that could be used for a number of tasks. There was no need to produce

specialized tools, and the simplicity and expediency of the technology made such flake tools very adaptable in the tropical karst environment of the region.

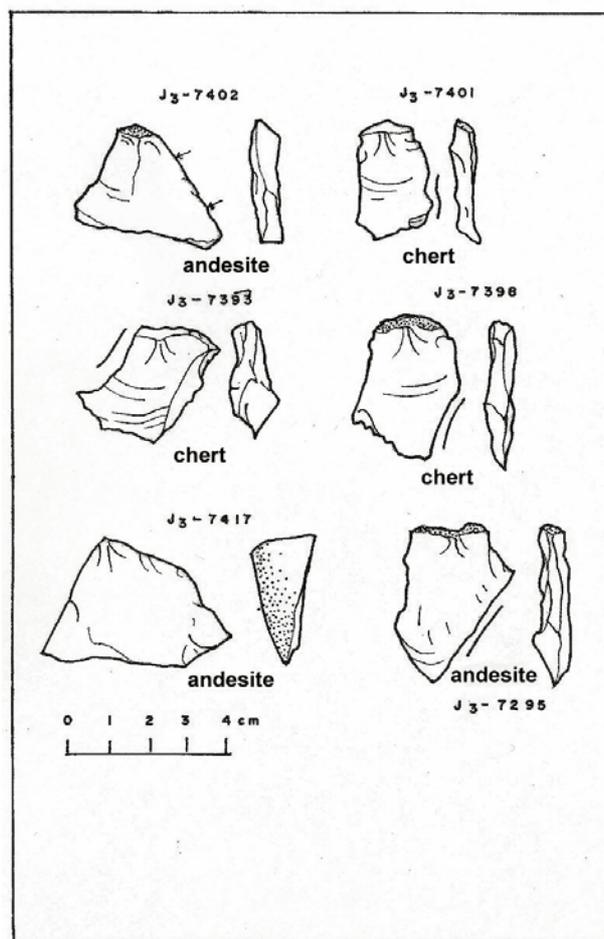


Figure 4. Callao Cave ceramic period flakes

DISCUSSION

The migration from Taiwan into Luzon by early Malayo-Polynesians was not necessarily a massive single-event phenomenon. And it probably did not emanate from just from one area in Taiwan. The presence by about 3500 BP of black pottery together with the red-slipped pottery in sites such as Nagsabaran, Irigayen, Bangag and Catugan in the Cagayan Valley, and Callao and Dalan Serkot Caves in Peñablanca, points to a possible additional contribution from sites such as Fengpitou in southwestern (rather than southeastern) Taiwan. Fengpitou has produced black pottery dating to as early as c. 3800 BP (Chang 1969). The close affinity of the spindle whorl found in Callao Cave with one from Fengpitou adds to this observation.

Besides pottery, other cultural materials apparently brought in by Malayo-Polynesian populations, not necessarily all at the same time, were clay and stone *lingling-o* earrings, baked clay spindle whorls, and shell and stone beads. In terms of economic subsistence,

Bellwood (2005, 1997) believes that the Austronesians brought with them domesticated animals such as pigs and cultigens such as rice. The Cagayan Valley has broad alluvial plains protected by mountain ranges, regularly enriched by inundation by the Cagayan River - it is ideal for rice cultivation today.

There is so far only limited evidence of rice cultivation in Luzon during this period, mainly the AMS-dated rice husk inclusions in the red-slipped pottery from Andarayan (Snow *et al.* 1986). To date we have not found any Cagayan sites similar to the deeply buried alluvial plain sites within the Tainan Science-Based Industrial Park in southwest Taiwan, from which abundant charred rice and foxtail millet samples have been collected (Tsang 2005).

In the Peñablanca cave sites, we also do not have any evidence of cereal-based subsistence, either cultivated locally or acquired through exchange. From the ceramic analysis we know that earthenware vessels were coming into the caves from the Cagayan valley, possibly through exchange, which would also have included shell beads, spindle whorls, and clay *lingling-o* earrings. But economic exchange of cereals was either absent, or so far not archaeologically visible. The analysis of both micro- and macro-botanical remains has revealed a subsistence strategy based on foraging wild roots (unidentified parenchymatous tissues), possibly *Caryota* palms, nuts and other arboreal forest products. These plant carbohydrates supplemented the hunting of pig and deer and the collection of shellfish from the river. If the ceramic phase Holocene hunter-gatherers in the Peñablanca Caves were exchanging forest products for cereal foods such as rice, then they were not consuming them inside the caves. Possibly they were not acquiring cereals at all, especially if rice production was not abundant enough for exchange or if the lowlanders were cultivating other crops. Paz (2002) has suggested that rice might have been replaced widely in the Philippines by cultigens such as yams (*Dioscorea alata*) and taro, and Latinis (2000) has pointed to the possible importance of an arboreal-based subsistence strategy.

In the foothills of the Sierra Madre, the middle Holocene (ceramic phase) hunter-gatherers might have been gathering plants for fibre, such as wild ramie (*Boehmeria cf. platanifolia*), rattan, the bark of mulberry trees, and grasses and sedges. These fibres could have been initially processed in the caves, e.g. by stripping the bark of a wild ramie stem with a simple unretouched flake (Cameron and Mijares forthcoming). They could have traded these forest products with lowlanders in exchange for pottery and other items, as extant hunter-gatherers like some Luzon Agta still do today (Griffin 1984, 1985; Griffin and Estioko-Griffin 1978; Headland 1986; Peterson 1978).

By 2500 BP, the sea had lowered to its present level, falling from about three meters above present level at c.4500 BP (Berdin *et al.* 2003). This marine retreat probably contributed to the increase in estuarine and freshwater shellfish (*Batissa childreni* and *Corbicula*

fluminea) in the lower reaches of the Cagayan River. These were then collected and consumed by the inhabitants of the Cagayan Valley in very large numbers commencing around 2000 BP.

The shell midden formation phase in the Cagayan valley also signalled the decline of the red-slipped and the predominance of the black pottery. This can also be seen in Eme Cave, where the ceramic period is contemporaneous with the shell midden formation phase and the black pottery tradition in the valley itself. Eme Cave has only black and plain pottery during this period.

ACKNOWLEDGEMENTS

This research has benefited from the support of many people. First of all I would like to express my deepest gratitude to Peter Bellwood, Atholl Anderson, Matthew Spriggs, Glenn Summerhayes, and Johan Kamminga for their advice. I am also grateful for the contributions of specialists who conducted different material analyses: Victor Paz and Jane Carlos for conducting the macrobotanical analysis, Jeff Parr for his phytolith analysis, Angel Bautista and Carmencita Mariano for their identification of the faunal remains, Judith Cameron for her analysis of the spindle whorl, and Helen Lewis for her patience in teaching me methods of soil micromorphology analysis.

I also would like to extend my gratitude for the support of the National Museum of the Philippines and, in particular, Director Corazon Alvina, Wilfredo P. Ronquillo, Eusebio Dizon, Cecilio Salcedo and Maharlika Cuevas. The National Museum personnel who assisted in the excavations were Clyde Jago-on, Alexandra De Leon, Nida Cuevas, Pablo Pagulayan and Domeng Pagulayan. Eduardo Bersamira and Antonio Peñalosa drew the scientific illustrations. My wife Aileen May Paguntalan-Mijares provided her unwavering support in all my endeavours.

REFERENCES

- Aoyagi, Y., Aguilera, M., Ogawa, H. & Tanaka, K. 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.
- Aoyagi, Y., Ogawa, H. & Tanaka, K. 1997. Excavation, and Ornaments Discovered at the Magapit Shell-midden Site, in Northern Luzon. *The Journal of Sophia Asian Studies* 167-180.
- Bellwood, P. 1997. *Prehistory of the Indo-Malaysian Archipelago*. Honolulu: University of Hawaii Press.
- Bellwood, P. 2005. *The First Farmers: The Origins of Agricultural Societies*. Oxford: Blackwell Publishing.
- Berdin, R., Siringan, F. & Maeda, Y. 2003. Holocene Relative Sea-level Changes and Mangrove Response in Southwest Bohol, Philippines. *Journal of Coastal Research* 19: 304-313.
- Blust, R. 1985. The Austronesian Homeland: A linguistic perspective. *Asian Perspectives* 26: 45-67.
- Cameron, J. & Mijares, A. forthcoming. Report on an analysis of spindle whorl from Callao Cave, Peñablanca.

- Northeastern Luzon, Philippines. *Hukay. Journal of the University of the Philippines Archaeological Studies Program*.
- Chang, K. 1969. *Fengpitou, Tapenkeng, and The Prehistory of Taiwan* New Haven: Yale University Publications.
- Cuevas, M. 1980. Preliminary Report on the Archaeological Excavation conducted at Callao Caves. Manuscript of the National Museum. Manila.
- Duff, R. 1970. *Stone Adzes of Southeast Asia* Christchurch: Canterbury Museum.
- Fox, R. 1971. Ancient Man and Pleistocene Fauna in Cagayan Valley, Northern Luzon Philippines. Manuscript of the National Museum. Manila.
- Fox, R. & Peralta, J. 1974. Preliminary Report on the Paleolithic Archaeology of Cagayan Valley, Philippines, and the Cabalwanian Industry. *First Regional Seminar on Southeast Asian Prehistory and Archaeology*. Manila.
- Griffin, P. B. 1984. Forager Resources and Land Use in the Humid Tropics: The Agta of Northeastern Luzon, the Philippines. IN Schrire, C. (ed.) *Past and Present in Hunter Gatherer Studies*, New York, Academic Press, Inc.
- Griffin, P. B. 1985. A Contemporary View of the Shift from Hunting to Horticulture: The Agta Case. IN Misra, V. N. & Bellwood, P. (Eds.) *Recent Advances in Indo-Pacific Prehistory*, pp. 349-352 New Delhi: Oxford and IBH.
- Griffin, P. B. & Estioko-Griffin, A. 1978. Ethnoarchaeology in the Philippines. *Archaeology* 31: 34-43.
- Headland, T. N. 1986. Why Foragers do not Become Farmers: A Historical Study of Changing Ecosystem and its Effect on the Negrito Hunter-Gatherer in the Philippines. Unpublished PhD dissertation, Department of Anthropology. University of Hawaii.
- Headland, T. N. & Reid, L. 1989. Hunter and Gatherers and their Neighbors from Prehistory to the Present. *Current Anthropology* 30: 43-46.
- Hung, H. C. 2004. A sourcing study of Taiwan stone adzes. *Bulletin of the Indo-Pacific Prehistory Association* 24: 57-70.
- Hung, H. C. 2005. Neolithic Interaction between Taiwan and Northern Luzon: The Pottery and Jade Evidence from Cagayan Valley. *Journal of Austronesian Studies* 1: 106-130.
- Latinis, K. 2000. The Development of Subsistence System Models for Island Southeast Asia and near-Oceania: The Nature and Role of Arboriculture. *World Archaeology* 32: 41-67.
- Mijares, A. S. 2001. An Expedient Lithic Technology in Northern Luzon, Philippines. *Lithic Technology* 26: 138-152.
- Mijares, A. S. 2002. *The Minori Cave Expedient Lithic Technology*. Quezon City: University of the Philippines Press.
- Mijares, A. S. 2005a. The Archaeology of Peñablanca Cave Sites, northern Luzon, Philippines. *Journal of Austronesian Studies* 1: 65-93.
- Mijares, A. S. 2005b. The Nagsabaran Shell Midden Site: A soil micromorphology approach. *Hukay. Journal of the University of the Philippines Archaeological Studies Program* 8: 1-12.
- Mijares, A. S. 2006. Lowland-Upland Interaction: The 3500-1500 BP ceramic evidence from Penablanca Cave Sites, Northeastern Luzon, Philippines. In Glover, I., Bacus, E. & Piggot, V. (eds.) *Uncovering Southeast Asia's Past*, pp. 359-377 Singapore: National University of Singapore Press.
- Ogawa, H. 2000. Introduction: The excavation of Lal-lo shell midden. In Ogawa, H. (ed.) *Excavation of Lal-lo Shell Midden*, pp. 1-15 Tokyo: Tokyo University of Foreign Studies.
- Ogawa, H. (ed.) 2002a. *Archaeological Research on the Lower Cagayan River*, Tokyo: Tokyo University of Foreign Studies.
- Ogawa, H. 2002b. Chronological Context of Non-Decorated Black Pottery Phase from Lallo Shell Middens-Analysis of the Black Pottery from Conciso Site in the Lallo Shell Middens, Northern Luzon, Philippines. In Ogawa, H. (d.) *Archaeological Research on the Lower Cagayan River*, pp. 103-115 Tokyo: Tokyo University of Foreign Studies.
- Ogawa, H. 2002c. Chronological Study on the Red-slipped Pottery of Lallo Shell Midden Special Reference on the non decorated Red-slipped Pottery under the Shell Middens. In Ogawa, H. (ed.) *Archaeological Research on the Lower Cagayan River*, pp.79-101 Tokyo: Tokyo University of Foreign Studies.
- Parr, J. 2005 Report on the Analysis of Microbotanical remains from Callao Cave. unpublished manuscript, ANH-RSPAS-ANU. Canberra.
- Pawley, A. 2002. The Austronesian Dispersal: Languages, Technologies and People. In Bellwood, P. & Renfrew, C. (eds.) *Examining the farming/language dispersal hypothesis*, pp.251-274 Cambridge: Mcdonald Institute of Archaeological Research, University of Cambridge.
- Paz, V. 2002. Island Southeast Asia: Spread or Friction Zone? In Bellwood, P. & Renfrew, C. (eds.) *Examining the farming/language dispersal hypothesis*, pp.275-286 Cambridge: Mcdonald Institute of Archaeological Research, University of Cambridge.
- Paz, V. & Carlos, J. 2005. Eme, Callao and Dalan Serkot Caves: Analysis of plant macro-remains. unpublished manuscript-UP ASP. Quezon City.
- Peterson, J. 1978. *The Ecology of Social Boundaries: Agta Foragers of the Philippines*. Urbana: University of Illinois Press.
- Reid, L. 1994. Unravelling the linguistic histories of Philippine Negritos. In Dutton, T. & Tryon, D. (eds.) *Language Contact and Change in Austronesian World*, pp. 443-476 Berlin: Mouton de Gruyter.
- Ross, M. 2005. The Batanic Languages in relation to the Early History of the Malayo-Polynesian Subgroup of Austronesian. *Journal of Austronesian Studies* 1: 1-24.
- Ronquillo, W. & Santiago, R. 1977. Archaeological Caves and Open Sites Exploration at Penablanca, Cagayan Province. Manuscript of the National Museum. Manila.
- Ruddle, K., Johnson, D., Townshed, P. & Rees, J. 1978. *Palm Sago: A Tropical Starch from Marginal Lands*, Canberra: Australian National University Press.
- Snow, B. E., Shutler, R., Nelson, D. E., Vogel, J. S. & Southon, J. R. 1986. Evidence of rice cultivation in the Philippines. *Philippine Quarterly of Culture and Society* 14: 3-11.

- Tanaka, K. & Orogo, A. 2000. The Archaeological Excavation at Pamittan Site, Barangay Lanna, Solana, Cagayan Province, Philippines. *Journal of Environmental Studies* 8: 113-141.
- Thiel, B. 1980. Subsistence Change and Continuity in Southeast Asian Prehistory.unpublished PhD dissertation, Department of Anthropology. Illinois: University of Illinois at Urbana-Champaign.
- Thiel, B. 1990. Excavation at Arku Cave, Northeastern Luzon Philippines. *Asian Perspectives* 21: 229-264.
- Tsang, C.-H. & Santiago, R. 2001. Recent Archaeological Studies in Northern Luzon and Their Implication for the Prehistoric Relationship between Taiwan and the Philippines. Paper presented at the International Conference on Austronesian Cultures: Issues relating to Taiwan. Taipei.
- Tsang, C.-H., Santiago, R. & Hung, H. C. 2001 Preliminary Report on the 2nd Excavation of Nagsabaran Site. Annual report of the Asian-Pacific Project of Academia Sinica. Taipei.
- Tsang, C.-H. 2005 Recent discoveries at a Tapenkeng culture site in Taiwan: implications for the problem of Austronesian origins. In Sagart, L., Blench, R. & Sanches-Mazas, A. (eds.) *The Peopling of East Asia*, pp. 63-74 London: RoutledgeCurzon.