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A Radiocarbon Chronology of Yapese Stone Money Quarries in Palau

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Abstract—A suite of new radiocarbon dates (including two conventional and nineteen AMS) provide the first chronology of Yapese stone money quarries in western Micronesia. Early ethnohistoric records document the Yapese carving of their large disks of 'money' in the limestone Rock Islands of Palau while oral traditions suggest it was also taking place prior to European contact. However, there has been no archaeological data to substantiate the antiquity of this exchange system. Recent archaeological excavation at three quarry sites has addressed this issue. Radiocarbon dating of charcoal, shell, and human bone, in conjunction with oral traditions and ethnohistorical accounts, suggest these stone money quarries were multi-component and that quarrying activity was taking place at least several hundred years prior to European contact and intensified shortly thereafter.

Abstract—Ngarngii a omesuub el mla meketmokl el olecholt el kmo, a rechad ra Belulechab a mirael el mei era ikal iungs el ngara Ngebard ra Micronesia el melasech a ududir el balang. Elsel tial omesuub, eng mla mo er ngii a luich ma tang el loruul aikel de dung el kmo, *radiocarbon dating*. Tiang a tara teletael el ousbech er ngii el olecholt a rekil a klalo. A omesuub el milketmokl ra ngaramong el tirkel semmong el chad ra omesubel a tekoi ma teletelel a klechad ma siukang a rirellii ma uldedlid el cheldecheduch ra irechar a ochotii el kmo, a rechad ra Belulechab a mla er Belau el melasech a ududir ra uchei ra lemei a rechad ra Ngebard (Europeans). Meng uaisei, eng di dimlak el rak e mle ua ngerang a klemengetir el ngar Belau el melasech aika el ududir. Tirkel semmong ra omesubel aua ekakid el tekoi a mla kmiis a edei el kekerous el basio el ikel mla er ngii a rechad ra Belulechab e melasech a baling el osiik a klalo el ngii a mo sebechel sumecheklii tial tekoi. A omesubel a rikel a bas, ma kai, ma chiuesir a rechad el milngai ra ikal basio el mla er ngii omelasech el balang, ma uldelid el cheldechederir a mle chad ra erechar, ma di mla meketmokl el omesuub, eng meketeklii el kmo, aika el basio a mla er ngii a usbechellel ra rechuodel ra uchei ra rechad ra Belulechab a lemei er Belau. Ng dirrek el meketeklii el kmo, a re Belulechab a mla

er Belau el melasech a balang era uchei ra lemei a re chad ra Ngebard. A uriul ra lemei a rechad ra Ngebard ea omelsechel a balang a meraeI el kmal mo klou.

Introduction

One of the most archaeologically dramatic, but least understood instances of portable artifact exchange in the Pacific, is the quarrying of stone money in Palau by Yapese Islanders in the Western Caroline Islands of Micronesia. This exchange process represents an unusual cross-cultural case where the workforce traveled to a separate island to quarry their materials. Stone money was only one of many mediums of exchange (*matchaf*) used by the Yapese; others included shell money, especially the mother-of-pearl (*yar*), and non-native spondylus shell (*gau*). Stone money disks (also referred to as *rai* or *fei* in Yapese and *balang* in Palauan) up to 4.5 m in diameter and weighing over several metric tons were carved from the many natural limestone caves around the Palauan archipelago and transported by ocean-going canoes or European trading ships sailing to Yap proper almost 400 km away (Figure 1). Four Yapese quarry sites have been recorded so far in Palau and many more exist which have yet to be thoroughly investigated (Rita Olsudong, pers. comm.).

The Palau Stone Money Project was initiated in 1998 to investigate Yapese stone money quarrying in the Palauan archipelago. One of the major goals of the project was to gain a diachronic perspective of quarry exploitation, habitation, and associated uses. This was necessary not only for understanding the development of exchange between these two societies, but also to comprehend how other cultural domains were influenced by exchange practices. A major task of the research and a critical step in constructing an exchange model is to develop a chronology of stone money quarrying and overall site use based on excavation and radiocarbon dating from stratified deposits. Ethnohistoric records and ethnographic descriptions suggest that quarrying was taking place prior to European contact. Until recently, however, no archaeological data were available to substantiate this claim. There is no doubt based on the Yapese evidence that the quarrying pre-dates European contact.

Although many researchers have commented on stone money and the social relationships surrounding its use (Cheyne 1852, Tetens and Kubary 1877, Einzig 1966, Bellwood 1979, de Beauclair 1963, 1971, Alkire 1980, Berg 1992, Hunter-Anderson & Zan 1996, Descantes 1998), the money quarries themselves have received little attention by archaeologists (see Osborne 1979 for only a brief note on Omis Cave). Investigations in Palau by archaeologists from the University of Oregon and the Palau Division of Cultural Affairs (DCA) from 1999-2000 provide evidence of at least 15 stone money disks in various stages of production as well as extensive pottery, shellfish, and other faunal remains in the vicinity of four recorded quarries. The time frame for the quarrying activity has not yet been defined. Although oral historical and ethnographic references provide some clues

about the production and transport of stone money, these are often synchronic and thus limited in their applicability (Kirch 1990, 2000).

In this paper I present the first radiocarbon dates from Yapese stone money quarry sites in Palau. I provide a brief background on stone money quarrying, a sequence of dates for three sites, and add an archaeological dimension to the study of this exchange system. The research provides a foundation for developing hypotheses regarding when Palauan-Yapese interaction commenced, with respect to stone money, and how these interactions may have influenced other exchange relationships in western Micronesia.

Background

According to Captain Andrew Cheyne (1852:148), who lived in Palau and traveled through the Western Pacific from 1841-44, "[the Yapese money] consisted of nothing more or less than a round stone, with a hole in the centre, similar to a small upper mill-stone. The stones are very rare, and consequently highly prized, being only found in the mountains of the Pallou [Palau] Islands." The Yapese also quarried money in Guam (Einzig 1966:36, de Beauclair 1971:186), but there has been little detailed discussion of the processes involved and why some quarries were chosen over others.

During the historic era, the traditional methods of quarrying using shell or stone implements were transformed through the use of metal tools and the transport of disks on European ships aided by traders. Tetens (Tetens & Kubary 1887), in 1862, became the first European trader involved in this production. Later, Captain David O'Keefe, an Irish-American ship owner, made arrangements with the Yapese to bring quarry workers to Palau and stone money back to Yap in exchange for labor, copra (dried coconut meat), and beche-de-mer (sea cucumber), which he then traded in Hong Kong and other Asian ports. Others soon became involved in this trade and by the late 1800s Yap was inundated with stone money (over 13,000 disks were counted by the Japanese during their administration in the 1930s, although deBeauclair estimated that by 1965 this number had been reduced by half due to typhoons, flooding, and their use for anchors, defensive walls, and other general purposes during WWII; see also Gilliland 1975:11). This trade network lowered the value of the stone money transported in larger ships, making the earlier money carved and transported using canoes, rafts, and other traditional technologies more valuable. The money's final worth depended on its size, shape, and quality (Einzig 1966:37), and probably effort expended (i.e., lives lost, amount of labor, and risk involved). Even smaller pieces today may be worth considerably more if it is known that a person or persons died while transporting a disk back to Yap, perhaps due to foul weather.

Prior to this research no dates had been obtained for the large stone money disks either in Yap or Palau, and it was unknown how stone money fit into the settlement chronology of either island. Yapese and Palauan oral traditions suggest that quarrying not only preceded the extended European trips to the area in the

late 18th century, but preceded (and may have influenced) the consolidation of the various Palauan chiefly confederations (Nero n.d.). Based on ethnohistoric evidence and oral traditions, Berg (1992:155) suggests that stone money production began around A.D. 500 with greater numbers of quarry workers coming to Palau during the later prehistoric period from A.D. 1000-1400. Because of uncertainties as to when the Yapese actually began quarrying stone money and when production intensified, archaeological investigation, including ^{14}C dating of quarry use was needed. Fieldwork at three quarry sites — Omis Cave, Metuker ra Bisech, and Chelechol ra Orrak — has placed quarrying activities into a temporal perspective and provided a framework to start defining the temporal boundaries of stone money production.

Stone Money Quarries

Omis Cave is located on the northern fringe of Koror Island, the main government and commercial center in Palau (Figure 1 – inset). The site is approximately three km south of the Koror-Babeldaob bridge, oval in plan view, and 780 m^2 in size. A large rock outcrop runs north-south along the eastern portion of the cave. A shallow pool lies directly below the outcrop and contains an abundant amount of refuse material including pottery and limestone debitage (Figure 2). Three stone money disks were recorded at the site in 1999 along with several stone architectural features (Fitzpatrick 2001).

Metuker ra Bisech is a large inland site a few km across the Toachel Mid Channel from Omis Cave in Airai State. The site boundaries have not been completely discerned because of dense vegetation, rough karst topography, and the exact relationship smaller features may have to the main quarry. Preliminary results, however, indicate that it is quite large (~2,500-3,000 m^2). The site has extensive architectural features including stone platforms, walls/alignments, and mounds (Figure 3). One finished and two unfinished stone money disks were recorded in 2000 (Figure 4). Another finished disk was located during survey near the site, but away from the main quarry area.

Chelechol ra Orrak is situated along the southern portion of Orrak Island, 1 km east of Babeldaob Island. A coral rubble causeway connects the two islands, but its use has not yet been determined. There are several caves and overhangs, but only the two largest caves show strong evidence for stone money quarrying. Two unfinished stone money disks and stone features (docks, alignments, and mounds) have been recorded at the site (Figure 5). Nearly all of these lie within the most southerly cave where the 2000 investigation was focused.

Archaeological Methods

Test excavations were conducted at these sites from 1999-2000. Three test units were excavated at Omis Cave (2 – 2.0 x 1.0 m; 1 – 0.6 x 0.5 m; 2.4 m^3 soil volume), four at Metuker ra Bisech (1 – 2.0 x 1.0 m; 3 – 1.0 x 0.5 m; 1.9 m^3 soil

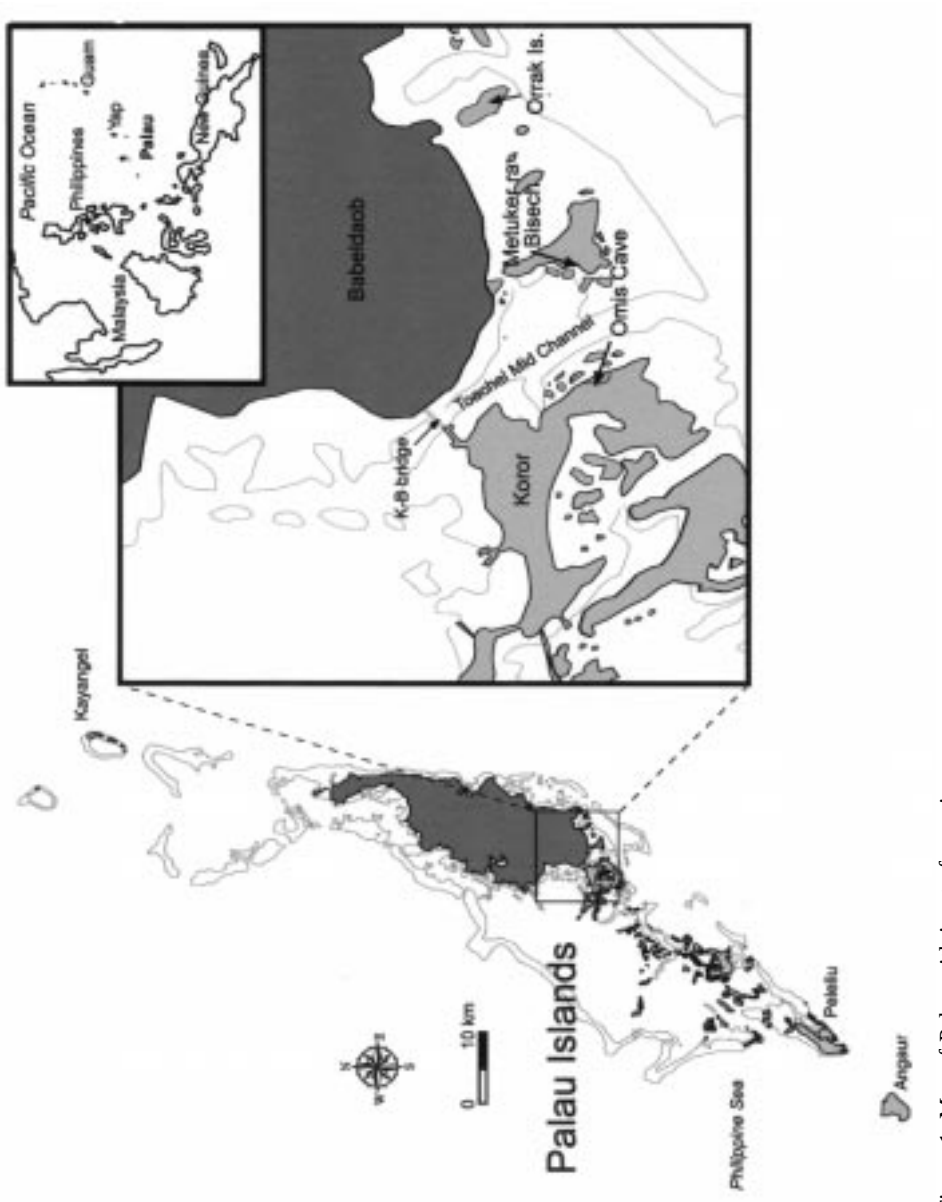

Figure 1. Map of Palau with inset of quarries.

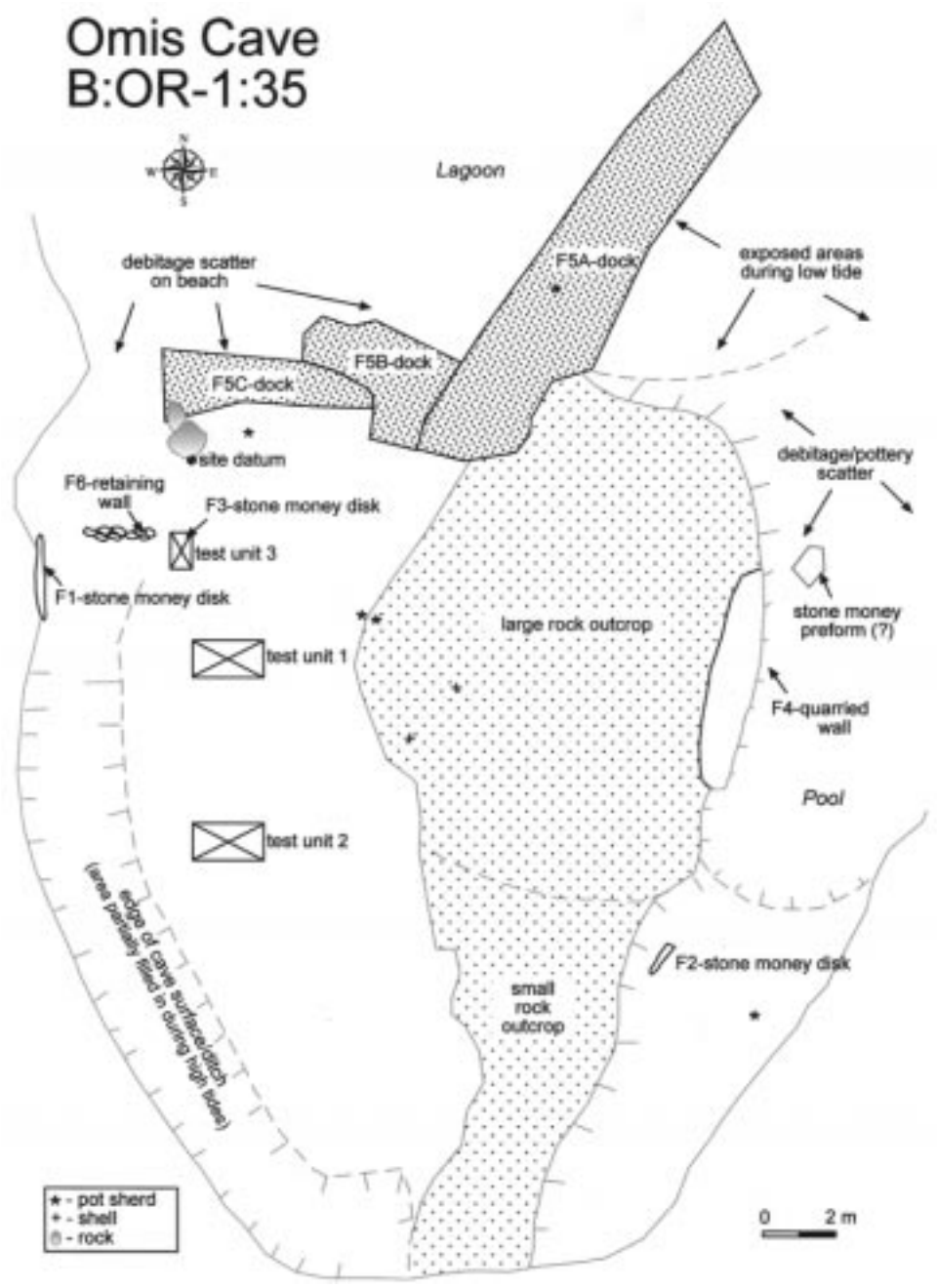

Figure 2. Map of Omis Cave

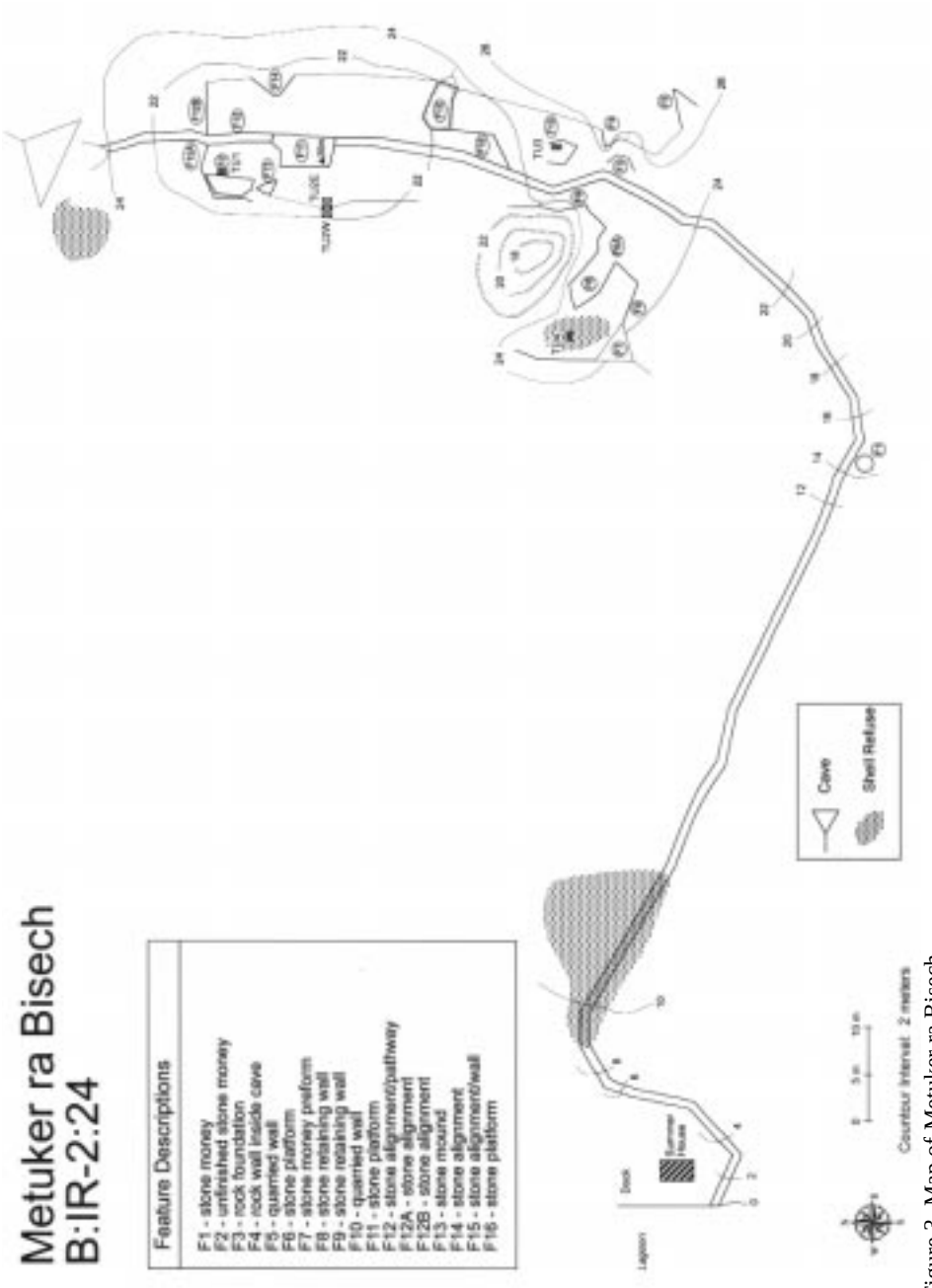

Figure 3. Map of Metuker ra Bisech

Figure 4. A large stone money disk at the Metuker ra Bisech site (photo by author).

volume) and four at Chelechol ra Orrak (2 – 1.0 x 1.0 m; 2 – 1.0 x 0.5 m; 2.6 m^3 soil volume). Soil was water screened through 1/8-inch mesh to ensure good recovery of smaller site constituents. In general, soils at Omis Cave were loamy sand with abundant calcareous inclusions, silty loam with abundant limestone debitage at Metuker ra Bisech, and a mix of calcareous sand and silty loam at Chelehcol ra Orrak. Charcoal and bone samples submitted for radiocarbon dating were recovered *in situ* to reduce the possibility of post-excavation contamination.

Dating Methods

The ^{14}C determinations were made at two different laboratories. Paired charcoal and shell samples from Omis Cave were dated at Beta Analytic Inc. (Only 0.8 g of charcoal was left after pretreatment for Beta 143446 so extended counting was done to ensure better precision.) The other 19 were dated using an Accelerator Mass Spectrometer (AMS) at the University of Arizona.

Limestone debitage, pottery, charcoal, mammal and fish bone, shellfish, and various tools of bone, stone, and shell were recovered from stratified deposits at the quarry sites. The dated specimens include nine charcoal, 11 marine shell, and one human bone fragment (Table 1). The samples were calibrated using CALIB 4.3 after Stuiver et al. (1998). A local ΔR for Palau has not yet been determined so the mean global reservoir correction was used for shell (~400 years; see Stuiver et al. 1998).

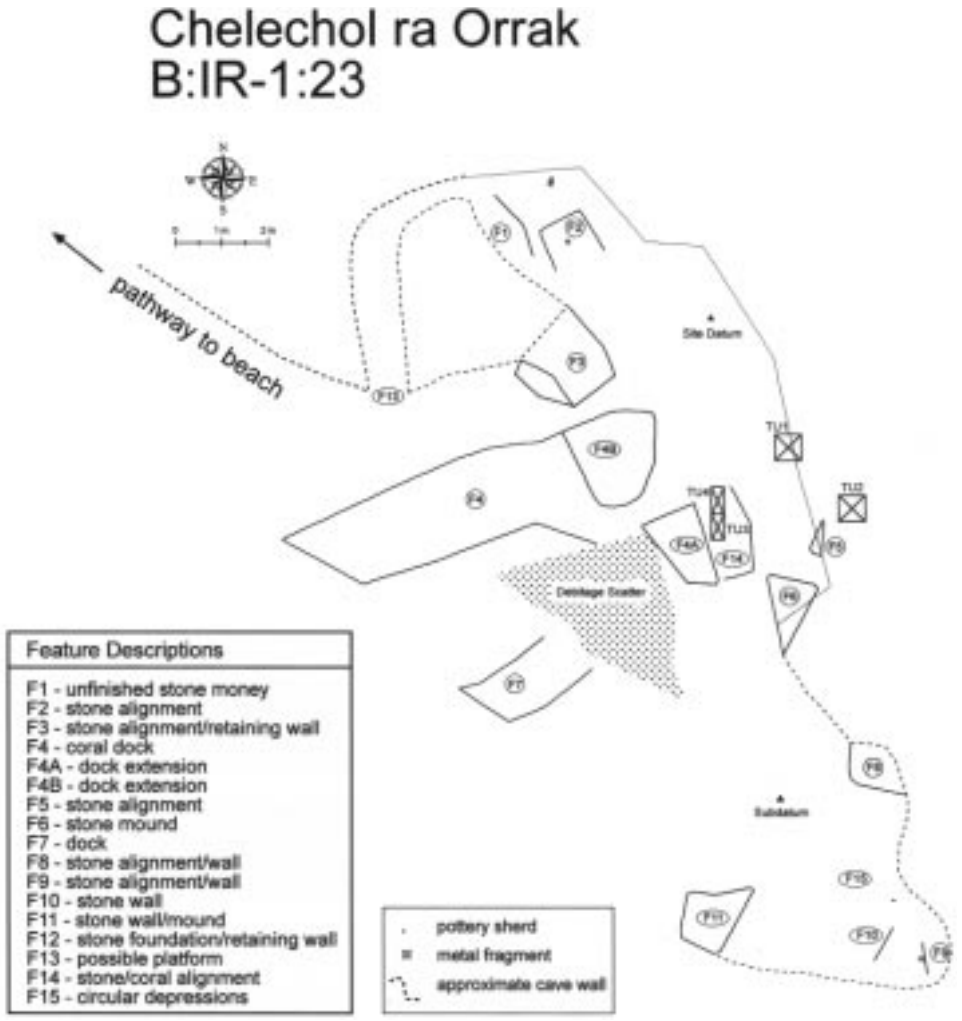

Figure 5. Map of Chelechol ra Orrak.

It is known that porous bone can absorb calcium carbonate from a surrounding limestone environment and skew the resulting age if standard radiocarbon techniques are used. Pretreatment procedures must therefore be employed to ensure an accurate age assessment of bone specimens (see Taylor, 1987:54-61 for further discussion). Typically, AMS is used to isolate protein or a specific amino acid such as hydroxyproline known to occur almost exclusively in bone collagen. For this research AMS radiocarbon analysis was used so that pretreatment procedures could isolate one or more of the organic constituents indigenous to the original sample (Taylor 1987:56).

The bone sample (AA40957) was first demineralized in 0.6M HCl with heat and rinsed to a neutral pH. The remaining liquid was evaporated, put back into

Table 1. Radiocarbon dates from Yapese stone money quarries (CO = Chelechol ra Orrak; MB = Metuker ra Bisech; OC = Omis Cave; AA = Arizona AMS Facility; BA = Beta Analytic, Inc.).

Site	Lab No.	Sample No.	Material	Unit	Layer	Level	Wt. (g)	$^{13}C/^{12}C$ ratio	measured ^{14}C age	Cal. B.C./A.D. (1 sigma)
CO	AA40957	COTU1.1	human bone	1	9	90-100	3.0	-15.7	2678±41	BC 890 (830) 800
MB	AA40969	MBTU1.1	charcoal	1	2	20-30	1.7	-27.6	116±36	historic
MB	AA40970	MBTU1.2	charcoal	1	6	50-60	1.1	-29.4	143±36	historic
MB	AA40971	MBTU2.1	*Cypraea* sp.	2	2	20-30	12.3	1.9	423±37	historic
MB	AA40972	MBTU4.1	*Anadara* sp.	4	1	0-10	9	0.6	509±36	AD 1720 (1820) 1950
MB	AA40973	MBTU4.2	*Cypraea* sp.	4	1	10-20	12	1.2	446±36	historic
MB	AA40974	MBTU4.3	*Anadara* sp.	4	3	20-30	11.3	2.1	529±38	AD 1700 (1810) 1840
MB	AA40975	MBTU4.4	*Venus* sp.	4	3	30-40	9.1	2.0	565±47	AD 1680 (1710) 1820
OC	AA40959	OmisTU1.2	charcoal	1	1	20-30	0.5	-25.2	96±37	historic
OC	AA40958	OmisTU1.1	*Chlamys* sp.	1	2	0-20	1.8	1.2	2379±39	BC 100 (40) AD 0
OC	AA40960	OmisTU1.3	charcoal	1	3	20-30	0.8	-25.6	1559±45	AD 430 (530) 560
OC	AA40961	OmisTU1.4	Cardiidae	1	3	20-30	15.3	2.1	2398±39	BC 130 (70) 20
OC	AA40962	OmisTU2.3	Strombidae	2	2	20-30	12.8	3.3	2519±40	BC 320 (210) 170
OC	BA143445	OmisTU2.1	H. *hippopus*	2	3	30-40	51.5	-2.3	2550±70	BC 360 (300) 170
OC	AA40963	OmisTU2.4	charcoal	2	3	30-40	0.6	-26.2	147±36	historic
OC	BA143446	OmisTU2.2	charcoal	2	4	40-50	1.4	-25.0	100.63±1.12%	historic
OC	AA40964	OmisTU2.5	*Anadara* sp.	2	4	50-60	7.0	2.2	616±37	AD 1660 (1680) 1700
OC	AA40965	OmisTU3.1	charcoal	3	1	20-30	2.7	-26.7	post-bomb	post-bomb
OC	AA40966	OmisTU3.2	charcoal	3	2	30-40	0.6	-26.6	202±37	historic
OC	AA40967	OmisTU3.3	charcoal	3	2	60-70	0.6	-27.6	46±58	historic
OC	AA40968	OmisST1.1	*Tridacna* sp.	ST1	---	---	7.3	1.9	post-bomb	post-bomb

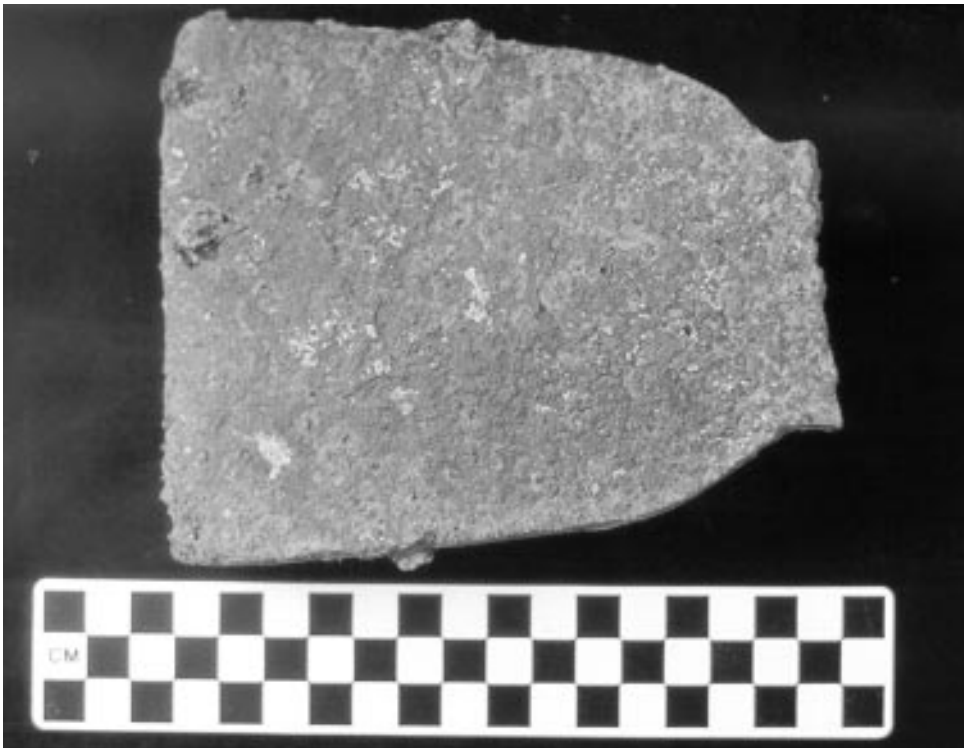

Figure 6. Metal blade tool found at Metuker ra Bisech (photo by Brian Diveley).

solution with dilute ammonium hydroxide, and run through a cation exchange resin. The sample was then freeze-dried to recover bone collagen. Collagen was then combusted under vacuum and the resulting gas converted to graphite for AMS analysis.

Results and Discussion

Of the 13 ^{14}C determinations from Omis Cave, two are post-bomb, five are modern (or could not be adequately calibrated due to the young age of shell specimens and an unknown reservoir effect), one is just prior to European contact, and five date from about 1400 – 2400 cal. B.P. The broad range of dates at Omis Cave suggest it was used by early Palauan settlers, perhaps as a campsite. The site was then utilized by Yapese quarrying their stone money and probably intermittently by Palauans within the last few hundred years. Given the complex stratigraphy of the site and lack of ethnographic data, it is difficult to determine specific periods of earlier activity because of engineering tasks and soil movement at the site (Fitzpatrick 2001).

The seven Metuker ra Bisech dates range from around A.D. 1600 to the later historic period. A cowry shell (*Cypraea* sp.) associated with two metal blade tools

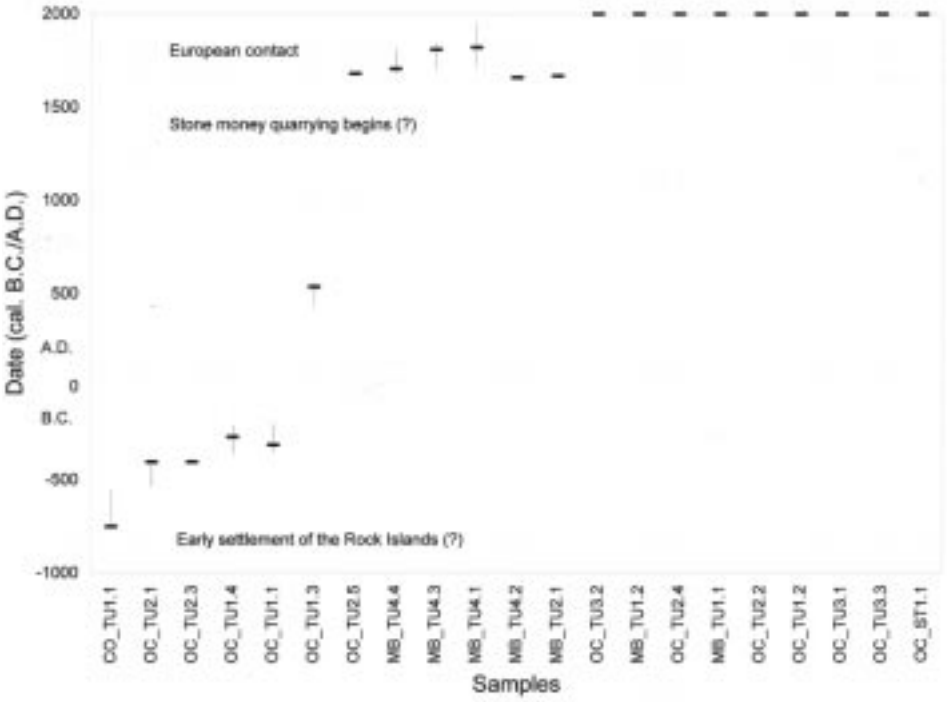

Figure 7. Yapese stone money quarry chronology.

recovered from Test Unit 2 at the site dated to 430 ± 40 cal. B.P. (Figure 6) and prior to European contact. Given that metal was not known to have been introduced until at least the late 1700s, the disparity in shell dates suggests the marine reservoir effect is probably on the magnitude of ~200-300 years if we assume the tools are contemporaneous with the shell. Overall, the marine shell dates appear older than charcoal specimens and artifacts within the same contexts. However, this is speculative and only a detailed study of shell-charcoal pairs will enable a local reservoir effect to be applied to Palauan archaeological assemblages.

A human cranial bone specimen recovered from one of the several burials at Chelechol ra Orrak dated to 2800 cal. B.P. This is one of the earliest dates from the Palauan Rock Islands and is certainly unrelated to stone money quarrying (Fitzpatrick 2002). Further radiocarbon dating and analysis of archaeological remains recovered in 2000 will enable a more comprehensive interpretation of how these burials relate to the overall assemblage and site stratigraphy. Several samples dating prior to 2000 cal. B.P. at Omis Cave and Chelechol ra Orrak are probably unrelated to stone money quarrying given the lines of evidence now available (current archaeological data, oral traditions, and ethnohistorical accounts).

Archaeological data collected from Yapese stone money quarries in Palau suggest these sites were multi-component and used for at least three millennia, but

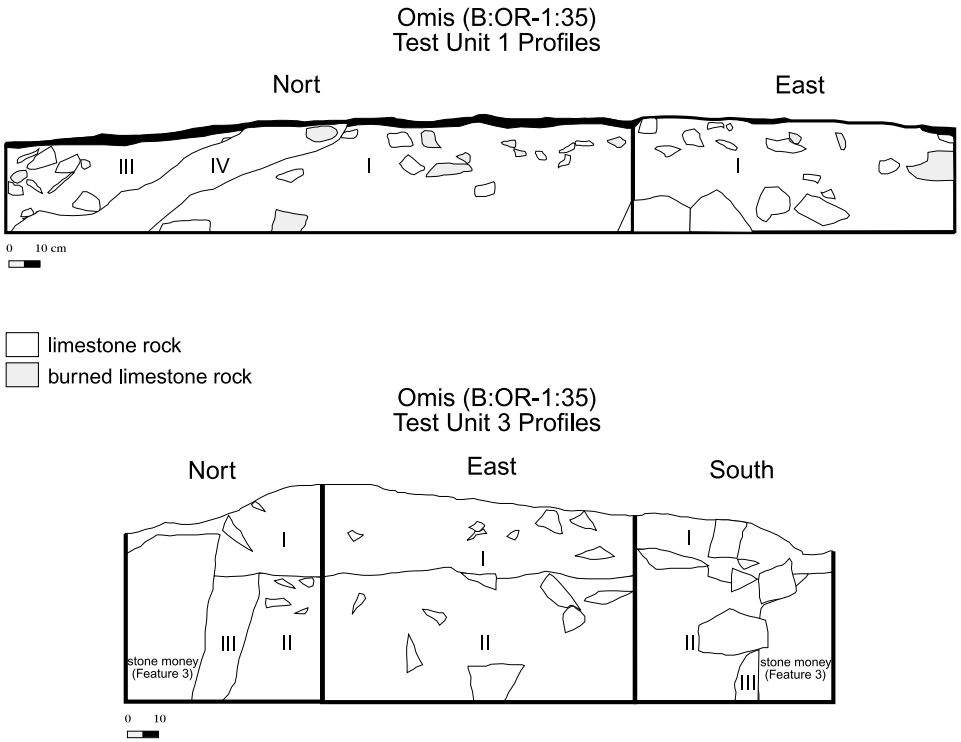

Figure 8. Stratigraphic representations from Test Units 1 and 3 at Omis Cave.

not necessarily just for quarrying. Fifteen specimens dating within the last 400 years or so coincide with the time range of quarrying documented by oral traditions and ethnohistorical accounts and support the suggestion that the Yapese were intensively quarrying stone money during the last few centuries. This corresponds to Descantes' (1998) assertion that stone money became more important in an historical context. Five dates ranging from about 2100 – 2800 cal. B.P. are some of the earliest recorded for the Rock Islands (Figure 7).

One difficulty in interpreting the archaeological assemblages at stone money quarry sites such as Omis Cave is that earlier dates are sometimes associated with artifacts and features related to quarrying episodes that presumably took place much later in time. Limestone debitage and stone money disks at Omis Cave are indicative of quarrying activity, although the archaeological assemblage appears to be mixed by human activity, including efforts to carve, move, and transport stone money disks (Fitzpatrick 2001). Stratigraphic representations in Test Units 1 and 3 testify to soil and debitage movement taking place (Figure 8).

Along with the human bone fragment date from Chelechol ra Orrak (Fitzpatrick 2002), it appears that five of the six dates indicate an earlier occupation of Palau's limestone islands than previously thought (Masse 1984 et al., Masse 1989, 1990), many of which are contemporary with recently dated sites

from the large volcanic island of Babeldaob (Liston et al. 1998, Wickler et al. 1998). Continued work at sites in the limestone Rock Islands, many of which appear to be multi-component, will surely expand on the information now available about Palau's complex cultural history and the exchange systems that evolved through time.

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