

**ARCHAEOLOGICAL RESEARCH IN WEST NEW BRITAIN PROVINCE,
PAPUA NEW GUINEA**

JUNE-JULY 2004

Submitted by
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Pollen coring at Lake Umboli

This project is affiliated with the National Museum and Art Gallery, Papua New Guinea

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PARTICIPANTS

Dr. Robin Torrence, Team leader, Australian Museum

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Marissa Torombe, University of Papua New Guinea

Blaise Vatete, Advisor on Culture and Tourism, WNB Provincial Government

Matthew Rabui, Cultural Officer, WNB Provincial Government

ITINERARY

June 14 Torrence and White arrive POM.

June 15 Visit National Research Institute and National Museum; present seminar and consult with Professor Hugh Davies at Geology Department, University of Papua New Guinea.

June 16 Meet with Chris McKee (Geophysical Observatory); present seminar at National Museum; travel to Mahonia Na Dari Research Station, Kimbe.

June 17-18 Consultations and planning with staff at West New Britain Provincial Cultural Centre.

June 21 Visit Lake Umboli and begin clearing helipad with villagers from Morokia; Athens arrives.

June 22 Torrence consults with Nick Thompson at NBPOL; gives presentation to upper class at New Britain International School, Mosa; continue consultations with WNB Provincial Cultural Centre.

June 23 Torrence and White give presentations to Grades 3-4 and 7-8 at Kimbe International School.

June 24 Neall and O'Neal arrive. Public talk at Mosa Social Club.

June 25-July 3 Environmental study; sampling at FAAH.

June 26 Public talk at Walindi Resort.

July 3 Athens departs; Torombe arrives.

July 3-July 8 Study of volcanic history.

July 9 Neall, O'Neal and Torombe depart.

July 10-15 Torrence and White travel to and fieldwork on Uneapa.

July 18 Torrence and White depart West New Britain

SUMMARY

Inter-disciplinary research begun in 1999 has achieved important results that help reconstruct the long-term relationships between human history and environmental change in the Willaumez Peninsula, West New Britain province, PNG during the period beginning with the earliest human colonisation c. 40,000 and extending up to the time of European arrival. Fieldwork during 2004 was designed to complete the fieldwork component of the current project. In addition to satisfying three major objectives, several important new archaeological findings were made.

Firstly, the team met with collaborators, school children, teachers, and the general public in Port Moresby and West New Britain to update them on research results. Maps showing the distribution of archaeological material in the study area and recent scientific publications were presented to stakeholders.

Secondly, environmental and tephrostratigraphical studies confirmed that the major Witori volcanic event of about 3,600 years ago drastically altered the coastline by infilling an area that encompasses most of Tili, Daliavu, Sapuri, and Garu plantations as well as the low lying portions of Haella (Figure 1). Samples useful for reconstructing the aquatic and marine environments that existed prior to this major event were acquired from augering. Pollen cores that will provide data necessary for better understanding how vegetation (forest, gardens, etc.) were impacted by the major Witori volcanic eruptions of the past 6,000 years were collected from Lake Umboli, Garu and Numundo.

Thirdly, a brief trip was made to Uneapa Island (Bali-Witu group) to assist with the ongoing inventory of cultural heritage and archaeological materials on the island

Finally, two significant new archaeological sites with important information for understanding the history of early human settlement during the Pleistocene period or for clarifying the nature of obsidian trade and social change prior to 3,600 years ago were recorded for the first time.

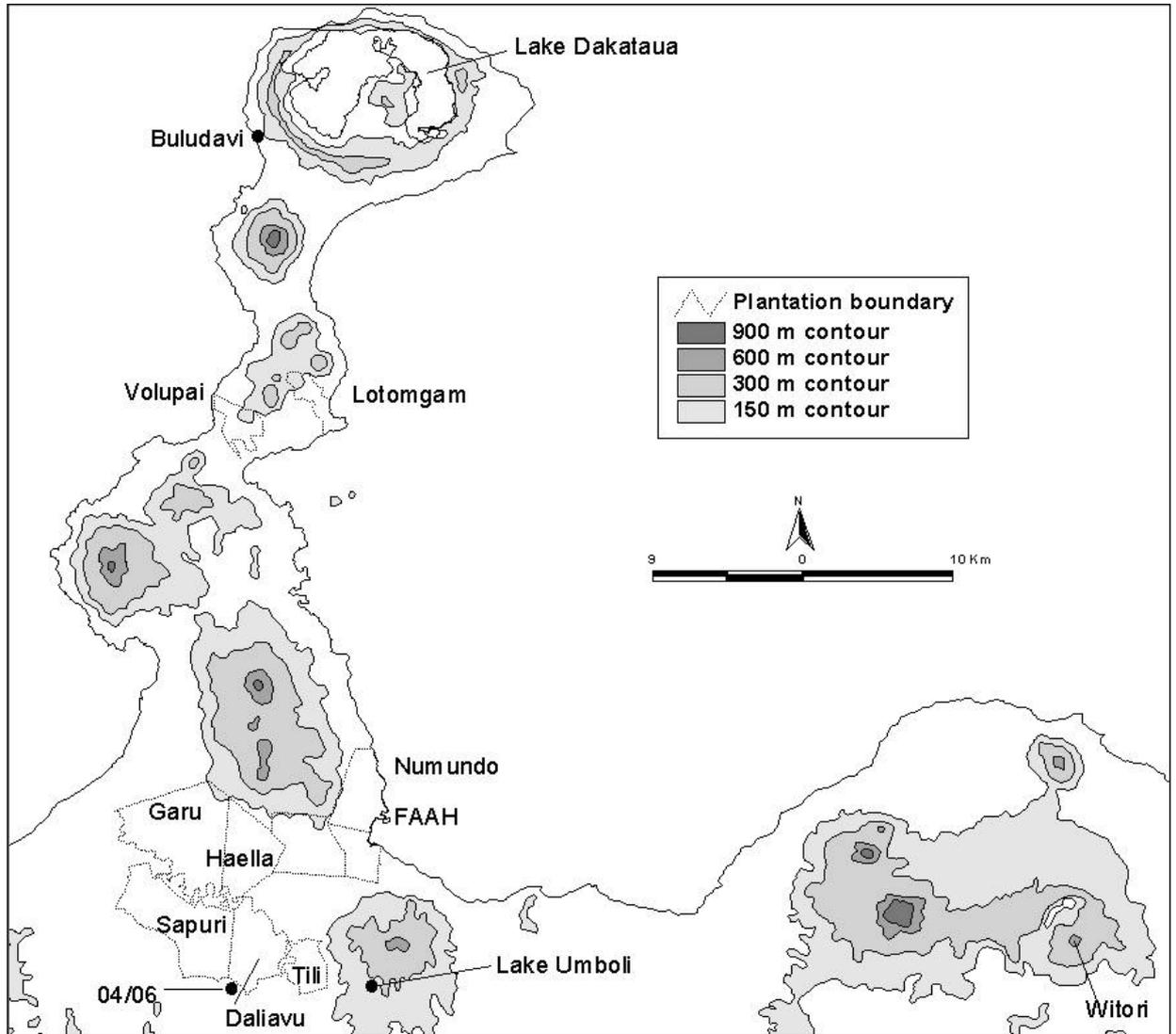


Figure 1 The study area

FIELDWORLD IN 2004

Since 1999 our inter-disciplinary research project has reconstructed the long-term history of human settlement in the Willaumez Peninsula, West New Britain, PNG (Torrence *et al.* 1999; Torrence 2000; 2001; 2002). The study area is the Numundo Group Plantations, Tili, and the Kulu-Dagi Project (Figure 1). This research is significant because it has recovered new information about human history in West New Britain since first colonisation about 40,000 years ago and because it has investigated how communities have responded to disasters caused by ancient volcanic activity. Our research is also important because the region is experiencing modern development activities that are exposing many archaeological sites. Our project has rescued irreplaceable data before it was lost forever.

Since the completion of the fieldwork in August 2002, the research team has been analysing the abundant data that were collected. A number of research papers have been published or submitted. A detailed presentation of project results is currently being prepared for publication as a monograph. During the analysis stage we identified a few deficiencies in our data that could be eliminated by a short fieldtrip. We also wanted to visit the region in order to report back to our affiliated agencies, National Museum and Art Gallery and West New Britain Provincial Cultural Centre, as well as the local WNB community about the significant new findings that we have made.

PROJECT AIMS

Our fieldwork in West New Britain in 2004 had three main aims. The first was to meet with staff at the National Museum and Art Gallery (Port Moresby), West New Britain Provincial Cultural Centre, West New Britain Provincial Government, and New Britain Palm Oil, Ltd. to inform them about the results of our research and to consult with them about possible ways to disseminate our research findings to the community at large. Our second objective was to collect additional information about environmental changes in the study area. Due to limitations in previous fieldwork, a few remaining studies were needed in order to complete our current project. Thirdly, several members of the team planned to revisit Uneapa Island to continue recording archaeological sites and to assist Sarah Bryne, a PhD student from the Institute of Archaeology, University College, University of London, in starting her archaeological research project concerning stone arrangements on the island.

REPORTING AND CONSULTATION

Torrence reported the results of previous fieldtrips to seminars at the University of Papua New Guinea and the National Museum and with White consulted with staff and students at both institutions. The library at the National Museum was presented with offprints of all recent published work by the team. Torrence also discussed ongoing collaborative research with Professor Hugh Davies at UPNG. Also in Port Moresby Torrence met with Chris McKee, Geophysical Observatory, to review the implications for archaeology of the results of his geological research in West New Britain.

In West New Britain Torrence donated a PhD thesis, maps based on the project GIS analysis which show the locations studied in the project overlaid over aerial photographs, and copies of published papers to stakeholders: West New Britain Provincial Cultural Centre; Nick Thompson and other staff at NBPOL; and the library at the Mahonia na Dari Research Station. Torrence gave a public talk at Mosa Social Club for staff from New Britain Palm Oil Ltd. and other interested members of the public and a second talk for the community at large at Walindi Plantation. Teachers and students from Kimbe High School attended the talk at Walindi, thanks to assistance from The Nature Conservancy. In addition, Torrence showed artefacts and talked to students and teachers at New Britain International School, Mosa. At Kimbe International School Torrence and White taught pupils in Grades 3-4 and 7-8 and met with the teachers.

On several occasions the team met with staff at the West New Britain Provincial Cultural Centre to report the results of their research and to discuss various matters concerning the recording of cultural heritage in the province.

ENVIRONMENTAL RECONSTRUCTION

Since one of the goals of our research is to understand changing patterns of human settlement and land use since people arrived on New Britain, it is necessary for us to reconstruct the various environments that people experienced. As summarised in previous reports, our project has studied the history of vegetation as represented by differences in the plant microfossils present at different times (pollen, phytoliths, starch) (e.g. Parr 2003; Lentfer 2003). Secondly, team members have analysed changes in the physical landscape caused primarily by variations in sea levels and the effects of the addition of the volcanic tephtras. Fieldwork conducted in 2004 was designed to enhance both of these approaches.

Lake Umboli

Relevant to the first task of reconstructing vegetational histories, one of the major objectives of the fieldwork was to obtain a pollen core from the small crater lake called Umboli (Figure 1). Very little is known about the history of climatic change in the lowland tropics in Papua New Guinea. This is a serious deficiency for our work since changes in the nature of the rainforest caused either by climatic changes and/or by the devastation created by volcanic eruptions are highly relevant for understanding human history. Although we have excellent data concerning the recent volcanic history, we do not have direct data on climatic or vegetation changes. For this reason we went to Lake Umboli in 1998. We did recover a small core from near the shore of the lake, but were not able to penetrate thick layers of volcanic ash and so core only covers the very recent period (Torrence *et al.* 1998).

This year we returned to Lake Umboli with more sophisticated coring equipment, but ran into similar difficulties due to the depth of the W-K2 tephra, presumably enhanced by material that washed off the surrounding steep slopes of the crater. Although somewhat disappointed by our results, we did recover 3 cores which extend to a depth of 3.63 below the lake floor. These will extend the previous core up to c. 3,600 years ago.

Sea level changes

On the basis of the 2002 fieldwork, the team proposed the hypothesis that catastrophic flooding following the W-K2 volcanic event significantly infilled a large tidal basin roughly equivalent to most of the Kulu-Dagi Project area, Tili and Garu Plantations and the low-lying section of Haella. The 'Tili' surface that represents this event was systematically mapped in 2002. In 2004 we sought data to test this hypothesis by augering beneath the Tili surface at several places on Sapuri/Daliavu Plantations (Table 1).

Our results have confirmed that at Kulu 14 and Kulu 3 there was an aquatic environment prior to the redeposition of the W-K2 tephra. The absence of the W-K1 tephra at these localities also indicates a marine environment at that time as well. Samples were taken from the augering which will clarify the nature of the environment (whether tidal, estuarine, etc.) through the analyses of various fossils (e.g. pollen, dinoflagellates). Augering at Kulu 15 showed that the boundary between an open water lagoon and a poorly drained swamp is somewhere between that locality and Kulu 3. Microfossil evidence from this location will help us assess the impact of the change on vegetation after the fall of the W-K2 tephra.

Augering and coring within the Garu peat swamp near the foot of Boku hill also produced important evidence to help us assess the impacts of sea level change and volcanic activity. Coral reached at the base of the core will help date the Holocene high sea level, unless there was uplift prior to the fall of the W-K1 tephra which fell onto a terrestrial setting. Unlike at the Kulu-Dagi region, the fall of W-K2 has had little impact at Garu which remained a peat swamp from before that time until the present day.

Finally, the team conducted a program of augering and coring around the base of the FAAH hill at Numundo (Figure 1) to reconstruct the history of sea level change at this important Lapita site. We focused on one site located just seaward of the mangrove swamp, which appears to have been a stable feature for a long time. At 04/04 we noted 1.75m of redeposited, recent sediment and W-H tephra on top of a sandy beach. At 2.75 m the core retrieved coral fragments, and marine shells. We can conclude that the shoreline has not altered markedly in the recent past, although the local environment has changed from marine to wet terrestrial, perhaps because of recent uplift. We can also conclude that since a beach existed during the time of Lapita occupation on the top of the hill, there is a possibility of finding additional cultural material in this setting, although the beach is currently almost 2 metres below the current ground surface.

VOLCANIC HISTORY

Our research on the volcanic history of the Willaumez Peninsula in relationship to changes in human settlement has been necessarily restricted to our study region. Laboratory analysis of the volcanic tephra identified a few problems that required revisits to key sampling locations or new data. In our short trip this year we took additional samples at FABM, rechecked and resampled a number of sections relevant to clarifying our understanding of the W-H tephra series, and expanded our knowledge of the Dakataua eruption which has been redated by our project to c. 1400 BP.

FABM

A detailed report on our study of the Pleistocene site at FABM, recently named Kupona na Dari, is nearing completion (Torrence *et al.* in press). To finalise this study, we required a few additional samples of layers that had been omitted previously because their definition was unclear. Neill and O'Neal revisited the site, double checked the stratigraphy, made additional notes, and took samples of the various components of what had been termed Unit D.

Rhodes report on the luminescence dating of FABM has been completed and is ready for publication. Due to the nature of the highly weathered sediments, the dates he obtained must still be considered as provisional. In order for him to continue experiments with the difficult material from this very old site, Neall and Torrence collected four additional samples from Units C and E because they hold the greatest promise for using this technique to date the arrival of humans in this region.

W-H tephras

Previous studies by Machida *et al.* (1996), Torrence *et al.* (2000), Pavlides (1999), and Davies (1999) have built up a tephrostratigraphy for the major Witori tephras W-K1-4 using macroscopic, physical characteristics backed up by SEM microprobe analyses of the chemical composition of glass shards in the tephras. This has enabled archaeologists to compare and contrast material of roughly the same chronological period across West New Britain. These investigators have not placed much emphasis on the more recent W-H series of tephras because they are generally represented by very thin or discontinuous layers and the chemistry of the glasses is not distinctive to single events. Nevertheless, the W-H tephras are common at many of the archaeological sites in the region and several are distinctive enough to be excellent stratigraphic markers.

Following a preliminary study by Davies (1999), Neall and his colleagues at Massey University have analysed W-H tephra samples from locations distributed across the study area. By using a combination of stratigraphic position and glass chemistry, they have had excellent success at discriminating among 5 of the W-H tephras. Taking this new knowledge into the field, the team revisited a number of the sampled sites in order to match the chemistry with the visual characteristics of each of the W-H tephras and to write a definitive description that will enable fieldworkers to identify each tephra in the W-H series on the basis of a combination of stratigraphic position and gross physical characteristics. The visits were important for clarifying the macroscopic differences among a number of the tephras which had previously been confused with each other. It seems likely that in the future it will be possible to discriminate among the W-H tephras in archaeological and geological research. This will greatly help refine the relative chronological sequence in the region and to focus on the impacts that these events had on human communities.

DK tephra

In 1999 the team identified a very thin layer of tephra that fell in the study area shortly before the W-K4 event. Our collaborator, Chris McKee, conducted fieldwork in 2000-2 to collect comparative samples of pumice from the Witori tephra sequence, the nearby Krummel-Garbuna-Welker volcanoes, and material from Dakataua. On the basis of geochemical analyses, it has been shown that the unidentified tephra belongs

to the DK eruption of Dakataua (McKee personal communication). Unfortunately apart from very preliminary work reported in Machida *et al.* (1996), the history of the Dakataua volcano is poorly known. Since it now impinges on the human history of our study area, the team decided to make a short visit to the northern portion of the Willaumez Peninsula to visit some of the sections reported in Machida *et al.* (1996) and the locality where McKee collected a sample that has provided a new radiocarbon date for the DK eruption.

The day trip was largely useful for acquainting us with the DK tephra as it occurs near the source. Neall also collected a number of samples to complete the Massey University team's study of glass chemistry. At Buludava, however, we were shown a pyroclastic flow which contains large carbonised pieces of wood and a sample was taken to confirm the dating of this event (Figure 1). The team also traced the southern boundary of the pyroclastic surges to between localities 04/11 and 04/12. At locality 04/13, which is adjacent to the manager's house at Lotongam Plantation (Figure 1), Neall identified a breccia with volcanic bombs. This deposit was formed by a localised volcanic event dating roughly 500-1000 years before the W-K2 event (e.g. c. 4600-3100 BP). It seems likely that the current low lying land nearby is an ancient crater relating to this event. The finding of volcanic activity in this region at this time is interesting given that we have previously found stemmed tools at Lotongam (Torrence 2002) and previous research suggest that they may date to the same period as this volcanic event (Araho *et al.* 2002). Clearly there is much very interesting archaeological and geological research to be done in this region.

ARCHAEOLOGICAL RESEARCH

Although the main emphasis of this year's fieldwork was the collection of environmental data, significant new archaeological information was also obtained. The locations of the findspots discussed below are presented in Table 1.

Locality 04/06

A potentially important location where rare artefacts, probably dating to the early Holocene and/or Pleistocene periods, are preserved was found along the Kandrian highway, just beyond the border of Daliavu Plantation (continuation of plantation road 7) (Figure 1). The locality consists of a road cutting through one of the foothills that form the southern border of the Kulu swamp. Unlike the sections beyond it, which are only comprised of saprolite (highly weathered bedrock) rather than coverbeds, a stratified sequence of weathered tephra has been preserved on this lower and less steep hill. A brief description of the stratigraphic units observed is presented in Table 2. As in the case of the Pleistocene site of Kupona na Dari (FABM) on Numundo Plantation, the units are very weathered and so it would be difficult to identify the source volcano, link the units back to the Numundo sequence, and to obtain chronometric dates, but further study of the sequence might yield useful information about the interaction between humans and volcanic activity in this region.

The stratigraphic position of the six artifacts recovered from this locality, five of which were observed within the section, is described in Table 2. Since the section was carefully searched over a distance of c. 15 metres, the density of artifactual material appears to have been very scarce throughout the early periods of human occupation in this region. The upper, Holocene-aged portion of the section was out of

reach of our investigation, but no artefacts were observed on the current ground surface of the hill, although surface visibility was poor.

An additional broken piece of crystallised quartz was found lying among loose sediment at the base of the section and has presumably eroded out of it. This manuport is important because it is foreign to this locality and must have been transported from elsewhere. The piece has not been modified and is unlikely to have been a functional tool, but before it was lost or discarded at this location, it must have held some significance for its owner. A second manuport found within the section may be a fire-cracked stone. Unlike at Kapona na Dari where they are quite common, it was the only manuport we observed in the section.

It is notable that only one of the 4 chipped stone artifacts was made from obsidian and was found near the top of the sequence. In contrast, the 2 chalcedony and 1 chert artefacts were derived from considerably older units. It seems likely that they were obtained from water rolled cobbles from a nearby stream. The site is therefore quite different from the FABM Pleistocene sequence from Numundo where these types of raw material are very rare and where obsidian artefacts are very common. The differences between the two localities are intriguing and suggest future potential for monitoring regional and temporal changes in Pleistocene land use patterns.

Stemmed tools

While rechecking the tephra sequence at FACR XXII (Daliavu), a small obsidian stemmed tool was found nearby on the second terrace of the hill and eroding out of the red-brown clay underlying the W-K2 tephra. No pottery was located this year. Finally, a brief survey of the eroded gully and outwash at the foot of the hill at FAAH recorded large quantities of undecorated ceramics, but these were left in situ. Two potsherds, a rim and a body sherd with a shoulder, however, were collected as they will add to our study of Lapita ceramic production at this location.

During our short trip to Volupai Plantation to look for sections with the DK tephra, a potentially important locality was found in the vicinity of the current manager's house (04/07 in Table 1). A surface scatter of obsidian artefacts was found on the bulldozed terrace on which the house sits and on the lower ground nearby. No stratigraphic information was preserved, except that the terrace was scraped to below the W-K2 tephra and so the artefacts presumably date before that time. Among the artefacts collected were the following important forms which relate to the manufacture of stemmed tools (Araho *et al.* 2002): 3 handles from broken Type 1 stemmed tools; 8 Type 2 stemmed tools, of which 3 are very small and well worked examples, 3 are medium-sized irregular forms, and 1 is a bifacially worked piece which may be a broken tip from an artifact resembling one found at Boku Hill (Torrence 2004: figs 3, 5); many proximal, medial, and distal segments of large prismatic blades which are likely to have been preforms for Type 1 stemmed tools (cf. Rath and Torrence 2003). It therefore seems likely that ready-made blades were imported to this locality and were converted into Type 1 stemmed tools. The presence of so many small Type 2 artifacts may indicate the presence of some other form of craft production. Although stemmed tools are known from this region, the presence of so many unretouched blade fragments is very unusual, especially since nearly all are from large trapezoidal blades, such as those used in Type 1 stemmed tools.

The unusual and very rich assemblage at Locality 04/07 indicates that further investigation at this site and/or the near vicinity is a high priority for future archaeological research in this region.

UNEAPA

An archaeological survey of the Bali-Witu islands in 2002 concluded that the high density of significant archaeological resources in this region, particularly the carved heads, engraved rock art, and several type of stone arrangement, merited further scientific study combined with an assessment of their cultural heritage values (Specht *et al.* 2002). During 2003 Torrence presented several papers on the team's findings in Washington D.C. and London (Torrence and Specht 2003). These received a great deal of support and generated much interest. A seminar by Torrence at the Institute of London, University College, London also attracted the attention of Sarah Bryne who discussed the possibility of undertaking PhD research on Uneapa. She was later awarded a postgraduate scholarship and then spent several months doing background research in preparation for fieldwork on Uneapa.

Torrence and White made a short trip to Uneapa in July to assist Sarah Bryne, her assistant Ken Bazley, and Blaise Vatete, (WNB Advisor on Culture and Tourism) with setting up a new field project which will investigate changes in the use of stone arrangements during the distant and recent past. During 5 days on the island, they attended several community meetings to explain the nature of archaeological research and to obtain permission to conduct surveys. At the meetings they showed people a display book of photographs to acquaint them with representative sites and artefacts that had been recorded in 2002 and to solicit opinions and assistance. At Nalevatumadirdir, Manapo and Malangai they encountered much enthusiasm and promises of support from community members. Further visits to other parts of the island were also planned. They also revisited some of the key sites identified in 2002. Finally, they helped the team to design a recording and mapping strategy for stone arrangements and piloted this approach on site Bali/37 (FFA). During the trip they also assisted in the training of local residents in surveying techniques.

During the course of their short stay on the island, the team identified several new rock art sites, found axe grinding grooves for the first time, and added a wide range of localities to the Bali site inventory. Bryne and Vatete will continue to update the site register as the research continues, but Bryne's main emphasis will be on the detailed recording of a few chosen sites. She and Bazley will remain on Uneapa until late September. Since the scope of PhD research is necessarily limited by time, it is important that archaeological surveying and recording on Uneapa be continued by others in future years. The density of rock art and stone arrangements is so high, that it will take a concerted effort to achieve a complete register of sites in this unique and highly significant locality. The isolation of Uneapa, due to the large distance from the mainland and the lack of a good ferry service, means that it is difficult to conduct archaeological research with an international team. Bryne's research forms a useful pilot project, however, and if successful may encourage the team to seek further funding for a detailed survey of the archaeological resources on the island.

CONCLUSIONS

The team achieved a number of important results from this short trip to West New Britain. These are essential for the successful completion the long-term interdisciplinary study of human and environment interactions in our study area. Consultations with various stakeholders were highly successful. These will continue in the future; it is hoped that another trip with this as a major aim can be made in the near future. The team completed the environmental study of the study area and collected a series of cores, sediments and tephra samples that will greatly enhance the study of long-term human/environment interactions during the past 6,000 years. It was particularly important to test our hypothesis about the impacts of the W-K2 volcanic event on infilling of the tidal embayment on the west side of the Willaumez Peninsula. New data which will be derived from the study of the pollen cores, sediment samples, and dating of the ancient corals will significantly enhance our knowledge about environmental impacts of volcanic activity in this region. Two important new archaeological sites were discovered (04/06, 04/07) and useful data was collected from two other localities (FAAH, FACR).

Finally, our brief trip to Uneapa island has confirmed the richness and importance of the archaeological materials there. It is hoped that in future years we will be able to assist the WNB Provincial Cultural Centre in making a full inventory and detailed spatial survey of the remarkable cultural heritage of this island.

ACKNOWLEDGEMENTS

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Table 1 Major locations studied in 2004. Two GPS readings may be presented.

Code	Location	GPS	Investigation	Samples
FAAH	Numundo	Various	Archaeological	2 decorated sherds
04/01	Numundo	E 150 05' 55.4" S 05 29' 54.9"	Environmental	Coral
04/02	Numundo	E 150 05' 51.3" S 05 29' 58.4"	Environmental	Auger only
04/03	Numundo	E 150 05' 47.8" S 05 30' 01.1"	Environmental	Coral
04/04	Numundo	E 150 05' 49.1" S 05 29' 58.3"	Environmental	Core 1, sediments
Tili 3	Tili	E 150 02' 56.6" S 05 35' 46.8"	Geological	Tephtras
04/05	Haella	E 150 04' 35.8" S 05 31' 41.4"	Geological	Tephtras
04/06	Kandrian Highway	E 150 00' 34.0" S 05 36' 09.7"	Archaeological	Obsidian, chert and chalcedony artifacts
04/07	Volupai	E 150 00' 28.2" S 05 14' 44.9"	Archaeological/Geological	Obsidian artifacts, tephtras
04/08	Lotongam	E 150° 02' 35.2" S 05° 14' 14.5"	Geological	Obsidian sample for characterisation
04/08	Lotongam	E 150° 02' 34.4" S 05° 14' 13.8"		
04/09	Buludava	E 150° 01' 37.2" S 05° 04' 46.5"	Geological	Carbon sample for dating, tephtras
04/10	Volupai,op.Wavua	E 150° 01' 24.3" S 05° 15' 45.8"	Archaeological/Geological	Obsidian artifacts, tephtras
04/11	Lotongam	E 150° 03' 44.8" S 05° 14' 45.6"	Geological	Observation only
04/12	Lotongam	E 150° 04' 08.9" S 05° 15' 07.8"	Geological	Observation only
04/13	Lotongam	E 150° 04' 02.3" S 05° 14' 42.7"	Geological	Geological
04/14	Garu	E 149° 58' 28.9" S 05° 30' 24.1"	Environmental	Core 1 (Drives 4-11), tephtras, sediments and coral
04/14	Garu	E 149° 57' 28.6" S 05° 33' 25.0"		
Lake Umboli	Lake Umboli	E 150° 05' 43.1" S 05° 38 03.7"	Environmental	Core 1 (Drive 2-4), tephtras, sediments
Kulu 1	Daliavu	E 150° 00' 56.8" S 05° 36' 17.4"	Geological	Tephtras
Kulu 3	Daliavu	E 150° 00' 35.9" S 05° 35' 13.7"	Environmental	Sediments
Kulu 5	Daliavu	E 150° 01' 09.8" S 05° 34' 51.7"	Geological	Observation only
Kulu 10	Daliavu	E 150° 01' 39.9" S 05° 35' 30.2"	Geological	Observation only

Kulu 14	Daliavu	E 149° 57' 29.0" S 05° 32' 24.4"	Environmental	Core 1 (Drives 1-5), tephras, sediments
Kulu 15	Daliavu	E 150° 01' 04.7" S 05° 35' 54.5"	Environmental	Sediments
Kulu River-1	Kulu River, E fork	no reading	Sediment provenance	River sand
Kulu River-2	Kulu River, W fork	E 150° 02' 59.2" S 05° 36' 31.8"	Sediment provenance	River sand
FABM	Numundo	E 150° 05' 18.5" S 05° 30' 19.1"	Archaeological/Geological	Luminescence dating, tephra analyses
FACR	Daliavu	E 150° 00' 58.9" S 05° 36' 20.5"	Archaeological/Geological	Obsidian stemmed tool
XVIII	Daliavu	E 150° 02' 14.3" S 05° 35' 54.0"	Geological	Observation only
FABS	Daliavu	E 150° 01' 45.7" S 05° 34' 06.2"	Geological	Tephras
Dakataua 1	Buludava	E 150° 01' 31.4" S 05° 04' 34.3"	Geological	Observation only
Dakataua 2	Buludava	E 150° 02' 35.3" S 05° 06' 03.1"	Geological	Observation only

Table 2 Pleistocene stratigraphic units at 04/06

Measurements (cm) represent depth below the base of the W-K2 tephra.

Soil on F

0-20 Strong brown, buried soil; strongly developed, medium blocky structure; soft plastic clay that is firmly friable.

Unit F

20-70 Gradational boundary to light brown, sticky, friable clay; moderately developed nutty structure; soft aggregates.

70 Artifact # 4: obsidian noncortical flake.

Unit E

70-75 Upper tuff; coarse sand; at some points represented by irregular pockets of reddish, orange 'creamcakes.'

Unit D

75-88 Light yellow-brown, friable, clay; moderately developed; fine blocky structure.

Unit C

88-101 Lower tuff; discontinuous heavily iron/manganese-stained, hard, massive tuff which breaks to a sandy loam; distinctive black and orange in colour.

Unit B

101-140 Light yellow-brown slippery clay; friable; moderately developed small blocks.

101 Artifact #5; manuport; fire-cracked (?) stone.

104 Artifact #3: chert; dark blue-grey; noncortical flake.

113 Artifact #1: chalcedony; retouched noncortical flake (?scraper).

115 Scattered horizon of yellow-orange material which is weathered lapilli, highly weathered rocks, or weathered creamcakes. It could be a useful chronological marker.

116 Artifact #2: chalcedony; flaked fragment of a water-rolled pebble.

Unit A

140-210 Brown, slippery clay comprising moderately developed, small blocks; moderately firm.

140 Scattered, dusky red discontinuous pockets of iron staining which may be a pedological feature

Road surface (presumably eroded out of section) Artifact #6: manuport; unmodified crystallised quartz fragment.