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30 years after P. Gorecki and D. S. Gillieson in Papua New Guinea: New data on the Holocene settlement of East Sepik, Upper Karawari-Arafundi Region

H. Forestier¹, J. Kariwiga^{2,3}, H. Baills^{1,4}, R. Tsang^{2,5}, S. Puaud¹, K. Miampa⁶, S. Plutniak⁷, A. Kuaso⁶, F.-X Ricaut⁸, M. G. Leavesley^{2,9,10}

¹Muséum national d'Histoire naturelle, UMR 7194 CNRS-MNHN-UPVD, Musée de l'Homme, France

²Strand of Anthropology, Sociology and Archaeology, School of Humanities and Social Sciences, University of Papua New Guinea

³Archaeology School of Social Science, The University of Queensland, Australia

⁴Centre Européen de Recherches Préhistoriques, Tautavel, France

⁵School of Humanities, Languages and Social Science; Place, Evolution and Rock Art Heritage Unit, Griffith University, Australia

⁶National Museum and Art Gallery (Port Moresby, Papua New Guinea)

⁷Laboratoire TRACES, UMR 5608 Université Toulouse Jean Jaurès, Toulouse, France

⁸Laboratoire Évolution and Diversité Biologique (EDB UMR 5174), Université de Toulouse Midi-Pyrénées, France

⁹College of Arts, Society and Education, James Cook University, Australia

¹⁰ARC Centre of Excellence for Australian Biodiversity and Heritage, University of Wollongong, Australia

Our research at Paimbumkanja (PBK) rock shelter (East Sepik, PNG) uncovered an archaeological sequence dating back to the late Holocene between 2,956 and 1,300 years cal. BP. Two stratigraphic units (SU1 and SU2) contained lithic tools, and the raw materials used for knapping were mainly local. The modalities of the knapping process follow a chaîne opératoire associating debitage and shaping methods. Human occupation in the PBK site is part of the Holocene chrono-sequence proposed by P. Gorecki and D. S. Gillieson in 1989. This confirms a blade production associated to macro-tools from 3,000 years BP in the Sepik lowlands.

The history of research in the East Sepik and the Upper Karawari-Arafundi region

Papua New Guinea (PNG) was first settled in the late Upper Pleistocene at least 50,000 years ago (Summerhayes et al. 2017; O'Connell et al. 2018), as evidenced by deposits from high altitude valleys approximately 1600 masl such as the open-air sites in the Ivane Valley (Summerhayes et al. 2010). Paradoxically, considerably less is known about the first populations that settled in the lowlands, including the Sepik floodplain, due to a crucial lack of archaeological chronological references. Although numerous surveys have been conducted in the lowland coastal areas, because they are easily accessible (Summerhayes et al. 2017), few surveys have been carried out in the inland areas of the northern region. This is due to the wet equatorial forest environment which is difficult to penetrate and rather hostile (Swadling et al. 1988), posing logistical problems when surveying and establishing archaeological sites. The establishment of long term projects has little to do with the physical environment.

Although the lowlands of the Sepik-Karawari region are little known from an archaeological perspective, it has a longer history in anthropological and ethnographic research (see the fieldwork of Mead and Bateson in the 1930s - Mead, 1934 - and others, e.g. Pawley et al. 2005). Apart from the programs started last year in the East Sepik by the French Prehistoric Mission in Papua New Guinea (MPF-PNG), only the excavations conducted by P. Gorecki and D.-S. Gillieson in the late 1980s

(Gorecki and Gillieson 1989), in the nearby Jimi-Yuat Valley, reported archaeological findings from what may be considered the largest wetland in the Indo-Pacific (Figure 1).



Fig. 1 Location of the Paimbumkanja rock shelter (PBK) in the Upper Karawari-Arafundi region and the surveys conducted by Gorecki in the Jimi-Yuat valley, East Sepik province, Papua New Guinea. Source: Modified after Google Earth.

The pioneering research of Gorecki and Gillieson (Gorecki & Gillieson 1989) aimed to find archaeological evidence at the highland-lowland transition in the Jimi-Yuat Valley. The Highlands fringe is of scientific interest because the Sepik Basin and its tributaries must have played a strategic role as channels of communication since prehistoric times (Swadling et al. 2008). Thus, the hypothesis that the river may have been transport routes across the plain and the river valleys conduit for communication between the plain and the uplands, guided the preliminary works of the 1980s and also our research thirty years later.

Open-air and rock shelter surveys in the Jimi-Yuat valley provided new cultural, environmental and chronological information (Gorecki and Gillieson 1989), such as the presence of an industry on pebble earlier than 5,000 BP at Yeni Swamp (540 m/alt), and forest clearance dating between 5,000 - 4,000 BP, followed by a blade lithic industry dated to at least 3,000 BP at the QBB rock shelter (Ritaumada, 280 m / alt). The authors concluded that the presence of macro-pebble tools in the Sepik region around 6,000 BP could be comparable to those found in the Central Highlands. From around 3-2,000 BP a lithic blade may reflect the onset of horticultural practices. This could explain why exchanges with the Highlands ceased in the Middle Holocene.

Another consideration is that around 2,000 BP the lowlands were less populated compared with the high-altitude valley sites. This could be a key period of transition in the settlement history of the region, in demographic, economic, social, and technological terms. According to the authors, the Wahgi groups increased their quarrying work to produce axes with a very characteristic “planilateral” shape around 2000 BP (Gorecki and Gillieson 1989). These types of axes were also found in the Jimi-Yuat valley, an observation related to the fact that humans and axes usually travelled together.

The authors of “A Crack in the Spine” (Gorecki and Gillieson 1989) also suggest socio-economic changes in the highlands and lowlands. This reflects the “altitudinal logic” of settlement history; these two geographical areas had been interacting as early as 10,000 years BP. Around 6,000 years BP populations interacted at an increased rate. This increase can be explained by environmental factors (rise in sea levels towards the current sea level) and climatic factors that have, among other factors, affected the physiography of the Sepik basin with the delimitation *sensu stricto* of a flood-plain. This mid-Holocene period is crucial because it marks the end of the “inland sea period” in the Sepik-Ramu region and the maritime connection between it and the Bismarck Sea to the foothills of the central highlands (Chappell 2005; Swadling 2010).

In summary, from this period the Sepik region became a large, swampier basin, less practicable and probably less viable as a habitable environment (e.g. pathogenic pressures, limited resources). Consequently, this region was probably depopulated in favour of the healthier, more fertile and more prosperous Highlands, where larger populations were organised in more complex ways compared with the simple organization of villages along the Sepik Basin waterways (Golson et al. 2017). Thus, the gradual abandonment of the fringe highlands during the period 4,000 - 2,000 BP was the result and/or the consequence of migration to the highlands where there was an increase in agro-horticulture.

From a palaeo-environmental perspective, the palynological study of sedimentary fills from Jimi-Yuat generated very interesting information on the anthropisation of the landscape. This identified the presence of a closed and dense forest in the mid- Holocene around 5,000 BP, followed by a reduction in forested area over the next two millennia thought to be the result of anthropogenic activities specific to horticulture in the swamp environment (e.g. slash-and-burn practices).

Thirty years after this first archaeological research in Jimi-Yuat, the French Prehistoric Mission in Papua New Guinea (MPF-PNG) decided to survey further west in the Sepik, in the karsts of Upper Karawari-Arafundi region. This region is located about 100 km south of the shoreline of the north coast of New Guinea and Wewak, the capital of the East Sepik Province. The Inyai, Auwim, Ewa, and Meakambut groups, inhabit of this area and have been the subject of various anthropological studies (Buhler 1961; Roscoe and Telban 2004; Edmundo and Sullivan, 2008; Sullivan 1998, 2012), but only one reliable archaeological survey (Gorecki and Jones 1987 a and b; Gabriel and Gorecki 2014).

These researchers did not excavate any sites but did carry out systematic surveys of more than one hundred rock shelters with paintings in the vicinity of the Auwim village (Gabriel and Gorecki 2014). Different ethnic groups have used these caves for funerary and ritual ceremonies since the late prehistory until very recently. These caves and the rock art paintings they contain have been the subject of preliminary description (Edwards and Sullivan 2008; Gabriel and Gorecki 2014), but they have never been scientifically studied or dated, due to time and logistic constraints related to field-work in a challenging forest environment.

The study and survey area of the MPF-PNG (2017-18) was based on these preliminary data and targeted a karst massif, several ten square kilometres, rich in caves and shelters located intermediate relief zone marking the Highlands / Sepik fluvial transition (Figure 2). The aim of this article is to present the chrono-cultural results obtained in the Arafundi region by the MPF-PNG team from the first survey conducted in the Paimbumkanja rock shelter. This rock shelter is located a few kilometres from Auwim village (Figure 2) and close to the rock painting sites visited over various field seasons, such as Pumdimbang, Aprannakanja, Kundumbu, and Pukang (Tsang 2018).

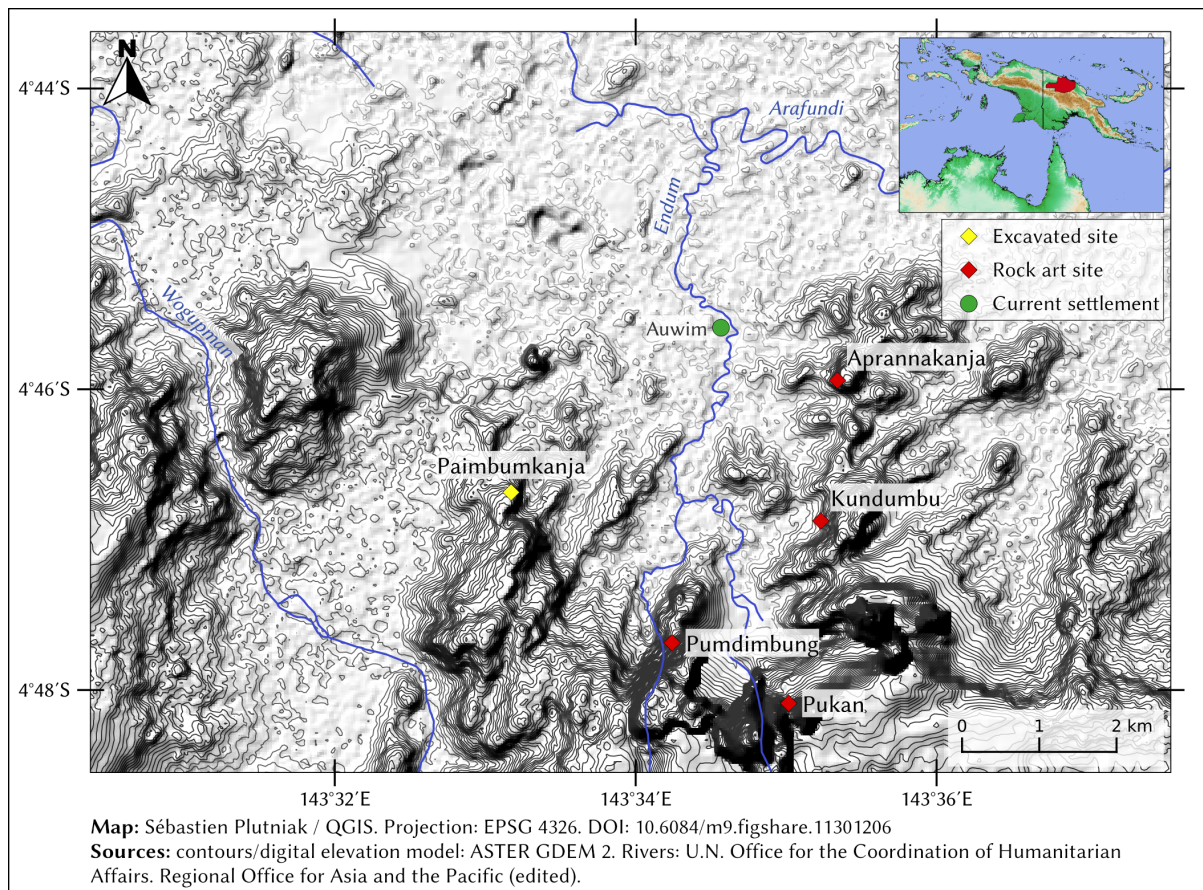


Fig. 2 Topography of the Upper Karawari-Arafundi region and location of Auwim village, rock art sites. The data presented below is derived primarily from the Paimbumkanja rock shelter. Source: S. Plutniak.

Environmental and stratigraphic setting of the Paimbumkanja rockshelter

The prehistoric rock shelter site of PBK is at an altitude of 200 m asl, located 3.4 km southwest of the Auwin village (East Sepik Province in the Arafundi basin itself a tributary of the Karawari river that drains into the Sepik river (Figures 3 and 4.1). From a geomorphology perspective (Löffler 1974, 1977), the Sepik river drains the large area of northern New Guinea (Central Intermontane Trough) by receiving the waters from both the Northern Coastal Ranges and those of the northern slopes of the central Cordillera, also known as the New Guinea Highlands. The site is situated in the low altitude foothills (100 - 300 masl) of the foot of the Northern Metamorphic Range. The geological environment of the site is the so-called “Sepik” complex (see the Sepik Complex of Davies 1990, 2012) which groups together volcanic, metamorphic, and sedimentary rocks (produced by the erosion of the two other rocks). Around PBK there are two detrital formations (Figure 3): the Salumei formation and the Karawari conglomerate (Dow et al. 1972). The PBK shelter probably results from erosion of the conglomeratic facies forming the high cliffs along the banks of the Arafundi River. So, the geological context is not karstic, there is no limestone. The site is located in a spur of detrital rocks (coarse conglomerate and sandstone of the Karawari and Salumei formations).

The archaeological excavations revealed a stratigraphic sequence down to 150 cm below the ground surface (Figures 4 and 5). The base of the excavation starts with many blocks on which two stratigraphic units were laid, SU2 then SU1. Each SU is limited by a level of pebbles and contained a black layer. From an archaeological perspective, and excluding the spit 14, 15 and 16, all the other contained lithic remains. Only the ground surface provided other non-lithic types of remains (fragments of shells and ceramics) (Figure 5). We analyzed these deposits to determine the origin and post-deposition history of the shelter’s sediments. Four sediment samples were taken and analyses were conducted including: particle size distribution (Miskovsky and Debard 2002), calcimetry (Cailleux and Tricart 1963), magnetic susceptibility (Djerrab 2002) and water and organic matter contents (CEAEQ, 2003). The facies are sandy-loamy black to brown and dark yellow brown, with

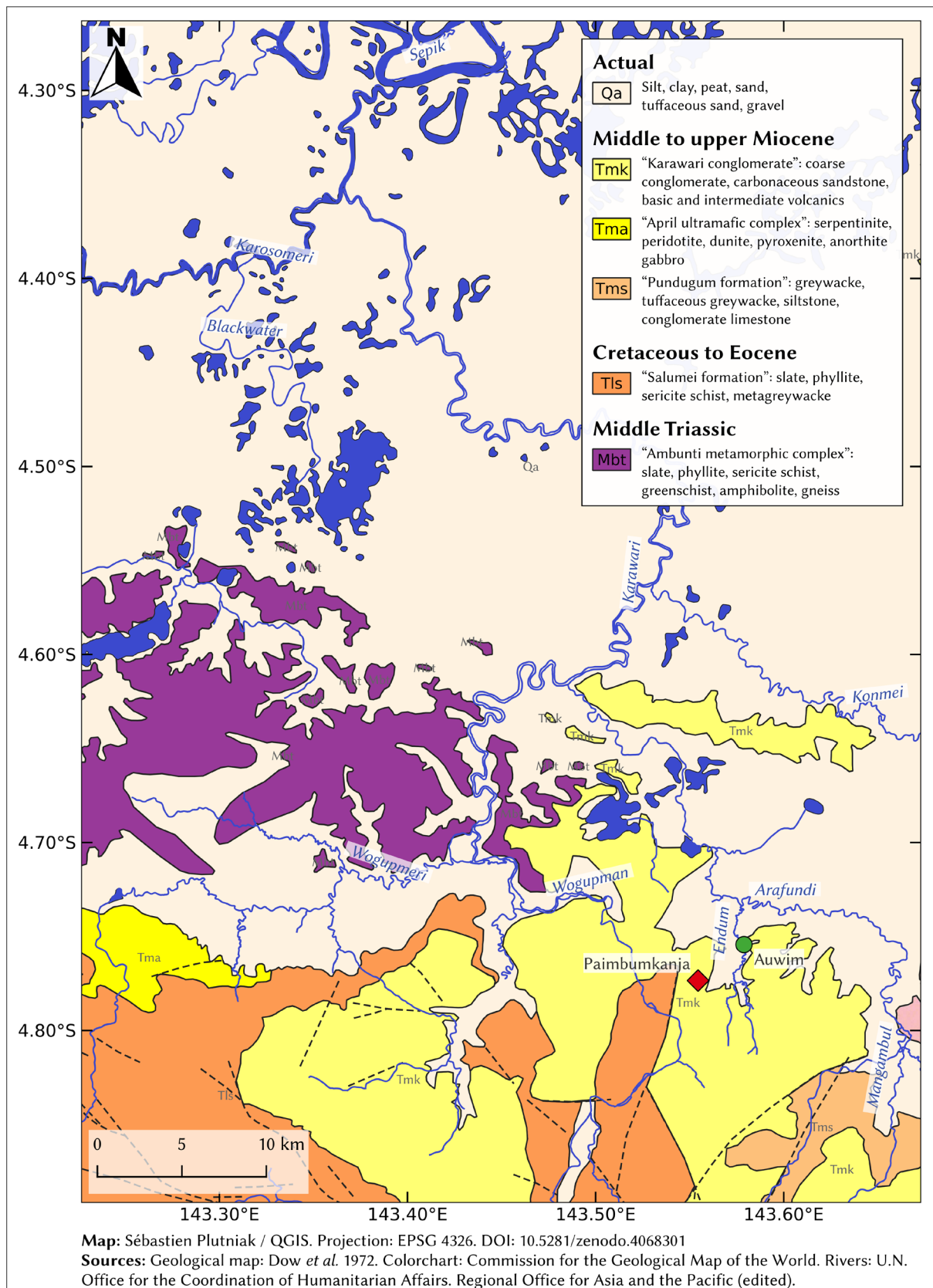


Fig. 3 Geological map of southern Sepik area (Papua New Guinea), locating Paimbunkaja and the main watercourses. Source: Modified from Dow *et al.* 1972 by S. Puaud.

uniform granular and coarse grain size fractions. The sample contain angular fragments of sandstone (conglomerate matrix) and pebbles; therefore, they are identified as puddingstone. Their lithology is varied: volcanic rocks, metamorphic rocks, and quartz.



Fig. 4 View of the Karawari River and the foothills of the Highlands west of Auwim territory (n. 1), the rock-shelter site of Paimbumkanja (n. 2) and the testpit of 2 m2 (n. 3). Source: H. Forestier.

The sedimentological study of PBK generated four important results (Figure 5):

1) Grain size

The granulometric analysis of each sample showed that in general the global composition of the sampled sediments are very similar: sediments of coarse fraction (> 2 mm) represent a quarter to less than a third of the total mass of the sample. The dimension of the coarse fraction is between 2 and 16 mm. Coarser elements (16 - 31.5 mm) exist but are less frequent. The fine fraction has a sandy (80 %) and silty (20 %) texture. The grain size distribution of the base samples (4 and 3) is identical with a majority of coarse sands (Sg). There is a clear difference between samples 1 and 2; although the percentage of sand is comparable for both, the distributions are very different. There is a difference between the percentage of Sg and other particle types: in sample 2 the latter increases at the expense of Sg.

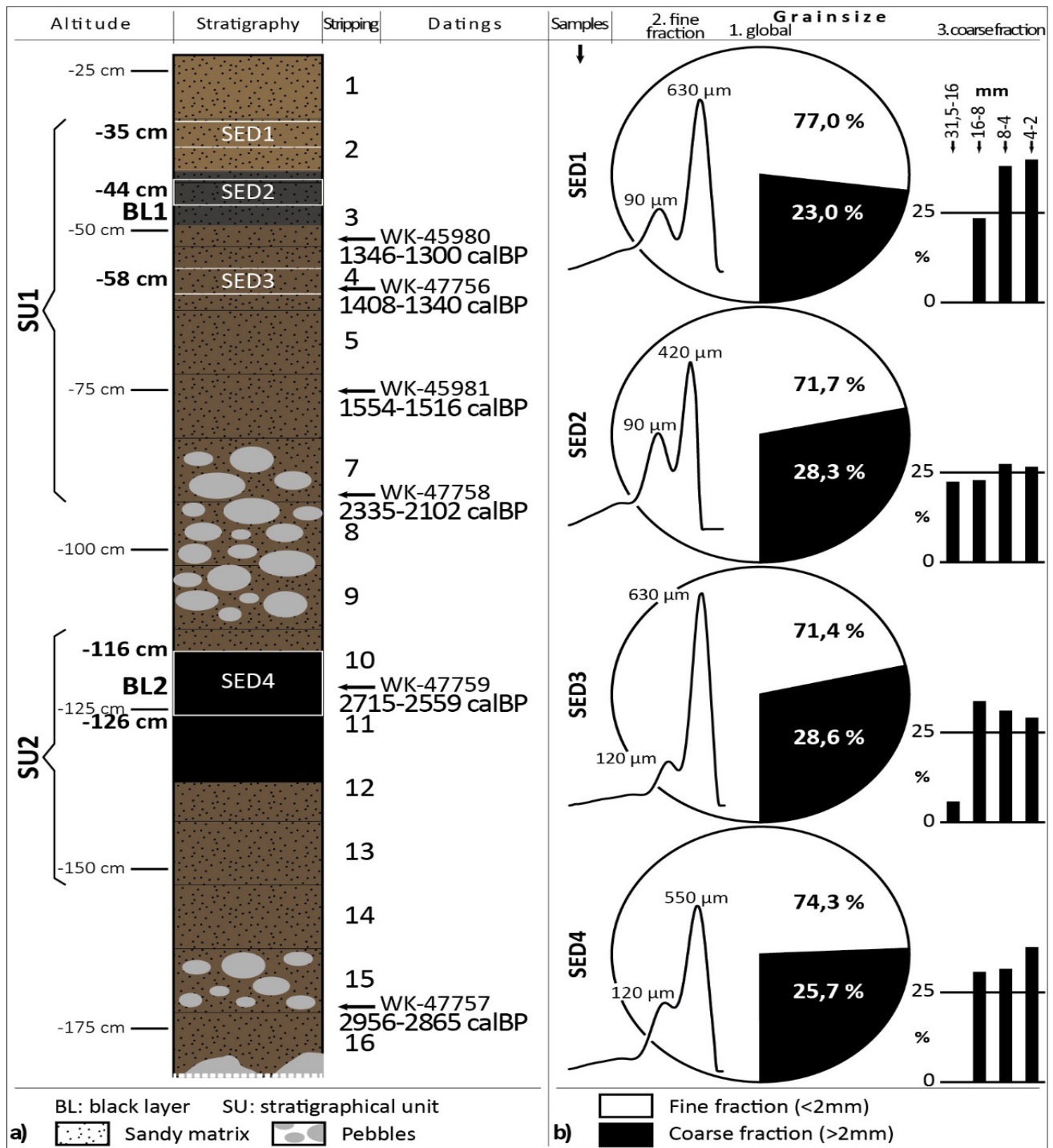


Fig. 5 a) Stratigraphic column with sedimentary facies, stratigraphic units, archaeological sample locations and radiocarbon dating; b) Grain size analyses: (1) Global grain-size (sector diagrams): for all samples ratio coarse/fine fraction is very close (1/4 to 1/3); (2) Fine fraction grain size (frequency curves): all curves are bimodal, with fine sand (63 to 200 μm) and medium/coarse sand (500 μm); (3) Coarse fraction grain size (histograms): The dimensional classes and their frequency are slightly variable, but the counted pebble number is small, there are only a few units for classes larger than 8 mm. (East Sepik, Papua New Guinea). Source: S. Puaud.

2) *Calcium carbonate*

The total carbonate content of the sediments is very low, being less than or equal to 0.1 %.

3) *Magnetic susceptibility (MS)*

Two groups of sediment are classified from the MS measurements: the first group is composed of black layers and the superficial horizon; the second group is only sample 3. The difference between the values is related to the concentration of iron oxide in the sediment.

4) *Water and organic matter (OM)*

The sediment contains about 10 % water, and sample 4 about 20 %. OM values remain between 2.5 and 4.5. The black layers have the highest values.

Thus, the results of the sedimentological analysis of the sequence of the PBK rock shelter show that all the deposits of the sequence come from the surrounding rock. The weathering of the conglomerate fragmented the sandstone matrix and released pebbles. Variation in the proportion of fine and coarse fractions reflect the heterogeneity of the substrate. The granulometric analysis of the fine fraction highlights variations in the upper part of the sequence. These appear to be related to the leaching of the finest particles of the superficial horizon. This horizon (SED1) is therefore enriched with coarse sands and vice versa for the underlying layers (SED2). OM and SM analyses highlight the most organic and oxidised facies. These two characteristics can be related to the anthropization of the sediment (e.g. remains of meals, feces, vegetable litter, fires) and characterize the two black layers and the superficial layer.

Study of the lithic material at Paimbumkanja

Material and methods

A limited test square extending 2 m², denoted by B and C, was excavated and revealed lithic material in a stratigraphic context (Figures 2, 3, 5, 6). A total of 601 lithic objects were recorded in stratigraphic unit 1 (SU1) and 149 objects in SU2. The Spit 6 contained the most material with 116 objects, which could correspond to a peak in the frequentation and number of knapping activities in the rock shelter during the mid to late Holocene.

Accepting the lithic deposit peaks, the lithic tools are distributed very homogeneously in SU1 and SU2 throughout the stratigraphy. Thus, we do not observe a high concentration of tools, or a particular type of tool, in a given level that could suggest a specific activity or a key moment in the occupation history of the rock shelter.

It is clear that the presence of a layer of blocks between the two SUs, located between the spits 9 and 10, did not generate a difference in the vertical distribution of lithic artefacts, neither in the nature of the artefacts, nor in the raw materials. Thus, whether it is the core, the laminar products or even some remarkable tools like “chisels” (whole or broken), their distributions are random in the archaeological sequence.

In addition, it is difficult to provide more information on the taphonomy of the PBK site given that the excavation stopped at a layer of small boulders, which may not have been the substratum (bed-rock).

Laboratory methods included the created an Access database (Microsoft®Access®2016). The access form has 14 records; five are quantitative: excavation year, artefact number, length, width, thickness; and nine are qualitative: square, spit number, lithic code, retouch, burn, use, raw material, heel, and

Spit	Square	Stratigraphical Unit	unused artefacts						tools							Number		
			unused flakes	unused pebbles	manuports	cores	splits	debris	bees and borers	chisels	utilized and retouched flakes	notches and denticulates	utilized pebbles	used blades and bladelets	hammerstones		scrapers	
1	B	SU1	1					1			1						3	
	C			3				1										4
2	B		6	5		2	11			2	2	3						31
	C		4	2		2	2	1	1	1		3						16
3	B		15	6		2	14	1		8		2	3				1	52
	C		3	4			25			1		1		1				35
4	B		4	1			12			1								18
	C		6	4			10	1									1	22
5	B		1	5			7					3						16
	C		23	6			42			6	1	1	1				1	81
6	B		1	6			1	24		2		1						35
	C		14	22		1	35			6	1	2						81
7	B						21											21
	C		5	17		1	50	1	2	5		1	3				1	86
8	B		1	7			7			1			2					18
	C		4	8		2	2	33	1	1	4		2					57
9	C	3	2		1	1	13			3		1				1	25	
BLOCK LEVEL																	601	
10	C	SU2	5	6	2	2	1	17			2		1	2	1		39	
11	C		4	3				18			2		1	1			29	
12	C		3	9				20			1						33	
13	C		1	1				1									3	
14	C							5									5	
15	C			5				22			2						29	
16	C		2	3				6									11	
BLOCK LEVEL																	149	

Fig. 6 Composition of the Paimbumkanja lithic corpus. Source: H. Forestier/H. Baills.

observations. An individual artefact identification number, (from 1 to 750), was assigned to each lithic piece in SU1 and SU2. For the qualitative data a coding table provided for different characters, such as raw material, which were determined petrographically using a microscope (x20).

Procuring and exploiting raw material at PBK

The raw materials present in the two SUs (SU1 and SU2) of squares B and C are homogeneous throughout the archaeological sequence (Figure 7). The raw material has a local origin; it was collected in the environment close to the site. Pebbles are predominant in the aggregate of the shelter wall, and they could have been detached due to erosion. The dominant material is quartz, which represents half of the archaeological corpus (Figure 7).

The raw materials in the two SUs have similar compositions, for example, a very low percentage of limestone rocks between 0% and 0.5%. This frequency, however, can be around 10% in the case of silicified limestone rocks which reflects the deliberate choice of people to preferentially use rocks of siliceous composition, which are known to be easier to knap. This type of rock is highly available in

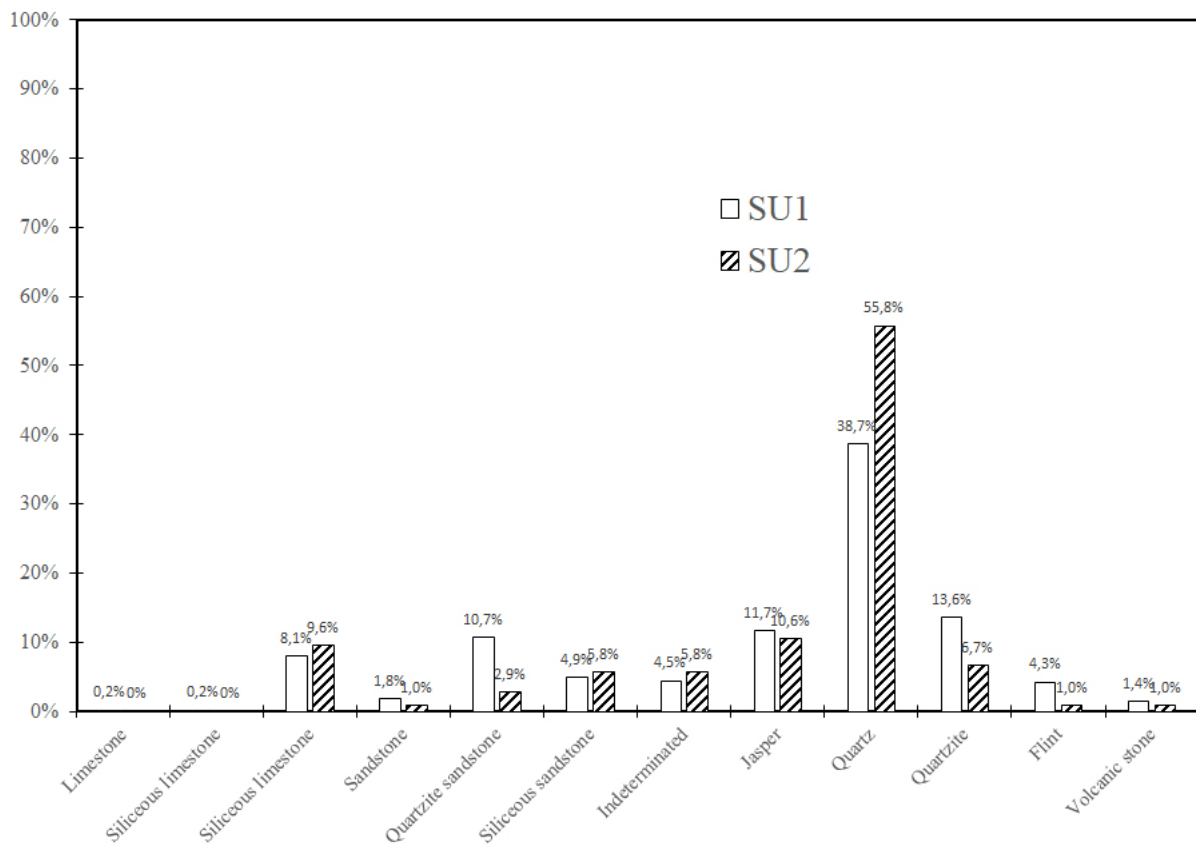


Fig. 7 Raw material in SU1 and SU2. Source: H. Forestier/H. Baills.

the secondary and primary positions in the near environment at PBK. This is also the case for sandstones, flints, and volcanic rocks which, although their frequencies remain below the 5% threshold, have been visibly selected to make tools, sometimes exceptional tools, such as chisels (Figure 11).

Jaspers and quartzites were present at frequencies slightly above 10 %. In contrast, quartz is widely represented, between 40 % and 60 %, because it is an abundant raw material around the site. These are the three predominant raw materials in the PBK corpus. Although the two SUs are clearly homogeneous in terms of their mineral composition, there are some discrete differences that can be observed that reflect the techno-economic, cultural or other dimensions, relative to the way of life of the occupants. Flint, jasper and quartzite sandstone seem to have been more widely selected by the stone knappers in SU1 compared with SU2. To conclude, stone knappers at PBK preferentially used siliceous limestone as the raw material to produce small blades, while quartz pebbles were used to produce macro-tools.

Typo-analysis of the PBK lithic assemblage

There is no morphostructural difference in the composition of the artefacts, either retouched or shaped, between the two SUs. For this reason, the typo-technological characters of the corpus were considered in their entirety, by accumulating/combining the objects from the two SUs.

The few cores recovered (Figure 8, n = 13) indicate that the majority of items were created by a direct percussion technique using a hard-stone hammer. Even if these cores are most often in the residual stage (Figure 8, n. 2, 3, 5, 6), it is possible to determine the operational patterns of orientation as preferentially blades and elongated flakes, by observing the stigmas and the dimension. Thus, from a natural striking platform (Figure 8, n. 1) or prepared by flat removals (Figure 8, n. 2, 5, 6), production was often undertaken in an ‘expedient’ way with little technical control and more or less oppor-

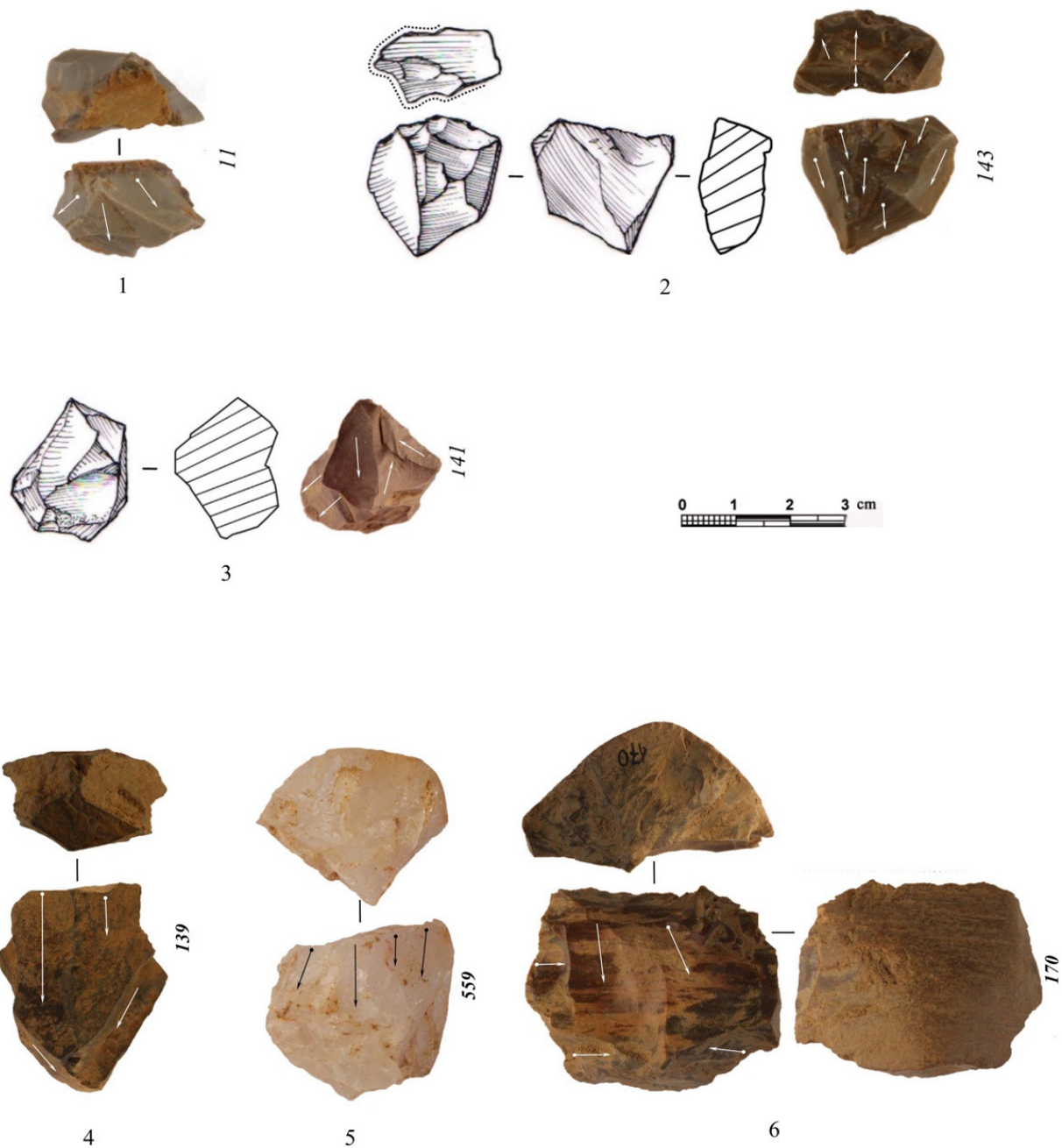


Fig. 8 (1-6): Examples of blade cores in the Paimbumkanja. Source: H. Forestier/H. Baills

tunistically. There are, however, cases where production occurred in a more ordered way of knapping, on larger pieces, with ‘radial’ debitage (Figure 8, n. 2). Finally, an interesting type of prismatic core (Figure 8, n. 2, 4) made it possible to obtain more elongated products of blades or bladelet, identical to those found during the excavation (Figure 9 n. 1-7).

The production system is characterized by unretouched flakes (n=106), but also some with macro-wear traces of utilization (Figure 9, n. 4, 8). Some small flakes were used as micro-drill (bore) or denticulated-notches (Figure 9, n. 8, 9, 4). Others, thicker and stocky, are present as ‘slugs’ (limace in French typology) with an abrupt denticulated retouch on their periphery (Figure 9, 10) or lateral side-scrapers made on thick flake (Figure 9, n. 11). Among the products resulting from the debitage, the blades and bladelets are unique blanks in the PBK corpus because they are the result of the volumetric exploitation from a core, as shown by two classical prismatic cores (Figure 8, n. 2, 4).

Typo-metrically speaking, they are authentic bladelets (Figure 9, n. 1-4, 7), or short blades, which are distinguished here from bladelets by their greater width (Figure 9, n. 6). These elongated products have a well-balanced triangular section without a crest or semi-crest/half-crest.

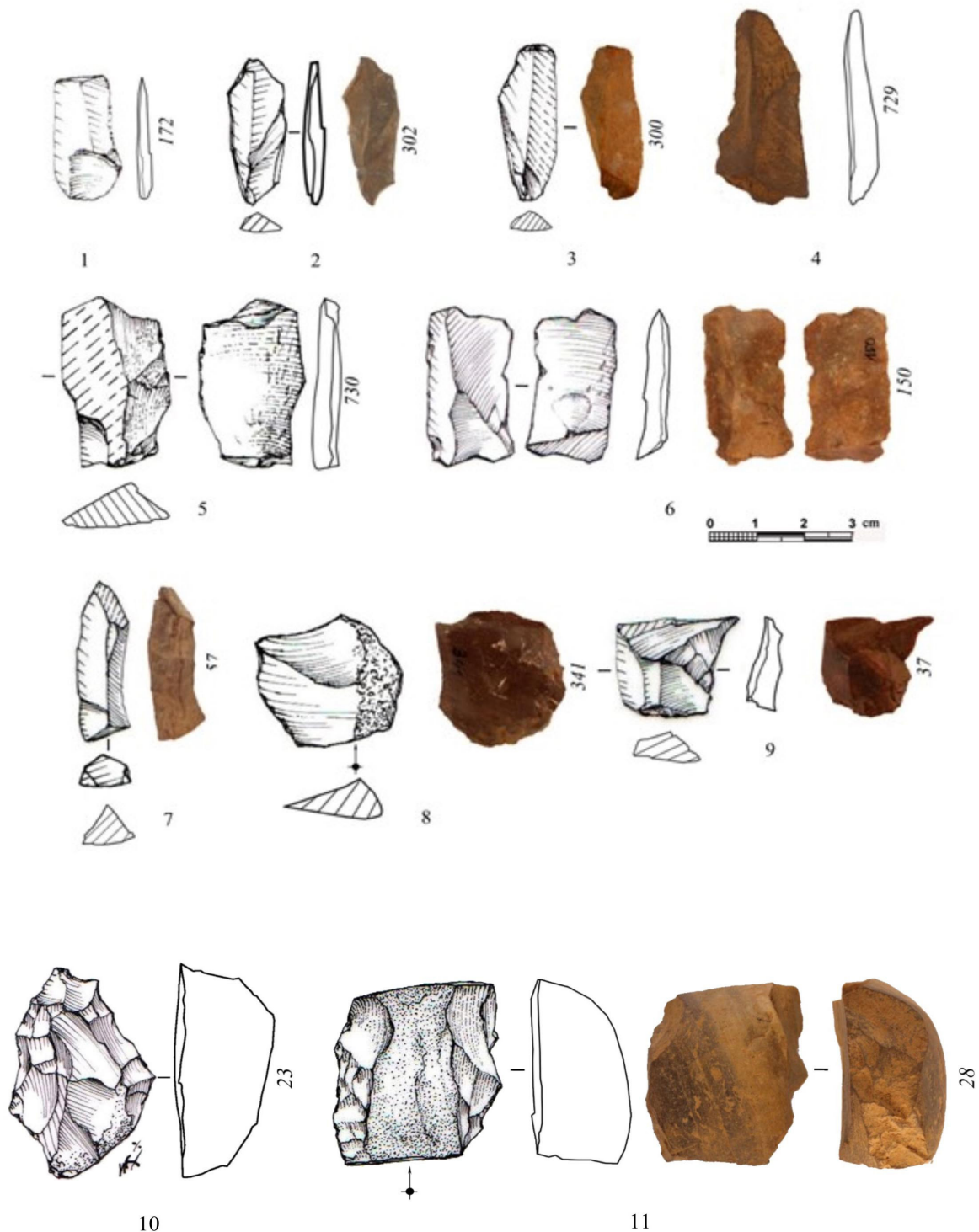


Fig. 9 Blades (1-7), flakes and small tools (8-11) in the Paimbumkanja corpu. Source: H. Forestier/H. Baills

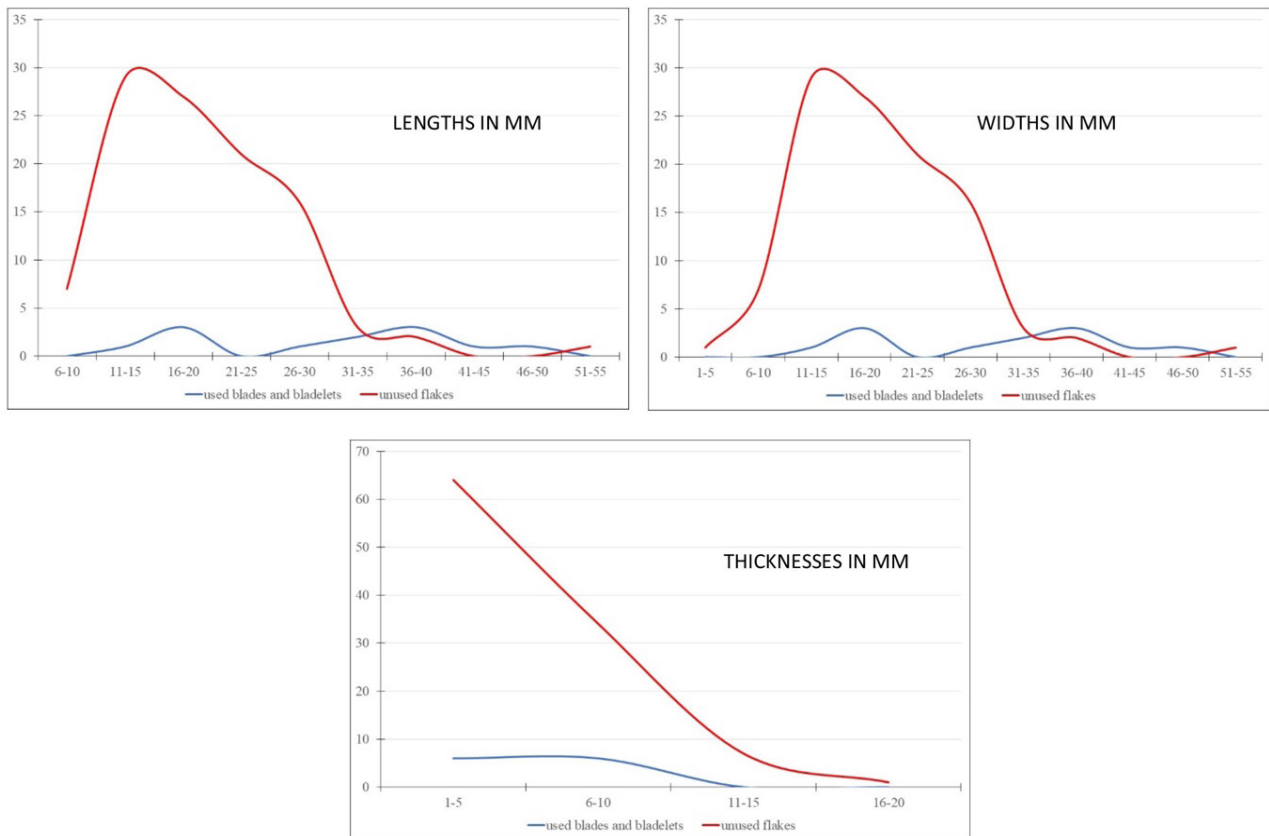


Fig. 10 Dimensions of blades and flakes in the Paimbumkanja. Source: H. Forestier/H. Baills

The majority of the items (> 80%) have visible signs of use (Figure 9, n. 1-6). The dimensions of the blades and bladelets have a bimodal distribution; this is quantitative evidence to categorize two distinct tool types (Figure 10). With respect to the dimension of flakes, the distribution is a broad modal plateau, indicating a greater variation in the length-width of items (Figure 10).

We can hypothesise that the variation in the dimensions of the raw flakes is because a given flake corresponds to a specific stage in the operational sequence. If we isolate the raw flakes and the used flakes, we observe that the occupants of the site chose the largest sized flakes (Average length of used flakes = 29.2 mm; Average length of raw flakes = 20.9 mm) for additional knapping/shaping and use as a cutting edge. Equally, there is a higher heterogeneity in the dimensions of the used flakes compared with their raw counterparts (SD used flakes = 22.7 mm; SD no-used flakes = 20.9 mm). With regard to the statistical data, it can be argued that the choice of a flake intended to be used would have been made according to the size of the required tool. In addition to production, there is the shaping operation: pebbles are the preferred support for shaping big tools (n=22). They are essentially composite tools combining notches and transverse or lateral scrapers. In the group of shaped tools, a special mention must be made to chisels that are considered to be original tools.

The stone tool in the PBK corpus

In the PBK corpus an original tool stands out: the chisel (Figure 11).

One whole and one broken specimen were found in the shelter section (pieces no. 338 and no. 558) in spits 7 and 8, i.e., in the base of SU1. The morphology of the chisels recovered at PBK (in 2018) corresponds to the definition provided by J. Cauvin (Cauvin 1983): “elongated tools which a narrow cutting edge”. These pieces are known to have been used for woodwork. They are regarded as complex tools because many morphological varieties exist: large and small, more or less narrow, some-

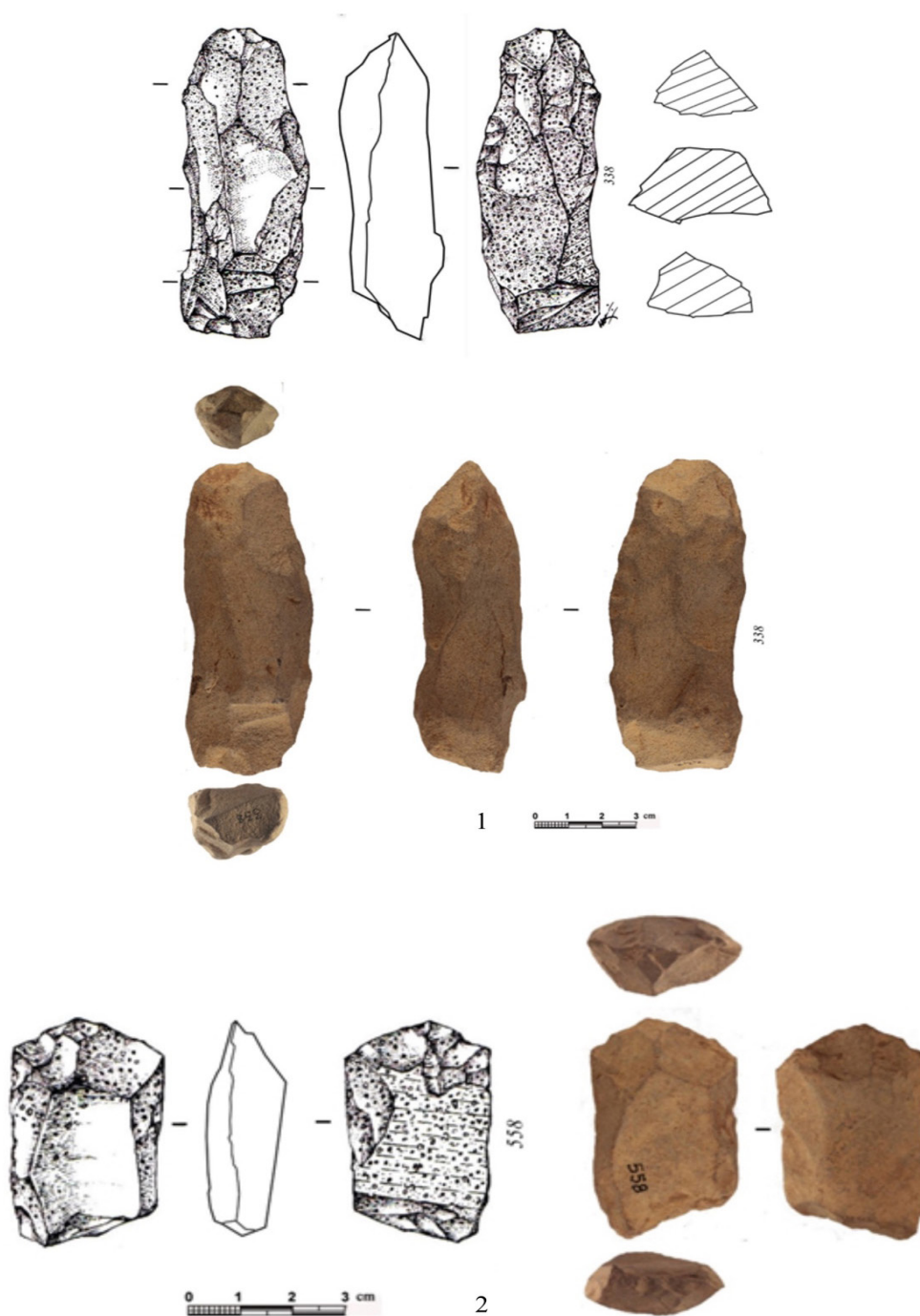


Fig. 11 Chisels in Paimbumkanja assemblage. Source: H. Forestier/H. Baills.

times only shaped or partially polished. The chisel is similar to an elongated “tranchet”; it is narrow and straight at the sub-quadrangular section. This type of tool has many intermediary shapes and structures between the tranchet and the chisel, so the theoretical limit is fixed as: the width $\leq 1/3$ of the length.

The silhouette of one of the chisels (Figure 11, n. 2) has certainly undergone morphological changes following successive re-sharpening phases which modified the original dimensions of the object. On the other hand, the whole specimen discovered in spit 7, SU1 (Figure 11, n. 1) was produced by bifacial shaping from an oblong block of volcanic rock with pronounced grains which, without being a pumice. The butt is a large flat surface obviously intended to be struck (which is in line with how

a chisel is used). The sub-parallel edges of both faces have been regularised by an ordinary bifacial and scalariform retouch giving the piece its sub-quadrangular section. The distal end has a slightly sinusoidal transverse bevel. The symmetry of the longitudinal profiles do not suggest a “hoe-adze”, since this tool has an asymmetrical silhouette. So the PBK specimen has for us, all the characteristics of a typical chisel.

Conclusion

Our archaeological exploration and excavations of the Highlands fringe in the middle Sepik are only the start, because the area is vast and logistics are challenging. The survey and 2 m² test excavation conducted in 2017-18 by the MPF-PNG in the PBK rock shelter is only the beginning. Our research has revealed a first archaeological sequence with two stratigraphic units (SU1 and SU2), as well as a chrono-cultural landmark for the period between 3,000 and 2, 000 BP, which brings new information on the variability of stone tools used during this period.

Producing blades from a siliceous material can support and advance the idea of formal tool technology, perhaps a “Late Holocene blade technology” associated with small tools on thick cortical flakes and with complex shaped tools such as the chisels. Several operational chains characterize the PBK tool-kit: blade and non-blade tools, debitage and shaping methods on various raw materials, but with a preferential use of pebbles. People took advantage of the mineral diversity in the environment close to the site. The typo-technological and techno-economic analysis of the lithic material at PBK reveals a diversity of technical behaviors of the human groups that lived in the rock shelters during the recent Holocene in the remote valley of the Sepik.

The period represented at PBK represents a time immediately following the Lapita cultural complex in the Bismarck Archipelago at 3500-3300 years ago. Others have argued that evidence of pottery in the Eastern Highlands at 3000 years ago suggests some degree of cultural diffusion from Lapita on the north coast of New Guinea (Gaffney et al 2016). While we believe the archaeology at PBK does not primarily reflect Lapita we are cognizant of the impact of Lapita in the region and the potential of further research to investigate notions of cultural contact.

Thirty years after the pioneering work and publications of Gorecki and Gillieson, our results on lithic production patterns in PBK are similar to those obtained in the Jimi-Yuat valley, for the same period. Thus, “blade technology” became widespread in the lowlands of Papua New Guinea during the Holocene, and maybe a techno-cultural marker of a recent settlement phase in the Sepik Basin. This technology is distinct from the older and more massive industries known hitherto, and with the contemporary industries present in the highlands. The study of new sites and lithic corpuses is still necessary to better understand the blade technology and his diffusion around the Fringe Highlands, and also its link to the lithic production of the highlands, at a time when there was a north-south interaction between the Sepik-Ramu region and the highlands.

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References

- Cailleux, A and Tricart, J (1963) *Initiation à l'étude des sables et des galets I* [Initiation to the study of sands and pebbles 1]. Paris: Centre de Documentation Universitaire.
- Centre D'expertise En Analyse Environnementale Du Québec Et Ministère De L'agriculture, DPRED-LaDQ (2003) *Détermination de la matière organique par incinération: méthode de la perte au feu (PAF)* [Determination of organic matter by incineration: loss on ignition method (PAF)]. Ministère de l'Environnement du Québec.
- Bühler, A (1961) Kultkrokodile vom Korewori [Cult crocodiles from Korewori]. *Zeitschrift für Ethnologie*, 86: 183-207.
- Cauvin, J (1983) Typologie et fonctions des outils préhistoriques: apports de la tracéologie à un vieux débat [Typology and functions of prehistoric tools: contributions of traceology to an old debate]. *Traces d'utilisation sur les outils néolithiques du Proche-Orient*. Table ronde 8-10 juin 1982 [Traces of use on Neolithic tools from the Near East. Round table 8-10 June 1982]. Lyon: GIS and Maison de l'orient, 266.
- Chappell, J (2005) Geographic changes of coastal lowlands in the Papuan Past. In: A Pawley, R Attenborough, J Golson & R Hide (eds.) *Papua pasts: Cultural, linguistic and biological histories of Papuan speaking peoples*. Canberra: The Australian National University, 521-541.
- Davies, HL (1990) Structure and evolution of the border region of New Guinea. In: GJ Carman & Z Carman (eds.) *Petroleum Exploration in Papua New Guinea. Proceedings of the 1st PNG Petroleum Convention*. Port Moresby: PNG Chamber of Mines and Petroleum, 245-269.
- Davies, HL (2012) The geology of New Guinea – the cordilleran margin of the Australian continent. *Episodes*, 35(1): 87-102.
- Djerrab, A (2002) La susceptibilité magnétique au service de la préhistoire [Magnetic susceptibility at the service of prehistory]. In: JC Miskovsky (ed.) *Géologie de la Préhistoire* [Geology of Prehistory]. Paris: Association pour l'étude de l'environnement géologique de la préhistoire, 1131-1154.
- Dow, DB, J, SJA, Bain, JHC and Ryburn, RJ (1972). *Geology of the South Sepik Region, New Guinea*, 88:1. Canberra: Australian Government Publishing Service.
- Edwards, E and Sullivan, N (2008) Preliminary Report of the Cruz Mayor Rock Art Expedition to Papua New Guinea. May-July, 2008. Available at: http://www.explorers.org/flag_reports/Ed-mundo_Edwards_Flag_83_Report.pdf [accessed 04 September 2020].
- Gabriel, J and Gorecki, P (2014) *The 'Karawari Caves Precinct' of the Sepik River Basin, Papua New Guinea*. Cairns: James Cook University.
- Gaffney, D, Ford, A and Summerhayes, GR (2016) Sue Bulmer's legacy in highland New Guinea: A re-examination of the Bulmer Collection and future directions. *Archaeology in Oceania*, 51(S1): 23-32.
- Golson, J, Denham, T, Hughes, P, Swadling, P and Muke, J (2017) *Ten thousand years of cultivation at Kuk Swamp in the highlands of Papua New Guinea*. Canberra: The Australian National University Press.
- Gorecki, P and Gillieson, D (1989) *A Crack in the Spine: Prehistory and ecology of the Jimi-Yuat Valley, Papua New Guinea*. Townsville: James Cook University.
- Gorecki, P and Jones, R (1987a) A new rock art province in New Guinea [Unpublished work]. Canberra: Australian National University, Department of prehistory, Research School of Pacific Studies, Canberra.
- Gorecki, P and Jones, R (1987) *Rock art of the Upper Arafundi and Upper Karawari Rivers, East Sepik, Preliminary report, October 15, 1987*. Canberra: Department of Prehistory, Research School of Pacific Studies, Australian National University.
- Löffler, E. (1974) *Geomorphology of Papua New Guinea*. Canberra: Division of Land Use Research, CSIRO.
- Löffler, E (1977) *Geomorphology of Papua New Guinea*. Canberra: CSIRO/Australian National University Press.

- Mead, M (1934) Tamberans and Tumbuans in New Guinea. *Natural History*, 34(3): 234-246.
- Miskovsky, JC and Debard, É (2002) Granulométrie des sédiments et étude de leur fraction grossière. In: JC Miskovsky (ed.) *Géologie de la Préhistoire*. Paris: Association pour l'étude de l'environnement géologique de la préhistoire, 479-501.
- O'Connell, JF, Allen, J, Williams, MaJ, Williams, NA, Turney C, S, M, Spooner, NA, Kamminga, J, Brown, G and Cooper, A (2018) When did Homo sapiens first reach Southeast Asia and Sahul? *Proceedings of the National Academy of Science*, 115(34): 8482-8490.
- Pawley, A, Attenborough, R, Golson, J and Hide, R (eds.) (2005) *Papuan pasts: Cultural, linguistic and biological histories of Papuan-speaking peoples*. Canberra: Australian National University.
- Roscoe, P and Borut, T (2004) The People of the Lower Arafundi: Tropical Foragers of the New Guinea Rainforest. *Ethnology*, 42(2): 93-115.
- Sullivan, N (1998) The Awim Caves, Paradise. *Air Niuguini Flight Magazine*, 129: 23-25
- Sullivan, N (2012) Sago Bark Painting and the Transformation of Community Identity on the Arafundi River. *Pacific Arts Journal* 12(2): 5-23.
- Summerhayes, GR, Leavesley, M, Fairbain, A, Mandui, H, Field, J, Ford, A and Fullagar, R (2010) Human adaption and plant use in Highland New Guinea 49,000 to 44,000 years ago. *Science*, 330: 78-81.
- Summerhayes, GR, Field, JH, Shaw, B and Gaffney, D (2017) The archaeology of forest exploitation and change in the tropics during the Pleistocene: The case of Northern Sahul (Pleistocene New Guinea). *Quaternary International*, 448: 14e30.
- Swadling, P (2010) The impact of a dynamic environmental past on trade routes and language distributions in the Lower-middle Sepik. In: J Bowden, NP Himmelmann & M Ross (eds.) *A journey through Austronesian and Papuan linguistic and cultural space paper in honor of Andrew Pawley*. Canberra: The Australian National University, Pacific Linguistic, School of Culture, History and Language, 113-141.
- Swadling, P, Wiessner, P and Tumu, A (2008) Prehistoric stone artefacts from Enga and the implication of links between the highlands, lowlands and islands for early agriculture in Papua New Guinea. *Journal de la Société des Océanistes*, 1/2: 126-127.
- Swadling, P, Schäublin, BH, Gorecki, P and Tiesler, F (1988) *The Sepik-Ramu: An Introduction*. Port Moresby: Papua New Guinea National Museum.
- Tsang, R (2018) Oral tradition and rock art in the Karawari. In: FX Ricaut and MG Leavesley (eds.) *French-Papua New Guinean Prehistoric Project in PNG*. [Unpublished work]. Paris: French Ministry for Europe and Foreign Affairs.