Archaeological Excavations at the Si'utu Midden Site, Savai'i Island

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Abstract

This paper reports archaeological excavations at the Si'utu midden site on Savai'i Island, the Independent State of Samoa. The paper contains the result of the excavations including stratigraphy, findings, faunal remains, and radiocarbon dates. Although plain pottery has been obtained from the site, the radiocarbon results indicate the site belongs to the period after fourteenth century AD, the later part of Samoan prehistory. The stratigraphy of the site suggests rapid and drastic change of sea level in the prehistory of the Samoa Islands.

KEYWORDS: Plainware, Tafagamanu Sand, midden site, archaeology, Savai'i, Samoa.

Background

The accidental discovery in 1973 of an underwater archaeological site at Mulifanua on Upolu has raised questions about the prehistory of Samoa, particularly about Holocene sea-level change. Abundant prehistoric pottery-including decorated sherds by dentate stamping-has been recovered from sediments beneath the shallow lagoon at Mulifanua during dredging of a new berth for the Upolu-Savai'i ferry (Green 1974b; Leach and Green 1989). This dentate-stamped pottery is considered to have been made by the Lapita peoples, the first colonizers of the Samoan Islands. Recent radiocarbon dating has indicated the site dates to 2880-2750 cal. BP (Petchy 2001). No other Lapita site has ever been found on Upolu and Savai'i. Non-decorated pottery-Polynesian Plainware-has been found at several locations such as the sites of Vailele (Green 1969) and Sasoa'a (Green 1974a) on Upolu as well as the sites of Potusa and Falemoa on Manono (Lohse 1980:21-32). It is assumed that the pottery making tradition ceased around AD 300 on Upolu (Green 1974c), AD 400-500 on Tutuila (Addison et al. 2006), and AD 400-500 in Manua (Kirch and Hunt 1993: 231); however, the `Aoa site on Tutuila suggested the probability that the pottery tradition had survived until AD 1500 (Clark and Michlovic 1996). No prehistoric pottery has ever been found in any archaeological context on Savai'i, except for the 2002 and 2003 excavations of the Pulemelei mound complex site at Palauli (Martinsson-Wallin et al. 2003).

In 2001 we collected a piece of pottery at Si'utu village on Savai'i during a general survey of the island. We also recognized a well-stratified midden deposit at an eroded coastal ridge. We expected good archaeological potential for the deposit at this site.

The Si'utu midden site is located at the east end of the village of Sala'ilua on the southwest coast of Savai'i (see Figure 1).

The area is formed by a slight embayment. The site is situated on a raised beach front located on the side of an intermittent stream that separates the settlements of Sala'ilua and Si'utu. The principal midden site can be seen on the eroded beach front. The site was initially found by A. G. Buist in 1965 during the investigations of Bernice P. Bishop Museum, the Auckland Institute and Museum, and the University of Auckland (Buist 1969); however, archaeological excavation was not conducted.

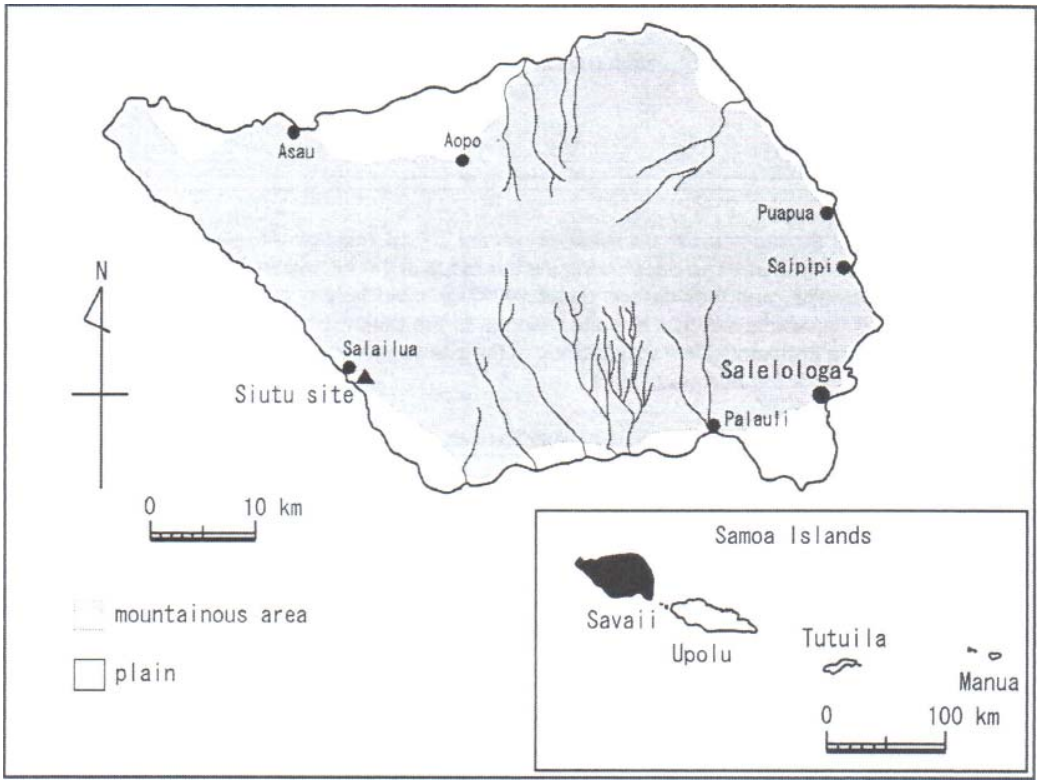

Figure 1: Map of Savai'i

Excavation

Archaeological excavations were carried out in two seasons in the period of September 2002 and October 2003. A plan view of the excavated area is shown in Figure 2.

Trench 1 (1 x 1 m) was set at an edge of the eroded beach ridge in 2002. Trench 2 (1 x 2 m) was placed near an abandoned house mound. The area is situated at the back of the settlement of Si'utu. The area is an open field with sparse vegetation and not used for agriculture at the time of our excavations. According to the villagers, although the area previously extended seaward, a part of the land was eroded by a cyclone in 1990. This suggests that part of the archaeological deposit has been lost.

All the excavated soils were dry sieved through one-quarter inch-mesh screens. All excavated materials (including pottery, stone tools, fish and animal bones, shells, and charcoals) were packed in plastic bags and taken to laboratories for analyses.

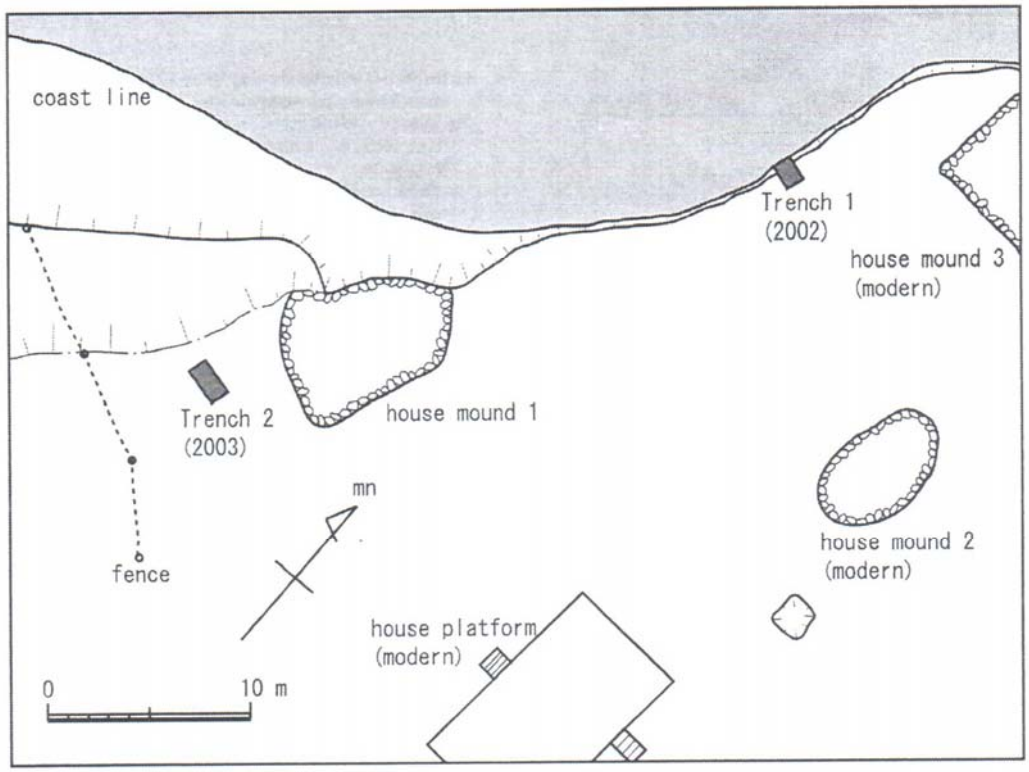

Figure 2: Plan of the Si'utu Site

Stratification

The stratigraphy of the site is shown in Figure 3

Both trenches had approximately the same stratigraphy. The first layers were top-soil and were likely to belong to recent time. Midden depositions that correspond to Layers 2a, 2b, and 2c in Trench 1 and ayers 2-6 in Trench 2 were positioned above the sand deposit of Layers 3a and 3b in Trench 1 and Layer 7 in Trench 2. The sand deposits consisted of fine coral sand. These deposits correspond to the so-called "Tafagamanu Sand" that is widely distributed throughout the Samoa Islands (Kear and Wood 1959). The layers below the sand were clay deposits of Layers 4-7 in Trench 1 and Layer 10 in Trench 2 containing abundant charcoals. The existence of the charcoals suggests some human activities such as cooking and/or slash-and-burn agriculture. The bottom deposits were archaeologically sterile clay layers without charcoal or midden materials.

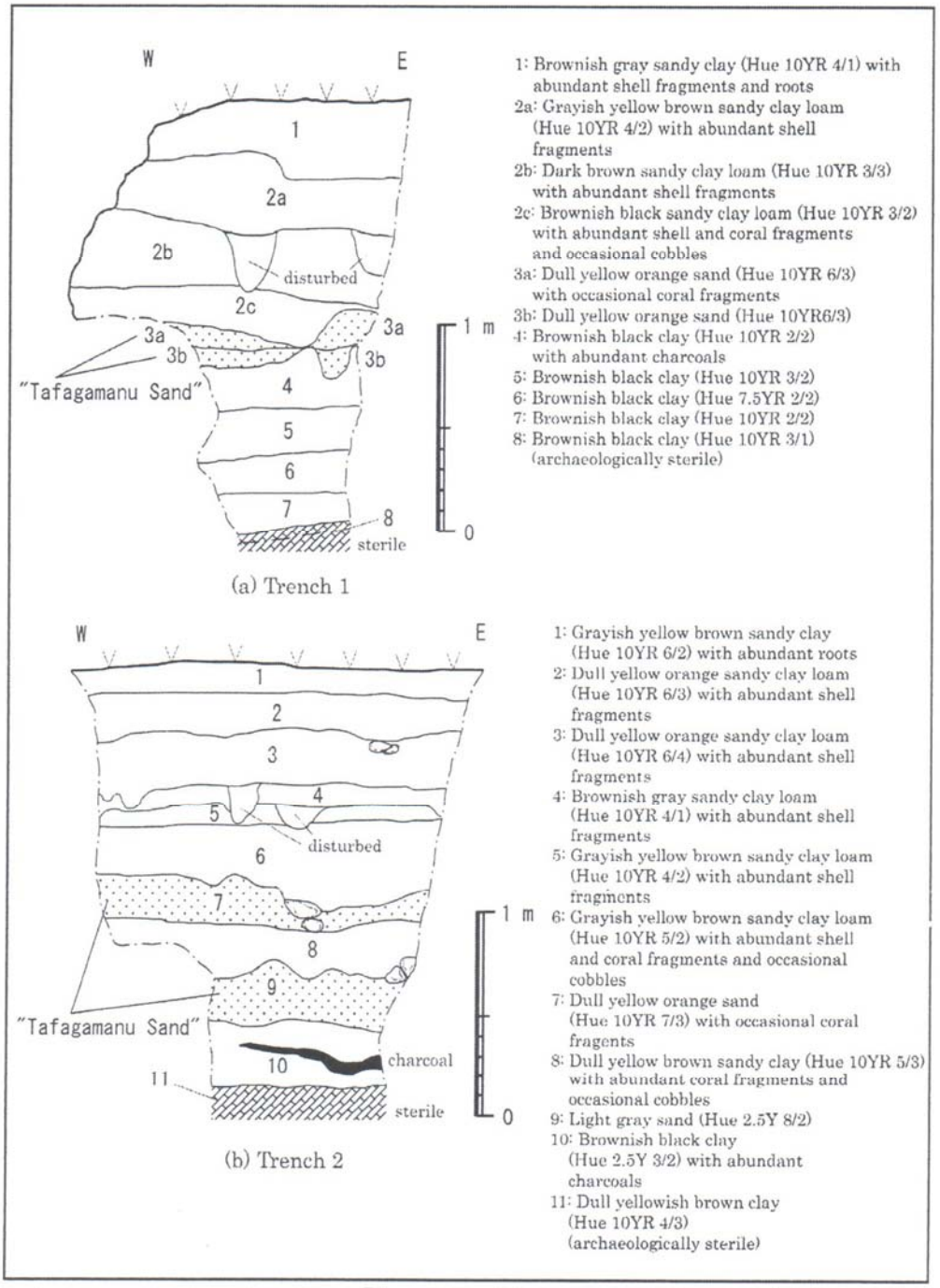

Figure 3: Stratigraphy

Material Culture

Pottery
Only two sherds were collected during the investigation (see Figure 4).

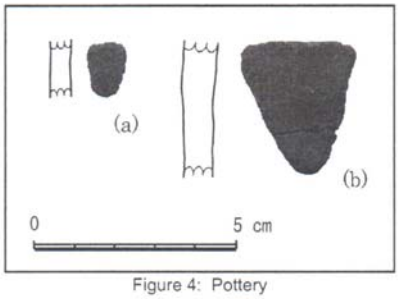

Figure 4: Pottery

Figure 4: Pottery

One small sherd (a) was found in archaeological context at Layer 6 in Trench 1. The colour is a dull reddish brown (Hue 2.5YR 4/3). The thickness is 5 mm. A second sherd (b) was obtained during the initial survey of the site in 2001. The colour is a bright reddish brown (Hue 2.5YR 5/8). The thickness is 8 mm. Both sherds have no decoration; which suggests that they may be classified as the Polynesian Plainware that dates back to the period between 500 BC and early in the Christian era (Green 1974c). This expected date contradicts the result of the radiocarbon dating discussed below.

Stone Tools
Two basalt adzes were obtained by surface collection (see Figure 5).

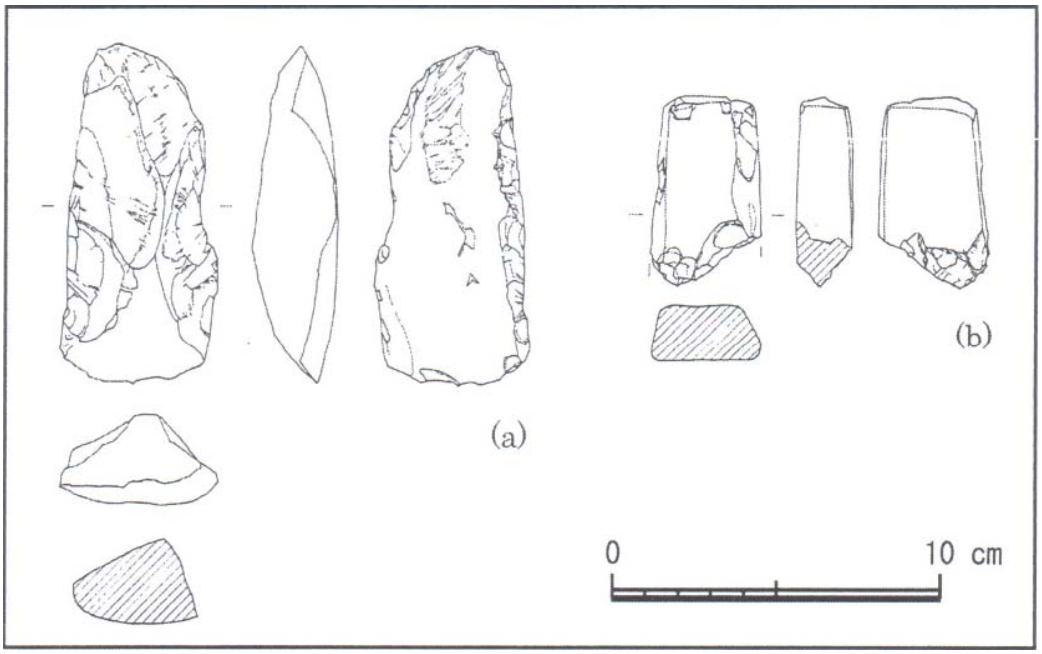

Figure 5: Adzes

One (a) is a complete adze made from relatively coarse basalt. The colour is a bluish black (Hue 5BG 2/1). The cross section is triangular. The edge and lower faces are partly ground. This adze is classified as Type VII in the typology of Green and Davidson (1969). The other (b) is a fully-ground adze fragment made from fine basalt. The colour is dark olive gray (Hue 2.5GY 4/1). The cross section is quadrangular. This adze is classified as Type Ill in the Green and Davidson typology.

Faunal Remains

Table 1 shows the inventory of identified faunal remains. The details of the remains by stratigraphic context are shown in Tables 2 and 3.

Non-shellfish **Remains (terrestrial and marine)**

A total of 242 bones were identified (Table 2). The majority (172) were fish bones, and of 70 bones other than fish, 66 were identified as terrestrial animal including pig, dog, chicken, and rat (pacific rat), and 4 were identified as turtle.

Inshore species such as parrot fish (Scaridae), emperor fish (Lethrinidae), and wrasse (Labridae) did not form a majority of the assemblage, an unusual finding compared to typical midden sites in the Pacific area (Butler 1988). It is likely that these results reflect the marine environment in front of the site, with its poorly developed coral reef. Grouper (Serranidae), that inhabits benthic water with a rocky environment, were present in relatively large numbers. Offshore species like bonito (Scombridae) and trevally (Carangidae) were also well represented, which suggests offshore fishing by angling and trolling. However, no fishhooks were obtained from the excavations. The remains of sharks and rays (Elasmobranchii) were unusually abundant, which leads to the interpretation that they were caught in order to compensate for the shortage of inshore species.

The majority of the terrestrial animal remains was pig *(Sus scrofa)* that is considered to have been a staple domestic animal for meat. Three fragments of human bone were found; they were not in situ and were likely mixed in the deposit from some disturbed burials (whose exact location remains unidentified).

A few crustacean remains were found. There were abundant urchin spines, especially in the bottom deposits of the midden layers (Layer 2c in Trench 1 and Layer 6 in Trench 2). It is not likely that the echinoderms were caught for food, since some of their remains were worn and water-rolled, implying that they were naturally deposited by waves. The exclusive concentration of the echinoderm in these layers suggests a drastic change of the coastal environment at that time.

Shellfish Remains

A total of 4,616 shellfish (11 kg) were identified (Table 3). Major catches of the site were turbo shell *(Marmarostoma argyrostoma),* sunguin clam *(Asaphis dichotoma),* and giant clam (Tridacnidae). These species are edible. It is assumed that they were major food resources. Other edible species were Trochidae, Neritidae, and Patellidae. Large Trochidae species such as *Trochus niloticus* are good food resources; however, they were few in quantity and the majority of the Trochidae specimens in the site was the smaller *Trochus maculates.* The rocky coastal environment around the site is not suited for trochus shells, since they like to live in shallow lagoon with coral sand. Neritidae and Patellidae are small shells. It is assumed that they were minor food resources but easily caught as snacks.

Although many *cowry* shells (Cypraeidae) were obtained, it *is* not likely that they were major food resources since some of them are toxic. Large cowry shell sometimes might be worked as a scraper (Jennings et al. 1976:71-73). However, we did not find any examples in our collection. It is also considered that a cowry shell might be used as a net sinker. However, we assume that most of them in the midden were discarded as rubbishes. Conidae, Muricidae, Cerithiidae, and other minor species are also inedible. It is likely that they were deposited as rubbish or naturally accumulated in the midden by waves and winds.

A characteristic of the shell midden was that there were few bivalves compared to other typical midden sites of the Pacific area (Nagaoka 1988). The typical species in the midden sites are *Anadara antiquata* and *Gafrarium tumidum.* However, they were absent or few in the Si'utu midden site. The environment around the site is not suited for these shells; their normal habitat is shallow water with a

Table 1: Taxa of faunal remains from the Si'utu excavations

Fissurellidae	Bradybaenidae	Scombridae
Patellidae	*Trishoplita spp.*	*Katsuwonus pelamis*
Acmaeidae		Scorpaenidae
Trochidae	Mytilidae	Serranidae
Trochus maculatus	*Septifer virgatus*	
Trochus niloticus	Limidae	Elasmobranchii
Turbinidae	Ostreidae	
Marmarostoma argyrostoma	Crassatellidae	Cheloniidae
Astralium stellare	*Crassatellites nanus*	
Neritidae	Carditidae	Phasianidae
Theliostyla alb/cilia	*Cardita leana*	*Gallus gallus*
Ritena plicate	Veneridae	
Littorinidae	*Gafrarium tumidum*	Muridae
Siliquariidae	Mactridae	*Ratus exulans*
Siliquaria anguina	Chamidae	Canidae
Planaxidae	Tridacnidae	Canis *familiaris*
Planaxis su/catus	*Tridacna maxima*	Suidae
Potamididae	Tridacna chametrachea	Sus scrofa
Cerithiidae	Cardiidae	Hominidae
Clypeomorus spp.	*Vasticardium flavum*	Homo *sapiens*
Stombidae	Veneridae	
Lamellariidae	*Periglypta puerpera*	
Lamellidae pusila	Asaphidae	
Cypaeidae	Asaphis *dichotoma*	
Cymatiidae	Tellinidae	
Bursidae	*Quidnipagus pa/atam*	
Muricidae		
Drupa spp.	Pleocyemata	
Turbinellidae		
Vasum ceramicum	Echinoidae	
Marginellidae		
Persicula persicula	Elasmobranchii	
Buccinidae		
Pollia spp.	Acanthridae	
Fasciolariidae	Balistidae	
Mitridae	Carangidae	
Conidae	Coryphaenidae	
Turridae	Diodontidae	
Terebridae	Holocentridae	
Atycidae	Labridae	
Atys naucum	Lethrinidae	
Ellobiidae	Monotaxis grandocuris	
Cassidula plecotrematoides	Lutjanidae	
Melampus nuxcastanea	Mullidae	
	Scaridae	

Table 2: Details of non-shellfish remains identified from the Si'utu excavations

Trench 1	1	2a	2b	2c	3a	3b	4	5	6	7	Sum (NISP)
Fish											
Acanthridae	1	3	1		1						6
Balistidae											0
Carangidae	1	2									3
Coryphaenidae	1										1
Diodontidae	8	6		3							17
Elasmobranchii		10	5	3			1	1	1	2	23
Holocentridae											0
Labridae	1	1		1			1				4
Lethrinidae					1				1		2
Monotaxis grandocuris											0
Lutjanidae	2	1									3
Mullidae											0
Scaridae	1	2		2	1		1			1	8
Scombridae		3	4				1	1			9
Scorpaenidae											0
Serranidae	4		4	1			1				10
Sum (NISP)	19	28	14	10	3	0	5	2	2	3	86
Non-vertebrate											
Crustacean	6	2	2								10
Echinoderm		4	2	114	38	3	14	8	4	1	188
Terrestrial animal											
Sus scrofa	11	7	3	1							22
Canis familiaris											0
Gallus gallus			1								1
Ratus exulans											0
Homo sapiens		2									2
Turtles										2	2

Trench 2	1	2	3	4	5	6	7	8	9	10	Sum (NISP)
Fish											
Acanthridae				1	1			1			3
Balistidae				1	1	1					3
Carangidae								1	1		2
Coryphaenidae											0
Diodontidae			1		1	4	2				8
Elasmobranchii			1	5		6	4		1		17
Holocentridae			1	2		6	2		1		12
Labridae			1				1				2
Lethrinidae			1		1						2
Monotaxis grandocuris			1								1
Lutjanidae			1	1		2		2		1	7
Mullidae			1								1
Scaridae		1	2	1	1			1		1	7
Scombridae		3		2		1	1		4		11
Scorpaenidae						1					1
Serranidae		1	1	2		2		1	1	1	9
Sum (NISP)		5	11	15	5	23	10	6	8	3	86
Non-vertebrate											
Crustacean				1							1
Echinoderm		1	22	17	22	224	57	56	61	11	471
Terrestrial animal											
Sus scrofa		2	21	6	3	1		1		1	35
Canis familiaris			1								1
Gallus gallus					2						2
Ratus exulans					2						2
Homo sapiens						1					1
Turtles						1		1			2

Table 3: Details of shells identified from the Si'utu excavations

Trench 1	Layer 1		Layer 2a		Layer 2b		Layer 2c		Layer 3a		Layer 3b		Layer 4		Layer 5		Layer 6		Layer 7		Sum	
	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)
Marmarostoma argyrostoma	198	707.6	56	272.2	58	303.3	135	453.7	62	151.6	5	18.9	23	55.5	10	29.5	6	13.9	28	25.1	581	2031.3
Cypraeidae	99	327.4	37	127.7	38	121.9	105	177.2	53	43.1	6	4.5	24	19.0	11	9.6	8	5.8	23	13.5	404	849.7
Trochidae	36	182.9	29	62.2	11	16.1	37	93.4	8	6.3	1	0.5	5	8.1	2	2.8					129	372.3
Conidae	27	81.5	13	19.0	9	33.1	15	35.3	5	5.5	3	4.8	3	8.0	1	2.5			2	2.4	78	192.1
Neritidae	167	179.4	54	73.7	20	32.8	30	26.2	7	3.9			8	6.3	1	0.5			1	0.9	288	323.7
Patellidae	67	40.9	60	37.6	27	22.8	17	9.3													171	110.6
Muricidae	16	23.7	14	30.1	2	4.2	11	11.4	5	3.5							1	0.6			49	73.5
Cerithiidae	9	8.1	2	1.1			1	2.5	9	4.1			3	1.3	3	1.0			1	1.0	28	19.1
Other gastropods	16	14.4	9	46.7	5	10.2	8	13.6	12	7.9	6	1.2	6	6.0	1	1.3	1	0.4			64	101.7
Asaphis dichotoma	144	196.5	61	117.0	24	61.7	35	69.5	12	9.6	3	3.7	12	10.8	2	0.9	3	3.1	2	1.2	298	474.0
Tridacnidae	19	184.8	3	48.5	12	132.5	25	336.0	9	98.1	3	41.1	3	43.3	3	16.5	3	63.9	12	75.7	92	1040.4
Other bivalves	16	16.5	20	7.2	3	2.2	28	22.2	6	47.5	8	1.8	13	3.9	4	21.2	3	0.6	3	0.9	104	124.0
Sum	814	1963.7	358	843.0	209	740.8	447	1250.3	188	381.1	35	76.5	100	162.2	38	85.8	25	88.3	72	120.7	2286	5712.4

Trench 2	Layer 1		Layer 2		Layer 3		Layer 4		Layer 5		Layer 6		Layer 7		Layer 8		Layer 9		Layer 10		Sum	
	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)	NISP	W (g)
Marmarostoma argyrostoma			45	192.7	171	795.0	55	288.0	57	165.5	100	289.0	43	133.6	112	300.9	28	70.7	25	66.7	636	2302.1
Cypraeidae			12	15.7	64	243.6	51	81.6	29	28.6	109	108.1	56	74.9	49	38.3	12	8.4	16	9.9	398	609.1
Trochidae			6	27.2	60	132.5	28	34.6	4	6.5	14	27.8	12	15.0	30	33.4	9	10.6			163	287.6
Conidae			1	1.9	11	28.9	4	7.0	3	3.0	18	37.1	5	12.0	10	31.2					52	121.1
Neritidae			19	16.6	60	93.2	16	20.5	4	3.5	12	7.2	5	2.7	11	7.3	1	0.1	2	2.2	130	153.3
Patellidae			16	7.9	34	21.5	29	6.4	1	0.5	16	5.8	12	3.5	9	3.3	8	1.8	4	0.7	129	51.4
Muricidae			1	1.9	13	25.3	7	7.1	8	8.1	16	21.4	7	6.0	4	2.5			2	1.0	58	73.3
Cerithiidae					6	5.1	4	2.9	1	0.5			11	5.3	9	6.3	3	2.5	2	1.2	36	23.8
Other gastropods					11	18.9	8	16.8	8	26.9	21	16.7	11	8.1	16	38.8	11	13.5	4	2.0	90	141.7
Asaphis dichotoma			55	58.6	209	282.1	68	69.5	12	6.5	27	23.9	9	7.7	15	12.7	9	4.8	3	3.6	407	469.4
Tridacnidae					15	271.8	6	60.3	5	152.5	11	68.4	5	103.8	16	190.0	2	23.8	1	54.7	61	925.3
Other bivalves			1	0.4	31	18.4	10	3.6	22	13.5	43	72.2	16	12.9	22	69.2	23	8.7	2	0.7	170	199.6
Sum			156	322.9	685	1936.3	286	598.3	154	415.6	387	677.6	192	385.5	303	733.9	106	144.9	61	142.7	2330	5357.7

sandy bottom or with vegetation of sea plants. Meanwhile, turbo shell and giant clam inhabit a rocky coastal environment. The midden content dominated by them reflects the surrounding environment of the site. The potential molluscan food resources of the place have been scarce because of the narrow reef flat. We estimate that the site was not a favourable place for coastal foragers like the Lapita peoples that targeted places with well-developed reef flats for their settlement.

Dating

Two radiocarbon dates were obtained from Trench 2 (see Table 4).

Table 4: Radiocarbon dates from the Si'utu excavations (Stuiver and Reimer 2005. Ages calibrated using CALIB REV 5.0, 1 sigma range given (68% probability)

Trench	Layer	Laboratory number	Sample material	813C (‰)	Conventional radiocarbon age (years BP)	Calibrated age (cal yr BP) (68% probability)	Calender age (68% probability)
2	9	IAAA-42464	Charcoal	-21.87	650±40	683-651 (82.7%) 581-570 (17.3%)	AD 1267-1299 (82.7%) AD 1369-1380 (17.3%)
2	10	IAAA-42465	Charcoal	-22.69	650±60	684-633 (60.7%) 597-561 (39.3%)	AD 1266-1317 (60.7%) AD 1353-1389 (39.3%)

The first date (IAAA-42464) came from the lower part of the sand deposit (Layer 9). The second date (IAAA-42465) was from the concentration of charcoal in the clay deposit (Layer 10) that corresponds to Layers 4-7 in Trench 1. Both samples indicated the dates around 14th century AD, and they were approximately contemporary. There are possibilities that the Layers 9 and 10 had been formed in a short period, or the sample of Layer 9 has been mixed out of the original deposition of Layer 10.

The dates indicate that the site belongs to the late prehistoric period in Samoa. However, the result contradicts the expected age of plainware pottery. The possibility of sampling errors is not likely, because the charcoal samples are secure from the error of delta R and the two dates do not contradict the stratigraphy. Therefore, we prefer the interpretation that the pottery from the clay layer was not in situ, and that is from secondary deposition.

Discussion

Although some plainware pottery was found at the Si'utu midden site, the radiocarbon dating indicates that the date of the deposit is after 14th century AD. The archaeological excavations suggest that the sherd from the clay deposit (Layer 6) in Trench 1 was not in situ. No sherds were found from the relevant clay deposit (Layer 10) in Trench 2. This evidence leads to the conclusion that the pottery is from secondary deposition, and the existence of the pottery does not imply a great antiquity of the site.

The radiocarbon date of Layer 9 in Trench 2 implies the age of the Tafagamanu Sand (Kear and Wood 1959). The strip of coral sand is widely distributed throughout the coasts of Savai'i and Upolu at approximately 1.5 m above the present sea level. It is considered that the depositions are the trace of a geologically recent 1.5 m high stand of the sea. The 1.5 m raised shoreline is common throughout the Pacific and elsewhere in the world, and is the result of a post-Glacial sea-level rise

accompanying a phase of warmer climate. Previous radiocarbon dating of the samples collected from the sediments shows dates between AD 200 and AD 1200 (Grant-Taylor and Rafter 1962). The Si'utu date of AD 1267-1380 is slightly younger but approximately corresponds to the previous results.

The date also corresponds to the "AD 1300 event" (Nunn 2000). Nunn suggests that the sea level in the Pacific region abruptly fell by 1.5-2.0 m around the 14th century AD. This was associated with a-1.5° C fall in temperature associated with the transition between the Little Climatic Optimum and the Little Ice Age. The sea level before AD 1300 was estimated to be 1.5-2.0 m higher than today's. Therefore, the sand deposition of the Si'utu site is estimated to have been formed in the end of the age of higher sea level.

The evidence of the Tafagamanu Sand contradicts the hypothesis of the islands' subsidence by Dickinson and Green (1998). They have presented the model of hydro-isostacy in order to explain the submerged situation of the Mulifanua Lapita site. An eruption leads to volcano-loading superimposed on the island and results in a deformation of the underlying mantle. In response, the island subsides in order to redress a balance. Continual volcanism on Upolu and Savai'i during the Holocene has led to a continuous subsidence of the islands. Dickinson and Green (1998) have estimated the subsidence rate at 1.4 mm per year, using data from cores in mangrove swamps on the south coast of Upolu (Bloom 1980), which implies the subsidence of a former coastline on the Mulifanua site by ca. 4 m. This model assumes regular subsidence of the islands and continual raising of the sea level, which means the relative sea level of the past has been lower than today's. The model does not account the existence of the Tafagamanu Sand as an evidence of the higher sea level of the past, since the model overlooks the global fluctuation of sea level. The effect of the sea-level change is critical as well in the Samoa Islands, and we assume the sea level around the 14th century AD was higher than today's. The mechanism of the sea-level change is pluralistic, with combination of the local change of tectonics and the global fluctuation of sea level. Therefore, we should anticipate a complicated picture for understanding the sea-level change and the site formation processes in Samoa.

The clay deposits containing charcoal were formed around the 14th century AD, just before the formation of the Tafagamanu Sand. It is likely that the deposits were formed in a situation of a mangrove swamp. The level of the deposits is 50 cm above the present sea level. This suggests that the deposits were formed underwater in the raised sea level of the 14th century AD. The low density of midden contents accords with this assumption. This means the location was not used for human activities. It is assumed that the charcoal came out of an upper land or was originated from carbonized woods in the mangrove. It is probable that the pottery sherd at Layer 6 in Trench 2 came from a certain original pottery-bearing deposit, somewhere inland of the excavation. Given that the original pottery-bearing deposit existed below the clay layers, it may be positioned below the present sea level. It is possible that potential pottery sites have been positioned below the sea level due to the island's subsidence in Samoa. Future studies will focus on the relationship between sea-level change and site formation processes.

Acknowledgements

We would like to thank Professor Le'apai Lau Asofou So'o (Director of the Centre for Samoan Studies, National University of Samoa), Mr Akira Nara and Mr Mitsuhiko Toho (former advisors to the Vice Chancellor, National University of Samoa) for helping our research. Our thanks should also go to the family of Fa'amomoi and IUlai at Si'utu for their great help and hospitality. The research was funded by the Japan Society for the Promotion of Science and the Takanashi Foundation (Japan).

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