Archaeological Investigation of Omis Cave: A Yapese Stone Money Quarry in Palau

Article *in* Archaeology in Oceania · October 2001

DOI: 10.1002/j.1834-4453.2001.tb00489.x

1 author:

Scott M. Fitzpatrick
University of Oregon
174 PUBLICATIONS **2,352** CITATIONS

SEE PROFILE

Archaeol. Oceania 36 (2001) 153–162

Archaeological investigation of Omis Cave: a Yapese stone money quarry in Palau

SCOTT M. FITZPATRICK

Abstract

Stone money disks, predominantly quarried in Palau, were part of a complex political economy on Yap and obtained through a series of exchange relations with Palauan clans or villages. Though ethnographic and ethnohistorical records provide some insight into this exchange relationship, a lack of archaeological data has prevented a better understanding of the methods involved in stone money production and how quarry sites were used by Yapese. I present the first systematic surface survey and excavation of a stone money quarry and document evidence for the only example of Pacific Islanders' carving and transporting of carbonate rock between culturally distinct island groups. Archaeological results obtained from survey and excavation at Omis Cave complement ethnohistoric and ethnographic accounts.

Introduction

The use of stone resources by Pacific Islanders is well known and represents some of the most archaeologically visible traces of human settlement and interaction (Ayres 1998). The most frequently documented rock types include basalt in Polynesia (Clark 1993; Weisler 1993; Weisler *et al.* 1994; Weisler 1998), obsidian in Melanesia (White 1996), and various volcanic glasses (Weisler 1990; Clark and Wright 1995), the analysis of which has significantly improved our understanding of trade and exchange systems, among other social processes (Kirch 1990; Baker 1993; Green 1996). The use of carbonate materials by Pacific Islanders for producing tools, objects or structures, however, is quite rare. Columns and capstones called *latte* were quarried in the Marianas Islands from upraised reef limestone and used in house structures as early as perhaps AD 1000 (Kirch 2000:184–86). Limestone slabs were used as chiefly backrests on Alofi Island in Tonga (Kirch 2000:227–8) while Burley (1998) and Sand and Valentin (1991) describe the Tongan use of beachrock blocks (sand and beach debris cemented by calcium carbonate) to define the perimeter of monumental features, certain earthen mounds, sitting platforms, and chiefly burial mounds. Beachrock, an exotic resource that probably represented chiefly symbols of rank (Burley 1993), was transported between islands and only used by peoples within the Tongan archipelago. One of the only other instances of indigenous peoples in the Pacific manipulating carbonate rock, and the only example of the finished product being quarried and transported to another island by a culturally and linguistically distinct group, is the Yapese quarrying of their famous stone money in Micronesia.

Yapese Islanders quarried stone money almost exclusively in the Rock Islands of Palau in the Western Caroline Islands, Micronesia. The production of this exotic valuable is known, in part, from European explorers who participated in the transport of these disks back to Yap in the 1800s. A rich collection of ethnographic data and oral traditions suggest that stone money manufacture took place prior to European contact. This makes these megaliths the largest portable object ever moved over open ocean by Pacific Islanders. Unfortunately, direct archaeological studies have not been conducted to test the ethnographic accounts, antiquity, chronology, and geographical distribution of limestone deposits in Palau associated with Yapese stone money quarrying activities.

In 1998 a project was initiated with the Palau Division of Cultural Affairs to intensively survey and record several of these quarries. As there had been no previous intensive archaeological investigations of any quarry, Omis Cave (B:OR-1:35) was selected as the first of these sites. Surface features found at the cave by Osborne (1979:283) in his Palau Archaeological Survey from 1968–69 suggested that "the cave (Omis) would repay excavation. Certainly some of the techniques of Yapese money mining would reveal themselves." Omis Cave has been impacted over the years by visitors and was easily accessible. So, for many reasons, the site was ideal for beginning a long-term research program on Palauan-Yapese interaction as evidenced through the quarrying of stone money.

In this paper I present detailed archaeological data from the excavation, mapping, and surface survey of Omis Cave. I provide background information on stone money quarrying, summarize the first radiocarbon dates from this site type, and outline the artifacts and faunal remains that were recovered during excavation. Ultimately, I add a previously undocumented archaeological dimension to these important exchange and status related artifacts. Addressing these issues allows for the refinement of methodologies and hypotheses for investigating other quarries in the Palauan archipelago and is a critical step for documenting how and why the quarrying of stone money took place.

Yapese stone money quarrying

Oral traditions and ethnohistorical accounts report that the Yapese sailed over 400 km to Palau and carved disks of limestone inside caves by splitting off rock slabs using fire and shell adzes. Le Hunte (1883:25) noted in his report that he found "no less than a hundred Yap natives at Pelew" occupied in cutting these stones and preparing

Department of Anthropology, University of Oregon, Eugene, OR, 97403

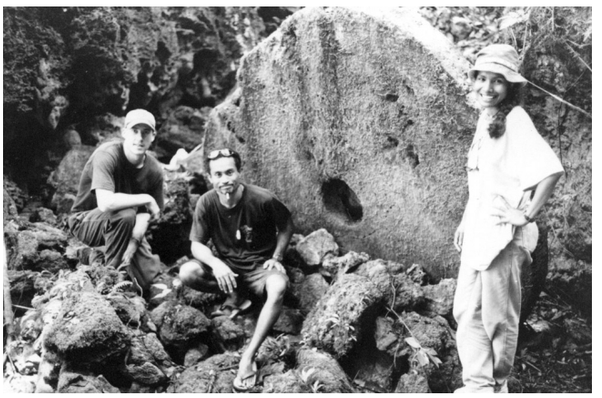

Figure 1. The author and DCA staff members Taurengel Emesiochel and Rita Olsudong next to a stone money disk at the Upper Orrak site in Palau.

them for transport. They would then drill a hole in the center with a reef stone used as a fire drill (de Beauclair 1971:188). Disks were moved to vessels by placing timbers through this hole and sailed back to Yap. "Many exceeded six feet in diameter and were proportionally thick, having a large hole in the centre through which a log of wood is passed and this when laid across two canoes is sufficient to support the stone in transit" (LeHunte 1883:25).

According to Yapese tradition, a navigator named Anagumang first discovered the stone in a Palauan cave and ordered his men to cut it into the shape of a fish, a crescent moon, and finally a full moon, perforating it in the center so that it could be carried with a pole (Figure 1). It was after this first stone was brought to Yap that it became highly prized, creating a demand for more (de Beauclair 1971:185). After contact with Europeans, traditional methods of quarrying were transformed through the use of metal tools and disks were then transported on European ships with the aid of traders. 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. This historical trade network thus succeeded in lowering the value of the money transported in larger ships, making the earlier money carved and transported using 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 the disk back to Yap, perhaps due to foul weather. Stone money today is considered quite valuable and is still used as a medium for exchange, although the disks themselves are not always moved; instead, ownership is transferred.

Palauan oral tradition suggests that the Yapese only had access to those quarries under the control of Palauan villages with which they had some affiliation. They were often able to arrange this access with gifts of exotic foodstuffs, glass beads (Florencio Gibbons 1998, pers. comm.) which were part of the standard Palauan monetary system (de Beauclair 1963; Smith 1997), and other valuables such as shanks of sennit cord. It is likely then, that there was differential access to quarry resources arranged by some formal agreement between specific Yapese and Palauan clans or villages based on the trade of various exchange items.

Similar to what Yapese and Palauan oral traditions describe, Tetens and Kubary (1887:126) stated that there was hostility between Palau and Yap and that owing to Palau's trading power, the Yapese had to obtain consent and permission to quarry stone money disks. Senfft (1903) and Müller (1917) also wrote that the Yapese were put to work building stone foundations, roads, and pathways for the Palauans as payment for quarrying stone money, and that the Yapese performed corvée labor and were treated in a subservient fashion for the right to quarry stone money from the chiefs of Oreor (a.k.a. Koror). According to reports from Cheyne (1852), this was a different arrangement from 20 years earlier in which Palauans were sending gifts of stone money to Yap. Thus, ethnohistorical records seem to imply that the political economy surrounding stone money disk quarrying changed significantly through time and that different methods of payment may have been used depending on what power struggles were taking place.

Geographical setting

The Rock Islands as they are locally known, consist of over 300 islands stretching 30 km along the length of the archipelago from southern Babeldoab to Peleliu. These islands are the result of tectonically uplifted reef systems developed during the Pleistocene that have slowly eroded away forming a karst topography. Dripstone and flowstone formations are commonly found in these islands and were the raw material for stone money quarrying.

Omis Cave is one of several known stone money quarries in Palau, all of which are located in the Rock Islands around the southern portion of Babeldoab and northern Koror (Figure 2). Stone money disks have been found in other parts of the archipelago, but no other quarries. The concentration of these sites may reflect a preference for limestone deposits found here or may represent restricted access governed by certain Palauan villages. It is more likely, however, that further survey in the south of the archipelago may lead to more quarries.

The word "Omis" has several different meanings in Palauan, but generally refers to a place where someone has a good view of their surroundings, for example to see a passing canoe or ship. Omis Cave is located on the eastern side of the Ngermeuangel portion of Oreor island (part of Koror State and overseen by Ngermid Village) near the smaller Rock Islands of Itelblong and

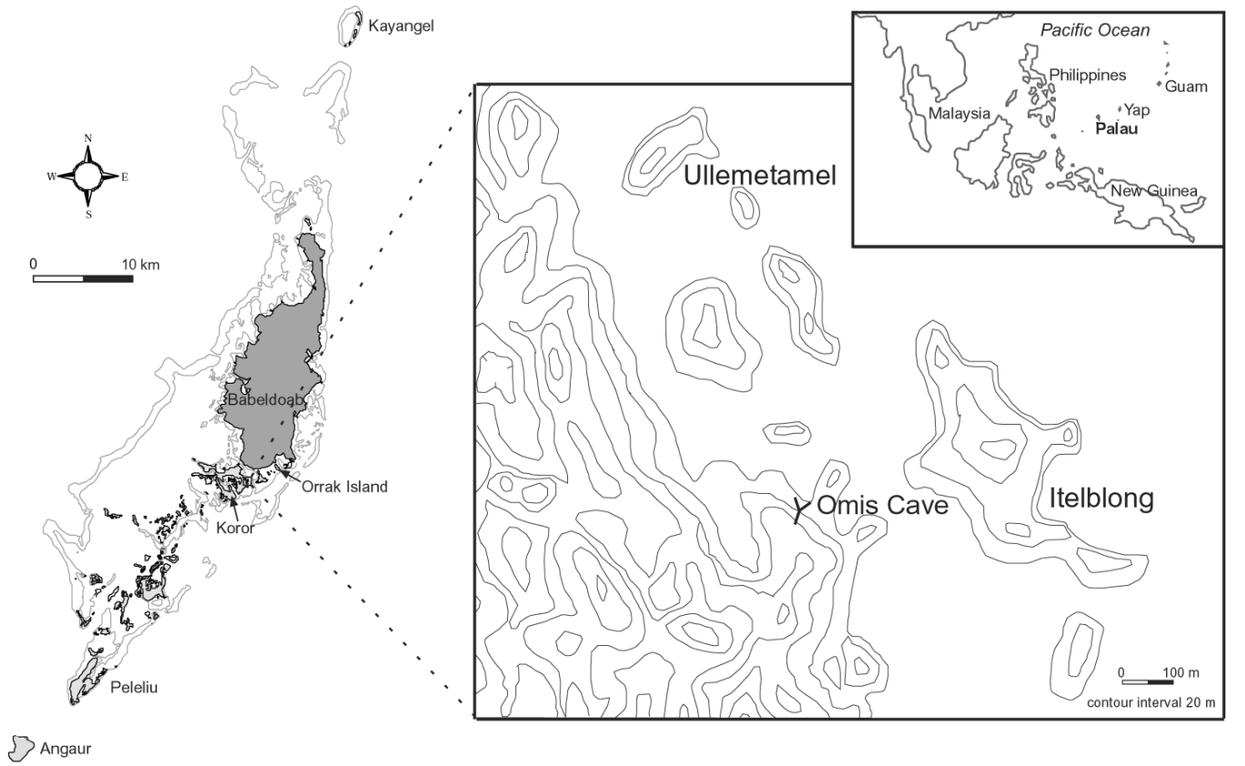

Figure 2. Palauan archipelago with inset of Omis Cave.

Ullemetamel (Figure 2), and is approximately 3.3 km south of the Airai side of the K-B bridge which connects the islands of Koror and Babeldoab. The cave is 780 m^2 and oval-shaped in plan-view (Figure 3). The entrance faces north out into a small lagoon where several smaller Rock Islands are visible.

Radiocarbon chronology

Two radiocarbon dates were obtained from Omis Cave. A juvenile *Hippopus h.* shell from layer 3 (30–40 cm) in test unit 2 dated to 2550 ± 70 B.P. without a local reservoir correction applied (Beta-143445). Charcoal from layer 4 (42 cmbs) in test unit 2 was dated to 100.63 ± 1.12 % modern (Beta-143446). As these are the first radiocarbon determinations from a Yapese stone money quarry, it can only be assumed that carving activity at Omis was taking place during the turn of the century about the time German administrators began prohibiting inter-island voyaging. The early date for *Hippopus* shell precedes the earliest documented time for stone money quarrying and even that for Rock Island settlement in Palau (Masse *et al.* 1984). Without a reservoir effect correction applied, assigning an precise age is problematic. This specimen may have been living in or near the cave and later incorporated into the fill during the movement of soil and debitage associated with engineering tasks. It is equally plausible that earlier or even contemporary Palauan assemblages were intermixed with Yapese material during quarrying activities and that Omis Cave is multi-component with the site being used as a temporary campsite by Palauans and for stone money production by the Yapese.

Research at Omis Cave

Surface survey was conducted at Omis Cave to identify features associated with stone money quarrying, possible refuse areas indicative of habitation, and quarried limestone deposits. Survey revealed few surface indicators of non-recent human occupation. However, we did record several stone money disks and architectural features; quarry debitage and pottery was collected. Results are summarized below.

Surface Features

Evidence of Yapese stone money quarrying recorded at Omis Cave include three unfinished stone money disks, a retaining wall, a coral and limestone rubble dock, extensive artifactual remains, and a large faunal assemblage.

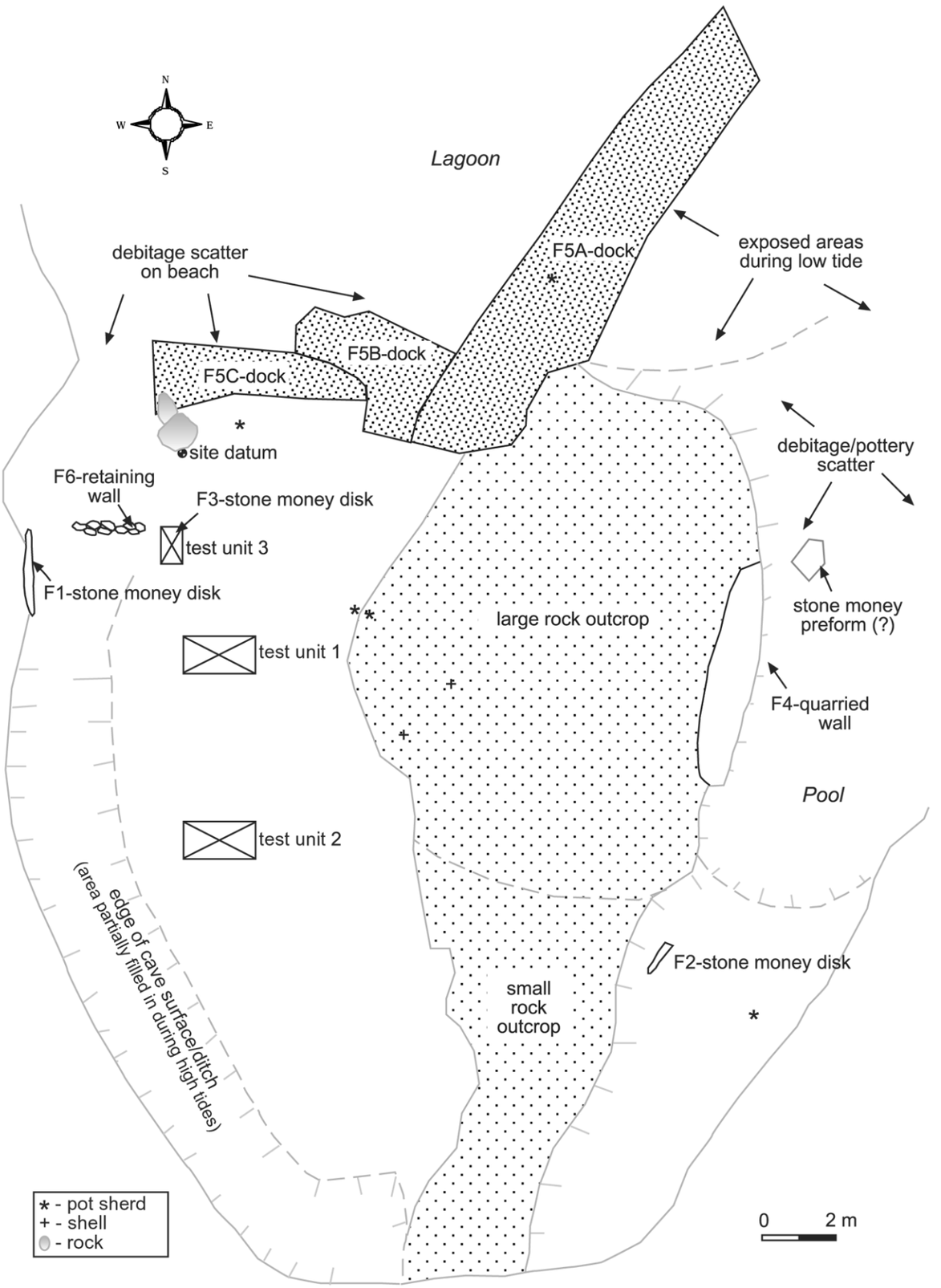

Figure 3. Omis Cave plan.

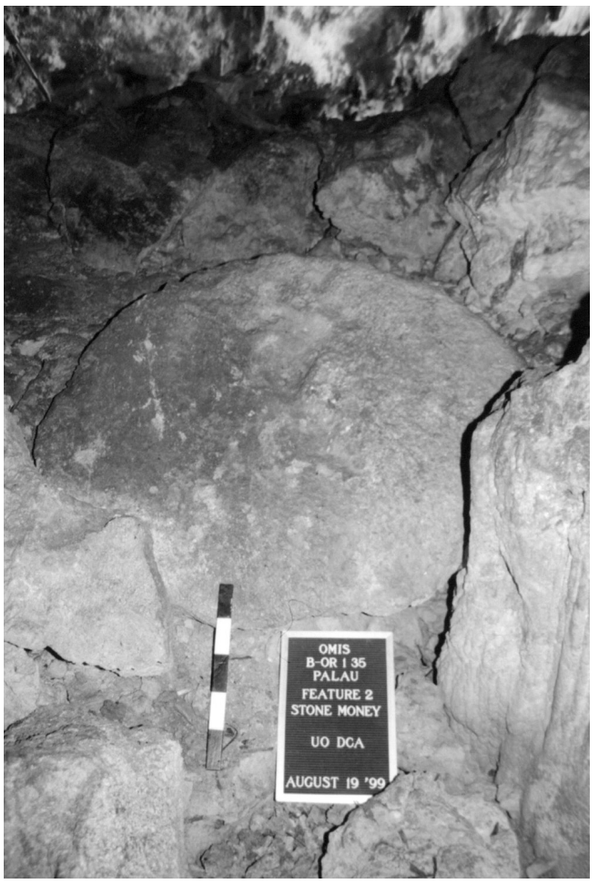

Figure 4. Feature 2 — Unfinished stone money disk (photo by author).

The largest of the three stone money disks (feature 1) is 3.3 x 1.7 x 0.8 m and situated on the west side near the mouth of the cave. It is roughly half-moon in shape and still attached to the original flowstone formation. Gouge marks are evident on the exterior of the disk. These gouge marks range from 1–2 cm x 2–3 cm in size; no perforation is present.

The second disk (feature 2), near the southeast corner of the site, is 1.3 x 1.5 x 0.2 m in size and propped up against several limestone boulders near a large rock outcrop running north-south through the middle of the cave (Figure 4). The beginning of a perforation is evident; there is also a second possible perforation just below the first. Only a few stone money disks in Yap are known to have dual perforations (Einzig 1966; Gilliland 1975), and this may represent another effort to complete one in a similar style. Gouge marks are absent indicating this disk had been already carved, removed from a flowstone deposit, and then placed semi-upright for the finishing stages of abrasion, polishing, and perforation.

The third unfinished stone money disk (feature 3) is situated 2 m east of feature 1. It initially appeared to be small in size and half-moon in shape, protruding only 30 cm above the surface. Because it was unknown whether this was the actual size and shape of the disk, a test unit was opened adjacent to its eastern face. This unit was excavated to a depth of 70 cm where it became evident the disk was larger than its surface size indicated. During excavation tidal water prevented further progress and so its full size has yet to be determined, although it is at least 0.8 x 0.6 x 0.2 m. A noticeable crack was probably the reason for its abandonment. Gouge marks ranging from 1–2 x 2–3.5 cm in size run vertically along the face; no perforation is evident. The similarities in gouge mark size between features 1 and 3 suggest that the same kind of tool may have been used to carve both disks, or at least one of comparable size and shape.

Figure 5. Feature 5 — Coral and rubble dock (photo by author).

A rock outcrop along the edge of a tidal pool on the eastern side of the cave is one of the more obvious limestone deposits quarried at the site. This feature (4) is part of the larger rock outcrop in the center of the cave. Examination of refuse in the pool directly below the wall revealed a large piece of limestone, possibly a disk preform, as well as limestone debitage and pottery suggesting that stone money was quarried from this outcrop and that the pool served as a disposal area.

A dock at the entrance of the cave extends out in a north/northeast direction. It is comprised of three main structural units built of coral and limestone rubble walls and infilled with limestone debitage and coral chunks. The dock is almost completely submerged at high tide and fully exposed at low tide and would have facilitated the loading of stone money onto watercraft (Figure 5). Surveys of another quarry on Orrak Island (Blaiyok 1993; Fitzpatrick 2000) located similar structures. One led down from a cave to the beach suggesting these features were used for transferring stone money from the site onto watercraft, or in negotiating watercraft closer to the quarries. Neither Yapese or Palauan oral traditions describe this architectural feature being used in the quarrying process. One Palauan informant stated that the dock at Omis was built by the Spanish, although this contradicts

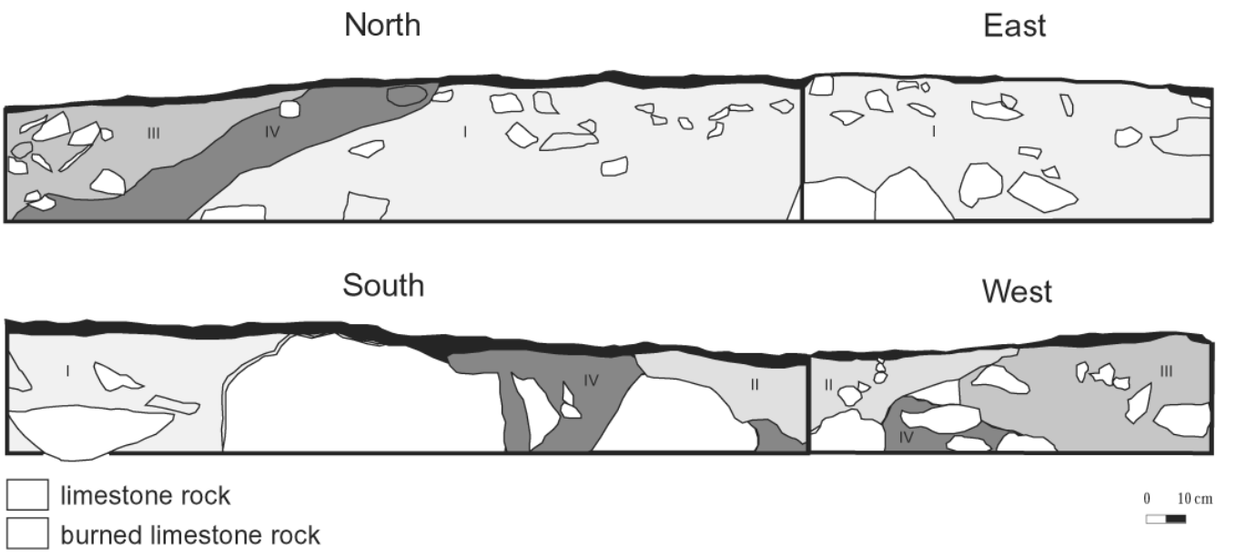

Figure 6. Stratigraphic profiles for Test Unit 1.

other oral histories about the site that describe it being used by the Yapese for quarrying or by Palauans during short visitations (Holyoak and Miko 2000).

A small retaining wall (feature 6) built of coral and limestone rubble is situated between two of the unfinished stone money disks (features 1 and 3) on the west side of the cave. Our preliminary surveys of other quarries have located various kinds of rock walls or mounds, usually in the vicinity of a stone money disk in the process of being removed from a flowstone deposit or in area of intensive quarrying. The rock wall at Omis was probably used for supporting disks during the final finishing stages. Its proximity to the two stone money disks suggests this was the case, although it may have also served the dual function of acting as a step for lifting disks up after completion.

Test Excavations

Test excavations were conducted to find evidence of habitation and stone money quarrying activities. Because there was little habitation refuse, but an abundance of limestone debitage on the surface, two of the three test units were placed along the western side of the cave near quarried limestone deposits. Test units were also in the vicinity of areas where habitation material would likely accumulate given the larger rock outcrops dominating the cave's surface. Excavation was done using trowels and soil wet-sieved through 1/8–inch screen to ensure good recovery of faunal remains. Cultural material recovered included limestone debitage, pottery, charcoal, bone, and shellfish.

A 1 x 2 m (TU1) excavation unit was placed 4 m east of the largest unfinished stone money disk (feature 1). This test unit was excavated to a depth of 40 cm and four stratigraphic deposits were recorded. Interestingly, these deposits were slightly sloping as if they had been mounded, probably due to the movement of soil and discarded limestone debitage during consecutive quarry episodes (Figure 6). The sediments were typically loamy sand with an abundance of calcareous inclusions, typical of nearly all sediments recorded at the site. A total of 1,858 pieces of limestone debitage (2.27/10 cm^3), 29 pottery sherds, shell, fish bone, and charcoal were recovered.

A 1 x 2 m excavation unit (TU2) was located five m south of test unit 1. This test unit was excavated to a depth of 60 cm where four stratigraphic deposits were recorded. A total of 3,599 pieces of limestone debitage (2.99/10 cm^3), 23 pottery sherds, five historic ceramic pieces, shell, fish bone, and charcoal were also recovered.

A smaller 1.0 x 0.6 m excavation unit (TU3) was placed adjacent to a buried piece of stone money (feature 3) to determine its size and shape. The unit was excavated to a depth of 70 cm and three stratigraphic deposits recorded, all of which were calacareous sand intermixed with dense limestone debitage. A total of 1,662 pieces of debitage (7.91/10 cm^3) were recovered along with charcoal, shell, mammal bone, and fish bone. No pottery was found.

Artifacts

Limestone Debitage. Because the use of carbonate flowstone as a raw material is not well documented in the Pacific this presented an obstacle for classification; not only for lack of references for comparison, but because this crystalline stone when flaked does not show the clear morphological characteristics typical of other rock

Figure 7. Limestone debitage specimens. Arrows indicate striking platforms and bulbs of percussion.

types like obsidian or basalt. Nevertheless, with careful observation it became apparent that standard lithic categories could be applied. Flake specimens were usually triangular in shape and had a rough bulb of percussion and striking platform (Figure 7). Specimens separated into 'chunks' did not exhibit these characteristics, although many had surfaces that were pecked or chipped. Because limestone is relatively crumbly, areas struck by a tool can easily be seen where crystals were crushed from a striking blow.

A total of 7,119 pieces of limestone debitage were collected during test excavations. Debitage was classified typologically by the presence of "cortex" (i.e., the exterior or skin of a dripstone or flowstone formation in which a fresh deposit of calcium carbonate comes into contact with the existing crystal structure of the solid, usually forming a smooth surface with no visible crystal terminations: Gonzalez and Lehmann 1988:84–86), and sorted into standard lithic categories of primary, secondary, and tertiary flakes or chunks. All specimens were then measured and average specimen weights taken from collection bags.

Of the total debitage assemblage 1,077 were primary, 398 secondary, and 5644 tertiary. In test unit 3 debitage was predominantly tertiary. The proximity of the stone money disk to Feature 1 and the rock wall, and its placement upright, makes it likely this area was used in the finishing stages of carving and abrasion for this and other disks. The sheer amount of debitage volumetrically in test unit 3 compared to units 1 and 2 (7.91/10 cm^3 versus 2.27 and 2.99, respectively) and average weight per specimen (TU1=61.9 g; TU2=91.8 g; TU3=60.8 g) suggest this area was used for completing stone money using smaller pieces of tertiary debitage from detailed carving as fill to support the disk.

Aragonite has typically been identified as the predominant mineral present in the Palau quarries (deBeauclair 1971; Einzig 1966; Bellwood 1979; Berg 1992; Descantes 1998; Kirch 2000), despite calcite being a far more commonly found type of carbonate rock. Debitage specimens from Omis were analyzed using petrography and X-Ray Diffraction (XRD) to determine the true mineralogy. Petrographic analysis of 15 specimens indicated they were calcite spars and little, if any, aragonite was present. XRD analysis also confirmed these results, substantiating the claim that calcite is the predominant material found at this quarry site (Fitzpatrick *et al.* n.d.).

Petrography indicated that the stone money disks and debitage found at Omis are composed of a medium grain crystalline structure that is easily manipulated. These crystalline structures also show bands of coralline algal growth. Analysis is currently underway to determine if these bands can be used to distinguish between stone money disks produced at different quarries. Accurately determining the provenience and ownership of stone money disks and quarry sites traced along ancestral lines could reveal differential access to resources (i.e., quarries) by certain clan groups and whether there were degrees of limestone quality that would suggest preference for quarrying.

Pottery. A total of 51 sherds (five rims), were recovered during excavation. Based on initial stylistic attributes none of these sherds appeared to be non-Palauan, correlating to Osborne's (1979:283) brief observations of surface finds. The majority of sherds have similar physical features including square rims, straight rim courses, and black hard cores. These features, distinct from Yapese Plain sherds, were also noted by Osborne (1979) and Intoh on Fais (1996:114) and Ngulu (1981:75) atolls.

Sherds were also collected from the surface (5), beach (6), pool (18), and lagoon (125). The 149 sherds col-

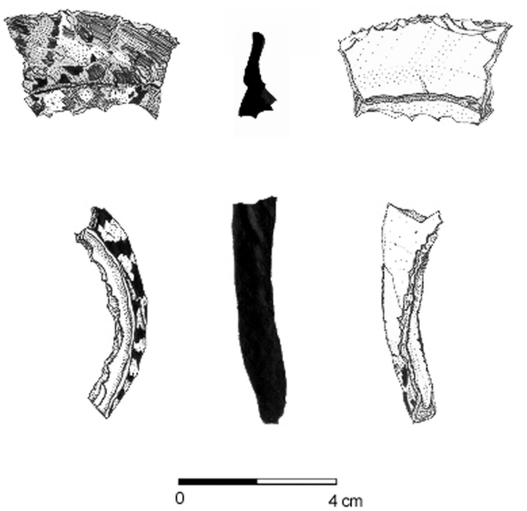

Figure 8. Trochus shell ring fragments (illustration by Jenna Boyle).

lected underwater are covered in thick calcareous cement so detailed typological analyses is not yet possible.

To help determine the composition and possible provenance of pottery, petrographic analysis of 28 sherds recovered from test unit 1 (6), test unit 2 (8), lagoon (5), beach (1), and the pool (8) was conducted by Dickinson (2000). Results indicate that tempers present in 16 of the sherds are dominantly grog with essentially no mineral constituents, similar to other Palauan grog tempers (Type A). Other grog tempers contain some rare sand grains and are probably natural temper in the clay paste from available regolith or colluviam (Type B). The remaining sherds (12) have composite tempers with the same grog as those in Type A and with sand grains similar to Type B. In most of the composite tempered sherds (7) the grog particles are abundant (Type C) whereas in Type D sherds (5) the grog particles are quite sparse and difficult to distinguish between weathered volcanic rock.

In general, it appears that all 28 sherds are made from local raw materials. Oral historical accounts collected from elders at Ngermid Village (Holyoak and Miko 2000) state that Palauans from the village would bring food to quarry workers at the cave, perhaps explaining why many of these sherds have Palauan characteristics. However, Dickinson (2000) notes that other collections of Palau sherds with non-grog temper contain volcanic sand temper of mafic (andesitic) character whereas the Omis Cave sherds have a quartzose detritus of apparently dacitic composition. This does not imply that Type D sherds are of foreign origin; it is only convenient to divide the tempers into Types A-D on an arbitary basis. The likelihood is that all four types form a related temper spectrum (Dickson 2000:3)

Shell. Two small fragments of a *Trochus* sp. shell ring preform were recovered from Test Unit 1 (layer 4). Pecking and grinding are evident on both pieces (Figure 8). This type of ornament is known ethnographically from Tobi Island (Intoh 1998:149–51), and was found in excavations by Osborne on Pelelieu (1979:45). A complete *Trochus* shell ring was recovered at the Chelechol ra Orrak stone money quarry site (Fitzpatrick 2000), only a few km away from Omis Cave. At this point it is unclear what role these ornaments may have played in societal relations between Yapese and Palauan groups, if any.

Faunal remains

Shell. Despite the fragmentary nature of shell in the assemblage, at least 53 discrete taxa from 31 different families of molluscs were identified. The major families represented are Cardiidae, Pectinidae, Tridacnidae, Tellinidae, Strombidae, and Trochidae. Tridacnidae (*Tridacna* sp. and *Hippopus hippopus*) is the most common, comprising over 80 % of the total weight, 56 % NISP, and 10 % of the MNI.

It is not entirely clear whether tridacnids are food remains or remnants of tool manufacture. Tridacnid adzes are quite common in Micronesia and, according to oral traditions, were said to have been used for quarrying stone money prior to the introduction of metal tools by Europeans (Gilliland 1975). Although no shell tools were found at Omis, the possibility that Tridacnid adzes or chisels were made at the site cannot be completely ruled out.

Osborne (1979:88) remarks that when Tridacnid shells are not wanted for tools, their meat is collected and the massive shells left on the reef. He also notes that *Hippopus h.* shells were not used for tools, although more recent data suggest otherwise, if only rarely (Moir 1986–87:106). Because the fragmentation of tridacnid remains is quite high (a weight of only 3.87 g per NISP), questions arise as to what the Tridacnid shells were actually used for since the shells did not need to be taken if nourishment was the intent for capture. We would expect the shells to be highly fragmented if tool manufacture was taking place. It is probable they were used in some utilitarian fashion for cooking, adze production, or collecting rainwater. But, given the small number of shell artifacts found in excavation and the high fragmentation of the assemblage, it is more likely that shellfish were collected for dietary purposes. I would argue that given the fragmentary nature of shellfish found at Omis Cave, that the assemblage was crushed during quarrying activities and from the movement of soil and debitage, thus making interpretation of tridacnid usage difficult.

Turtle. Nine fragments of hawksbill (*Eretmochelys imbricata*) turtle carapace were found in Test Unit 2 (0–20 cmbs). Hawksbill is prized for its meat and carapace for jewelry or utilitarian items, although these pieces show no evidence of modification.

Fish. Identified fish remains include Serranidae (grouper), Scaridae (parrotfish) and Labridae (wrasse), all reef fish commonly recovered from archaeological assemblages in Western Micronesia (Masse 1989). Further analysis is in progress.

Summary and Conclusions

The archaeological evidence suggests that Omis Cave was a major site for quarrying stone money disks and that peoples living here were taking advantage of local shellfish resources, especially giant clams. Architectural features constructed from limestone and coral rock demonstrate that quarry workers needed to devise methods for lifting and moving stone money to ensure their successful transport back to Yap.

Central to the investigation of Yapese stone money quarrying is determining the processes involved in the production of stone money and how Yapese carvers made use of the sites. Results from Omis Cave suggest the following:

1. Architectural features such as the dock and rock wall, although not described in oral traditions, would have aided quarry workers in lifting and moving disks out of the cave onto watercraft. These architectural features are also found at other quarry sites and were probably an important mechanism for ensuring that the breakage of disks was minimized and subsequent transport successful.

2. Contrary to previous statements about stone money mineralogical composition, XRD and petrographic analyses indicate that the material used in manufacturing stone money at Omis Cave is calcitic limestone, not aragonite or other rock types.

3. Limestone debitage served several functions. It was moved away from the central work areas for use as fill and to make room for more detailed carving and abrasion, and as a building medium to facilitate the transport of stone money disks out of the cave. This is substantiated by the great quantity of debitage found in test units and in architectural features such as the dock.

4. Pottery found within stratified deposits may represent evidence of interaction between Palauans and Yapese during the quarrying process. Petrographic analysis indicate that most, if not all sherds, were made from local Palauan raw materials and implies one or more of the following: Palauans and Yapese were interacting on a level yet unknown, perhaps with gifts of food contained in ceramic vessels; Yapese quarry workers were making pottery with Palauan clays and tempers; Early or contemporary Palauan pottery was intermixed into Yapese quarry deposits.

5. The predominance of Tridacnid shell in the faunal assemblage may indicate the importance this type of faunal material had for both subsistence and tool making.

The use of carbonate rock by indigenous groups in the Pacific is uncommon. Archaeological documentation of Yapese stone money quarrying adds to the list of raw materials used by Pacific Islanders and is a testament to their ingenuity of searching and traveling long distances for exotic resources. Stone money manufacture is also the only recorded example thus far of one Pacific Island culture traveling to another island group for limestone. All known sources suggest this exchange system was occurring before European contact making stone money the largest portable artifacts ever transported over open ocean prehistorically in Oceania.

Further research is needed to help develop a strong temporal framework for when stone money quarrying was taking place, the geographical distribution of quarries throughout the Palauan archipelago, the tools used in carving disks, and how European technologies and involvement transformed this unique exchange system. On-going analysis of material collected from two additional quarries at Metuker ra Bisech and Chelechol ra Orrak will surely expand on the information we now have about Yapese stone money quarrying in Palau in an effort to better understand Western Carolinian interaction spheres and exchange networks through time.

Acknowledgements

This project was supported by the Hawaii East-West Center for DCA staff training awarded to William S. Ayres (UO), an NSF dissertation research improvement grant (BCS-0001531) and a Sigma Xi Grant-in-Aid for Research for radiocarbon dating. I am especially indebted to the staff from the Palau Division of Cultural Affairs, the Palau Historical and Cultural Advisory Board, and Klobak er Ngermid (Chiefs of Ngermid) for their support and permission to work at the site. Rita Olsudong, Taurengel Emesiochel, Tamael Klouchelad, and Thomas Techur from the DCA put many long hours into site survey and excavation. Vicky Kanai and Dave Orak provided logistical and administrative support. Others, including Florencio Gibbons, Walt Metes, Melson Miko, and Lorne Holyoak also participated and helped during various portions of work at Omis Cave. I thank Dr. William Dickinson for conducting thin-section petrography on the pottery. Cliff Ambers (Department of Geological Sciences, University of Oregon) helped analyze the limestone samples using XRD and petrography. Bethany Watson and Cassidy deBaker spent a considerable amount of time working on this project in the field and lab. Molly Brown, Brian Diveley, Sally Jones, Bill McGivern, Jeremy Rae, Ryan Reeves, Kate Swanger, and Erika Zwarg also helped in processing artifacts and faunal material. Jenna Boyle illustrated the artifacts. Thanks goes to Jon Erlandson, Madonna Moss, Torben Rick, William Ayres, and John Craib for their comments on previous drafts of this paper. J. Peter White graciously worked with me on several issues that greatly improved this paper.

References

Alkire, W. H. 1980 Technical Knowledge and the Evolution of Political Systems in the Central and Western Caroline Islands of Micronesia. *Canadian Journal of Anthropology*: 229–237.

Ayres, W. S. 1998 Lithic Resources and Uses of Stone in Oceania. In *Easter Island in Pacific Context* (C. M. Stevenson, G. Lee, and F. J. Morin, eds.):277–78. Los Osos: Easter Island Foundation.

Baker, P. E. 1993 Archaeological Stone of Easter Island. *Geoarchaeology* 8:127–139.

Bellwood, P. 1979 *Man's Conquest of the Pacific*. Auckland: Collins.

Berg, M. L. 1992 Yapese Politics, Yapese Money, and the Sawei Tribute Network before World War I. *The Journal of Pacific History* 27:150–164.

Blaiyok, V. 1993 Archaeological Survey of Airai State, Republic of Palau. Manuscript in possession of the Division of Cultural Affairs, Koror, Palau.

Burley, D. V. 1993 Chiefly Perogatives Over Critical Resources: Archaeology, Oral Traditions, and Symbolic Landscapes in the Ha'apai Islands, Kingdom of Tonga. In *Culture and Environment: A Fragile Co-Existence* (S. Abonyia and N. Mirau, eds.):437–443. University of Calgary: Calgary.

Burley, D. V. 1998 Monumental Architecture and the Use of Stone in the Classical Tongan Chiefdom. In *Easter Island in Pacific Context* (C. M. Stevenson, G. Lee, and F. J. Morin, eds.):320–325. Los Osos: Easter Island Foundation.

Cheyne, A. 1852 *A Description of Islands in the Western Pacific Ocean North and South of the Equator: With Sailing Directions Together With Their Productions: Manners and Customs of the Natives and Vocabularies of their Various Languages*. London.

Clark, J. T. 1993 Prehistory of Alega, Tutuila Island, American Samoa: A Small Residential and Basalt-industrial Valley. *New Zealand Journal of Archaeology*. 15:67–86.

Clark, J. T. and E. Wright 1995 Volcanic Glass in Samoa: A Technological and Geochemical Study. *Journal of the Polynesian Society* 104:230–266.

de Beauclair, I. 1963 The Stone Money of Yap Island. *Bulletin of the Institute of Ethnology, Academia Sinica* 16:147–160.

de Beauclair, I. 1971 Studies on Botel Tobago, and Yap. In *Asian Folklore and Social Life Monographs* (Lou Tsu-k'uang, ed.):183–203. Taipei: Orient Cultural Service.

Descantes, C. H. 1998 Integrating Archaeology and Ethnohistory: The Development of Exchange Between Yap and Ulithi, Western Caroline Islands. Unpublished Ph.D. Dissertation. Eugene: University of Oregon.

Dickinson, W. R. 2000 Petrographic Report WRD-199: Temper Sands in Thin Sections of Pottery from Omis Cave on Palau. Manuscript in possession of author.

Einzig, P. 1966 *Primitive Money: In its Ethnological, Historical, and Economic Aspects*. Oxford: Pergamon Press (2nd edition).

Fitzpatrick, S. M. 2000 A Report on the 2000 Excavations at Chelechol ra Orrak and Metuker ra Bisech, Palau. Report submitted to the Division of Cultural Affairs, Koror, Republic of Palau.

Fitzpatrick, S. M., W. S. Ayres, and G. G. Goles. n.d. Mineralogical Determination of Lithics from Yapese Stone Money Quarries in Palau. Manuscript in possession of authors.

Gilliland, C. L. C. 1975 *The Stone Money of Yap: A Numismatic Survey*. Washington D.C.: Smithsonian Institution Press.

Gonzalez, L. A. and K. E. Lehmann 1988 Controls on Mineralogy and Composition of Spelean Carbonates: Carlsbad Cavern, New Mexico. In *Paleokarst* (N. P. James and P. W. Choquette, eds.):81–101. New York: Springer-Verlag.

Green, R. C. 1996 Prehistoric Transfers of Portable Items During the Lapita Horizon in Remote Oceania: A Review. *Indo-Pacific Prehistory Association Bulletin* 2:119–130.

Holyoak, L. and M. Miko 2000 Oral History of Omis Yapese Money Quarry, Ngermid Hamlet, Koror State, Republic of Palau. Report on file at Division of Cultural Affairs, Republic of Palau.

Intoh, M. 1981 Reconnaissance Archaeological Research on Ngulu Atoll in the Western Caroline Islands. *Asian Perspectives* 24:69–80.

Intoh, M. 1996 Multi-Regional Contacts of Prehistoric Fais Islanders in Micronesia. *Indo-Pacific Prehistory Association Bulletin* 15:111–117.

Intoh, M. 1998 The Catalogue of Prehistoric Micronesian Artifacts Housed in Japan. Micronesian Archaeological Survey Report 34. Division of Historic Preservation: Saipan, CNMI.

Kirch, P. V. 1990 Specialization and Exchange in the Lapita Complex of Oceania (1600–500 B.C.). *Asian Perspectives* 29:117–133.

Kirch, P. V. 2000 *On the Road of the Winds*. Berkeley: University of California Press.

Le Hunte, J. R. 1883 Report of HMS Espiegle to Sir G. W. Des Voeux, Acting High Commissioner for the Western Pacific, 10 October, 1883. *General Proceedings* (1–83). Central Archives of Fiji and the Western Pacific, Suva: Fiji.

Masse, W. B. 1989 The Archaeology and Ecology of Fishing in the Belau Islands, Micronesia. Unpublished Ph.D. dissertation. Carbondale: Southern Illinois University.

Masse, W. B., D. Snyder, and G. J. Gumerman 1984 Prehistoric and Historic Settlement in the Palau Islands, Micronesia. *New Zealand Journal of Archaeology* 6:107–127.

Müller, W. 1917 Yap 1. *Halbband in Ergebnisse der Suedsee Expedition, 1908–1910*. Hamburg: Herausgegeben von G. Thilenius.

Moir, B. G. 1986–87. A Review of Tridacnid Ecology and Some Possible Implications for Archaeological Research. *Asian Perspectives* 27:95–121.

Osborne, D. 1979 Archaeological Test Excavations in the Palau Islands, 1968–69. *Micronesica* Supplement 1.

Sand, C. and F. Valentin 1991. First results of the excavation of the burial mound of Petania, 'Uvea, Western Polynesia. *Indo-Pacific Prehistory Bulletin* 11:236–46.

Senfft, A. 1903 Ethnographische Beiträge über die Karolineninsel Yap. *Petermann's Mitteilungen,* 49:49–60; 83–87.

Smith, D. R. 1997 Recommendations for the Preservation of Historic and Cultural Resources in Palau. In *Micronesian Resources Study, Palau Ethnography Volume 2* (W. H. Adams, ed.). San Francisco: Micronesian Endowment for Historic Preservation and the U. S. National Park Service.

Tetens, A. and J. Kubary 1887 Die Carolineninsel Yap Oder Guap nach den Mittheilungen von A. F. Tetens und Johann Kubary. *Journal des Museum Godeffroy*. 1:84–130.

Weisler, M. 1990 Sources and Sourcing of Volcanic Glass in Hawai'i: Implications for Exchange Studies. *Archaeology in Oceania* 25:16–23.

Weisler, M. 1993 Provenance Studies of Polynesian Basalt Adze Material: A Review and Suggestions for Improving Regional Data Bases. *Asian Perspectives* 32:61–83.

Weisler, M. 1998 Hard Evidence for Prehistoric Interaction in Polynesia. *Current Anthropology* 39:521–532.

Weisler, M., P. V. Kirch, and J. M. Endicott 1994 The Mata'are Basalt Source: Implications for Prehistoric Interaction Studies in the Cook Islands. *Journal of the Polynesian Society.* 103:203–216.

White, J. P. 1996 Rocks in the Head: Thinking about the Distribution of Obsidian in Near Oceania. In *Oceanic Culture History: Essays in Honour of Roger Green* (J. Davidson, G. Irwin, F. Leach, A. Pawley, and D. Brown, eds.):199–209. New Zealand Journal of Archaeology.