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Multi-isotopic analysis of first Polynesian diet (Talasiu, Tongatapu, Kingdom of Tonga)

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ABSTRACT

Both archaeological and isotopic data document dietary changes over the first five centuries of Western Pacific island settlement, a time period beginning with the Lapita expansion about 3000 years ago. This change is marked by a decrease in marine food intake and an increase in vegetal food intake occurring in the Late Lapita/immediately post-Lapita populations. The recent discovery of human burials at Talasiu (~2700–2600 cal. BP) in the Kingdom of Tonga opens new opportunities to assess this matter. We characterize the nature of the food items consumed by the Talasiu humans (n = 21) using collagen and apatite carbon and nitrogen stable isotope ratios. We conducted an intra-Pacific comparison to examine the use of marine resources and the contribution of horticultural products and to look at the homogeneity of dietary practices within the Tongan group. Isotope results indicate a mixed diet of terrestrial and marine resources including a differential contribution of more specific marine foods (e.g., non-reef fish/inshore fish and shellfish). The Talasiu dietary pattern appears closer to that of the early Lapita population of Teouma than to other Late Lapita populations suggesting a different pattern of dietary change at the eastern end of the Lapita distribution. The slower rate of change may be due to the small size of both the island and the population, and also the additional potential role of social or cultural factors.

1. Introduction

Colonization causes new connections and relationships between migrating humans and their cultural and natural environments that can be examined through studying dietary change (Twiss, 2012). Originating from South-East Asia, the first settlers of the Pacific region east of the Solomon archipelago are associated with the Lapita culture that appeared about 3300 years ago in north Melanesia (Summerhayes et al., 2010; Skoglund et al., 2016; Valentin et al., 2016). These original colonizers are generally regarded as people with a mixed subsistence economy that combined the exploitation of marine resources with a low level of terrestrial resource production based on chicken or pig husbandry and taro cultivation (Groube, 1971; Burley, 1999; Kirch, 2002; Kennett et al., 2006). In less than 500 years after the first arrivals in the pristine islands, food resources used by humans appear to have largely changed. Consumption of wild terrestrial and marine foods decreased and the agricultural component of the diet increased (Davidson et al., 2002; Kirch, 2002; Anderson, 2009; Sheppard, 2011). A declining mid-Holocene sea level and human-induced landscape alteration including deforestation and faunal extinctions have been identified as potential driving forces that –coupled with an increasing emphasis on the products of horticulture– caused significant dietary change between the beginning and the end of the Lapita period (Clark and Anderson, 2009; Cochrane et al., 2011; Sheppard, 2011). From a dietary change perspective there are three issues in our understanding of Lapita subsistence that require investigation: (1) what was the balance between native animal, plant and marine foods and introduced foods, especially tuber crops?, (2) did the shift toward horticultural foods occur soon after colonization everywhere in the Pacific?, and (3) what influence did population size and mobility have on these processes?

Stable isotope studies, applied to skeletal remains of early Pacific populations, have shown a trend toward a horticultural diet with temporal variation in response to local environmental conditions (Field et al., 2009; Kinaston and Buckley, 2013; Valentin et al., 2010, 2014; Kinaston et al., 2014, 2015, 2016). As a consequence, human groups associated with the late-Lapita/immediately post-Lapita period are

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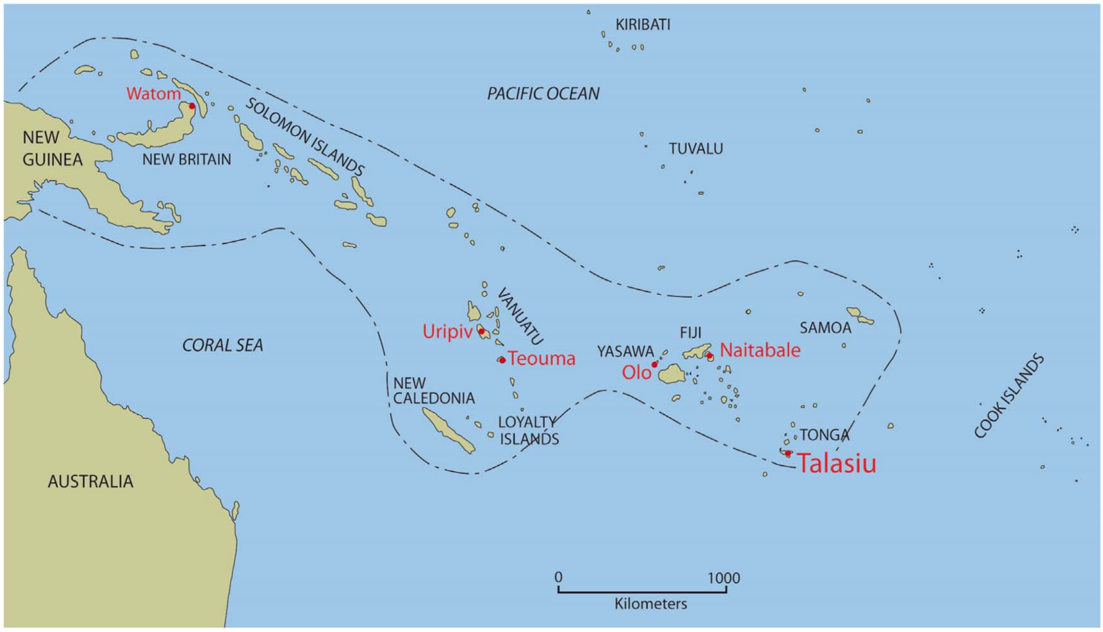

Fig. 1. Lapita expansion and Pacific archaeological sites considered in this study.

expected to have stable isotope ratios indicating that fewer marine resources were consumed compared with the first Lapita colonizers. We expect that post-colonization groups should have: (1) lower collagen stable carbon and nitrogen isotope ratios suggesting a higher terrestrial animal intake; (2) lower apatite stable carbon isotope ratios indicating an increased reliance on food items with a higher carbohydrate content such as taro and other cultivated plants and, (3) a lower dispersion of collagen and apatite stable isotope ratios reflecting adoption of a dietary standard based on terrestrial resources. These assumptions are examined here through multiple stable isotope analyses, including results from new human collagen and apatite bone samples (n = 21) obtained on early Polynesians people from the Talasiu site (Kingdom of Tonga) and their comparison with isotope results from other parts of the Pacific.

2. Talasiu site

The Talasiu site (TO-Mu-2) is located on the palaeoreef-limestone shoreline of the Fanga ʻUta Lagoon, north of Lapaha Village, only 2.5 km south of Nukuleka Village which is regarded as the place of the initial Lapita landfall in Tonga (Burley et al., 2010) (Fig. 1). The site consists of a dense shell midden deposit ~90 cm thick covering some 450 square meters. This midden contains large numbers of bivalves, mixed with pot sherds, charcoal, bone, and shell and stone artifacts, but no fishing gear except perhaps for tiger cowrie caps (*Cypraea tigris*) that have been considered parts of a composite octopus lure rig (Poulsen, 1987, for a critical discussion of these artifacts see Spennemann, 1993; Best, 1984: 459), and perforated *Anadara* sp. shells that are sometimes thought to be net weights (but see Connaughton et al., 2010). The pottery is predominantly plain with some dentate-stamped vessels bearing simple open designs typical of late Lapita ceramics. Shell artifacts include short and long shell units, broad *Conus* spp. rings, narrow rings made of *Conus* spp. and *Tridacna* spp., and small circular flat beads that are similar to Lapita ornaments. Lithics items comprise adzes, flakes, grinding stones and oven stones whose raw material has a distinct geographical source with obsidian from northern Tonga and lithics from ʻEua (south Tonga), Samoa, east Fiji and volcanic islands within Tonga, suggesting significant population mobility (Reepmeyer et al., 2012; Clark et al., 2014). The deposit also includes features, such as ʻhearths, ovens, oven rake outs, and burials, placed at the base of the deposit or interstratified within the midden.

The 95% probability range of radiocarbon determinations obtained on coconut endocarp, unidentified charcoal, worked shell grave goods and human bone samples fall between 2750 and 2150 cal. BP (Valentin and Clark, 2013; Clark et al., 2015; Skoglund et al., 2016) (Table 1). Calibrated charcoal and bone ^{14}C ages between 2600 and 2300 BP are

Table 1
Radiocarbon dates on nut charcoal and human bone calibrated (95.4%) with Calib7.10 using the SHCal13 Southern Hemisphere Calibration following advice from F. Petchey (Waikato Radiocarbon Dating Laboratory, Waikato University). Marine shellfish ages calibrated with Marine13 and Delta R set at 11 ± 83 years after Petchey and Clark (2011).

Lab number	Unit and depth	Material	Conventional radiocarbon age (CRA) ^{14}C age and error (BP)	δ^{13}C (‰)	Calibrated age 95.4%, cal. BP
Wk-22999	TP.1: 40 cm	*Tridacna* sp.: grave good	2767 ± 37	2.2 ± 0.2	2291–2720
Wk-23000	TP.1: 65 cm	*Tridacna* sp.: grave good	2726 ± 30	2.8 ± 0.2	2210–2695
Wk-23001	TP.1: 80 cm	*Conus* sp.: grave good	2682 ± 30	3.5 ± 0.2	2150–2660
Wk-25461	TP.1: 40–65 cm	Human bone (burned): bone concentration	2499 ± 31	−12.2 ± 0.2	2360–2700
Wk-41883	TP.A2	Human bone: Sk10 fibula	2594 ± 20	−16.4 ± 0.2	2340–2680
Wk-22876	TP.1: 91 cm	Charcoal from F6: structure	2452 ± 30	−23.5 ± 0.2	2350–2700
Wk-23002	TP.1: 80 cm	Charcoal from F5: structure	2562 ± 30	−25.0 ± 0.2	2490–2750
Wk-28234	TP.1: 55–60 cm	Carbonized coconut endocarp: shell midden	2473 ± 31	−21.3 ± 0.2	2350–2700
Wk-28235	TP.1: 70–75 cm	Carbonized coconut endocarp: shell midden	2510 ± 30	−21.3 ± 0.2	2380–2720
Wk-33572	TP.2: Spit 4, 15–20 cm	Carbonized coconut endocarp: shell midden	2533 ± 25	−22.6 ± 0.2	2440–2740
Wk-33573	TP.2: Spit 11, 50–55 cm	Carbonized coconut endocarp: shell midden	2448 ± 25	−22.5 ± 0.2	2360–2690
Wk-33574	TP.2: Spit 18, 85–90 cm	Carbonized coconut endocarp: shell midden	2504 ± 25	−23.0 ± 0.2	2380–2710