Late Lapita colonisation of a high island in Western Polynesia: the case of 'Eua Island, Tonga

Dirk H. R. Spennemann

Abstract: One of the major issues under discussion is the initial spread and subsequent intensification of Lapita settlement in Polynesia. The paper presents a brief account of the findings of a test excavation on 'Eua, Tongan Islands and provides the first 14C dates for the location. This allows us to compare its settlement with neighbouring Tongatapu, and permits us to postulate that settlement of high islands in the Tongan Group is later than that of the more accessible low island.

Introduction

Much of the literature on Pacific prehistory focuses on the initial colonisation of island groups, placing emphasis on the nature and speed of the geographical spread of sites. Of likewise importance however, is the understanding of subsequent colonisation moves in an already partially occupied area, as this may explain parameters governing further expansion.

The sites of the Lapita culture are predominantly shell-midden refuse dumps, located near the seashore. Jennings (1980:3) summarising previous data, has presented a series of criteria for such sites: (1) they should be located on an islet; (2) not more than 10m inland from mean high-tide line; (3) where there is a shelving sand or coquina rock-beach lacking coral heads; (4) that extends some distance out on the reef. Further, (5) the site should lie on a low basalt knoll or promontory with a thick mantle of soil; (6) be elevated from 1.5 - 5.0m above present mean sea-level; (7) where the reef is ~1.0km in width and where there is a deep passage through the outer barrier reef. Lepofsky (1988), apparently unaware of Jennings’s list of criteria, conducted a comprehensive but not exhaustive survey and analysis of the natural environments of Lapita sites along the lines of rigid site - catchment theory principles. She has added a few interesting observations, namely: (8) that most of the sites have a fresh water source nearby; (9) and that all sites have access to arable land within 1.0km distance.

The settlement pattern as reconstructed for the early Lapita settlers should be thought of as intentional. Given their social and cultural background and their needs, the settlers were forced to adopt this pattern and had not much choice in the matter. Let us look at this from a logical point of view. Take a canoe-load of people, say twenty-five, arriving at a previously uninhabited island. Arriving in their canoes, they had to find a passage through the reef. Moreover, their need to travel was not over, as they had to keep in contact with the parent population if they did not want to be stranded. Thus placing the settlement at a location near a reef passage was necessary. Since they did not want to keep on living on their canoes, settlements had to be built. However, there were constraints upon where. Upon arrival they would be confined to the shore, as the island was probably heavily forested. Forest clearing is a painstaking exercise and would not have been conducted for its own sake. Locations would be ruled out therefore where the rain forest approached the shore. Small offshore islands, however, were likely to be sand cays or derivatives, allowing only a coastal-fringe type of vegetation, which could be easily cleared. Rocky or cliffed shores and those with extensive mangroves at the back of extensive mud or sandflats were also unsuitable, as the settlers could not beach their canoes at all or only during high tide, thus restricting their movements. Thus some sort of sandy beach next to a deep-water passage was required. As the newcomers were horticulturalists, they were interested in locations where arable land was within walking distance. In addition, sources of timber suitable for the construction of houses and canoes needed to be handy.

Spennemann (MS) could show that many early Lapita sites at the time of settlement were situated in an embayment.
at the leeward shore of a larger island, which provided protection against the pounding ocean swell and ensured calm and navigable waters near the anchorages/berthing places. The entrance to the bay itself was usually blocked off by smaller islands, which in turn provided protection during the cyclone season, when the wind and wave patterns were likely to shift. The small islands would also effectively break any cyclonic tidal surge. If the settlement was located on an island in the bay, it was located on its rear, away from the ocean and facing the main island. This could be shown for the sites on Tongatapu (Tonga), as well as Avunatari on Malo (Hedrick 1983) and Erati on Efate (Garanger 1972:26; fig.8), both in Vanuatu; Naigani in the Lomaiviti group of Fiji (Best 1984:fig 2); Yanuca on Viti Levu, Fiji (Best 1984), and Malifanua on Upolu, Samoa (Leach & Green 1989). Fruminacel's (1980) reconstructions for some of the sites on New Caledonia indicate similar conditions.

This settlement pattern is predicated on the need of the Lapita people to have a secure anchorage at their disposal. Whatever the models advanced to explain the spread of the Lapita culture, most of them include close contacts between individual settlements, at least during the initial colonisation period, when overall population densities would have been small and new colonies most at risk. During that time the canoe would have been the single most valuable item of the entire material culture as large ocean-going specimens took two years or more to build and their destruction in a disaster would have cut off the settlement from independent contact with the outside world.

The initial colonisation of Tonga

Several Early and Middle Lapita sites are known from Tungua, Lifuka and Foa in the Ha'apai group (Burley et al. 1995; Dye 1987; Shutter et al 1994; Spennemann, unpublished fieldnotes; for chronology see Poulsen 1987 and Spennemann and Head 1998). These sites, comprised of shell middens containing decorated pottery, are in the main situated on dune systems or old shorelines. It seems that at the time of occupation all sites were located at the shore. Few surveys have been conducted on Vava'u and fewer reports have been published. Pottery has been recorded by Davidson (1971) and the author (Spennemann 1987b:104-267). Although some decorated pottery has been found the numbers of sherds are too low to allow for sequencing the sites. Again, the sites containing the decorated sherds are located near the present shore or along an old shoreline. The Lapita sites of Niuaotoputapu are clustered within a narrow band along an old shoreline around the inner core of the island (Rogers 1974; Kirch 1978; 1988). The distribution of the pottery seems to be more or less continuous, without any clear-cut clusters.

On Tongatapu, five sites of the Early and twelve sites of the Middle Lapita Period have been found so far (Poulsen 1987; for revised 14C chronology see Spennemann and Head 1998). All are located at the northern shores and with the exception of one Middle Lapita site, all are located along the shores of present Fanga 'Uta lagoon. The selection of Fanga 'Uta lagoon as the prime initial settlement area on Tongatapu is predetermined by the environmental configuration of Tongatapu.

Throughout the better part of the year the entire southern and southeastern coast of the island is exposed to the tradewinds and a strong southeasterly swell, factors which make the safe navigation of large canoes a complicated affair. In addition, the fringing reef is very close to land and virtually no passages exist. Given the nature of the cliffed shoreline, very few protected pocket beaches exist, and these are also very limited in their dimensions. Similar conditions prevail along the northwestern and northeastern shorelines. Leeward and thus protected areas exist along the northern shore, including Fanga 'Uta Lagoon. Geomorphological studies have shown a higher than present sea level (approx 1.5m above present MSL) at the time of initial settlement of Tongatapu (Taylor 1978; Spennemann 1997). At that time the shore west of Nuku'alofa is likely to have resembled present conditions, that is, extensive intertidal sand and mudflats protected by an extensive fringing reef, greatly impairing navigation by canoe. The only area on Tongatapu, where channels of sufficient (canoe) navigation depth existed regardless of tidal conditions was at the Fanga 'Uta Lagoon, which was then an open bay (Spennemann 1997). Because of easier access, the western sector of the bay would have been favoured. The islets located across the western sector would have provided protection during the approach of cyclonic wind systems, when wind and waves came from the north.

The environmental setting of the early sites on Tongatapu closely resembles that of other early Lapita sites described above. What about neighbouring 'Eua, a volcanic island 8km to the east of Tongatapu? 'Eua possesses only a narrow fringing reef and does not offer the optimal conditions preferred by the Lapita people in the early period. The question of whether early sites exist on 'Eua is of great importance for our understanding of the systematics of Lapita settlement of the Tongan Islands. The Late Lapita period on neighbouring Tongatapu is a period when large scale cultural change took place, when the settled area expanded, new settlements were founded and some settlements were relocated from the coast into the interior (Spennemann 1991). It is of utmost interest to know whether the initial settlement of 'Eua is connected with this Late Lapita expansion or whether 'Eua was settled earlier.

'Eua Island

The island of 'Eua (21°22'S, 174°56'W) covering 87.4 km² is dominated by an eastern ridge rising to a maximum of 312m. 'Eua has a complicated geological sequence. A volcanic base is capped by a layer of marine limestone, which in turn is overlain by volcanic tuffs. Tectonic uplift, which occurred in various stages, has produced three major coral limestone terraces. Most of the soils of 'Eua, like those on Tongatapu, are of Quaternary
age, derived from Andesitic ash showers and originating from an unknown volcanic source, probably a submarine vent north-west of Tongatapu (Cowie 1980).

The habitable and arable area on 'Eua is confined to the terraces, mainly the large third terrace, and consists of two large parts, one north and one south of the river. Following this distribution of habitable land, all communication is oriented north-south, rather than east-west. 'Eua has one river, the Lakatoha, which flows to the west and which is fed by numerous creeks originating in the eastern ridge. A few additional creeks originate in the eastern hill and drain in small lakes in the central valley. The river and its tributary creeks form a barrier, which can only be crossed easily at three points, one of them at the river's mouth at Ohonua. If early Lapita sites exist on 'Eua, the only likely spot on the entire island can be expected is the area around Ohonua, because a passage through the fringing reef is an imperative feature for the location of Lapita settlements.

**The Ohonua area**

The area around Ohonua is dominated by the Lakatoha river descending from the eastern ridge. It cuts into the landscape forming a deep gorge in the coral limestone, with cliffs rising to approximately 20m to 25m in height. The area of the township of Ohonua consists of a regular sequence of terraces. The area directly at the coast forms the 250-m wide, flat first terrace demarcated by the 7-m contour. The land then rises for 40m to the second terrace, located some 700m from the shore. This terrace leads to the large third terrace, which is defined by the 70-m contour. Taylor (1978) was able to identify two formations near the shore, the 130,000 year-old *Lakatoha formation*, which is 7m above the present high water level (HWL) and the 6000 year-old *Ohonua formation*, which is 2.2m above the present HWL. The latter ties in closely with a similar formation visible on Tongatapu, dated to approximately the same time period.

The marine resources available at Ohonua consist of fish and molluscs (including sea urchins and sea cucumbers). The reef is a short distance from the shore, offering a reef flat, but no distinct lagoon. Thus the shellfish species encountered today are mainly rocky shore species. Sandy bottom was only seen in small patches. The passage in the reef allowed the people to exploit both reef and offshore fish.

**State of previous archaeological research on 'Eua**

Previous archaeological research undertaken on 'Eua Island has been very limited. McKern's (1929) research in 1920/21 mainly encompassed an archaeological assessment of outstanding field monuments, such as *langi* and fortifications. Other sites were recorded to a lesser extent. On 'Eua, McKern apparently test excavated two rock shelters (TE-Oh-1 and TE-Oh-2) on the banks of the river very near its mouth at Ohonua. One of the sites (TE-Oh-1) contained numerous undecorated sherd, indicating that it was probably used during Late Lapita times. The other rock shelter also yielded pottery, but to a lesser extent. The faunal remains encountered included shells and a few bones of fish and small land animals. Other archaeological material deriving from 'Eua held in overseas and Tongan collections is fairly limited. It includes stone adzes, pottery, and a few human remains.

**The 1987 fieldwork**

A site survey was conducted on foot at the end of February 1987 to assess the implications of a proposed harbour development (Spennemann 1987). A total of ten sites was encountered, mainly pottery bearing middens (5), sitting mounds (1), burial grounds (1), rock shelters (5) and other middens (1). The area of Ohonua township is very much modified by recent developments. Various houses have been built on foundations of concrete pillars or complete poured concrete floors. Other houses have been erected on levelled ground, modifying and destroying previous patterns. No house-mounds or similar structures were encountered in the survey area.

**Pottery-bearing middens**

The two pottery-bearing shell middens found (sites TE-Oh-4 and -10) were located on both sides of the river, well above high tide mark. Site TE-Oh-10 is an eroded pottery-bearing midden with only a very thin layer of cultural deposits intermixed with the topsoil, and overlying a base of coral limestone. Site TE-Oh-4 is a clearly defined midden measuring some 30m by 15m, with a cultural deposit of up to 0.5m thick. The midden has been cut by the present day road running to the bridge and it was originally larger in extent.

**The rockshelters**

Besides the two rockshelters already mentioned by W. C. McKern three further rockshelters were noted. All them were covered with recent midden debris such as tin cans. No test excavations were undertaken in them, since they were not threatened by the harbour development.

**The sitting mound (‘esi)**

Directly opposite the jetty is a three-tiered stone-lined platform, a sitting mound (‘esi) site TE-Oh-5. The ‘esi sits on a small mound measuring approx. 0.5m in height. The top surface of the third tier is slightly moulded as well. The structure is severely damaged on its northern side, where it has been partially cut by the road leading to the jetty. The bottom two tiers have been destroyed. Villagers pulling out the curb stones for use as seats and the large *Toa* tree that is growing on the structure, have caused further damage.

**Other sites**

One other midden site was seen (TE-Oh-3), which had already been noted during the reconnaissance survey in 1986. This midden is situated on the southern side of the river, and there is an old beach deposit on both sides of the road in which recent midden material has been deposited.
Excavation of site TE-Oh-4

Since site TE-Oh-4 (UTM: 1K GS 12535/38450) was already severely damaged, and only a small portion was left, it was decided only to clean the exposed western profile already cut by the road leading to the bridge, and to take one column sample at an undisturbed spot located centrally in the midden.

The stratigraphy as displayed in the profile showed one thick midden layer. It was not clear whether the midden layer could be split into two, which included a bottom one with more stones than the top one. Analysis of the midden samples (collected as a column sample in arbitrary 5cm spits) has shown that the midden layer can be split into three sub-layers. The midden deposit is capped by a 50mm to 100mm thick layer of topsoil. The midden rests on a 0.20m thick layer of volcanic ash derived subsoil (Hango soil; Wilde 1984). Some midden material has been incorporated in this subsoil, most likely by trampling. This volcanic ash layer overlies a deposit of clean yellowish sand, which originates from an old beach. No cultural material was found in this layer, which was also bulk sampled.

Towards the north the midden deposits sit on a small soil mound, which contained almost no midden material. A hearth was visible in the profile. The function of this soil mound remains unclear, but it seems possible that a house was erected on top of the mound, as is documented for the classical Tongan period on Tongatapu, and that the midden is directly associated with the mound. The archaeological finds recovered from site TE-Oh-4 during the excavation and previous surveys are fairly limited. They consist mainly of pottery and one very small, fully ground stone adze. It is the smallest adze in the entire known adze series from 'Eua. All pottery found is undecorated, and the rim types belong to the chronologically late group.

Analysis of the midden deposits indicates that the Lapita people living at Ohonua kept pigs and chicken as domestic animals. We can only speculate about the existence of dogs, since no dog bones have been found, nor do any of the other bones show evidence of being chewed or gnawed by dogs. Besides chicken and pigs, there are wild birds (passerines) possibly taken for their plumage rather than their meat. It is unclear whether the regular occurrence of rat bones in the sample indicates that rats were also part of the diet.

The analysis of the fish bones revealed that mainly inshore or reef species were exploited. The occurrence of some bones of Carangidae ('trevally') indicates that pelagic fish were taken as well. All fish species/families represented in this sample can be taken by two general methods, netting and trapping, both of which leave no traces in the archaeological record. The other heavily exploited marine resource was shellfish. Given the nature of the environment, mainly rocky shore species were collected. These species are still exploited today, although some other sandy bottom species also occur in the midden, which can no longer be found on 'Eua today.

The distribution of shellfish species indicates a changing environment in the vicinity of the site (Spennemann 1987 for shellfish data; Spennemann 1997 for environmental change implications). We may envisage a bay with some areas of sandy bottom at the beginning of the occupation. At a later stage more rocky shore species were exploited, possibly indicating a drop in sea level, or a tectonic uplift. These changes in the midden composition and environmental conditions correlate with events on neighbouring Tongatapu at about 700-500BC to 100BC.

Based on the interpretation of the few rim sherds, the pottery from all layers seems to belong to a Late Lapita horizon (about 700-500BC to 200AD).

Radiocarbon dates

In order to obtain absolute dates for the site, three samples have been submitted for radiometric age assessment to Beta-Analytics. All three samples for radiocarbon analysis are shell samples from spits 5, 9 and 13. Their schematic stratigraphic position is shown in Figure 1.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Layer</th>
<th>14C Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TOPSOIL</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>BUFFER I</td>
<td>2500±90 BP* (Beta-20577) cal BC 914 (814) 781</td>
</tr>
<tr>
<td>3</td>
<td>BUFFER II</td>
<td>2070±100 BP* (Beta-20574) cal BC 179 (50) cal AD 70</td>
</tr>
<tr>
<td>4</td>
<td>SUBLAYER III</td>
<td>2060±100 BP* (Beta-20575) cal BC 914 (814) 781</td>
</tr>
<tr>
<td>5</td>
<td>VOLCANIC SUBSOIL</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>OLD BEACH</td>
<td>2500±90 BP* (Beta-20577) cal BC 914 (814) 781</td>
</tr>
</tbody>
</table>

Figure 1: Schematic stratigraphy of site TE-Oh-4, showing the position of the dated radiocarbon samples in relation to the assignment of layers, which is based on soil fraction size, faunal and archaeological material. Laboratory quoted ages are given.
The provision of standard results by Beta in 1987 did not take into account a correction for isotopic fractionation or the ocean reservoir effect. A $\delta^{13}C$ value has been calculated for Tongatapu, based on the average of all measured $\delta^{13}C$ values outside the lagoon. The mean of +1.69±1.07‰ PDB (n=10) is used as a substitute in those cases where no determination has been made (Spennemann and Head 1998). Further, the dates need to be corrected for the ocean reservoir effect. A correction factor has been determined specifically for neighbouring Tongatapu, based on a modern, pre-bomb shell sample. The ocean reservoir factor for coastal, non-lagoon samples was determined to be 270±70 years (ANU-6421: Age 1926=272.7 ± 68 years (Spennemann and Head 1998).

| 2510 ± 115 |
| Beta-20576. Ohonua, 'Eua I. | $\delta^{13}C$: 1.69±1.07‰ |
| Shell sample (shell mixture, 22.6g) from site TE-Oh-4, Sample 9. The sample dates a Late Lapita midden horizon. |
| $\delta^{14}C$: -227.2±10.9‰; $D^{14}C$: -268.0±10.5‰. The open sea average for Tonga: (1.69±1.07‰) was used as the $\delta^{13}C$ value. Beta Analytics reported age (no $\delta^{13}C$): 2070±90BP. |
| Ocean reservoir corrected age: 2240 ± 115 BP*. |
| Calibrated age (CALIB 3.0): cal BC 197 (50) cal AD 70, cal BP 2147 (1999) 1880 |

| 2935 ± 120 |
| Beta-20575. Ohonua, 'Eua I. | $\delta^{13}C$: 1.69±1.07‰ |
| Shell sample (shell mixture, 54.6g) from site TE-Oh-4, Sample 5. |
| $\delta^{14}C$: 267.2±10.9‰; $D^{14}C$: -305.9±10.5‰. The open sea average for Tonga: (1.69±1.07‰) was used as the $\delta^{13}C$ value. Beta Analytics reported age (no $\delta^{13}C$): 2500±90BP. |
| Ocean reservoir corrected age: 2665±120 BP*. |
| COMMENT: The sample, although taken from the midden horizon, dates a shell stemming from the underlying beach sand, layer 13. (cf. Beta-20577). |
| Calibrated age (CALIB 3.0): cal BC 914 (811) 774, cal BP 2864 (2760) 2724 |

| 2940±115 |
| Beta-20577. Ohonua, 'Eua I. | $\delta^{13}C$: 1.69±1.07‰ |
| Shell sample (shell mixture, 16.9g) from site TE-Oh-4, Sample 13. The sample dates a shell from the natural beach sand underlying the Lapita site. (cf. Beta-20577). |
| $\delta^{14}C$: -267.7±10.9‰; $D^{14}C$: -306.4±9.7‰. The open sea average for Tonga: (1.69±1.07‰) was used as the $\delta^{13}C$ value. Beta Analytics reported age (no $\delta^{13}C$): 2500±80BP. |
| Ocean reservoir corrected age: 2670 ± 115 BP*. |
| Calibrated age (CALIB 3.0): cal BC 914 (814) 781, cal BP 2864 (2763) 2731 |

Table 1: Nafanua Series

Discussion

A date of cal BC 197 (50) cal AD 70 (Beta-20576) for the lower levels of the midden fits the expectations nicely, since the pottery also points to a date within the Late Lapita Period. The Nafanua series of 14C dates, however is not straightforward. The date Beta-20575, which is stratigraphically younger than date Beta-20576 is as old as the stratigraphically oldest date Beta-20577. This inconsistency of the series can be explained by older shells having become incorporated in the younger layers. A contamination of marine shell samples can be ruled out.
The early Holocene beach

The date received for the beach (Sample 13) is much younger than expected, given the other radiometric age determinations for the Ohonua area. Based on the limited exposure of the site, it was expected that the encountered beach would belong to the raised terrace of the Ohonua formation (Taylor 1978:68), which had been dated to 5700 to 6100 BP (see Table 2). This is obviously not the case. It is thus likely that the dated beach is a younger storm beach, an explanation which is supportable given the location of the site.

<table>
<thead>
<tr>
<th>Locality</th>
<th>LabNo.</th>
<th>Method</th>
<th>Height</th>
<th>Date (BP)</th>
<th>BP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUA-Av-1</td>
<td>i-9820</td>
<td>14C</td>
<td>0.5</td>
<td>6120±110</td>
<td>6280±105</td>
</tr>
<tr>
<td>EUA-A-1</td>
<td>LDGO 1406A</td>
<td>230Th,234U</td>
<td>1</td>
<td>5700±500</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Radiometric results on the Ohonua formation, ‘Eua. Dated are Acropora sp. coral heads. Height in metres above HWL. Dates after Taylor 1978.


The ‘ash’ layer

To date, no absolute age determinations are available for the various ashfalls, which form the substrate for almost all soils on the Tongan Islands. The current published dates, between 5000 and 10000 BP for the last ashfall, all derive from the state of decomposition of the ash (Orbell 1977a, 1977b) than to direct or indirect scientific dating. The sequence excavated at TE-Oh-4 offered the first opportunity to date the last ashfall, since the volcanic ash layer is bracketed by two radiocarbon dates of the beach sand underneath and the midden deposit. However, the age bracket provided for the ash layer, that is, between cal BC 197 (50) cal AD 70 and cal BC 914 (813) 777 (weighted average samples 5+13), provides for a time period for which there are several other sites on Tongatapu. Since in all but one site (TO-Pe-5; Poulsen 1979-34), ash or clay layers are absent in the archaeological deposits of Tongatapu, and since ash falls on Tongatapu are thought to have come from the west, it would appear that the soil layer at TE-Oh-4 is not an ash deposit but a layer of slopewash deposited by an large-scale erosion event further upslope. The absence of humus content in the alluvial layer, as well as its overall homogeneity suggests that the erosion event was rapid.

Conclusions

Based on the attribute analysis of pottery recovered from site TE-Oh-4, as well as the pottery found by McKern (1929) at TE-Oh-2, and by the present author at TE-Oh-10, the initial settlement of ‘Eua occurred during the late Lapita period. This is confirmed by the 14C dates available for TE-Oh-4. Even though ‘Eua is the only source of volcanic rock close to Tongatapu, it seems the island was not settled prior to 2000 cal BP. The erosion event represented in the stratigraphy of site TE-Oh-4 could indicate land clearance above the Ohonua area, and thus indicate slopewash, or it could be the result of landslide generated by seismic activity.


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