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# Evolution of prehistoric lithic industries of the Philippines during the Pleistocene

## *L'évolution des industries lithiques préhistoriques des Philippines au cours du Pléistocène*

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ABSTRACT

During the past ten years, our knowledge of Paleolithic industries in the Philippines has grown thanks to new excavations and discoveries of stone implements, but also thanks to new studies on older collections. The study of knapped stones in the Philippines dates back to the 1920s. At this time, stone tools were used as type fossils to propose an initial chronology of prehistoric cultures. Later, taxonomies and functional analyses were used to assess lithic assemblages until the end of the 1990s. Current functional technology and traceological methods allow us to propose new hypotheses about prehistoric behavior during the Pleistocene, and also technological developments across the archipelago during the Paleolithic.



RÉSUMÉ

Depuis dix ans, les connaissances des industries paléolithiques des Philippines a progressé grâce à de nouvelles fouilles et aux découvertes de matériel, mais aussi grâce aux nouvelles études des collections historiques. L'intérêt pour la pierre taillée aux Philippines remonte aux années 1920. À cette époque, les outils en pierre sont des fossiles directeurs pour élaborer une première chronologie préhistorique. Les typologies et les analyses fonctionnelles vont être ensuite utilisées jusque dans les années 1990. Les méthodes technologiques et tracéologiques actuelles permettent de proposer de nouvelles hypothèses concernant le comportement des préhistoriques au cours du Pléistocène, mais aussi un développement technologique de l'archipel au cours du Paléolithique.



## 1. Introduction

In Southeast Asia, Prehistoric research is confronted with a dilemma of chronology. In Europe, many chronological categories are based on the linear and often very obvious evolution of stone tools. However, we observe in Southeast Asia a long-continuing existence of apparently

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unchanging stone tool traditions and a mixture of different technological systems within the same period.

As in the rest of Southeast Asia, archaeologists working in the Philippines have been trying to resolve this dilemma since the beginning of lithic studies in the 1920s. Nevertheless, this problem persists not only because many historical discoveries were not recovered in stratigraphic contexts but also because of an inappropriate methodology for studying Southeast Asian stone tools.

A number of lithic assemblages and artefacts have been discovered in recent excavations in the islands of Palawan, Mindanao and Luzon since 2000. Their analysis using current technological and traceological methods provides us new data for understanding the evolution of human behaviour during the Pleistocene.

## 2. Historical background of the lithic studies in the Philippines between 1920 and 1990

Because the study of Philippine Archaeology began rather late, a slow and continuous advancement of research and theoretical models of the evolution of lithic assemblages, their morphology, production technologies and function assembled by a large number of researchers and archaeological institutions in Europe did not happen in the Philippines as early as in the rest of Southeast Asia. Studies on lithic production technologies and the knapping process of flaked artefacts were rather neglected at first (Fox, 1970a, 1970b). Analyses of Philippine lithic materials focused on forms and classifications. However, the establishment of a chronological classification was prone to fail due to the wide absence of recurring "type fossils", indicative of a certain place in context with a specific period (Dizon, 1994; Evangelista, 1960; Henson, 1977; Ronquillo, 1985). Consequently, a shift to technological approaches in lithic analysis occurred in the late 1970s and early 1980s.

The earliest descriptions of lithic materials were presented by H. Otley Beyer. His work relates to a collection of sixty tools recovered in the late nineteenth and early twentieth century by various collaborators, supplemented by a corpus of surface finds, discovered between 1926 and 1948 in the southwestern part of Luzon, the Visayas and the Sulu archipelago (Beyer, 1931, 1947). Although analysis focused more on polished stone tools rather than what he called "Palaeoliths", he applied a comparative descriptive method to all his recorded finds. Each artefact was morphologically chartacterised and then compared with Chinese and Mainland Southeast Asian material in order to develop a chronology of prehistoric Philippines as part of a regional chronology of Southeast Asia.

Some "palaeoliths" are thus classified as products of the Middle Pleistocene analogous to those found in the Pacitanian sites of East Java. Beyer's work was furthermore influenced by Hallam L. Movius. Between 1937 and 1938, Movius travelled around India and various parts of Southeast Asia and China to study the different lithic industries and compare them to the lithic traditions of Europe. He determined a line that separated two cultural regions of the Early Palaeolithic roughly along northern India. In this scheme, the characteristic artefacts west of the "Movius Line" are Acheulean handaxes and other bifacial cobble tools (e.g., the indian "Soan" culture) while those in the eastern part are characterized by simple chopping tool assemblages attributed to *Homo erectus* (Pacitanian industry in Java, Anyathian in Burma and Choukoutian in China). Consequently, Movius proposed that those eastern Asian tool forms were archaic and technologically backward (Movius, 1944). The Movius Line theory is still being debated today. Although bifacial tools have now been discovered in Vietnam, China, Indonesia and the Philippines, several authors still support the Movius Line theory (Norton and Bae, 2009; Norton et al., 2006). The preferred arguments are that the frequency of handaxes in the eastern part of the line is much less than in the western part, and that the morphology of these artefacts is very different. But this last assumption is only based on a morphometric analysis. Boëda demonstrated in a techno-functional study that the western bifacial tools were technically more advanced than those from the eastern ones, which were local inventions disconnected from western influence (Boëda, 2005).

After Beyer's death, Robert Fox took the leadership of Philippine Archaeology as head of the Anthropology Division of the National Museum of the Philippines. While recognizing the merits of the basic research of his predecessor, he tried to establish a chronology of Philippine prehistory by conducting systematic field research: "*When Philippine chronology and culture-history have been firmly established by controlled excavations in the Philippines, it will then be possible to attempt details cultural and chronological comparisons with the archaeological data from neighbouring areas of South and East Asia and the Pacific*" (Fox, 1967, p. 90–91). Robert Fox's approach marked a significant change in Philippine Field Archaeology, although his knowledge of lithic analysis was empirical because his background was in social anthropology rather than archaeologiy. Nonetheless, he applied the established theories of his time to his method, which had significant impact for the Prehistory of the Region. Also, his work was from the beginning influenced by evolutionary and diffusionist theories, including the Movius principles for his study of the pebble tools of the Cabalwanian. His idea of a classification was however quite innovative for that time. "*Most of the existing classifications of unifacial pebble-cobble tools available to the authors stress functional descriptions of the tool types or given them terms based on use – axes, picks, cleavers, points, choppers, scrappers and so forth. We do not believe that this is necessary, that the description of the tools can be independent of speculations about the use*" (Fox and Peralta, 1974, p. 110).

The eight divisions of his system were well defined regardless of their possible use. His classification was based on the criteria of raw material, patina, weight, dimensions (length, width, thickness), cortex density and presence and form of retouch. The classification of flaked artefacts was based on their morphology[1]. Moreover, blanks were listed in three different categories: sharpening flakes, used flakes and retouched flakes. This classification was

[1] Cabalwan prehistoric assemblages are from sites in Cagayan, northern Luzon. Tabon, Guri and Duyong assemblages are from sites located around Lipuun Point on the Southwest coast of Palawan Island.

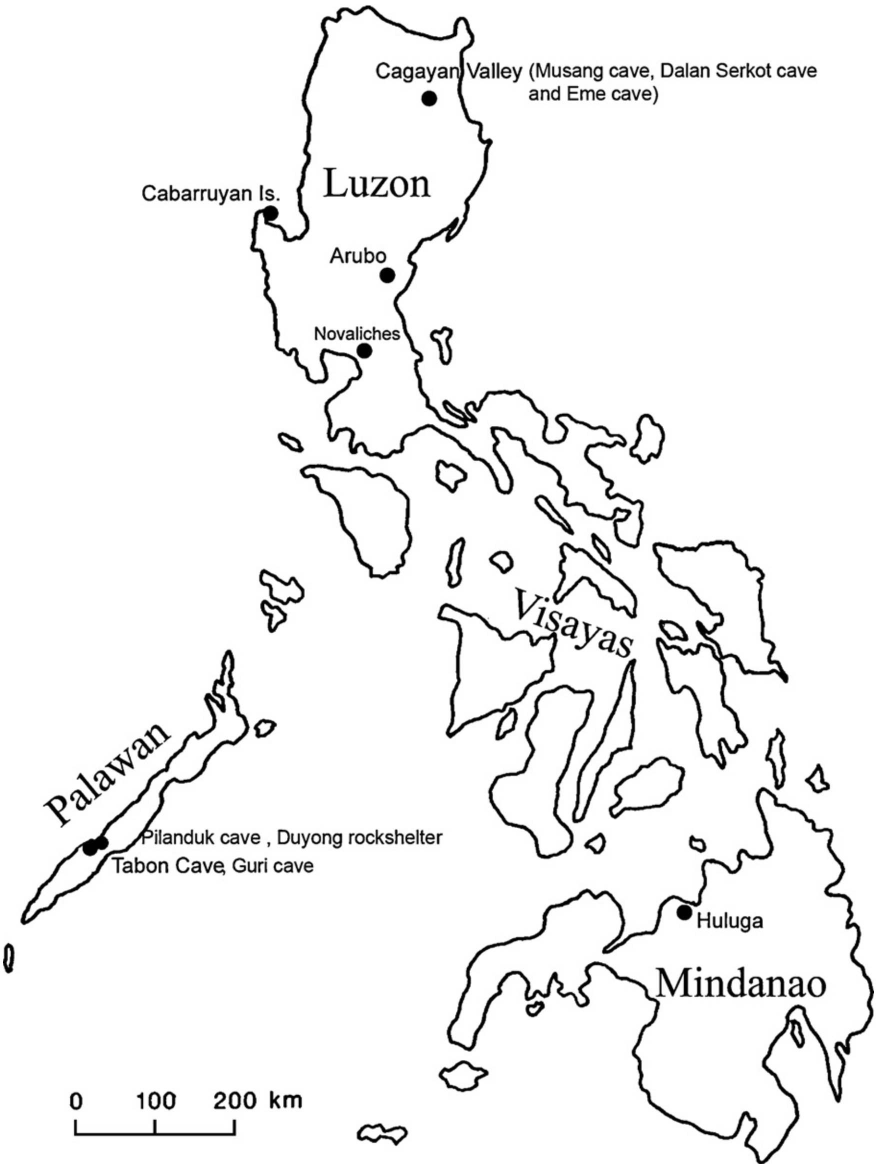



**Fig. 1.** Map of the Philippines with main archaeological sites.

**Fig. 1.** Carte des Philippines montrant les principaux sites archéologiques.

complemented by a description of typical forms. According to Fox, the Tabonian tradition was characterized by the recurring presence of the so-called *Kuba* core-scraper as a characteristic "type fossil" found in the levels of Tabon and Guri Cave in Palawan. Other modified flakes were analyzed according to the location, distribution and morphology of their retouch. The cores were as well classified based on the degree of preparation (Fig. 1, Fox, 1977).

Contrary to what he stated for the pebble tools, he tried to apply a functional reflection. For flaked artefacts, used unmodified flakes are highlighted first. Their size (length, width, and thickness), weight but also the angle of the used edge (blunt, medium or sharp) and the extent of the use-wear were examined. Following Binford's hypothesis of a general failure of the first hominids to make standardized stone tools (Binford and Binford, 1968) and using ethnographic observations, Fox suggested that the amorphous character of the Philippines' lithic material does not reflect any cultural backwardness but rather the poor preservation of more sophisticated equipment made of perishable organic raw materials. He also insisted on the relationship between tool function and specific activities. Thus, two general functions might have existed for the stone industry: the maintenance of sharpening wooden and other organic material tools and an extractive function in which the stone tool is used for the processing of various environmental resources (Binford and Binford, 1968). This analysis resolves the discussion begun in 1964 by Shawcross in

New Zealand around the amorphous blanks which likewise could not be compared to their European counterparts (Shawcross, 1964).

New criteria were also set for functional analysis, based on comparative ethnographic information (Gould et al., 1971; White, 1969; White and Thomas, 1972). They were mainly based on work underway in Australia. Indeed, the *pirri* point and the *muduk* (bone tool), "type fossils" for the Pirrian and Mudukian's cultures, were replaced in the archipelago by the *Kuba* core-scraper as characteristic of the Tabonian tradition (Mulvaney, 1966).

Perhaps not completely unaffected by the harsh political climate during the Cold War, Robert Fox dismissed Sergej Semenov's innovative approach of microscopic use-wear analysis (Semenov, 1964) as not applicable to Philippine materials. He regarded the geometric form of the active edge and the concept of a short operating life of tools, developed by Gould on Aboriginal tools (scrapers and knives) of the Southwest desert of Australia (Gould et al., 1971), as more relevant to the identification of tool function, despite the fact that Gould himself as well as other authors (White, 1969; White and Thomas, 1972) adopted Semenov's principle of edge wear research in conjunction with ethnographic analogies and comparisons to a certain extent at least and applied this on material from Sahul. In any case, the review of the functional analysis used by Fox shows that for the first time in the Philippines, stone tools were considered witnesses of human activity. The amorphous nature of flaked tools was accepted and the research thus focused on the different states of sharpness. Fox's research influenced all succeeding lithic analyses in the Philippines.

The use-wear analysis that developed in the Philippines since the 1970s was mainly influenced by American and Australian scholars (Broadbent, 1979; Gould et al., 1971; Kamminga, 1982; Keeley, 1980; Odell, 1981; Tringham et al., 1974; White and Thomas, 1972; Wilmsen, 1970). However, at first the usual metric criteria were associated with only macroscopic observations and hand lenses, in some cases low-powered microscopy on polished and sharp angles appearing on tools. In 1972, Bevacqua analyzed the industry from Sohoton Cave. He characterized the use-wear of the edges of blanks according to their delineation, angle and length (Bevacqua, 1972). The same attributes were selected by Peterson in 1974 for the study of the stone implements from Pintu rockshelter (Peterson, 1974). Between the end of the 1970s and the beginning of the 1980s, Ronquillo and Thiel applied a more advanced approach. For the study of the lithic artefacts from Rabel Cave in North Luzon, Ronquillo correlated metric criteria to the delineation of the edges, the angle inclination and the morphology of edge scarring at low magnifications (Ronquillo, 1981). He used the Wilmsem method with regard to the angle. Also, he took into account the assumptions suggested by comparative ethnography. Also Thiel applied the Low Power approach (Odell, 1981) for the lithic assemblages of Arku and Musang Cave (Thiel, 1978, 1990a, 1990b). She also used the Gould method, which develops a classification of micro-cuts depending on the type of rock (sedimentary siliceous or not) from Australian material observed with a magnification of 30 and 50 times (Gould et al., 1971). In his study of the lithic industry of Laurente Cave in Cagayan, Florante Henson focused on the variability of angles of the different edges, mass, perimeter and length of the portion used (Henson, 1978). A variation of the macroscopic analysis was presented by the Australians Coutts and Wesson who used macroscopic and microscopic methods to establish nine categories of macro-changes and 12 categories of micro-alterations for their analysis of the lithic industry from sites on Panay Island (Coutts, 1983). Ogawa used the same approach as Ronquillo for the analysis of material from the Lattu Lattuc Cave in Cagayan valley; however, he included an experimental program for the identification of use traces and added a study of micropolish adopting Kamminga's attribute system on use polishes (Kamminga, 1979; Ogawa, 1984).

Studies of lithic industries in the Philippines seem to have passed without transition from chronological classifications to functional analyses. The technological approach has mostly been either ignored or neglected. Fox considered refitting to *"attempt reconstruction of the flakes into their original nodules which will provide us with the data necessary to thoroughly understand the technology of flaking used by these ancient hunters and food gatherers"* (Fox, 1970a, 1970b, p. 14). Bevacqua tried to define a specific knapping process in Sohoton (Bevacqua, 1972). Then Cherry provided more evidence on the Buadian industry in Samar Island to represent a blade technology (Cherry, 1978). But the different analyses in the the 1980s never suggested any knapping process as for Europe or Africa. The absence of a regular form of blank is interpreted as a lack of core structure. And all prehistoric lithic industries of the Philippines had been defined as "smash and grab" (Coutts and Wesson, 1980).

More comprehensive, multi-level lithic studies incorporating microscopic low and high power use-wear analysis have been conducted in the Philippines since the 2000s. With the opening of the Lithic Studies Laboratory at the Archaeological Studies Program of the University of the Philippines, it became possible to combine morphological and technological analysis with functional studies, including the determination of residues. Several assemblages have been analysed, coming from new excavations, e.g. at Minori Cave (Mijares, 2002), Callao Cave, Eme Cave and Dalan Serkot Cave (Mijares, 2008) in northern Luzon, Arubo in central Luzon (Pawlik, 2004; Teodosio, 2006) and on flakes and polished adzes from Ille Cave in northern Palawan (Barton, 2006; Pawlik, 2006, 2011) as well as on re-excavated classic sites such as Tabon Cave (Mijares, 2004).

At the same time, a new technological approach has been proposed. Analysis based on study of techno-types and techno-functional unit identifications (Boëda, 1991, 1997, 2001; Bourguignon, 1997; Geneste and Plisson, 1996; Lepot, 1993; Plisson, 1985) and using refitting to understand the process of knapping from the raw material selection to the final tool has been applied to Tabon, Guri, Duyong, Musang and Laurente lithic assemblages (Arzarello et al., 2008; Patole-Edoumba, 2002).

**Fig. 2.** Arubo open air site, Luzon.
**Fig. 2.** Site de plein air d'Arubo, Luzon.

## 3. Some results for the Pleistocene lithic assemblages of the Philippines

### *3.1. The Lithic Artefacts of Arubo*

The exploration of Arubo in central Luzon conducted in 2001 has again brought up the issue of the limitations of classification and technology for open sites (Pawlik, 2009). Arubo is situated approximately 80 km north of Manila and 300 km south of the Cabalwanian sites of Cagayan in a pasture landscape at the foothills of the Sierra Madre mountain range (Pawlik, 2002, 2004). Upon its discovery, the site was heavily disturbed by the dredging of a fishpond (Fig. 2). However, that activity brought back the archaeological material to the surface, thus leading to their discovery. Arubo is characterized by the presence of large chert boulders from a Miocene limestone formation that once covered large parts of Luzon, which served as the raw material for the majority of the artefacts. During the 2001 fieldwork, 200 lithic finds were made at Arubo. At least 18 of them could be identified as modified stone tools, mostly cores. Most artefacts were recovered during surveys on the surface, few were found during test excavations on top of a sandstone bedrock. The morphology of the artefacts, especially a handaxe, bifacial cleaver and several pebble tools seems to point to a Lower Palaeolithic age of the site. Also a so-called horsehoof core, similar to those found in Java associated with the Lower Palaeolithic Pacitanian industry (van Heekeren, 1957; von Koenigswald, 1936), is among the several cores recovered at Arubo (Figs. 3 and 4). However, no directly datable material could be retrieved.

Arubo provided an assemblage different from the stereotyped "chopper/chopping tool industries" (Movius, 1944). Unlike the Philippine Cabalwanian and also the Pacitanian in Indonesia, it incorporated bifacial technology. Evidence of curation is present, as well as variation in core preparation and core reduction. The artefacts exhibit traces of multiple uses and function. In a functional study of the Arubo artefacts, Teodosio noted use traces from working soft and hard materials of organic and inorganic origin, including bamboo. Not just the handaxe but also some of the used flakes and core tools show signs of multiple uses on various contact materials (Teodosio, 2006). Consequently, Arubo represents a technological concept disctinct from smash-and-grab or expedient strategies common in the region (Mijares, 2002).

### *3.2. Tabon Cave assemblage*

Tabon Cave is located at Lipuun Point on the southwestern coast of Palawan. It is currently the most important site for understanding the peopling of the Philippines. Excavations of the National Museum of the Philippines in 1962, 1965 and in 2000 (Dizon et al., 2002; Fox, 1970a, 1970b) identified two levels of occupancy during the Pleistocene. Human fragments, faunal remains and over 3800 artefacts were discovered (Corny, 2008; Fox, 1970a, 1970b). Human fossils were found in levels II and III. Indeed, four fragments of jaw and frontal bone, which belonged to three different individuals, were found between 50 and 88 cm depth. Two of them seemed to belong to the same individual (Macintosh, 1978). The other two, however, differ markedly. Recent studies of these fossils reveal that two different modern humans lived at the same time (Détroit, 2002; Détroit et al., 2004; Dizon et al., 2002). The age of these individuals, which was first associated with the dating of level III, 22,000–24,000 BP, was more recent for the frontal bone with 16,500 ± 2000 years BP and especially for the older jaw (31,000 BP ± 8000–7000 years) and a tibia fragment

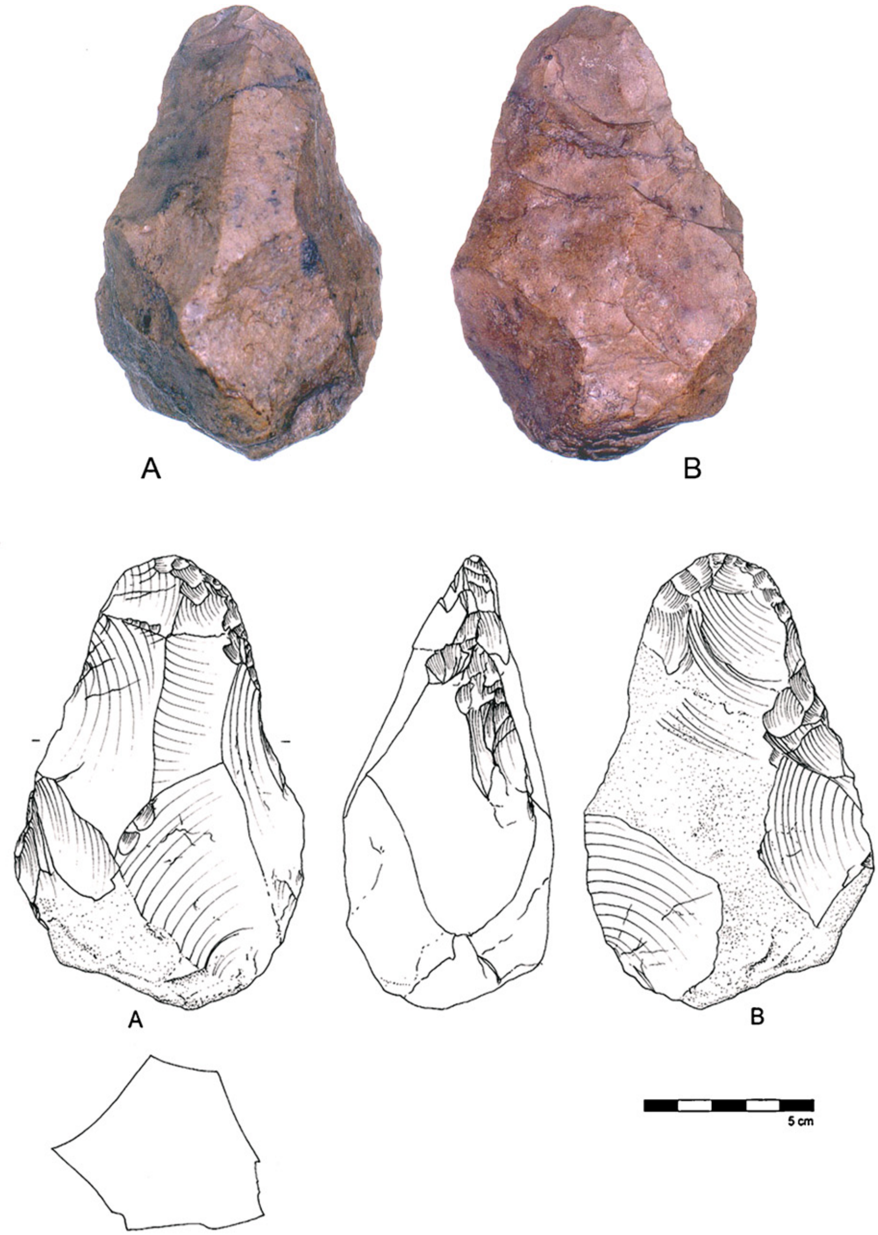



**Fig. 3.** Handaxe from Arubo site, Luzon.

**Fig. 3.** Biface du site d'Arubo, Luzon.

discovered in 2000 (47,000–10,000 BP ± 11,000 years) (Dizon et al., 2002).

The lithic material from Tabon Cave was divided into five assemblages (flake tool industry I to V). According to Fox, it was an industry of more than 19% chert flake tools, produced by direct percussion with a hard hammer or in some cases by percussion on an anvil. Only 1% of the blanks have been retouched including *kuba-scrapers* (Fox, 1977). The technological analysis that we conducted on the material of the layer dated to 9,500 years BP, and the study of hundreds of specimens discovered in 2001 relativized the initial results (Jago-on, 2006; Orogo, 2001; Patole-Edoumba, 2002, 2009; Patole-Edoumba et al., In press). Chert (probably red jasper) has been used for more than 80% of the artefacts but also andesite occurs as raw material. It is likely that the Panitan and Malatgao rivers, located c. 7–8 km away from the site, have been the main raw material sources (Schmidt, 2008). The selection of the best samples was made at the source by fracturing the rock to assess its potential. Blanks are elongated with laminar flakes (42.3%) and sometimes narrow blades (20.6%) appearing, mainly with thin cross-sections (51.6%). The mean dimensions of the flakes at Tabon Cave are 25.1 mm length, 18.7 mm width and 6.4 mm thickness.

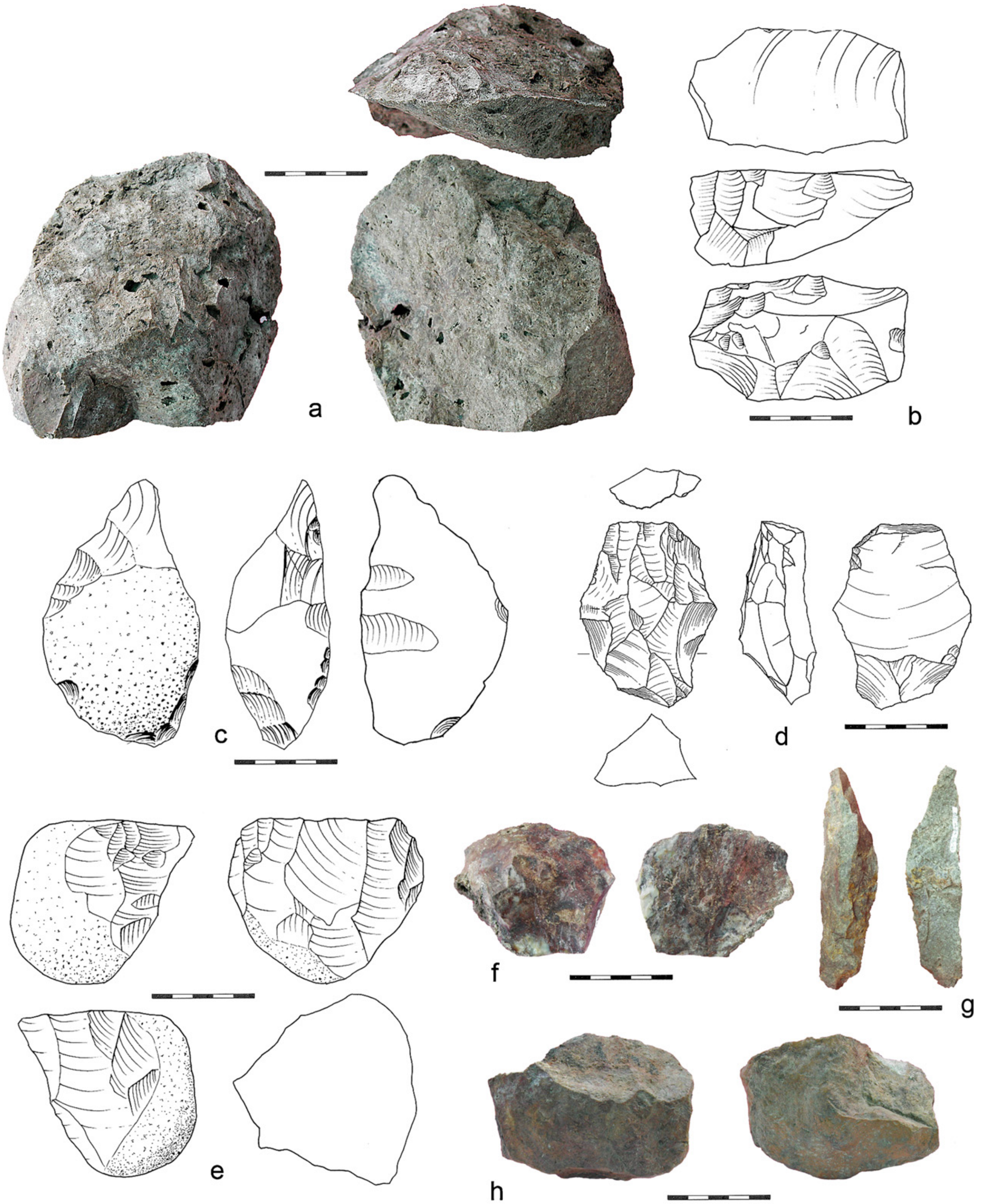



**Fig. 4.** Core tools from Arubo site, Luzon.

**Fig. 4.** Outils sur galet d'Arubo, Lozon.

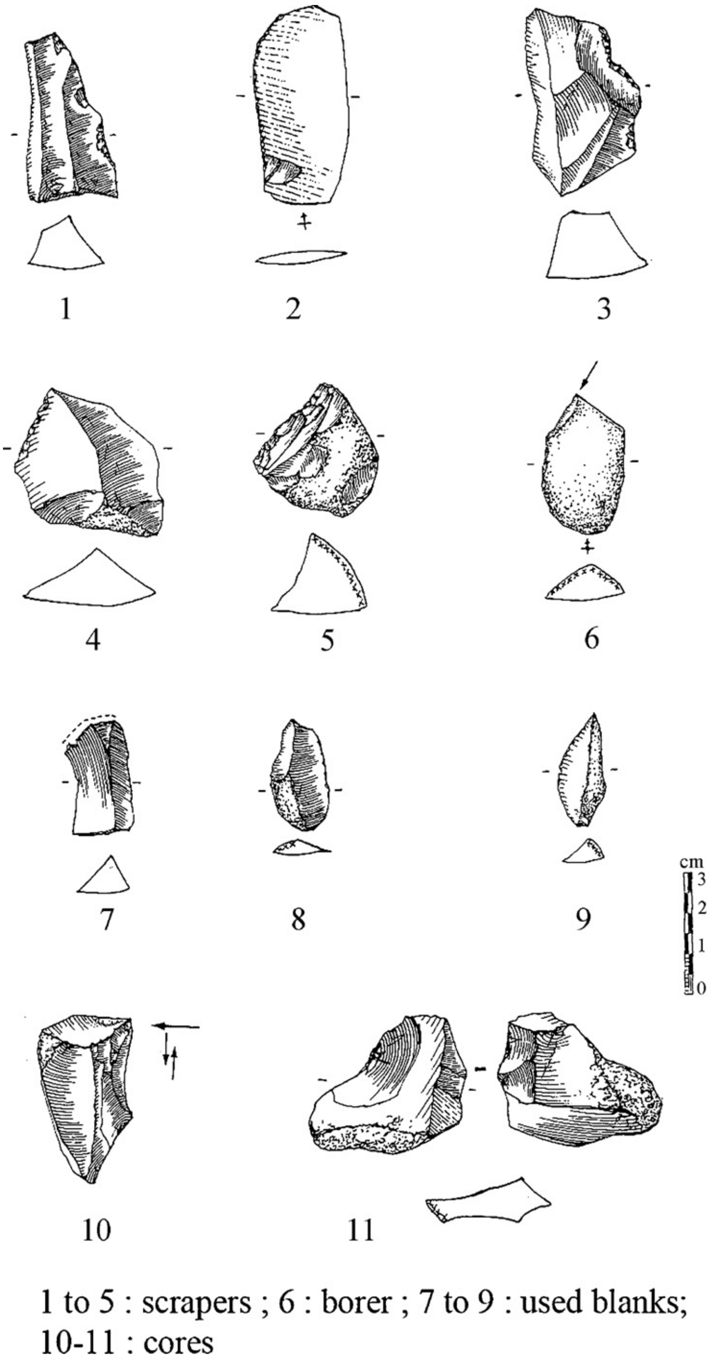



**Fig. 5.** Tools and cores from Tabon cave, Palawan (drawings H. Forestier).

**Fig. 5.** Outils et nucléus de la grotte de Tabon, Palawan (dessins de H. Forestier).

Macroscopically visible use traces are located in most cases, along one edge only (90.3%). The angles of active edges are between 40–59° (49.5%) then between 30–39° (15.9%). When the delineation of the edge is straight, the edge angle is usually regular (40–49°) or greater than 70°. When it is convex, the angle is between 40° and 59° (Figs. 5 and 6). The identification of micropolish on several stone tools discovered in 2001 showed that they were used for the manufacturing of wooden implements (Mijares, 2004).

A number of blanks were retouched into borers, scrapers, notches or composite tools (e.g. scraper-burin). The retouching increased the edge angles to prepare the tools for a particular use. The knapping technique applied is usually direct percussion with a hard hammer. Nevertheless, it appears that occasionally a soft hammer (limestone or

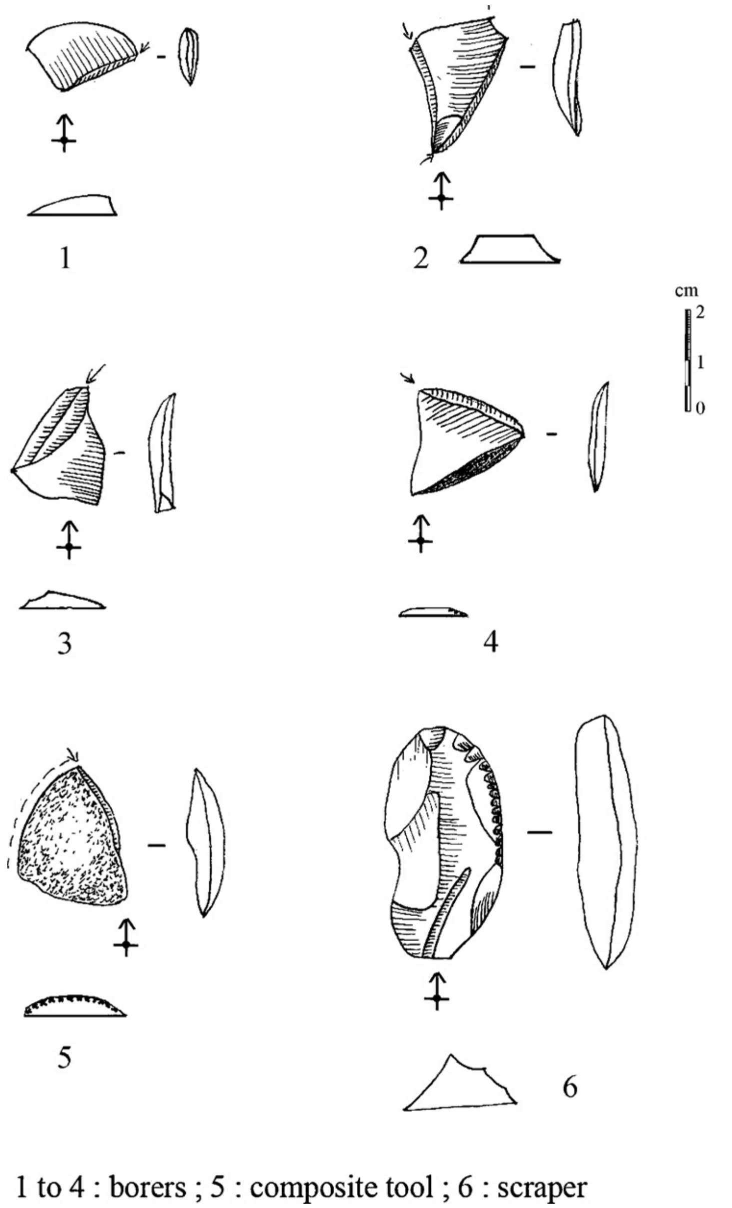



**Fig. 6.** Tools from Tabon cave, Palawan (drawings E. Patole-Edoumba).

**Fig. 6.** Outils de la grotte de Tabon, Palawan (dessins d'E. Patole-Edoumba).

animal bone) had been used as well. The knapping process was short with no more than two or three sequences. This method fits into the algorithmic type system of alternating debitage surface (SSDA). Here, during each sequence the previous debitage surface is used as a striking platform for new removals (Forestier, 1993). This technological system has been identified on other sites of the same and later periods, e.g. in Musang Cave in northern Luzon (Patole-Edoumba, 2002).

### 3.3. Musang Cave assemblage

The karst formation overlooking the Pinacanauan River, a tributary of the Cagayan River, near the city of Tuguegarao, is home to the Musang Cave remains, older than 12,000 years. Two successive excavations during the 1970s succeeded in identifying a stratigraphy over a depth of two meters with two occupational levels. The older level contained a lithic assemblage associated with a shell midden, composed mainly of freshwater snails (*Thiara scabra*) from the river and animal bones (wild pigs, deer and fish). Thiel considered that the site had been used as a temporary settlement by hunter-gatherers approximately 10,500 years ago (Thiel, 1978). Different traceological and technological studies on the lithic material provided some information about prehistoric activities (Barbosa, 1979; Patole-Edoumba, 2002; Thiel, 1978). The tools were mostly manufactured from andesite (60%), a raw material

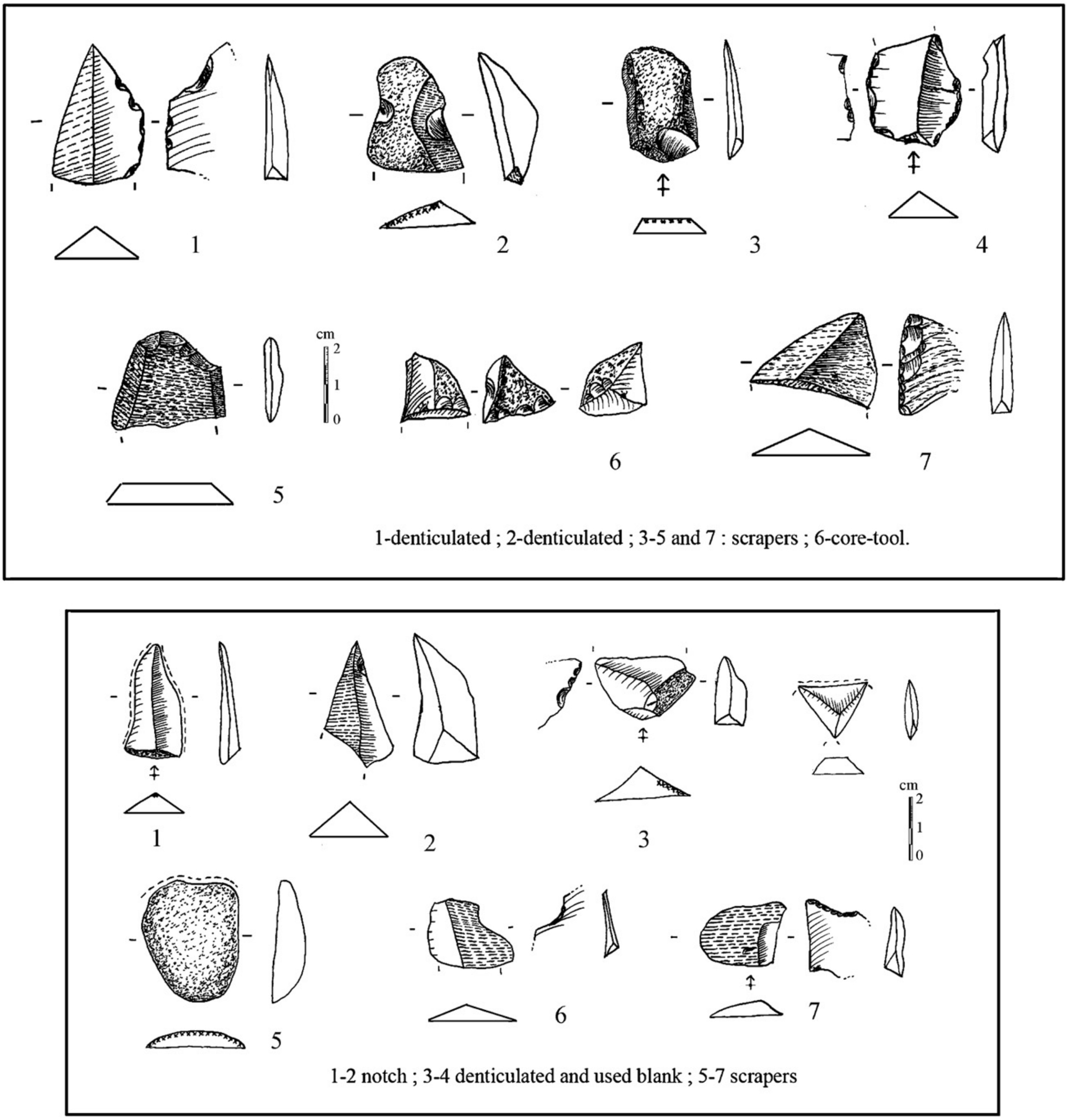



**Fig. 7.** Stone tools from Musang cave, Luzon (drawings E. Patole-Edoumba).

**Fig. 7.** Outils de pierre de la grotte de Musang, Luzon (dessins d'E. Patole-Edoumba).

available at the Pinacanuan river bed, followed by a chert (32%) distributed all over the place, Fig. 7).

The majority of the blanks are thick (55%), elongated and laminar flakes (47%) with an average length of 26 mm. They were used without any further modification of the edges. Straight and convex lateral edges often have angles above 50°. The functional analysis of the stone tools showed that they were used for scraping and cutting wood, bamboo or bone. Only 2.4% of the entire assemblage comprises retouched flakes. Retouching was applied to produce more specific tools such as notches and denticulates or a nosed-end scraper. In some cases, some cores and raw materials were also used for the natural properties of some of their edges.

The knapping technique was again identified as direct percussion with a hard hammer. With regard to the limited access to a better quality raw material, the orientation of the reduction shows a maximum use of the raw nodules although the knapping sequence remains very short with usually two sequences with four removals each.

The analysis of the flaked industries from Tabon and Musang Cave shows that tools forms are not haphazard products but correspond to specific techno-types, linked to an identifiable recurring knapping process.

## 4. Discussion: a chronological framework based on lithic evolution in the Philippines

The artefacts recovered in the Philippines and assigned to the Pleistocene belong to two different technological systems. On one side, the presumably oldest chopper/chopping-tool and handaxe assemblages belong to a system of sharpening (*façonnage*). After one or more stages of reduction, the cobble or pebble becomes the intended tool while the removed flakes are either waste or were also used as tools. This technological system seems to disappear during the Paleolithic in favor of a debitage system in which the tool is the blank flaked from a pebble core that is usually not used further but discarded. The pebble called core is the waste. Three production centers in Luzon, on the Southwest coast of Palawan, and in Visayas reflect this evolution.

### 4.1. The reduction mehod during the Lower Palaeolithic

Several islands have provided stone implements that were attributed to Palaeolithic cultures. The first discoveries were made in the Cagayan Valley, northern Luzon. During the 1950s, when Ralph von Koenigswald worked on several Southeast Asian sites and assemblages such as the Pacitanian in Java, he decided to conduct surveys at Espinosa Ranch in Cagayan Valley where fossils of a Pleistocene megafauna, including stegodon and rhinoceros bones, had been discovered several years ago by H. Otley Beyer. He collected a set of modified pebbles and fragments of quartzite and sandstone on the surface which he presented as a new lithic tradition named "Cabalwanian" after the Cabalwan region where Espinosa is situated. Over a decade later, the National Museum of the Philippines organized several archaeological campaigns in Cagayan as a research project on the first Filipinos. Fox and Peralta made a systematic survey of the Cagayan Valley. Of the sixty-eight sites recorded in the region of Kalinga-Apayao (west of the Cagayan Valley), twenty-one were identified as knapping workshops or butchering sites, belonging to the Pleistocene Awidon Mesa formation. These test pits were supplemented by the excavation of three open sites: Espinosa 1–4, Madrigal Wanawan 1 to 12 and 1, 3 and 5 (Bondoc, 1979; Fox, 1978; Fox and Peralta, 1974). This fieldwork resulted in a collection of one hundred stone tools and animal fossils. A selection of sixty-three tools was used to create a classification (Fig. 8). Two more campaigns in 1976 and 1980 complemented the corpus of pebbles and flakes (Shutler and Mathisen, 1979; National Museum paper, 1981). All assemblages were dated only by typological comparison with other industries known in Southeast Asia even though this was a highly unreliable method. Von Koenigswald associated the pebbles with the Middle Pleistocene faunal remains found in the same area and concluded that they were produced by *Homo erectus* around 400,000 to 500,000 BP, contemporaneous with the finds from Java and Choukoutien in China (von Koenigswald, 1958). For von Koenigswald the choppers were made by *Homo erectus* around 400,000 to 500,000 BP because their features were very similar to those from Choukoutien in China. The presence of extinct animal fossils was used as another argument for such an old age. Von Koenigswald's hypothesis was then taken over by Fox and Peralta who insisted on the status of a *cul-de-sac* of the Cagayan Valley which would have resulted in the concentration of extinct species such as elephant, *Stegodon*, buffalo and rhinoceros from China (Fox and Peralta, 1974). However, there is at present no site in Cagayan (or elsewhere in the Philippines) where lithic artefacts and Middle Pleistocene faunal remains have been found together and in context. The assumed old age of the Cabalwanian remains, therefore, entirely speculative (Dizon and Pawlik, 2010). Furthermore, a taxonomic comparison is insufficient to establish a date of lithic material without any stratigraphic position and absolute dating, especially since a working classification system is lacking for the entire Southeast Asian region. Moreover, taxonomic analysis shows only morphological differences whereas a techno-functional approach addresses the process by which a tool is created.

The island of Luzon has yielded other sites and artefacts outside the Cabalwan region. In the 1970s, Peterson identified several choppers, chopping tools and flakes in an assemblage collected in 1926 by Beyer during the building of a dam for Manila's water supply (Beyer, 1947; Peterson, 1979; Ronquillo, 1998). More recently, the open site of Arubo in central Luzon delivered a lithic assemblage including a bifacial handaxe and a cleaver (see above). In their paleontological surveys in Solana (Cagayan) and on the island of Cabbaruyan (in Pangasinan), Bautista and De Vos discovered Pleistocene fossil remains in association with flakes and sharpened pebbles that they compared to Cabalwanian (Bautista and de Vos, 2002a, 2002b).

Other stone tools with a Lower Palaeolithic "appearance" come from the islands of Palawan and Mindanao. In Palawan, a dolomite handaxe was collected in a secondary deposit of Ile Cave, in El Nido (Fig. 9; Archaeological Studies Program, 2007: 13; Dizon and Pawlik, 2010). On the northern coast of Mindanao in Cagayan de Oro, a team from the University of the Philippines Archaeological Studies Program recovered five pebble tools at the open site of Huluga (Fig. 10, Neri, 2006).

But all these assemblages are surface finds and without direct dating the age remains uncertain. Their lack of context has been stated by a number of researchers (Mijares, 2002; Patole-Edoumba, 2002, 2006; Pawlik, 2009; Pawlik and Ronquillo, 2003).

Absolute radiometric dates for the earliest human occupation of the Philippines at present go back to app. 66.7 ka for Callao Cave in northern Luzon (Mijares, 2008; Mijares et al., 2010) and around 50,000 years BP for Tabon Cave in Palawan (Détroit et al., 2004; Dizon, 2003; Dizon et al., 2002). So far, no artefacts have been found in association with these ancient human fossils. In Callao Cave, about seven cervid bones have been observed to have cut marks but no stone implements were recovered

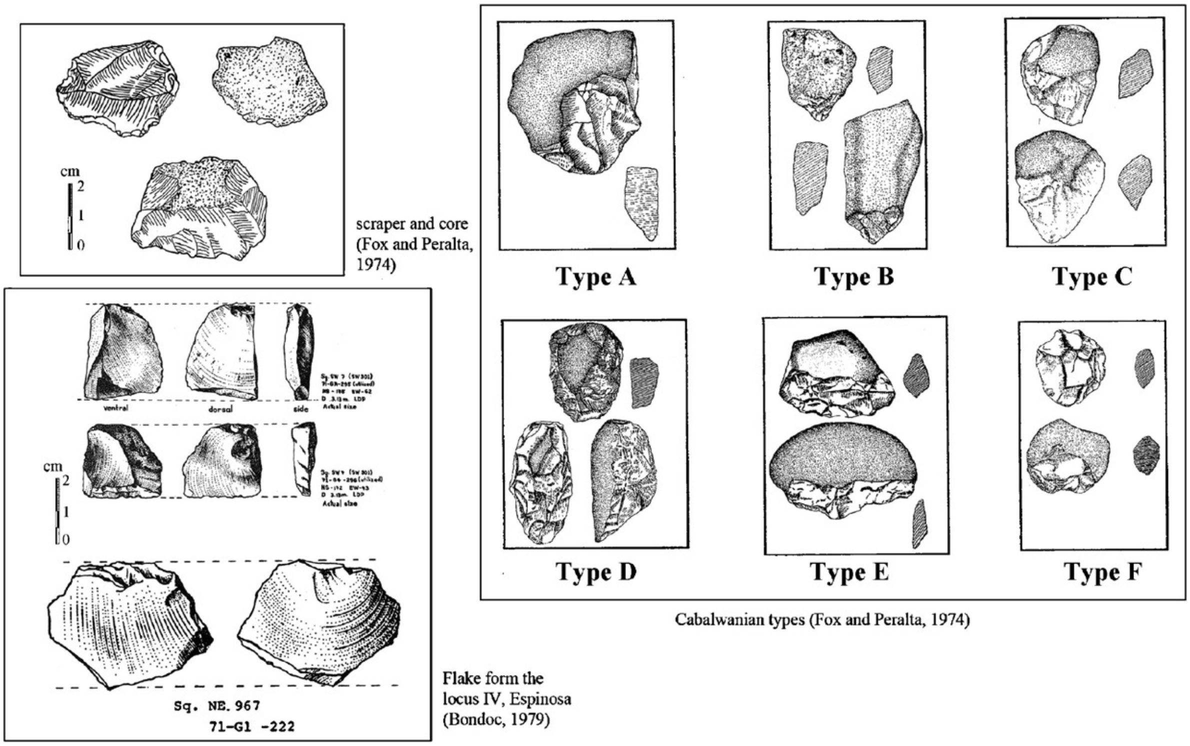



**Fig. 8.** Cabalwanian.
**Fig. 8.** Le Cabalwanien.

(Piper and Mijares, 2007; Mijares, 2007). The earliest stratigraphic layers containing stone material are dated 22,000–24,000 years BP at Tabon Cave and 26,000 years BP at Callao Cave (Détroit et al., 2004; Dizon, 2003; Dizon et al., 2002; Fox, 1970a, 1970b; Mijares, 2008; Mijares et al., 2010).

### *4.2. Evolution of unifacial and bifacial lineages in the Philippines*

Some authors have shown a technological evolution (Leroi-Gourhan, 1943, 1945; Simondon, 1989) and that each artefact can be seen as a stage of one kind of technological evolution (named lineage). For André Leroi-Gourhan, this evolution is linked to a search for functional efficiency. Simondon thinks that major technological lineages are governed by the law of concretization. Indeed, he has shown that there is a structural determinism of the artefacts independent of their environment impact: "*there is a primitive form of a technical subject, the abstract form as an absolute, complete perfection inherent in requiring, for its operation, to be incorporated in a closed system...*" (Simondon, 1989, p. 21).

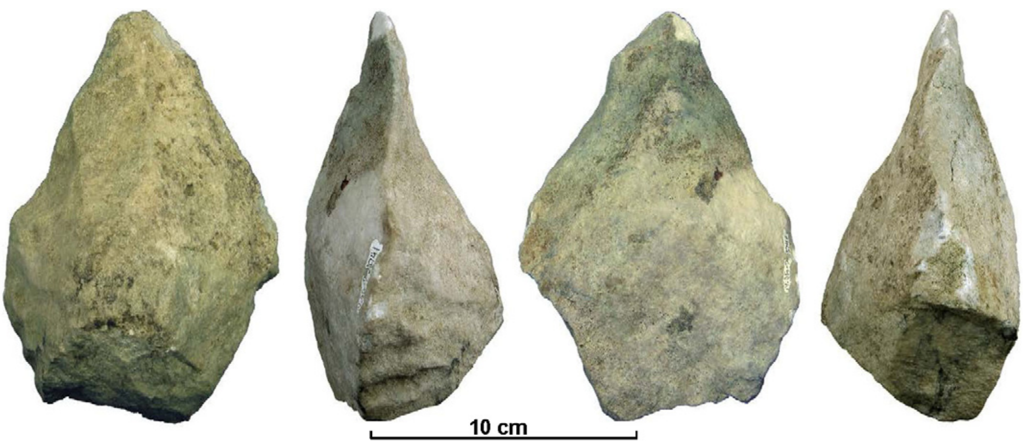



**Fig. 9.** Handaxe from Ille cave, El Nido, Palawan.
**Fig. 9.** Biface de la grotte d'Ille, El Nido, Palawan.

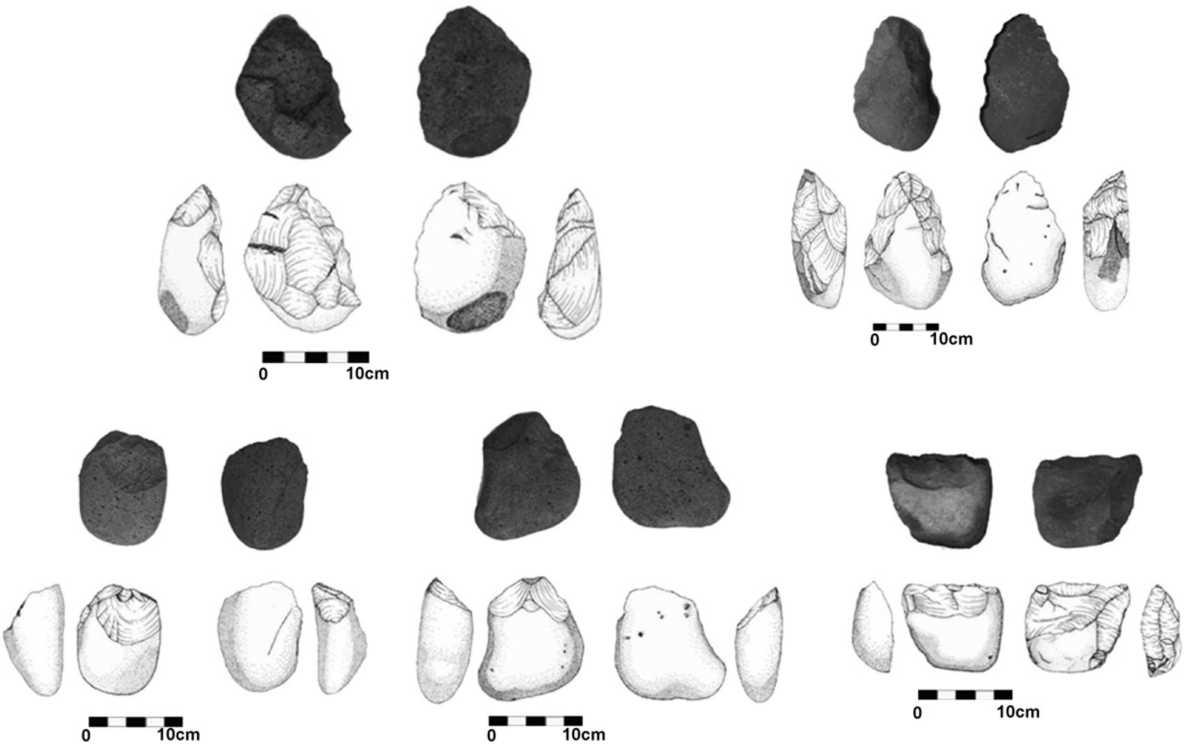



**Fig. 10.** Core tools from open site Huluga, Mindanao.
**Fig. 10.** Outils sur galet du site de plein air de Huluga, Mindanao.

According to this last theory, prehistoric artefacts are developed from the abstract to the concrete in the direction of maximum optimization of production capacity of a pebble. For example, the chopper corresponds to the degree 0 of fracturing to get a sharp edge. From this initial stage, two technological lineages are formed: debitage, which is aimed at getting a sharp edge on a blank and the sharpening (*façonnage*) which is based on the creation of the sharp edge on one core. The sharpening evolution is based on the best way of core reduction to get a desired shape. The debitage optimization is based on the core managing to get the maximum number of blanks. In this context, the SSDA core-type (mentioned earlier) is at the beginning of a lineage of which the best result is the Levallois core-type, which requires a high ability of anticipation (Boëda, 1997, 2005). The integrated structure of the laminar core is the most advanced and most practical in the European and Mexican Neolithic because the volume is fully exploited to produce sometimes up to a hundred blanks (Boëda, 2005). The identification of lineages does not mean that each prehistoric culture is destined to develop all the production systems of the same lineage; the identification of the Levallois method does not mean that the SSDA existed previously.

We can apply this last analysis to the prehistoric Philippines as it has been proposed for Chinese Pleistocene lithic assemblages (Boëda, 2005). In the Philippines, we observe the coexistence of two lineages of lithic traditions at the sites mentioned above: a lineage represented by bifacial artefacts found in Luzon and Palawan and a unifacial lineage at all other sites. Since the early 2000s, three handaxes have been discovered in the archipelago. The principle is based on a double symmetry: side axial and bifacial (Texier, 1996). It also implies a biconvex volumetric design. For us the Arubo specimen at this later stage belongs to the category of "blanks on bifacial artefacts" of which the distal end was modified into a scraper (Boëda, 1997, 2001; Pawlik, 2002). The bifacial asymmetry and the cortex reserve put this specimen at the beginning of the technological lineage of the bifacial production system.

The artefacts found in Cagayan de Oro in 2008 and at Ille Cave, Palawan have quite similar characteristics but have not been retouched. By these techno-functional criteria they are still close to handaxes found in the Bose valley in southern China dating from 800,000 years BP (Feng, 2008; Huang, 1989; Leng and Shannon, 2000; Schick and Zhuan, 1993; Xiang, 1990; Xie, 1990; Xie and Bodin, 2007; Yamei et al., 2000). Furthermore, whereas the bifacial phenomenon has been identified in Africa for at least 1.7 million years, in Europe 500,000 years ago and now in Asia for about 800,000 years, the technological stages of Asian artefacts do not support the hypothesis of technological expansion from the center of hominin origin. The Asian handaxes from China and possibly from the Philippines are not linked to those from Africa (and can be seen as local inventions: Boëda, 2005).

If we apply the same logic to analyze unifacial artefacts found at different sites, we find that several modes of production existed. Besides the choppers and chopping tools from Cagayan Valley and from the Huluga open site in Mindanao as the most "primitive" artefacts, handaxes and cleavers at Arubo, core-scrapers and two hemi-choppers in Mindanao and Cabalwan appear. Among the 68 tools identified by Robert Fox for the Cabalwanian, the so-called D-type possesses an asymmetrical design with a plano-convex shape. The retouching was performed on the more convex side and from the partially cortical flat surface. We can identify different sequences of flaking: first preparation of the tool's shape, then pre-sharpening. The morphology of the D-type artefact is very close to the so-called "Sumatraliths", the "type fossil" of the Hoabinhian technocomplex of mainland Southeast Asia (Colani, 1927; Patole-Edoumba, 2006). The modification of the surface can be regarded as an optimization of the potential of the peripheral edge. This type of hemi-chopper is probably the final result of the unifacial lineage. Also, we propose that the lithic assemblages of Luzon, Palawan and Mindano contain tools at different technological stages.

### *4.3. The variability of debitage in the archipelago between 25,000 and 10,000 BP*

The technology-based re-analysis of historic collections also gives a new picture of the evolution of the knapping process between 25,000 and 10,000 years ago. Although a technological homogeneity has been proposed up to now, it seems that several methods of operating sequences existed.

The assemblages II and III from Tabon Cave, excavated by Fox and dated between 22,000 and 23,000 years BP, yielded a large amount of stone tools. A recent study recognized four different operating sequences. Two methods show a surface exploitation of the core; the other two used a volumetric exploitation of the core. Although the algorithmic SSDA system (system of alternating debitage surface) is the most representative in these assemblages (Tabonian facies), a discoid reduction sequence was also identified (Arzarello et al., 2008).

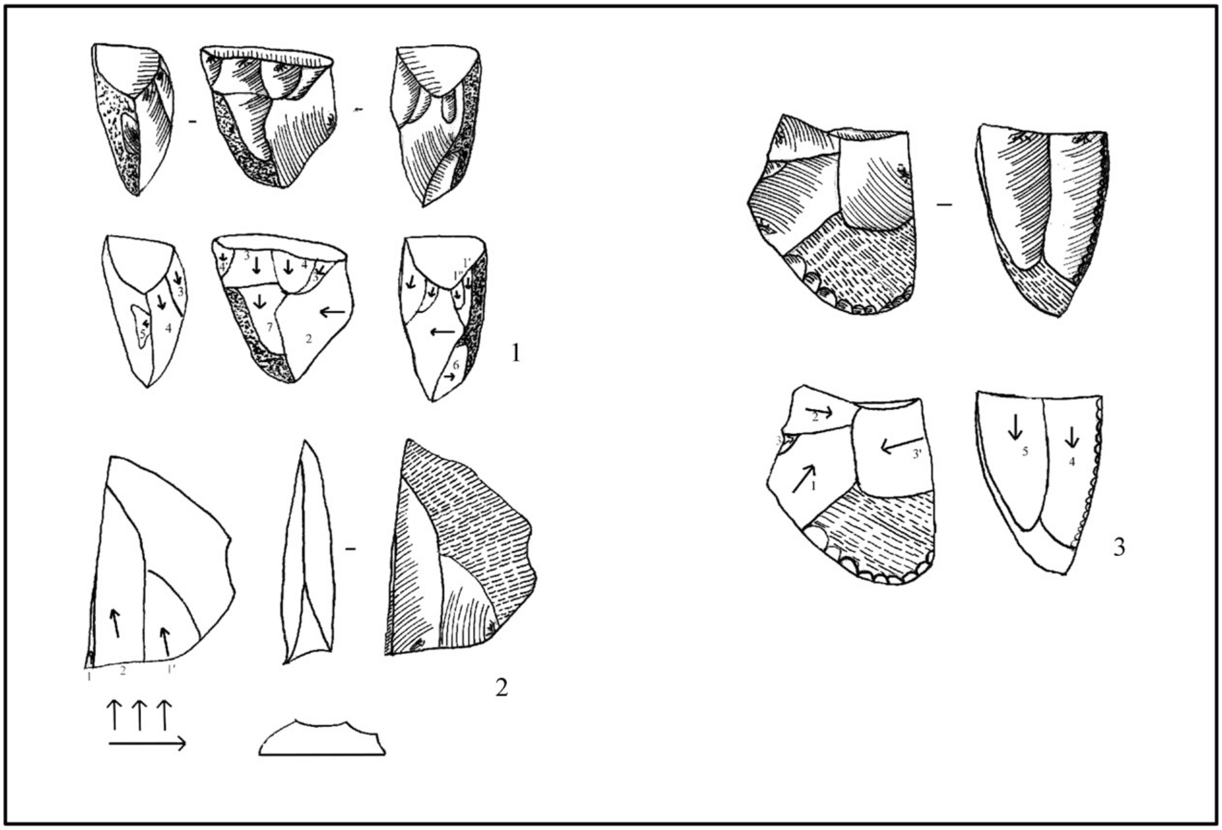
In Pilanduk Cave in the Isugod area, app. 11 km north of Quezon, Palawan, an excavation conducted in 1969 by Jonathan Kress revealed four cultural layers (I–IV) containing a small flake assemblage (Fig. 11). The layers were dated between 25,000 and 18,000 BP. However, no mention of the origin of these dates, nor their laboratory numbers was made (Fig. 11). Additionally, some disagreement can be observed in the assessment of the artefact material. Whereas Fox (1978) regarded the material as practically identical to Tabon Cave, Kress did not confirm a relationship between the two sites. He assessed that the chert flakes from Pilanduk are smaller and proportionately more retouched than those in recent levels in Tabon Cave, comparing them instead to the Hoabinhian (Kress, nd, 3; Kress, 1977, 2000).

Stone implements from Callao Cave in Peñablanca, northern Luzon appearing in a layer radiocarbon-dated to 26,000 BP are mainly chert flakes manufactured by simple direct percussion. However, the recovery of more blade-like flakes in the Late Pleistocene period in Callao Cave could point to a certain variation in Philippine lithic tradition through time. The possible evidence of two blade-like flakes being used as spear- or arrow-points hints at a more formal lithic technology.

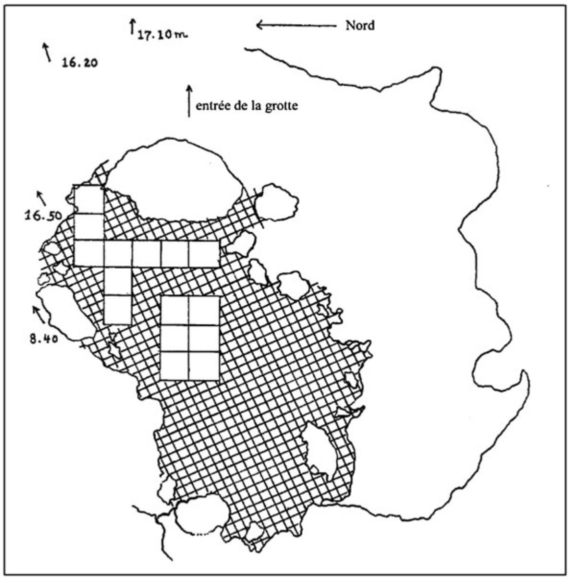
Very recent evidence for the use of unretouched flakes as hafted projectile points and the manufacture of composite tools comes from the lowest layer of Ille Cave, Palawan (Pawlik, In press). Radiocarbon-dates delivered an age of app. 14,000 cal. BP (Paz et al., 2008). A microwear analysis of its small flake assemblage identified on a triangular flake the presence of characteristic impact scars with hinge- and step-terminations together with polish spots and longitudinal striations on the tip of the tool. The flake's basal part displays on the interior surface polishes which are not use-related but do conform to what is expected from minor movements of a tool against its haft (Cahen et al., 1979: 681). Together with such polishes appear blackish residues, obviously remains of organic resin used as hafting mastic. Another tool, a drop-shaped endscraper exhibits similar hafting polishes and blackish-reddish resin at its base. This kind of adhesive appears to be very similar to resinous residues found on projectile points made of bone and stingray spine from the West Mouth of Niah Cave in Borneo, dated to 11,700–10,690 cal. BP (Barton et al., 2009). The resins have been identified as deriving from either *Shorea* spp., *Agathis* spp. or *Canarium* spp. These trees and their resins are also common in the Philippines and Palawan, and have been found in the Neolithic layers of Ille Cave as well, used there as appliqués on shell disk beads (Basilia, 2010). The use of unretouched lithic flakes as hafted implements for multicomponent tools and projectiles at Ille Cave is a unique find for the region and points to a technological concept that is beyond traditional morphological and categorical models. It is another indication that seemingly simple and "backward" lithic technologies can nevertheless be a part of complex sequences of action.

Unfortunately, there is yet no evidence in the Philippines for stone points made with platform preparation techniques as reported by Ian Glover for the Late Pleistocene site of Leang Burung 2 in South Sulawesi, or the bifacial techniques reported by Bellwood for the Tingkayu industry from Sabah, or the backing and serrating techniques used in the Holocene Toalian industry of South Sulawesi (Bellwood, 1988; Glover, 1977, 1981). Callao Cave is also the only lithic assemblage in Luzon dating to c. 25,000 BP found so far. Its size is also small, thus limiting our analysis and interpretation. It is, therefore, absolutely necessary to verify this lithic technology in other cave sites of the same time period.

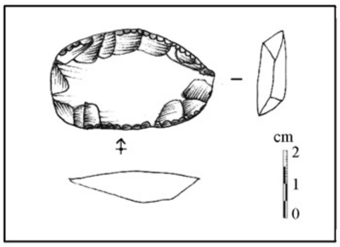
The proliferation of human occupation during the Late Pleistocene in different parts of the Philippines seems not to have significantly affected the manufacturing system of stone tools. All industries known at present display similar characteristics. Variations are linked with environmental and/or economic constraints (Patole-Edoumba, 2002, 2009). For example, the method of lithic production used in Musang Cave remains very close to what was identified for Tabon Cave. This manifests itself by the frequency of some types of tools (14% blanks are retouched to chisels, scrapers and multiple tools in Tabon versus 2.4% in Musang Cave, mainly scrapers, notches and denticulates) and the nature or the preference of the raw material. These criteria are primarily economic constraints such as a difficult access to raw material sources, rather than environmental, with a




Cores from Tabon cave (drawings E. Patole-Edoumba)




Pilanduk cave (Kress, 2000)




Scraper from Pilanduk
(drawing E. Patole-Edoumba)

**Fig. 11.** Cores from Tabon cave and scraper from Pilanduk cave, Palawan.

**Fig. 11.** Nucléus de la grotte de Tabon et grattoir de la grotte de Pilanduk, Palawan.

different use of a more open environment in Cagayan than in Palawan.

## 5. Continuity of lithic production into the Holocene

Variation in the production system continued during the Holocene. Archaeological sites in Palawan such as Guri Cave and Duyong Rockshelter are characterized by a decrease in number and diversity of tools, including retouched blanks (Patole-Edoumba, 2002, 2009). Although their size decreased and they became thicker, the characters of their active edges remained the same. In Cagayan Valley, the evolution over 6000 years of producing stone tools at Musang Cave reflects an increase in activity that resulted in a more systematic collection of chert and a diversified range of tools related to a more complex knapping process, whereas at Dalan Serkot Cave a change in raw material selection can be observed in the archaeological layer at the same time (Mijares, 2008). Mid-Holocene foragers were now using volcanic rocks, particularly andesite in addition to chert. Most of the flakes, especially those of andesite, carry varying amounts of cortex. The addition of volcanic rocks might signal a diminishing access to raw chert in the area. Also, all of the flakes from Dalan Serkot and Eme caves show no intentional retouch during the mid-Holocene period (6000–3500 BP). They only need to knock off a few new flakes rather than retouch one that had become blunt or dull from use. Although there are 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 seem to have ceased, and a simpler, more expedient lithic technology persisted (Mijares, 2002).

The same raw materials and the same simple hard-hammer percussion technique continued even after the introduction of pottery in the Cagayan Valley about 3500 years ago. At Eme Cave, flake tools mostly made from andesite and basalt materials were found associated with earthenware pottery at around 1900 BP. The previous research by Thiel, Henson and Ronquillo in other Peñablanca caves confirms the long existence of this flake industry (Henson, 1977; Ronquillo, 1981; Thiel, 1980, 1990a, 1990b). At this time, there was no more need to produce specialised tools, and the simplicity and expediency of the technology made such flake tools very adaptable in the region's tropical karst environment.

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