ARCHAEOLOGICAL FIELDWORK
IN WEST NEW BRITAIN, PNG
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with assistance from
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NOTE: This report summarizes PRELIMINARY results compiled immediately following fieldwork. For confirmed and accurate data, please consult publications.
Mt. Pago is located within the caldera of a much larger volcano, Witori, which spewed out giant ash clouds like this at least 12 times during the past 6,000 years. The Witori volcanic eruptions were many times larger than this one. One of the major aims of our archaeological fieldwork is to assess the impact of these sudden, catastrophic events on the history of people living in the Willaumez Peninsula of West New Britain.
SUMMARY

Fieldwork by a multinational team during 9 weeks in June-August, 2002 recovered new information about the history of the southern part of the Willaumez Peninsula. Thirty-nine test pits were excavated on Numundo, Haella, Garu, Tili, and Kulu-Dagi plantations (Figures 1-3). Obsidian artifacts were recovered from contexts dating to the past c. 10,000 years. Lapita pottery dated to c. 3200-1800 years ago, including some with distinctive dentate stamping, was also found (Figure 12). Human settlement appears to have been mainly focused on the coastal zone, with varying degrees of emphasis on inland areas. Following the W-K4 Witori eruption (1400 years ago), there was an influx of people who spread themselves over the entire study area, whereas during the most recent 500 years, the population decreased significantly and was focused on the coast, possibly as a consequence of European contact.

Volcanological and geomorphological research traced major changes in the physical landscape as a result of volcanic eruptions. For example, following the W-K2 (c. 3,600 years ago) eruption of the Witori volcano, a massive volume of volcanic sediments was transported down the Kulu River, filled a marine embayment, and over a relatively short period of time converted it into the current swamplands within Haella, Garu and Kulu-Dagi plantations.

In addition to the major study, Torrence, Specht and Blaise Vatete (Adviser on Culture and Tourism, WNB Government) recorded rock art, standing stones, boulders with ritual associations, stone arrangements of several types, and various artifacts including pottery, an obsidian stemmed tool, stone axes, and other ground stone items at 102 localities on the Bali-Witu Islands (Specht et al. 2002) (Figures 17-28). Due to the very rich and diverse archaeological remains that represent a long and complex prehistory, further archaeological research among these islands is desirable.

In Port Moresby, Torrence met with the prehistory staff at the National Museum and Art Gallery and with archaeology and geology staff and students at the University of Papua New Guinea. In West New Britain, the Provincial Administrator, the Adviser on Cultural and Tourism, staff at the WNB Provincial Cultural Centre, head of the UPNG extension centre, and plantation managers at Numundo, Haella, Garu, and Kulu-Dagi were informed about the research and discussions were held to increase awareness about the significance of the archaeological resources in this region.
FIGURE 1 The Willaumez Peninsula region of West New Britain, PNG showing the oil palm plantations where test pits were located and the Witori volcano, which is the source of the volcanic tephras/ashes that have created a stratified series of prehistoric landscapes.
RECOMMENDATIONS

The 2002 fieldwork reinforces the previous recommendations and we urge that these be reviewed regularly. We note that NBPOL has made efforts to protect the important archaeological sites previously reported, particularly the Pleistocene remnant at FABM. These basic principles should guide further development activities.

1. All areas should be assessed through archaeological survey and test excavation before development activities, such as road making, terracing and construction, are commenced.

2. A watching brief should be carried out during development activities. If significant archaeological material is uncovered, activities should cease temporarily until a proper assessment can be made, and followed up with surface collection and excavation if warranted.

3. An attempt should be made to conserve a sample of hill and ridge tops because significant archaeological remains are most likely to have been preserved in these settings. Currently, these areas are the most heavily impacted by development.

4. NBPOL should establish and maintain links with the impact archaeologists in the Prehistory section of the National Museum in Port Moresby and with the staff of the West New Britain Provincial Cultural Centre. They will be able to assist with monitoring during development and with rescue excavations.

5. Successful monitoring of archaeological resources requires much better knowledge and awareness on the part of the people living and working in the area. Several sites have been brought to the attention of the team by NBPOL employees. The cooperation and assistance of people who have detailed on the ground knowledge of the region is an important aid to the study and preservation of cultural heritage. We therefore recommend that NBPOL assist staff from the WNB Provincial Cultural Centre in raising awareness about cultural heritage among all the people in the province and that the company encourage their employees to report findings of archaeological material to the Provincial Cultural Centre.
FIGURE 2 Small test pits were excavated in a range of environmental situations within the oil palm plantations.

a) Team excavating in the inland foothill region of Kulu-Dagi Plantation with the swampy Kulu River floodplain visible in the background. Prior to 3,600 years ago, the flat ground in the background was covered over by the sea.

b) Excavation in progress in the inland foothills of Haella Plantation.

c) A completed test pit showing the typical stratigraphy of alternating volcanic tephras and buried soil horizons. The pit was terminated after sampling the soil under the W-K1 tephra.

d) Digging a test pit on a small hill in the riverine floodplain of Garu Plantation.
FIELDWORK IN 2002

The support of the West New Britain Provincial government, the WNB Provincial Cultural Centre, and local residents, the contribution of an enthusiastic and talented group of volunteers, and the cooperation and collaboration of New Britain Palm Oil Ltd have contributed substantially to a successful archaeological fieldtrip. The Willaumez Peninsula (Figure 1) is an important area for archaeological research because the relatively high frequency of volcanic activity and associated falls of tephra (volcanic ash) have preserved a series of well-dated ancient landscapes (Figure 4). The tephras, which have been sourced by several methods to the Witori volcano located on the Hoskins peninsula (Machida et al. 1996; Torrence et al. 2000), define a series of chronological periods, which are described in Table 1. Both the archaeological and environmental studies reported here rely on visual identification of the tephras to correlate between various parts of the study region.

The abundant occurrence of the well stratified, open-air contexts that have been discovered by this project is currently unprecedented elsewhere in the Pacific region, although there is potential for similar findings elsewhere. This unusual setting is important because it provides a rare opportunity to pursue the major aim of the overall multi-year project of which this fieldwork is a part, which is to study changes in patterns of human settlement and land-use over a relatively long period (Torrence 2002a). Excavation on a much more limited scale also took place in 1999-2001 (Torrence et al. 1999; Torrence 2000; 2001). A second aim of the larger project is to compare and contrast the effects of volcanic disasters of varying magnitudes on human groups and to monitor the long-term consequences on human societies of exposure to relatively frequent volcanic activity over a long period of time (e.g. Torrence 2002a).

The major goal of this year’s fieldwork was to excavate a large number of test pits designed to sample the different environmental zones within the study area, which is defined as an irregular shaped band running east-west across the southern end of the Willaumez peninsula. Due to ease of access, the research area is equivalent to the oil palm plantations of Numundo, Haella, Garu, Tili and Kulu-Dagi (Figure 2). This report begins by summarising the results of geomorphological research reconstructing
FIGURE 3 Location of the test pits. Labelled pits were excavated in 2002. Unlabelled pits were excavated in previous years.
FIGURE 4 Stratigraphy and Chronology of the Study Area

The unusual stratigraphy of the study area makes it an important region for archaeological research. This section from one of the test pits illustrates how the region is composed of an alternating series of ancient landscapes (dark layers) which have been buried under ashes from various eruptions (light layers). The labels identify the various volcanic ashes which bracket and define the chronological periods used in this research (cf. Table 1).
the coastal history of the region. The findings of the test pit survey are then discussed and followed by brief accounts of other observations made in the region. Finally, a summary of the findings of a short trip to the Bali-Witu islands is presented.

ENVIRONMENTAL STUDIES

In order to understand changes in human land use, the archaeological record needs to be studied in conjunction with knowledge about the contemporary environment. This is especially important in the Willaumez Peninsula because the high frequency of volcanic activity means that the local environment has altered considerably due to fluctuations in relative sea level, emplacements of differing amounts of airfall tephra at various times, and the effects of earthquakes. Collaborative research with specialists in the fields of geology, geomorphology and paleobotany has therefore been an important component of our archaeological research. Ongoing studies of plant microfossils, especially phytoliths, starch and pollen, will help reconstruct the history of vegetation in the region and its relationship to volcanic events and human activity (Therin et al. 1999; Lentfer et al. 2001; 2002).

This year we were aided by Professor Vince Neall (Massey University, New Zealand), Professor Bill Boyd (Southern Cross University), and Carol Lentfer (Southern Cross University). Lentfer collected modern reference material and soil samples for phytolith analysis, whereas Boyd and Neall concentrated on the study of sediments in Kulu-Dagi, Tili, and to a lesser extent Haella and Garu in order to reconstruct the history of coastal change.

Sediment Mapping

Three principle lines of evidence were used to reconstruct the sediment history of Kulu-Dagi, Tili, Haella and Garu plantations. (For the previous results of work on Numundo plantation see Torrence et al. 1999; Torrence 2001). The visually distinctive Witori tephras defined the chronological periods (Figure 4). Due to their airfall origin, they also offer a sound basis for distinguishing between terrestrial and aquatic conditions. At a number of sections we made detailed descriptions of sediment type, internal structures, and relationships between sedimentary units. This allowed us to infer paleoenvironmental conditions. We also mapped the presence of selected
sediments—noting where they are present as land surfaces or where we can demonstrate their buried presence—as well as distinctive surface geomorphological features, such as depositional surfaces, terraces, breaks of slopes, and large-scale features such as river channels and hill edge cliffs.

In mapping the study area, six basic geographical units with distinctive spatial distributions were identified in terms of both their surface geomorphology and sediment stratigraphy and lithology.

**Geographic unit 1: Southern foothills**

The southern margin of the study area is defined by slight topographic rises, arranged as a set of short ridges protruding approximately northwards into the low lying flats of the Kulu-Dagi Plantation. These are bedrock rises, characterised in places by pre-Holocene volcanic sediments (possible pyroclastic flows and tephras). They are overlain by terrestrial airfall tephras, including all the W-K tephras. In the Tili area, the same surface is draped by the fan component of the “Tili Surface” (unit 2). Unit 1 represents dry land conditions throughout the Holocene.

**Geographic unit 2: “Tili Surface”**

This is a complex of surface and buried exposures of redeposited W-K2 tephra. It defines a tidal embayment which was present prior to the W-K2 eruption. It appears to co-occur with the swampy or poorly drained land in the study area. At Tili Plantation, the W-K2 tephra occurs in deeply bedded sorted units representing remnants of river terraces or a fan surface. In the neighbouring Kulu-Dagi Plantation and along the southern edge of the Haella Plantation, the W-K2 tephra consists of bedded and cross-bedded sediments exhibiting the characteristics of tidal deposits. While we mapped this latter component of the “Tili Surface” through to the Haella Plantation, we were unable to define its eastern-most boundary, although evidence from archaeological test pit XXXV suggests that it may extend to the base of the divide between Haella and Numundo (unit 6). Westwards, we traced the tidal component of this unit well into the Kulu-Dagi Plantation and it may also recur at the base of the deep peat sections we have observed in the centre of Garu Plantation.

**Geographic unit 3: Kulu River channels and terraces**

The present Kulu River is incised into a 4-5m deep channel through the low plain of the study area. Channels and terraces belonging to previous courses of the River occur at slightly higher elevations and cut through the Tili Surface in the Tili and Haella Plantations, but their history has not been fully studied.

**Geographic unit 4: Kulu-Dagi & Garu floodplain and back swamps**

The land surface in the Kulu-Dagi and Garu Plantations is largely characterized as a floodplain, with a range of overbank flood deposits and back swamps present in varying proportions through time. These conditions date from some time after the W-
K2 eruption and reworking of the W-K2 tephra and have culminated in the current character of the plain surface, except where cut by Unit 3.

Geographic unit 5: Foothills of Krummel/Garbuna

The rising land at the northern boundary of the study area comprises several components: lava flows, including Boku Hill and the neighbouring hill to the west; fans and higher foot slopes rising up to the slopes of Krummel and Garbuna; and lower slopes. The lava flows are characterised by steep slopes and cliffs and tend to be capped by stacks of airfall tephras. These would have been dry land for the duration of the period under investigation, although the surface would have varied from being highly unstable and variable in the active areas of fan erosion and deposition, to stable in areas between flows, where airfall tephras accumulated unhindered. Much of the evidence for stable conditions comes from the archaeological excavations. Finally, the lower slopes are low-lying areas close to the present plain, in which airfall tephras are found to be lying on red brown clay (possibly Pleistocene tephras). These include the small hills south of the lower edge of the fan in Kulu-Dagi. The shoreline prior to the W-K1 eruption probably lies close to this component of the unit, although it appears to have been dry land for all the period under consideration, and would have formed the immediate margins of the floodplain once it was formed.

Geographic unit 6: Haella – Numundo divide

This area comprises a low-lying elevated dissected rise with a seemingly horizontal upper surface only a few kilometres wide. It may represent a former, now-raised, coastal platform, but during the past 6,000 years it would have formed a narrow barrier between the two mid-Holocene shorelines and it may have immediately overlooked the tidal embayment immediately prior to the W-K2 eruption times.

Palaeogeographic history

On the basis of the analysed sections and the mapping, a summary history of the paleogeography can be constructed using the volcanic tephras as period boundaries.

Landscape phase 1: pre W-K1 eruption (Period 2)

This period was only observed at few sites at Kulu-Dagi and Tili where the Holocene tephras are underlain by a volcanic sediment representing a possible pyroclastic flow, source unknown. In most of the area we surveyed this year, we did not have access to this phase because of the depth of the overlying Tili surface.

Landscape phase 2: the W-K1 eruption

On a number of hills the W-K1 tephra was deposited on a terrestrial surface, but in the low-lying areas, it has been obscured by the Tili surface. Since this phase dates to the time of maximum Holocene sea level, one might expect that at this time a large part of the study area was inundated by the sea. Much more research is needed to clarify landscape phases 1 and 2.
Landscape phase 3: early period between W-K1 and 2 (Period 3)

This period is also poorly represented in our records, except for Kulu Ditch 8 where there is evidence for the terrestrial weathering of the W-K1 tephra to provide a soil at its upper surface.

Landscape phase 4: late period between W-K1 and 2 (Period 3)

Kulu Ditch 8 provides indication of at least local disturbance on the land surface. Combined with evidence from the related archaeological site (LXVII), there seems to have been slope wash of this soil and possibly also the underlying tephra, with the latter apparently reworked in water; whether this was under tidal conditions is not clear. At Kulu Ditch 7, however, an unusual sandy clay may represent former tidal conditions. Whether this is an intertidal flat deposit will be tested by examining a sample for palynological content.

Landscape phase 5: immediately prior to the W-K2 eruption (Period 3)

At Kulu Ditch 7, the W-K2 airfall tephra has not been reworked or redeposited, suggesting that, due to uplift in the region, possible intertidal conditions in Landscape phase 4 had ceased at the time of the eruption at this locality at least.

Landscape phase 6: the W-K2 eruption

There is sparse evidence in the study area for the terrestrial airfall deposition of the W-K2 tephra. Again, only Kulu Ditches 7 and 8 record this event; both sites are on a slight rise above the general low surface of the Kulu-Dagi Plantation, suggesting that these records indicate the conditions on elevated surfaces. Elsewhere, either the sediment sections are not sufficiently deep to expose the tephra of the W-K2 eruption, or the tephra did not fall on land. The evidence for the following period strongly suggests that throughout the lower parts of Kulu-Dagi, Hæella and Garu Plantations, the W-K2 tephra fell into water, possibly a tidal embayment. It is highly likely, therefore, that in this phase tidal conditions existed up to the base of the southern foothills, close to the foot of the slopes of the lava hills bordering the Krummel/Barbuna foothills in Garu Plantation, and all the way to the Numundo divide.

Landscape phase 7: early period between W-K2 and 3 (Period 4)

This is the period of maximum environmental diversity in the study area. While some localities register the presence of dry terrestrial conditions (e.g. Kulu Ditches 7 and 8), elsewhere in Kulu-Dagi a range of other terrestrial environments are indicated: alluvial floodplain at Kulu Ditch 5; possibly a flowing river at Kulu Road 5 Avenue 15; and a swamp at Kulu Ditch 9. However, the most significant conditions during this period are those of the widespread redeposition of fresh W-K2 tephra in very large quantities.

Throughout the Tili Plantation, W-K2 tephra was deposited under fluvial conditions, thereby forming an extensive, steep gradient fan, dipping to the north from the river. This fan represents the rapid deposition of a large bed load of the proto-Kulu river, derived from its mountainous catchment. It was deposited rapidly as the river breaches
FIGURE 5 Environmental setting during Landscape Phases 1-5 and Cultural Periods 2-3.

FIGURE 6 Environmental setting during Landscape Phases 7-11 and Cultural Periods 4-7.
its confines where it enters the broad embayment that is our study area. Throughout the eastern margin of the Kulu-Dagi Plantation, and further north in parts of Haella, this sediment was reworked in tidal conditions. Thick bedded and cross-bedded sequences were observed in many localities. We have recorded many other sequences for which direct evidence for tidal conditions is not so clear, but clearly the sediments were redeposited in an open body of water. The important implication of this finding, is that during this period the mouth of the Kulu River lay somewhere close to the western margin of the Tili Plantation, and that the larger part of the low surface of Kulu-Dagi, Garu and Haella Plantations was an open body of tidal water. The coastline lay close to the present boundary between the low flat surface of the Kulu-Dagi Plantation and the southern foothills.

Landscape phase 8: late period between W-K2 and 3 (Period 4)

With a few exceptions, this period is characterised by the widespread deposition of floodplain alluvium over the land surface. The sedimentary sequences recorded largely indicate a regressive coastal sequence, with the gradation from open water and tidally controlled sedimentation through to the onset of swampy conditions, and up to the overbank deposition of fine (silty) alluvium. The exceptions are localities where the W-K3 airfall tephra lies on either bedded tephras or sediment that may represent tidal or intertidal conditions. These latter sites may simply be wet terrestrial environments or represent later uplift. More importantly, the extensive evidence available indicates a transition from open water tidal conditions to floodplain conditions.

Whatever the driving mechanism for this change, it implies that the mouth of the Kulu River migrated seawards, probably well to the west of the main area surveyed. Following the deposition of the W-K2 tephra, silts eroded from the catchment were deposited creating a moderately extensive floodplain. A number of sites provide good evidence for back swamps, some of which had peat, located at the outer margins of the floodplain beyond the overbank deposition.

The conversion of a previously extensive body of tidal water, with its shoreline close to the rises, to a widespread and probably ecologically rich floodplain represents a significant change in environment. Within a relatively short period immediately following the eruption of W-K2, fresh tephra was stripped from the catchment and redeposited in the lower river and off-shore. There is no chronological evidence for the timing of the onset of alluvial overbank deposition over the redeposited tephra. It is entirely possible that the period of tidal conditions was short-lived. At Garu, a single radiocarbon date (c. 2,800 BP) provides a possible beginning age for the deposition of a layer of peat that formed until the W-K3 tephra was deposited. If it is possible to equate the onset of peat formation with the onset of alluvial overbank sedimentation, then this may yield a date for the establishment of the floodplain. Ongoing pollen analysis will help determine the timing and nature of this change.

Landscape phase 9: immediately prior to the W-K3 eruption (Period 4)

If analysis confirms that the overlying W-K3 airfall tephra at Kulu Ditch 3, which has not been reworked, was deposited on an intertidal sediment, then this would suggest a period of uplift.
Landscape phase 10: the W-K3 eruption

At the time of the W-K3 eruption, most localities represent the continuation of the established conditions of a well-drained floodplain with associated back swamps.

Landscape phase 11: post W-K3 (Periods 5-7)

Conditions during this period appear to be somewhat similar throughout the period, with periodic airfall tephas adding to the sediments and soils of the study area. Overbank flooding of the flood plain continued and appears to have been more frequent, therefore leading to additional overbank deposits and an increase in temporary and permanent swampiness. In addition, at Garu Plantation, there is evidence for a possible marine incursion late in the sequence, followed by exposure and the partial development of a soil prior to the re-establishment of the peaty swamp.

Landscape Summary

The paleogeographical study has revealed several significant environmental changes in the study area during the Holocene. These reflect the combined effects of volcanic deposition and the reworking of volcanic sediments, global sea level change, tectonic processes (in particular uplift), and the addition of sediments from river flooding. The net effect has been a shift from an extensive marine environment to an evolving terrestrial floodplain environment following the W-K2 eruption (c. 3,600 BP). We suggest that prior to and shortly after the W-K2 eruption most of the area now forming the flat lowland plain of Kulu-Dagi, Garu and parts of Haella Plantations (ie under the current 40 m contour) was a large tidal embayment (Figure 2a, 5). At that time the mouth of the Kulu River lay at the edge of the foothills in or close to the boundary between Tili and Kulu-Dagi Plantations. Immediately after the W-K2 eruption, the Kulu River catchment was stripped of the fresh tephra, which was washed down the river and redeposited as a large fan beginning at the river mouth where it emerged from the confines of the hills and extending further seawards. This massive dumping of fresh tephra must have had significant ecological and geochemical impacts on this part of the coast (Figure 6). This event was probably short-lived, occurring within the decades following the eruption, if not sooner. The single radiocarbon date of c. 2,800 BP which dates the onset of peat in the Garu swamp probably provides a good estimate for the earliest date of the change from tidal to alluvial conditions. Subsequently, the floodplain gradually evolved as successive tephas were deposited upon its surface, palaeosols developed, and the river changed courses and deposited sediments over the floodplain surface. Apparently the floodplain became more
swampy with time. Humans living in the region would have had to cope with a very dynamic landscape characterised by sudden, discontinuous and slow, continuous changes.

**Volcanology**

In 1999-2001 the team recognised a new tephra that directly underlies Witori W-K4, but has a different chemical composition (Torrence 2001). This represents a new disaster faced by the past populations in our study area. Since it may be the source volcano, with the implication that it is not yet dormant, Chris McKee (Geophysical Observatory, Port Moresby) has began work on a new project aimed at understanding the history of Mt. Garbuna. His fieldtrip overlapped with ours and we were able to share equipment and discuss results. His team also found some obsidian flakes in stratified contexts near the top of the volcano.

**ARCHAEOLOGICAL RESEARCH**

**Test pits**

The major aim of this year’s research was to significantly increase the sample size of one metre square test pits which are being used to sample the range of human activities that took place within this region. Previous archaeological research in the island region of Papua New Guinea has mainly concentrated on specific places or ‘sites’ which are located within a very short distance of the contemporary shoreline. In contrast, this project has attempted to expand our understanding of human subsistence and land-use by examining a wider range of environmental settings and by adopting a landscape or non-site approach that is not centred on old villages (cf. Torrence 2000b; Torrence and Stevenson 2000). By sampling a much broader range of places, the goal is to recover material relating to activities that took place at short-term camps or settlements as well as in gardens or other locations where specialised tasks were carried out.

Thirty-nine test pits were excavated in 2002 as follows: Numundo (4); Haella (14); Garu (12); Kulu-Dagi (6); Tili (3). The total sample for the project, shown in Figure 3, now stands at sixty one metre square test pits, distributed over an area of c.
31,000 hectares, only about one-half of which was available for human settlement during the past 3,600 years, due to the environmental changes summarised previously.

In selecting the location of the test pits, an attempt was made to sample the range of environmental situations. We tried to take account of the following factors: distance from seashore; distance from the Kulu River, elevation; general topographic setting (e.g. hilltop, ridge, stream levee, flat land, etc.); potential variation along east-west and north-south transects. Areas seriously affected by development activities, such as staff housing, factory, nursery, etc. had to be excluded, although these are generally located in highly desirable positions for ancient settlement. Although the palaeogeographic units summarised above had not been formally identified when the location of excavations were chosen, the test pits nevertheless provide good coverage of these with two important exceptions. The Kulu River channels and terrace (unit 3) were avoided because they have been heavily affected by recent erosion. Within the Kulu-Dagi, Garu, Haella floodplain and back swamps (unit 4) only small rises were sampled because they offered the only place where dry conditions up to two metres deep exist. Although human activities undoubtedly took place in these contexts, as evidenced by the presence of recent graves which mark former settlements within the Kulu-Dagi development, deep excavation would have been impossible because of the high water table. Furthermore, it was very clear early in the project that these surfaces were underlain by an extremely thick layer of redeposited W-K2 tephra which meant that sampling Periods 2 and 3 by manual excavation is impossible. We preferred to concentrate our efforts in localities which offered the potential to sample the full stratigraphic sequence.

All the test pits were dug according to natural stratigraphic units defined by the volcanic tephras (e.g. Figures 2, 4). Archaeological material, consisting almost entirely of obsidian chipped stone artifacts and some pottery, was recovered from soils formed on top of airfall tephra (volcanic ashes). These marker horizons form the boundaries of the chronological periods defined in Table 1 (Figure 4). Preservation of the full section is excellent throughout most of the study region, but has been truncated by erosion at higher elevations on the steeper slopes. In these situations both the W-K1 and W-K2 tephras are rarely preserved in situ (e.g. pits XXXI, LXI, LXIII, LXV, LXVI). In addition, the W-K1 tephra has a very patchy occurrence, possibly because it was emplaced during the wet season and was washed away. At any rate, this means that archaeological material found beneath the W-K2 tephra, in situations where W-K1
is not preserved, lies on top of the underlying Pleistocene tephras. In these cases, material dating to Periods 2 and 3 cannot be distinguished stratigraphically and could be mixed together on the same paleosurface. For many types of analysis, therefore, we must combine Periods 2 and 3; this is referred to Period 2/3 in this report.

For the purposes of archaeological analysis, the region has been classified into 6 major landscape zones as follows: (1) coastal plain; (2) coastal hills; (3) coastal foothills; (4) divide between Kimbe Bay and the Kula River; (5) higher elevations or small hills within the floodplain; and (6) inland foothills (Figures 5, 6). Due to the major landscape changes summarised above—particularly the drastic move of the coast from somewhere close to the current 40 m contour during Periods 2-3 to its current position following the W-K2 eruption in Period 4 and the establishment of the modern swampy floodplain—the coastal hills zone in Haella, -Dagi and Tili was transformed into floodplain hills or inland foothills (Figures 5, 6). Recognising this shift is very important for interpreting the distributional data provided by the test pit excavations.

A very preliminary analysis of the data recovered from the total sample of test pits (1999-2001) is provided by the distribution maps in Figures 7 to 15 and the data presented in Tables 1-4. Beginning with the maps, Period 2 (?10,000-5,900 BP) (Figure 7) and Period 3 (5,900-3,600 BP) (Figure 8) represent situations where the W-K1 tephra was preserved and are a very small sample of the region. Nevertheless, they show that the major area of land-use as measured by the deposition of obsidian artifacts is near the seashore or on coastal hills, although the inland foothills were also used, particularly in the later period. Although we have not yet mapped it accurately, the coastline in Numundo was also probably somewhat further inland especially at the southern part of the plantation. The map showing obsidian distribution from Period 2/3 (?10,000-3,600 BP) (Figure 9) represents all deposits stratified under the W-K2 tephra and therefore presents a more comprehensive sample. As in the smaller samples, however, the bulk of the obsidian was deposited directly on the coast or on coastal hills, with an additional sparse use of the foothill region. There does not appear to be any clustering of material; most locations have moderate to high densities of material. The lack of clustering implies multiple short-term occupations.

Despite the major environmental changes that took place at the beginning of Period 4 (3,600-1,800 BP), the obsidian distribution is remarkably similar to the previous period (Figure 10). Again the majority of the obsidian was deposited in a
FIGURE 7 Distribution of obsidian artifacts during Period 2.

FIGURE 8 Distribution of obsidian artifacts during Period 3.
FIGURE 9 Distribution of obsidian artifacts during combined Periods 2 and 3.

FIGURE 10 Distribution of obsidian artifacts during Period 4.
coastal setting with a reasonable proportion of material in the foothills, although the
divide was more heavily used than previously. There is a surprising amount of
obsidian around the old coastline in Kulu-Dagi and Garu, possibly representing the
ey early part of the period when these areas might have been within the tidal range.
Alternately, the data may represent a different use of these zones, taking advantage of
new environmental diversity created by the swamps. Or are people simply returning to
areas (possibly by boat up the river) that they remembered from before the W-K2
event?

The spread of probable Lapita pottery mirrors the obsidian distribution with the
majority on the coast, particularly at a single hill on Numundo (site FAAH), and a
sprinkling in the inland region, with a surprising concentration in the southern part of
Kulu-Dagi (Figure 11). Lack of knowledge about the exact timing of the infilling of
the embayment makes precise interpretation about the use of this region difficult and it
is hoped that radiocarbon dating from test pits at Kulu-Dagi and Garu can help sort out
the chronology of use of these areas. It is notable that 6 fine dentate-stamped sherds
were recovered by Junias Tumana from a spring high in the foothills in Garu plantat
tion (Figure 12). Since this region would always have been some distance from the coast,
this find suggests either that pottery was used in a range of different contexts (coast
and inland) or that the same activities took place both on the coast and in the inland
foothills.

Turning to Period 5, we see a very different pattern of land-use (Figure 13). At
this time there is a definite shift from the coast to the inland, particularly the foothills
of Numundo ridge. If the obsidian is an accurate indication of where activities took
place, then much of the region was not used. Period 5 (1,700-1,400 BP) is difficult to
interpret, however, because of its very short duration (300 years) in comparison to the
others. Since deposition is cumulative, there may not have been enough time for the
distribution to fill in to the same extent as for the other periods, possibly because the
region was abandoned for some unknown length of time following the W-K3 eruption.
However, the emphasis on the inland zone is difficult to account for merely in terms of
a time-dependent process. It is also worth noting that after the major W-K3 event,
small amounts of fine-grained tephra or ash continued to be added to the land surface
and these gradually added up to a very thick layer. The frequent dusting of ash may
therefore have made the region largely unsuitable for habitation during this period,
although this should not have affected the very inland character of the distribution. On
FIGURE 11 Distribution of pottery during Period 4.
FIGURE 12 Dentate-stamped Lapita pottery from Garu Plantation
FIGURE 13 Distribution of obsidian artifacts during Period 5.

FIGURE 14 Distribution of obsidian artifacts during Period 6.
the contrary, it seems likely that there was a change in land-use patterns between Periods 4 and 5.

Period 6 (1,400-500 BP) provides a striking contrast from its predecessor, because it is characterised by large quantities of obsidian which were spread almost evenly across all the sample pits. As in the previous period, the coast was not as heavily used as the inland and the divide was a preferred area (Figure 14). It seems plausible that the type of land-use exhibited in Period 5 may have continued and intensified during this longer period of time. During excavation the layer representing Period 6 was very distinctive. It was generally very black and disturbed to such a degree that the underlying tephra was often incorporated into the soil, suggesting reasonably intensive use (e.g. Figure 4). The change between Periods 5 and 6 in terms of quantity of material is so dramatic that it seems likely that there was a large rise in the population of the region, possibly through immigration. We may be detecting the presence of refugees fleeing the effects of the Dakatau eruption which seriously impacted the northern part of the peninsula part way through Period 6 (c. 1000 BP).

Another dramatic change is illustrated by the Period 7 (500-0 BP) obsidian distribution (Figure 15). Despite the short length of time available for the region to fill up, the comparison with Period 6 is quite striking. In Period 7 the study area appears to have been seriously depopulated resembling the situation in Period 5 (Figure 13). The majority of the test pits contained no artifacts at all. It must be kept in mind, however, that as this period forms the modern day surface, it is most likely to have been disturbed by development activities. Clearing the forest to create the oil palm plantations often resulted in the removal of at least the topsoil. In addition, gardening activities in Numundo near test pits LXV and LXVI and bulldozing near test pit I have clearly reduced the amount of obsidian found in these test pits, despite the evidence from surface survey that obsidian artifacts are abundant in these localities. So caution must be taken in interpreting the scale of the raw numbers presented for Period 7, although there is less reason to doubt the integrity of the spatial patterning. The obsidian data reflect a clear return to a concentration on the coast, although there is a second smaller focus at Kulu-Dagi. In addition, the Period 7 distribution is a very clustered one with artifact density centred on three places where relatively large quantities of material were recovered.

The drop in population in Period 7 is difficult to explain purely as a function of volcanic processes. As evidenced by the occurrence of tephras belonging to the W-H
FIGURE 15 Distribution of obsidian artifacts during Period 7.
series (Machida et al. 1996), the region experienced at least three eruptions during this
time, but these were very minor in comparison to the previous Witori eruptions.
Period 7 contrasts with the pattern following the previous W-K4 event after which
there was a widespread use of the region. It seems more likely that the Period 7
distribution is a signal of the effects of contact with outside, mainly European
populations, and resulting depopulation through disease combined with a move to the
coast to take advantage of new trading opportunities. An increase in internal conflict
may also be related to these processes, as witnessed by the location of the majority of
places with large quantities of obsidian on easily defensible coastal hills. The second
concentration inland at Kulu-Dagi may even represent a population fleeing to the
interior from the disease and conflict generated on the coast as a product of interaction
with European explorers and traders. Alternately, it may represent specialised use of
the swamp.

A simple comparison of changes in the distribution of test pits within the
various periods is presented in Table 2. Since the sample size for unmixed Periods 2
and 3 is so small, it is preferable to combine them, but all the data are presented here
for comparison. To begin with, there is a major difference between Periods 2/3 and the
subsequent periods in terms of the spread among the abundance classes. Whereas for
Periods 2/3 there is a fairly even spread of data, for all the other periods, there is a
relatively high percentage of pits where obsidian was absent or had very low counts.
Part of this difference may be explained by the much longer time allocated to the
combined Periods 2 and 3 because this might have allowed the distribution to be filled
in by infrequent visits to parts of the landscape. However, the pattern is repeated even
when the small sample of unmixed Periods 2 and 3 is considered. In contrast, Periods
4 and 6 have an uneven spread between the classes and Periods 5 and 7 are even more
clustered since the majority of the pits contain no artifacts at all. This means that
activities involving the discard of obsidian were restricted to a very few areas. This
trend toward a clustered distribution is similar to previous findings on nearby Garua
Island. For this case it was hypothesised that through time there had been an increase
in the length of time that each locality had been occupied (Torrence 2002). Further
analysis is required to test whether this proposition also applies to the southern part of
the Willaumez Peninsula.

Another approach to characterising the degree and nature of clustering is to
examine whether or not most of the obsidian was discarded in just a few places. One
way to measure this is to compare the largest amount found in a single test pit with the total amount recovered from the entire period. As shown in Table 3, there is again a contrast between Periods 2/3 (11%) and the remainder (greater than 20%). Periods 5 and 6 have a smaller proportion of the assemblages recovered from a single test pit, than does Period 4, but Period 7 is by far the most clustered.

Another interesting trend exhibited in this very preliminary analysis of the data is in the relative rate of deposition through time, as illustrated in Table 4, where the total obsidian artifact count is divided by the number of years represented in the period. This crude index shows that through time, despite a fluctuation in the number of artifacts, there is an increase in the rate at which artifacts entered the archaeological record. One interpretation of these data is that obsidian use was more expedient or wasteful through time. This behaviour can be related to the proposed decrease in mobility. As people became more sedentary, there was less need to conserve their raw material because it was readily available from storage contexts. For example, the very large amount of obsidian found within the one test pit XIV in Period 7 is perhaps similar to what one would expect from a dump at a residential site where obsidian was consumed in relatively large quantities.

In summary, the test pit sampling has been demonstrated to be an effective methodology for studying ancient land-use within a highly dynamic environmental setting. Even a very simple and preliminary analysis of one aspect of the data collected indicates significant changes in land-use during the past c. 10,000 years. In Periods 2-4, dating before c. 1700 BP, there was a focus on coastal locations despite a catastrophic change in landforms which involved a massive infill of a large tidal embayment (Figures 5, 6). Surprisingly, although Lapita pottery and obsidian were mainly discarded in the coastal zone, they were also found in inland and upland settings, not all of which were associated with the prior coastline (cf. Torrence and Stevenson 2000). The inland component of Lapita subsistence and settlement has previously been neglected by Pacific archaeologists, but this new study may provide a new way to access the data necessary to rectify this limitation in our understanding of this important period.

Period 5 land-use represents a significant shift away from the coast to the inland zone followed in Period 6 by an expansion to most areas, although the focus of activities had moved back to the coast. Whereas all parts of the landscape appear to have been used in roughly equal proportions during Periods 2 and 3 and to a lesser
extent in Period 6, Periods 4 and especially 7 are characterised by a clustering of activities at just a few locations. Hypotheses for population decrease in Period 5 and 7 and a dramatic and perhaps sudden increase in Period 6 have also been proposed.

These preliminary results are highly encouraging because they have revealed a great deal of variability in the data that should be linked to changes in human behaviour. More sophisticated analyses of the artifact assemblages, combined with a better understanding of environmental change derived from pollen and phytolith analyses now in progress will also help clarify the patterns and be used to test the general hypotheses proposed here.

Other Finds

While undertaking a geological survey of Garbuna volcano, Chris McKee noted obsidian at two localities near the summit of the mountain. An obsidian flake was found within a streambed and another was observed in a stratified context within an orange-brown, fine soil above a tephra resembling W-K3. It was also associated with some charcoal. These localities are important because they record the presence of human activity inland at a relatively high altitude and close to volcanic activity.

Two new localities were reported to us by Junias Tutanana, assistant manager of Garu Plantation. While cleaning out a spring within his garden, which is located at the northern end of the plantation to the east of Boku Hill (in between excavated test pits XLII and XLIII), he uncovered 16 pieces of pottery of varying sizes, 6 of which bear dentate stamped decoration (Figure 12). These appear to be part of a single Lapita pot. Unfortunately no pottery was found in the two sample pits located on either side of the stream, although obsidian and fire-cracked stones (oven stones) were recovered from the level contemporary with Lapita pottery in test pit XLII.

Tutanana also showed us to a large rounded boulder (2m x 1.5m x 1.1m) which has two roughly circular, smooth, depressions (21 cm x 21 cm x 5cm and 22 cm x 23 cm x 10 cm) which have been ground (Figure 16). It is located on Avenue 7, between roads 7 and 7 on Garu Plantation (5° 30' 54.1", 150° 00' 51.3"). The boulder does not appear to have been moved during road building. Next to the boulder is a smaller stone with a long groove, but this marking is irregular in form and is unlikely to have been caused by deliberate human action.

A brief visit was made to Bitokara Mission to acquaint Sophie Collins, a PhD student at the Australian National University, with the obsidian outcrops and quarry
FIGURE 16 Unusual finds from the 2002 research.

a) Large boulder with two grinding hollows from Garu Plantation.
b) Small boulder with cupules from Malaiol Stream, Garua Island.
sites at FDQ and FQT. Some nodules were collected for Collins’ proposed experimental work, which will study how use-wear is formed on obsidian tools. The plentiful source of large obsidian cobbles at the Talasea airstrip was found to be unsuitable for flaking.

Another short trip was made to Garua Island to acquaint Pip Rath and Josh Symons with the FAP, Malaiol stream site because they have conducted Honours level research projects on obsidian artifacts from this locality, but had not visited the site. A surface collection of obsidian stemmed tools and related debitage was made to assist Rath’s current PhD project and a few cobbles of obsidian were also collected from the Baki obsidian outcrop at FAP (GO02) to assist use-wear replication studies. The sides of the FAP gulley have collapsed in many places since the original survey in 1989 and many exposures of quarry-workshop deposits are no longer visible and accessible.

During the survey, a small cobble (roughly 55 cm x 41 cm), bearing cupules was found lying in the streambed of a tributary (S5° 17' 45.8", E150° 04' 42.3") (Figure 16). One side of the rounded boulder is covered with cupules, whereas on the other side the cupules are arranged around a central hollow area. The stone appears to have fallen from the sides of the stream recently, but no stratigraphy is preserved at this location and no other large stones with cupules could be located. A large number of boulders with cupules were previously found at the southwestern end of Garua Island (Torrence and Boyd 1997).

Two trips were made to observe the Mt. Pago eruption (Cover photo). The team collected a sample of fresh ash at Hoskins airport and then proceeded down the Bialla road where several vantage points provided an opportunity to watch the build up and dispersal of ash clouds emanating from 5 separate vents on the volcano. Torrence, Boyd and Neall also flew over Pago in a helicopter and were able to observe the formation of a series of lava flows on the side of the volcano. These visits were invaluable for obtaining a first hand impression of the effects of a very small eruption of Witori, one that would not have been preserved in the archaeological record because of the thinness of the tephra layer. Despite this, a large number of people living up wind from Pago have been forced to evacuate their homes and this has already had a significant impact on the local society and economy. Furthermore, the event provides a good analogy for the type of behaviour that would have created the tephra accretion layers that are associated with W-K3 and later eruptions preserved in the study area.
On our last day in the field, the team visited areas on the Hoskins peninsula that had been impacted by ash falls from the recent Pago eruption. We were able to observe the adverse effects on gardens and forest. The most badly affected areas we observed were freshly planted taro gardens where even the small amount of ash was suffocating the new plants because there had been no rain to remove the ash. Clearly the timing of an eruption in terms of subsequent rainfall is an important factor in the degree of impacts on vegetation.

At Lavilelo (5° 28' 25.1", E150° 27' 19.8") a small stone alignment consisting of three boulders was observed along the side of the road. A small number of cupules occur on the middle boulder, which had also been propped up by a small stone. The cupules are fairly irregular in plan and profile, but are arranged around the outside of the boulder. These are the first cupules reported from the mainland of West New Britain, but we expect that given their occurrence on Garua Island and in the Bali-Witu group (see below), this art form, as well as stone arrangements of various forms, are more widely spread that has been previously realised.

**Bali-Witu Survey**

Between 29 June and 11 July, Specht, Torrence and Blaise Vatete (Adviser on Tourism and Culture, West New Britain Government) conducted ten days of foot survey on six of the eight Bali-Witu islands: Unea, Witu, Ningau, Goru, Silenge and Vambu (Specht et al. 2002)(Figure 17). The aim of the survey was to assess the nature and extent of archaeological resources on the islands. The research aimed to assess three different types of data: (1) the carved stone heads reported from Malangai village, Unea, by Riebe (1967), since they appeared to be marked with cupules similar to the rock art reported on Garua by Torrence and Boyd (1997); (2) the possible presence of Lapita pottery as reported by Ambrose and Johnson (1986: 494); and (3) the nature of the stone arrangements, such as the table illustrated by Parkinson (1999: 90, Pl. 14).

A sample of villages representing all major areas of Unea were surveyed, 65 localities of archaeological interest were recorded and notes were also made about additional place described by informants but not visited (Figures 18). A very brief survey of the other islands yielded 38 additional localities (Figure 19-20). A detailed description of the localities has been filed with the West New Britain Provincial Cultural Centre and the PNG National Museum.
FIGURE 17 Location of the Bali-Witu Islands.
FIGURE 18 Distribution of archaeological features recorded on Unea Island
FIGURE 19 Distribution of archaeological features recorded on Garove Island.

FIGURE 20 Distribution of archaeological features recorded on the Mundua Islands.
Hundreds of boulders with various forms of surface modification, termed 'rock art' in this report, were noted, especially on Unea. There were also reports of rock art on Wiru Island, but limited time prevented us from visiting these places. The various forms of rock art consist of cupules, which are small, circular, pecked depressions (Figure 21); engraved designs made by pecking away the rock surface (usually curvilinear) (Figure 22a, c); scratched or abraded (usually rectilinear) designs (Figure 22b); and the three-dimensional carved heads (Figure 22d). In addition to the six published carved heads at Malangai, another six definite or probable carved heads were recorded on Unea and two others were reported to us but not visited. A report of a carved head on Ningau was found to be incorrect.

Cupules are common is all areas of the island and occur in many circumstances (Figure 21). They were noted on isolated large boulders in gardens and regrowth areas, as boulders eroding through the road surface, as groups within present-day and previous settlement areas, in streambeds, on beaches, on boulders with carved heads, on boulders with engraved designs, on boulders with grinding grooves, and on the top slabs and/or legs of stone seats and tables. On some seat and table slabs the cupules have been partially worn away, possibly by people using them over a long period. By close examination of the boulder surfaces, we were able to see that some cupules were almost certainly made before the engraved rock art. The scratched, rectilinear designs (e.g. Figure 22b) are very similar to the painted designs seen on several churches and related buildings on Unea, suggesting that this form of rock art may be relatively recent in origin. Some of the boulders with carved heads have weathered cupules that look much older than the worked surfaces of the heads. We can tentatively suggest, therefore, that cupules are older than both the pecked and scratched designs and may also pre-date the carved heads.

A large numbers of boulders with smooth ground areas of various sizes as well as large and small boulders with small bowl-shaped depressions worked by pecking and grinding were also recorded (Figure 23). The function of these is unknown, although those with very deep depressions may have been mortars (e.g. Figure 21d; Figure 23b, d) and a series of hollows found along the sea shore on Wiru and Unea may have been used to prepare poison to catch fish (Figure 23c). In addition, boulders with grinding grooves occur on several islands (Figure 23a). These may have been used for making tools such as stone axe blades that needed grinding to produce smooth
FIGURE 21 A form of rock art called 'cupules' is widespread in the Bali-Witu Islands and occurs on many different types of features. These examples illustrate the wide range of contexts in which cupules occur.

a) Cupules on the upper surface of a table.

b) Cupules on a large boulder.

c) Cupules on a small irregularly shaped stone.

d) Cupules on a mortar.
FIGURE 22 Examples of engraved rock art from Unea Island. Note the presence of cupules on the upper surface of all the boulders.

a) and b) Curvilinear style.

c) Rectilinear style.

d) Carved head with engraved features: hair, eye and cheek with tatoos, mouth and nose.
surfaces. Some grooves are much wider than most stone axes, and several people suggested they were for making slingshot stones.

Boulders that have not been modified, but which have names and significance to the local people were also noted. Several lava bombs, one of which has cupules pecked on one surface, also have stories associated with them.

Stone arrangements of many forms are common on all the islands (Figures 18-20). The basic components are 'tables' or smaller 'seats' made from quarried andesite slabs (Figures 24, 25d) and 'seats' made from large boulders propped up with 'feet' made from smaller stones (Figure 25b, c). These occur singly but often a group is arranged in a circle, or more commonly along a line, said to represent sitting areas adjacent to the men's house or simply meeting places in old settlements (Figure 25c, d). Within this category are also boulders or tables said to have been used for sorcery, in circumcision ceremonies, as butchery tables for both pigs and enemies, or serving tables for butchered meat (Figure 25a). A related class are large (c. 2-3m high) upright, 'standing stones' found in several places on Unea.

The stone seats and tables continue to have meaning for the people. On every island (except Vambu, which is presently unoccupied on a permanent basis), people have moved tables and seats from former settlement areas to their present village sites. On Witu, a completely new table has been constructed from newly quarried rock (Figure ) and one householder on Unea has moved seats and a table from the house sites of his deceased father and grandfather (Figure 27). On Ningau, Goru and Silenge there are tables and seats and isolated boulders that were moved to the present village sites to commemorate Independence in 1975. It is therefore important to emphasise that these kinds of stone structures are not only part of the past, but are also a vital element of present day lives. Furthermore, the reuse of slabs and boulders with cupules in the construction of stone tables and seats suggests there has been a long history of re-working material features of the landscape.

In addition to rock art and stone arrangements, the landscape was marked by constructed ditches, said to have been built for defense. Two of the three recorded by Ambrose and Johnson (1987: 496) on Unea were relocated and another was identified (Figure 19).

Two sites with pieces of pottery were recorded: one each on Unea and Goru (Figures 18, 19). The site on Unea is on a hilltop and the sherds on Goru are probably derived from the hilltop above the findspot, but time did not permit examination of this
FIGURE 23 Examples of boulders from Unea Island with different types of ground hollows.

a) Large boulder with cupules, linear grooves, and shallow hollows.

b) Roughly-shaped, medium-sized boulder with deep hollow.

c) Series of deep hollows made on bedrock near the shoreline.

d) Medium-sized boulder that has been shaped and has a flat, ground surface.
FIGURE 24 Typical examples of 'tables' on Unea Island made from quarried, tabular and columnar volcanic stones.
FIGURE 25 Examples of stone arrangements from Unea Island.

a) Large stone with flat surface propped up by smaller stones. According to oral history, some arrangements like this one were used for slaughtering captured enemies or as serving tables at feasts.

b) Large boulders propped up and supported by smaller “feet.” Some of these are said to have been used as “seats.” They occur singly or as a group, sometimes arranged in lines or circles.

c) A linear arrangement of small “seats.”

d) A linear arrangement of “tables.”
area. This pottery is plain, but could belong to the Lapita pottery series (about 2500-3200 years ago) that is found widely on West New Britain mainland and from the New Guinea islands south to New Caledonia and Tonga-Samoa. In addition, there are many localities on all islands that are described as former settlement areas, including some dating to the 20th century (e.g. Karamata on Ningau Island). Some of these have obsidian pieces and marine shells on the ground surface. Obsidian is present throughout the islands, often as a low background scatter although it is occasionally visible as more dense scatters.

Small portable artefacts belonging to the past including stone pestles, stone axe blades, stone clubs, and blocks of obsidian were photographed and described. Perhaps the most interesting find noted is an obsidian stemmed tool of a type dated on the Willaumez Peninsula to older than 3,600 years ago and found near Tamangone village on Unea (Figure 28). The find suggests that Unea was occupied at least by this early date and may represent significant interaction between these two regions in the distant past. In addition to recording cultural localities, we sampled volcanic ash on Bali and Vambu. Analysis may identify the source volcanoes and provide a tie into the sequence of volcanic ash falls known for the Hoskins-Kimbe-Willaumez Peninsula areas (Machida et al. 1996).

It is clear from this brief survey that the archaeological resources of the Bali-Witu islands extend over a period of at least 3,600 years, are extremely rich, and would therefore benefit from additional detailed research. The carved heads are unique in the western Pacific region. The rich variety of rock art and stone arrangements that have been made, used, and reused over a very long period and which continue to be significant to the local community also make these islands a very special place. The possible presence of Lapita pottery on these small isolated islands is also very important. It is therefore important that the future care and protection of the cultural heritage of this island group be considered very seriously by relevant interest groups.

**FUTURE RESEARCH PLANS**

The major period of fieldwork for this project is now completed. Some follow-up work and environmental sampling, however, may be required if questions arise during the analyses of the current set of data. During the next year or so the team will
FIGURE 26 Examples of standing stones. Unea Island (upper), Garove Island (lower).
FIGURE 27 Modern Stone arrangements.

Some stone arrangements, particularly "tables," continue to be meaningful and have been moved around and reconstructed at new localities.

The upper table from Garove Island was recently made from stone quarried locally.

The lower group of tables from Unea Island was brought together from old villages, including those previously occupied by the owner's deceased father and grandfather.
be preparing a scientific monograph and a series of specialist articles reporting on the results of the research. This will include a discussion of changes in patterns of human land-use in response to volcanological activity and consequent environmental changes. Although the research has concentrated on the Holocene period (most recent 10,000 years), the analysis of site FABM excavated in 2001 will provide important information on the late Pleistocene period (c. 35,000-10,000 years). Analyses of the archaeological assemblages will include technological and use-wear/residue studies of the stone tools, characterisation studies of the obsidian artifacts and possibly the pottery, and basic descriptions of other finds. Changes in the nature and distribution of artifacts will be compared to an environmental reconstruction of the region using the results of geomorphological research and analysis of pollen, phytolith and starch samples collected during the course of the project. All of these studies are already well advanced.

Finally, it is planned that the results of the project be presented in a format with nontechnical language for distribution to schools and other interested parties in West New Britain.

CONCLUSIONS

Fieldwork conducted by an interdisciplinary team has again expanded our knowledge of the dynamic environmental and human history of the Willaumez Peninsula region and has revealed more of the fascinating story of the complex interaction between volcanoes and humans during the past 40,000 years or so. Despite being subjected to frequent volcanic disasters, the people of this part of West New Britain, repeatedly recolonised the devastated area and then created new and often quite different cultural landscapes within environments that had changed radically. Further laboratory studies of material collected will take place in the next few years and these results, along with a full synthesis of the project’s findings, will be reported within a series of scientific and popular publications.

During additional fieldwork in the Bali-Witu islands a multitude of important and fascinating places with importance both for past and present people living there were recorded. Many of these places also have important international significance and discussions with local communities about their management should be initiated.
FIGURE 28 An obsidian stemmed tool found on Unea Island.
COMMUNICATION OF RESULTS

During the course of the fieldwork Torrence met with the following to discuss the fieldwork: William Padio, WNB Administrator; Blaise Vatete, Adviser on Culture and Tourism; Mary Kimbe and Matthew Rabui, WNB Provincial Cultural Centre; John Pamanani, Director, Kimbe Open Campus UPNG; NBPOL management, staff and labourers; staff at Mahonia Na Dari; and a study group from Japan. Special seminars were also presented to students from Kimbe High School and students at the University of Papua New Guinea. Torrence presented posters and papers about the project and discussed the research with Stephen Saunders of the Rabaul Historical Society. The team also met with Herman Mandui, Nick Araho, and Baiva Ivuyo, archaeology staff at the National Museum and Art Gallery, and with Vincent Kewibu, John Muke, and Hugh Davies from the University of Papua New Guinea to inform them of our findings.

ACKNOWLEDGEMENTS

We are especially grateful to the people of West New Britain for permission to carry out this research and for providing many forms of hospitality, information, and other assistance. Our trip to Bali-Witu especially depended heavily on the extensive knowledge and hard work of Blaise Vatete (Advisor on Culture and Tourism). Australian Research Council grants to Torrence and to Boyd provided the major funding. The University of Sydney and the Australian Museum also gave important logistical and administrative support. The research would not be possible without the continued support of New Britain Palm Oil Ltd. The company provided access to their plantations, a vehicle, temporary storage of equipment, computer printing, and much help with maps and advice. We are especially grateful to Nick Thompson, Bob Wilson, Mike Hoare, Kefu Boromana, Junias Tutnana, Jamie Graham, and Ruari MacWilliam for their goodwill, hospitality, and many forms of assistance. Mary Kimbe from the WNB Provincial Cultural Centre assisted the fieldwork. We are very thankful to Mary Kimbe and Blaise Vatete for their valuable help liaising with local communities and the Provincial Government. Leo Metta is thanked for guiding the
team to Lotomgan and Bitokara Mission. Mahonia Na Dari Research Station provided excellent facilities and the staff gave logistical support, advice, and good company. Frank Lewis (OPIC, Nahavio) and Lesley Lewis provided transport and accommodation on their yacht during the Bali-Witu survey and we are very grateful for their gracious hospitality and enthusiastic support. Max and Cecilie Benjamin and the staff of Walindi Resort were again welcoming and supportive. John Ray shared his private collection with us and provided hospitality. Les and Norelle Hartwig of Garua Plantation were gracious and helpful as always. Vince Freedman and Blaise Dau of Kimbe Bay Shipping Agency helped once again with accounts and freight. Nick Lyons kindly assisted with transport and accommodation in Port Moresby and Rabaul. We also thank the following for help with permits and visas: archaeology staff at the National Museum and Art Gallery; National Research Institute; West New Britain Provincial Cultural Centre; PNG Consulate in Canberra.

REFERENCES


PARTICIPANTS

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Blaise Vatete, Mary Kimbe, West New Britain Provincial Cultural Centre
Kari Heri, PNG National Museum and Art Gallery
Dodi Doiwa, Steven Mirikai, Luke Petai, Tio Jorry, University of Papua New Guinea
Table 1 Chronological Periods
(Calendar years)

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<th>Date (bp)</th>
<th>Cultural Material</th>
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<td>pre-710,000</td>
<td>Obsidian/chert flakes</td>
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<td>Period 2</td>
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<td>710,000-5,900</td>
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### Table 2 Relative Abundance of Obsidian Artifacts

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<th>51-100</th>
<th>&gt;10</th>
<th>Total Sample no.</th>
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<td>%</td>
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<td>%</td>
<td>no.</td>
<td>%</td>
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<td>5</td>
<td>31</td>
<td>2</td>
<td>13</td>
</tr>
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<td>5</td>
<td>7</td>
<td>21</td>
<td>38</td>
<td>9</td>
<td>16</td>
</tr>
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<td>15</td>
<td>25</td>
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<td>34</td>
<td>38</td>
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<td>7</td>
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<td>58</td>
<td>55</td>
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### Table 3 Contribution of Largest Sample of Obsidian

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<th>Number in Largest Sample</th>
<th>Percentage of Total</th>
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<tr>
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<td>11</td>
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<tr>
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<tr>
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### Table 4 Rates of Obsidian Deposition

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<th>Duration (years)</th>
<th>Total Artifacts</th>
<th>Yearly Rate</th>
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