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Prehistoric Settlement in the Upland Portions of the Island of Hawai'i

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ABSTRACT

Recent archaeological research in the upper elevations of Hawai'i Island suggests that the area may have been intensively utilised by prehistoric Hawaiians for procuring natural resources scarce at lower elevations. Adzes from the Mauna Kea Adze Quarry Complex and birds and possibly plant products from the saddle region may have been regularly redistributed in lowland areas during prehistory. Radiocarbon annual frequency distribution diagrams suggest that most prehistoric activities peaked around A.D. 1400, although use of the upland region probably continued into the nineteenth century.

Keywords: HAWAI'I ISLAND, AVIFAUNA, ADZE MANUFACTURING, REDISTRIBUTION, POHAKULOA TRAINING AREA, LAVA TUBES, QUARRIES.

INTRODUCTION

The saddle region of the "Big Island" of Hawai'i has not until recently been considered a significant area for investigating prehistoric Hawaiian lifeways. Recent archaeological research suggests that data from sites in the saddle may throw light on prehistoric cultural processes which occurred throughout the Hawaiian archipelago, particularly those concerned with traditional land tenure, settlement patterns, natural resource procurement, and the development of class stratified society.

The saddle region represents a truly marginal area to which traditional Hawaiian agricultural systems could not be adapted. Therefore, prehistoric activities in the region probably required considerable labour investment by agricultural communities living nearer the coast.

This investment could have been prompted by several factors. The natural resources available in the saddle may have been so vital to prehistoric Hawaiian society that the benefits derived from their procurement outweighed the costs. Alternatively, specific resources may have been so abundant in the saddle that the high costs in travel and transport were outweighed. Finally, the agricultural core areas may have achieved a sufficient level of surplus production so that labour could be invested in procuring the saddle resources. These resources would then have been available for redistribution within the agricultural core areas, supporting processes of social rank intensification.

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ENVIRONMENTAL SETTING

The saddle region is an area between about 4,200 and 8,200 ft (*c.* 1,300–2,500 m) above sea level, bounded by the volcanoes Mauna Kea, Mauna Loa, and Hualalai. Median annual rainfall in most of the area is around 20 in. (500 mm), with slightly more towards the east. The relatively arid conditions are somewhat mitigated in the lower elevations by moisture from cloud cover during most of the year. Average day time temperatures range between 50 and 70° F according to elevation, with night time lows often falling to 30–40° F. Frequent sudden thunderstorms and high winds are common throughout the year.

Vegetation cover within the saddle varies considerably, but generally conforms to the type and age of the volcanic substrata. The northern portion of the saddle towards the base of Mauna Kea is covered in sparse grass and shrubs. The central portion contains recent unvegetated *a'a* and *pahoehoe* lava flows with dispersed *'ohi'a* (*Metrosideros*) forest and numerous *kipuka* (remnant geomorphological land forms encircled by later lava flows). The *kipuka* are covered in high shrub and dryland forest in which *naio-mamane* (*Sophora-Myoporum*) forest and various other native Hawaiian species predominate. Introduced, non-native plant species generally increase towards lower elevations.

Much of the saddle area was suitable habitat for a large number of native Hawaiian bird species before the historic introduction of feral and other mammals (house mouse, dog, goat, cat, sheep, pig, and mongoose), and non-native and game birds (chukar, francolin, turkey, cardinal, pigeon, etc.). It is remarkable that the most abundant bird species present in the archaeological assemblages, the Hawaiian *'u'au* or dark-rumped petrel (*Pterodroma phaeopygia*), is now totally absent from the area.

ARCHAEOLOGICAL BACKGROUND

Research topics in the saddle have included the investigation of traditional Hawaiian land tenure systems, primarily the *ahupua'a* and the district. The development of these land tenure units has been seen as related to the evolution of class stratification in prehistoric Hawaiian society (e.g., Cordy 1981; Hommon 1976; Kirch 1985). Hommon (1976) has postulated that territorial units approximating the *ahupua'a* did not develop until some time after A.D. 1400. The saddle region has been assigned to a particular district (Hamakua) on the basis of known traditional trail systems in the region (e.g., Cordy in prep.; Hommon and Ahlo 1983; McEldowney 1982) and interpretation of oral traditional accounts associated with the Ahu a 'Umi site complex near Hualalai volcano (Hammatt and Shideler 1991). There is evidence that resource procurers from throughout Hawai'i Island probably used the saddle region (e.g., Haun 1986; Athens and Kaschko 1989).

Until recently, it was predicted that archaeological sites in the saddle were very sparse and probably occurred only in narrow corridors paralleling prehistoric trail systems (Hommon and Ahlo 1983; Rosendahl 1977). However, a relatively large number of archaeological sites have now been identified, mostly in areas not containing recognisable interdistrict prehistoric trails (e.g., Athens and Kaschko 1989; Haun 1986; Streck 1985b, 1986a, 1986b, 1990b).

Investigations of traditional Hawaiian resource procurement within the saddle have concentrated on the pre-modern avifauna. It is immediately obvious to even a casual observer that there were once immense numbers of nesting seabirds, particularly the Hawaiian petrel. Virtually every lava tube and sinkhole (cultural and noncultural), particularly in the western portion of the saddle, contains great numbers of bird bones.

Avifaunal exploitation has been interpreted as both for food (including provisioning craftsmen at the Mauna Kea Adze Quarry Complex (Hommon and Ahlo 1983) and collection of petrel chicks, a high status food item) and for feathers from passerine forest species (Athens and Kaschko 1989; Athens *et al.*). Feather adornments, including helmets, capes and cloaks, god images, *kahili* (flywhisks or fans), and *lei* (garlands) were important symbols of rank and status in traditional Hawaiian society. This exploitation is thought to have occurred quite late in Hawaiian prehistory (after about A.D. 1400–1500), perhaps as a response to the evolution of class stratified societies in coastal areas. Little attention has so far been given to identifying other (particularly plant) resources which may have been exploited in the saddle. Some oral historical evidence suggests that sandalwood and other woods in the region may have been sought by Hawaiian craftsmen for canoe manufacturing.

Compliance with United States Federal historic preservation legislation has provided the impetus for archaeological investigations in the saddle region, particularly at the U. S. Army Pohakuloa Training Area (PTA). Although more than 20 archaeological reports have been compiled, most have been from fairly low intensity reconnaissance surveys (e.g., Rosendahl and Rosendahl 1986; Streck 1985a, 1990a, 1990b). Over 50 archaeological sites have been identified at PTA. With the exception of prehistoric and early historic trail systems, a few isolated cairns or *ahu*, one and possibly two low stacked platforms, one surface lithic scatter, and late nineteenth century basalt cattle walls, the archaeological remains are situated in lava tube caves or lava blister caves. None appear to represent permanent long-term habitation. The two most intensively studied regions in the saddle are the Bobcat Trail Habitation Cave (BTHC) *kipuka* and the Alala *kipuka* (vicinity of the Multi-Purpose Range Complex or MPRC) in the southwestern portion of PTA.

The results of the BTHC investigation (Haun 1986; Rosendahl 1983) included identification of the Hawaiian petrel as a desired traditional Hawaiian resource, and suggestions on the reuse of the site on a seasonal basis (probably corresponding to petrel nesting) over a long period of time (600–700 years), the potential for nuclear or extended family use of the site, and the possibility that activities traditionally associated with females were carried out.

The *kipuka* Alala archaeological investigations included the identification of 16 sites through intensive survey of 1,800 acres (730 ha) for the proposed MPRC (Athens and Kaschko 1989). Two probable functional classes of prehistoric sites were identified, one reflecting single or short term use and the other longer or repeated use), and it was suggested that exploitation of nesting petrels may have been the prime traditional Hawaiian use of the entire saddle area, although an argument was also presented for the exploitation of passerine species for their plumage (based on negative evidence). The researchers postulated that there was an apparent "surge" in prehistoric Hawaiian activity in the saddle between A.D. 1400 and 1450, which declined dramatically after A.D. 1500–1540, possibly because of depletion of forest bird species.

Archaeological data recovery at eight of the archaeological sites at the MPRC was performed in 1990 (F. Reinman and R. Schilz pers. comm.). Preliminary results from this investigation, including age determinations, suggest that several of the sites initially interpreted as single or short term occupations may have been reused, tools may have been made opportunistically from local basalt sources, and a wider range of local forest products than previously considered may have been exploited.

The Ahu a 'Umi site complex, situated on a volcanic ash plain near Hualalai volcano, represents the only major surface structural complex within the saddle region. This complex features in Hawai'i Island oral traditions as the location of political centralisation during prehistory. Investigations at the site complex suggest that it may not have been used until after A.D. 1500 (Watanabe 1986).

Although not within the saddle, the middle and upper slopes of Mauna Kea and the Mauna Kea Adze Quarry Complex are important in interpreting prehistoric activities in the saddle region (McCoy 1984, 1985, 1986). The Mauna Kea Adze Quarry Complex is a monumental site including over 500 features spread over several square miles of upper Mauna Kea. The adze quarry has dominated all research taking place within the saddle.

This brief summary of archaeological research in the upper elevations of Hawai'i Island shows that a number of topics germane to the interpretation of traditional Hawaiian culture are being addressed. If information from this marginal region is to contribute to the understanding of archipelagic-wide social processes during prehistory, it is essential to place this information within a temporal framework. Therefore, annual frequency distribution diagrams were produced for radiocarbon dates from both the saddle and Mauna Kea using the technique described by Dye and Komori (this volume).

DESCRIPTION OF RADIOCARBON SAMPLES

Sixty-seven age determinations from 25 archaeological sites in the Pohakuloa Training Area were available (Appendix 1). Two determinations from the vicinity of Ahu a 'Umi were also considered. Twenty-three age determinations from archaeological sites on Mauna Kea were included for comparison. Ten are from three shelter sites in the Mauna Kea Adze Quarry Complex while the remainder are from five shelter/workshop areas along the volcano's middle slopes.

The archaeological sites in the saddle were separated into two categories: repeatedly used lava tubes containing recognisable structural modifications (terraces, walls, cleared areas, cupboards, etc.), multiple functional features (fireplaces/hearths, stratified cultural deposits, etc.), a range of artefactual remains, and midden; and restricted use lava tubes, including those representing a single use (often one fireplace on a bare lava tube floor), merely a surface scatter of midden or other cultural remains, and/or a single or double component cultural deposit. These two types are found in close proximity in the saddle region.

The samples were derived either from discrete cultural features (hearths, fireplaces or surface scatters) containing wood charcoal, or from stratified cultural deposits. Sampling bias should be minimal within this assemblage. Few of the samples represent attempts to date only the initial occupation at a particular site. Rather, most sampling in the saddle has been oriented towards determining the entire temporal range of human activity.

The dates were segregated into four types on the basis of geographic location and probable prehistoric intensity of use. These types include lava tube sites in the saddle which appear to have been repeatedly used (30 samples); lava tube sites in the saddle which appear to have been utilised once or a restricted number of times (30 samples); the Mauna Kea middle slope workshops/shelters associated with lithic tool manufacture (13 samples); and features within the Mauna Kea Adze Quarry Complex (10 samples). Nine samples from one natural and one culturally anomalous site were not considered.

RESULTS

The annual frequency distributions suggest that prehistoric cultural activity in the uplands of Hawai'i Island may have been most intense from A.D. 1400 to 1450. The curves derived from samples from the Mauna Kea Adze Quarry Complex and the middle slopes workshops differ slightly in that the workshop curve appears strongly unimodal with a sharp peak around A.D. 1425 (Fig. 1). There appears to have been relatively infrequent use of the middle slopes before this time. The adze quarry curve suggests more intensive use over a longer period. The most intensive use seems to have occurred around A.D. 1440, with significant use between A.D. 1300 and 1650. Prehistoric Hawaiian use of Mauna Kea covers a maximum of around 700 years until the nineteenth century.

The maximum span for prehistoric cultural activities within the saddle is several hundred years longer than at Mauna Kea (Fig. 2). The region may have been used for over 1,000 years (A.D. 775 to the nineteenth century). Comparison of the curves for repeated use and restricted use lava tube sites shows some divergence. The repeated use sites may have been intensively utilised from the late A.D. 1200s until the modern era. Although use seems to peak around A.D. 1425, there are also minor peaks around A.D. 1000 or before, and less variation in intensity during the entire prehistoric period than at all other types of sites.

The restricted use lava tube sites also show strong evidence of maximum cultural usage in the early A.D. 1400s. The main differences in intensity of use between the repeated and restricted use sites are before A.D. 1430, when the restricted use sites appear to have been used more sporadically. After A.D. 1430, patterns of site use among the saddle region lava tubes are virtually indistinguishable, although the intensity of use at the restricted use sites appears to have been much less.

In summary, annual frequency distribution curves for radiocarbon dates from the four prehistoric Hawaiian site types exhibit a high degree of similarity, particularly for the period from around A.D. 1400 until the 1800s. Prehistoric cultural use of the entire high elevation region of Hawai'i Island increased abruptly in intensity around A.D. 1200 and peaked in the first half of the A.D. 1400s. Sharp declines occurred around A.D. 1500, and again in the early A.D. 1600s. Most of the site types illustrate a minor resurgence in intensity of use in the second half of the A.D. 1700s (possibly associated with cultural change in traditional Hawaiian society culminating in the ascendancy of Kamehameha I).

INTERPRETATION

Similarities and differences in the curves for radiocarbon dates from different site types may reflect cultural processes occurring in the saddle region of Hawai'i. The repeated use lava tube sites in the saddle may have been used as shelters by extended family groups exercising traditional exploitation rights in the region. All of the saddle lava tube sites are associated with great numbers of bird bones (presumably representing only a small fraction of the total nesting population). This seems to suggest that exploitation of the avifauna was at a sustainable level so as not to deplete the resource. The early exploitation of the avifauna indicates that this was a desirable resource before late prehistoric and early historic times when such resources were conspicuous symbols of status and rank. The Hawaiian petrel, bones from which constitute the bulk of the avifaunal sample, appears to have been actively exploited in the saddle region during the A.D. 1500s and possibly up to the time of Western contact in A.D. 1790. Although quantitative data are limited, there are indications that bones from passerine birds may increase in frequency in midden assemblages dating after A.D. 1400. This suggests that the class stratification system which used feathers from these species in insignia of rank was in existence during this period. This conforms with postulated archipelagic prehistoric social processes (Kirch 1988).

Exploitation of birds and other as yet unidentified regional resources in the saddle may have started by the A.D. 700s. Because of the long distance from traditional population

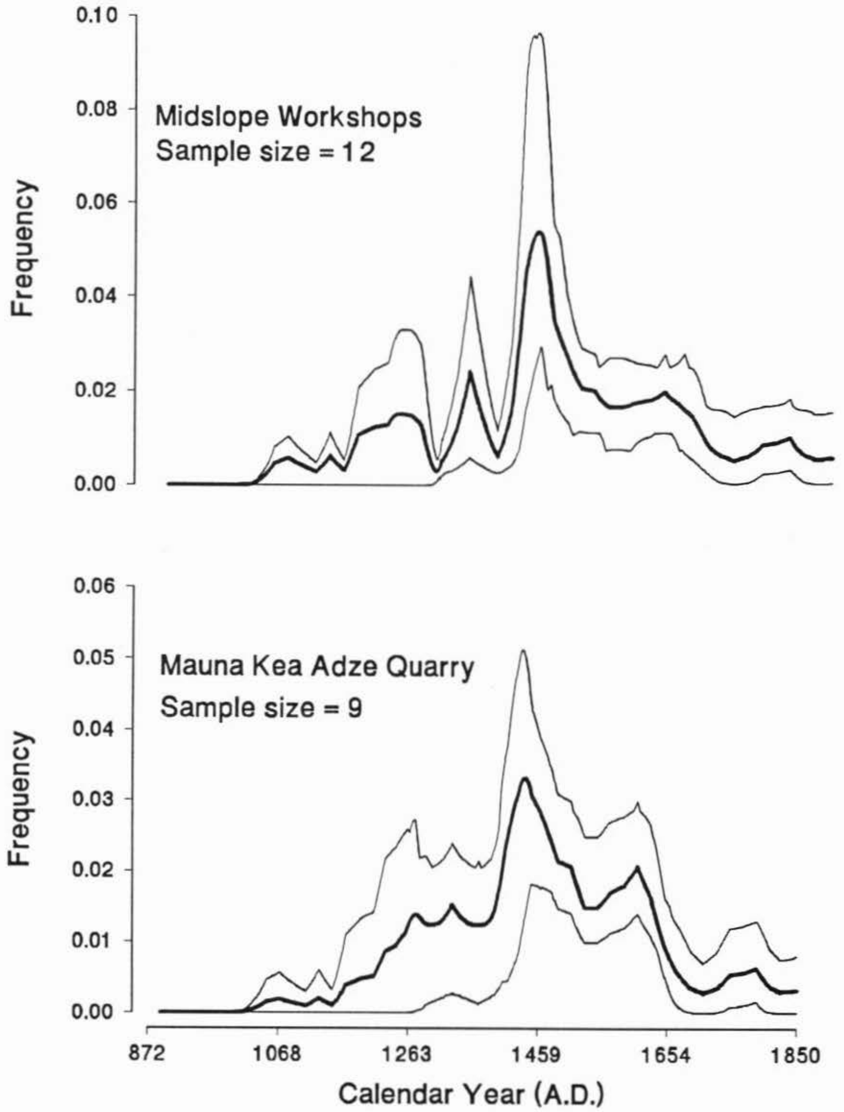

Figure 1: Annual frequency distributions for radiocarbon dates from Mauna Kea midslope workshops (upper) and Mauna Kea Adze Quarry Complex (lower).

centres on the coast, the rough terrain, inclement weather, and unadaptibility of traditional Hawaiian subsistence technologies to the saddle, visitors would have had to carry in most of their foodstuffs as well other items needed for lengthy stays in the area. This would have been particularly necessary if extended family units occupied known archaeological sites on a seasonal basis. Therefore, the resources, particularly birds, which were being procured must have been considered worth this considerable labour investment from an early period.

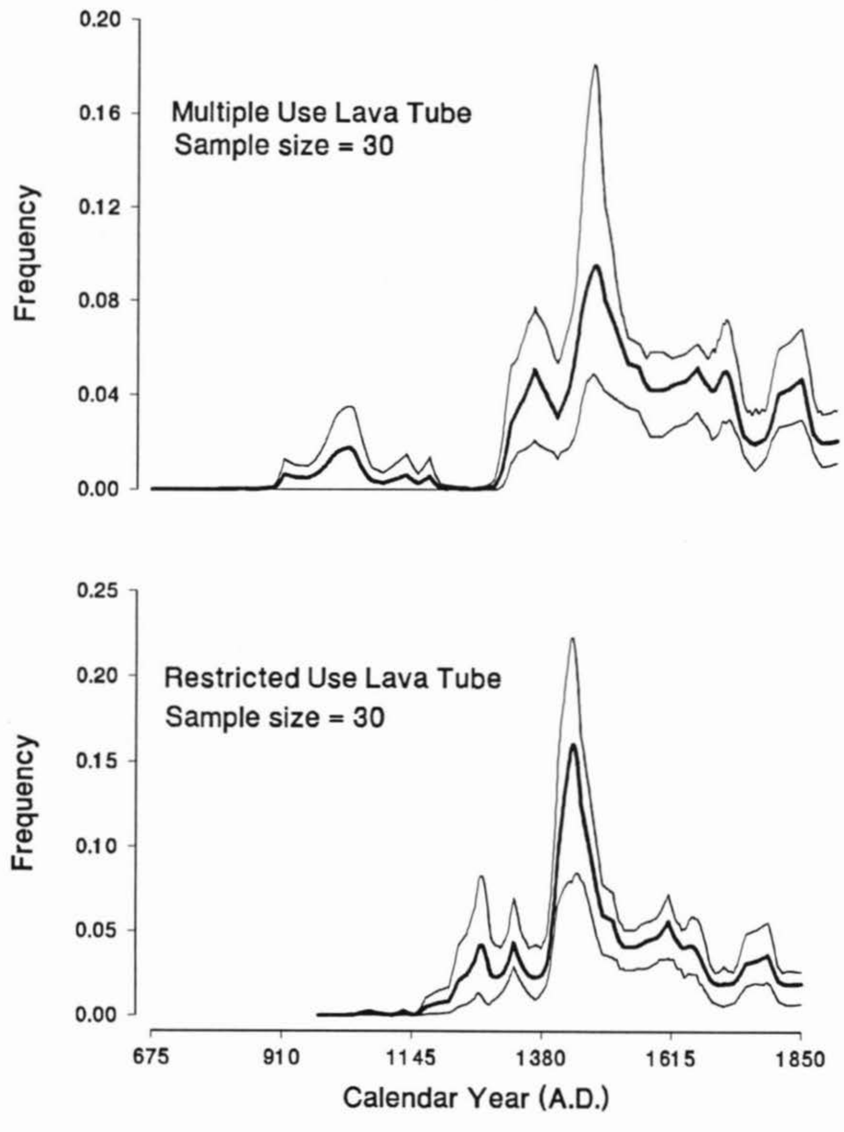

Figure 2: Annual frequency distributions for radiocarbon dates from lava tube sites in the saddle region of Hawai'i Island.

If, as it appears, the Hawaiian petrel was the most exploited bird species in the saddle, it is not surprising that labour was invested in its procurement at an early date. It is a ground nesting seabird which is extremely susceptible to human and animal predation and activities. It is likely that nesting areas near the coast had been disturbed quite early (before A.D. 1000). During most of Hawaiian prehistory, major nesting areas would have survived only in areas with slight human impact, such as the saddle region of Hawai'i Island.

Several possible explanations can be suggested for the relatively abrupt decrease in intensity of cultural use of the saddle lava tube sites around A.D. 1500 and in the 1600s. Over-exploitation may have depleted the resource. Social demand for the resources of the region may have lessened or there may have been fewer exploiters in the area. This could have been due to diversion of manpower to other activities in the populous coastal areas, or to a decline in the attractiveness of the saddle resources or the development of restrictive redistribution systems for them in the agricultural core areas. The focus of exploitation in the saddle may have changed from subsistence goods to resources restricted to high status members of Hawaiian society. Concomitantly, traditional Hawaiian land tenure units may have been formalised around this time. This would have restricted access by people who did not live in the district or land tenure unit to which the saddle was assigned.

The available radiocarbon dates suggest that the main prehistoric use of the Mauna Kea Adze Quarry Complex was during a relatively short period of around 300 years. This covers the period when the development of class stratified societies and the formalisation of traditional land tenure systems are thought to have occurred. It also includes, towards the recent end, the oral historically recorded battles associated with the sons of 'Umi a Liloa in the vicinity of Ahu a 'Umi (Hammatt and Shideler 1991). The apparent abrupt lessening in intensity of use of high altitude sites in the early A.D. 1600s may coincide with this battle and resultant changes within traditional Hawaiian social organisation. The battle may have been part of a "package" of social processes resulting in the formalisation of land tenure systems in the saddle region.

The radiocarbon annual frequency distributions derived from saddle region archaeological sites do not differ greatly from chronologies for other areas of the Hawaiian Islands. The value of this analysis, however, is to suggest that the restricted resource base in the saddle (stone tools, birds, and possibly various woods) assists interpretation of the development of class stratification and other social processes in the lower elevation core agricultural areas. As the body of cultural data from the saddle sites grows, its potential to contribute to wider interpretations of Hawaiian prehistory will also increase.

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APPENDIX 1
RADIOCARBON DETERMINATIONS
SADDLE REGION, HAWAI'I ISLAND, HAWAII

Lab Number	Archaeological Site	CRA	SD	$\delta^{13}C$	Provenance	Source
LAVA TUBE SITES, RESTRICTED USE						
Beta-16895	Judd Trail Shelter 1	430	90	-27.93	Hearth	WA
Beta-42899	PTA-5003	30	50	-23.4	TP2, L.II	W
Beta-42900	PTA-5003	210	50	-23.5	TP2. L.IV	W
Beta-42901	PTA-5003	150	60	-23.4	TP2, L.V	W
Beta-13094	PTA-10220	400	65	-26.27	Hearth	S
Beta-13563	PTA-10222	370	80	-27.26	Deposit	S
Beta-13564	PTA-10222	350	90	-23.29	Hearth	S
Beta-16434	PTA-10272	430	60	-26.49	Hearth	S
Beta-24596	PTA-10644	440	80	-24.6	Hearth	AK
Beta-44435	PTA-10644	270	50	-25.9	-	RS
Beta-24592	PTA-10645	150	60	-25.8	Charcoal Con.	AK
Beta-24595	PTA-10646	480	50	-24.7	Hearth, F.A	AK
Beta-26594	PTA-10646	510	60	-27.0	Hearth, F.D	AK
Beta-44436	PTA-10646	480	60	-24.2	-	RS
Beta-44437	PTA-10646	470	50	-23.6	-	RS
Beta-24597	PTA-10647	450	140	-24.8	Hearth	AK
Beta-24598	PTA-10648	370	50	-26.0	Poss. Hearth	AK
Beta-24590	PTA-10649	290	60	-25.4	F.B Hearth	AK
Beta-24591	PTA-10650	770	60	-23.1	F.B Hearth	AK
Beta-26592	PTA-10650	220	70	-26.2	F.E Hearth	AK
Beta-24599	PTA-10651	430	50	-26.4	Charcoal Con.	AK
Beta-26595	PTA-10652	520	50	-27.1	Charcoal Con.	AK
Beta-24600	PTA-10652	440	60	-23.3	Charcoal Con.	AK
Beta-43881	PTA-10652	570	60	-24.5	N4/E2-3, F.C	RS
Beta-24601	PTA-10653	160	50	-26.7	Charcoal Con.	AK
Beta-24602	PTA-10654	440	50	-26.0	Charcoal Con.	AK
Beta-43882	PTA-10654	720	60	-25.1	N9/E6	RS
Beta-44438	PTA-10654	200	50	-25.0	-	RS
Beta-24603	PTA-10655	250	50	-25.0	Hearth	AK
Beta-43883	PTA-10655	720	70	-24.9	N1/W2, L.II	RS
LAVA TUBE SITES, MULTIPLE USE						
Beta-16896	Waikulukulu Shelter	210	60	-25.51	Hearth	WA
Beta-15230	PTA-5004	560	80	-17.28	E.Tube, Hearth	H
Beta-15231	PTA-5004	190	50	-24.18	E.Tube, TU-3	H
Beta-15232	PTA-5004	650	60	-25.3	E.Tube, TU-3	H
Beta-15233	PTA-5004	10	60	-23.48	Ter. 1, TU-7	H
Beta-15234	PTA-5004	160	60	-23.18	Ter. 4, TU-8	H
Beta-15235	PTA-5004	160	80	-23.26	Ter. 4, TU-8	H
Beta-16402	PTA-5004, T-101	320	50	-22.58	F.B-3, TU-10	H
Beta-16403	PTA-5004, T-102	540	60	-22.45	F.D	H
Beta-16404	PTA-5004, T-107	190	60	-24.32	TU-6	H
Beta-16405	PTA-5004, T-107	370	50	-26.83	TU-6	H
Beta-13561	PTA-10221	1040	60	-27.28	Hearth 2	S

Beta-13562	PTA-10221	1000	60	-27.75	Hearth 3	S
Beta-16432	PTA-10269	240	50	-23.73	F.A, Hearth	S
Beta-16433	PTA-10269	330	70	-24.38	F.B, Hearth	S
Beta-24593	PTA-10269	190	50	-25.4	F.B, Hearth	AK
Beta-26593	PTA-10269	410	60	-25.1	L.3	AK
Beta-24594	PTA-10269	560	70	-24.2	L.5	AK
Beta-43880	PTA-10269	420	60	-25.2	N4/E7, Surf.	RS
Beta-44430	PTA-10269	220	50	-24.8	N4/E7, L.I	RS
Beta-44431	PTA-10269	350	50	-24.1	N4/E7, L.II	RS
Beta-44432	PTA-10269	610	50	-24.6	N4/E7, L.III	RS
Beta-44433	PTA-10269	430	50	-25.1	N4/E7, L.IV	RS
Beta-44434	PTA-10269	510	50	-24.5	N4/E7, L.V	RS
Beta-24606	PTA-10656	470	50	-26.1	TP-1	AK
Beta-24607	PTA-10656	500	70	-27.1	TP-2, L.2	AK
Beta-44439	PTA-10656	260	50	-24.8	-	RS
Beta-44440	PTA-10656	410	60	-24.9	-	RS
Beta-44441	PTA-10656	210	60	-24.7	-	RS
Beta-44442	PTA-10656	340	50	-23.5	-	RS
OTHER SADDLE REGION SITES						
Beta-24604	PTA-10657	130	50	-27.1	Hearth	AK
Beta-24605	PTA-10657	920	60	-24.8	TP-1, L.2	AK
Beta-43884	PTA-10657	190	50	-25.9	F.J, L.II	RS
Beta-44443	PTA-10657	220	50	-23.2	-	RS
Beta-44444	PTA-10657	100.7%[1]	0.6%	-23.9	-	RS
Beta-44445	PTA-10657	100	50	-25.5	-	RS
Beta-44446	PTA-10657	100	60	-24.6	-	RS
Beta-44447	PTA-10657	70	50	-25.0	-	RS
Beta-31831	PTA-Noncultural	2890	80	-25.0	L.2	S
MAUNA KEA MIDSLOPES WORKSHOPS						
Beta-15644	Hopukani Springs	840	60	-22.34	7C/8C,L.II	M
Beta-15647	Hopukani Rockshelter	290	80	-20.87	M24, L.II/III	M
Beta-15648	Hopukani Rockshelter	250	70	-26.21	M24, L.V	M
Beta-15645	Hopukani Rockshelter	810	60	-22.82	M28, L.II	M
Beta-16400	Hopukani Rockshelter	520	60	-22.15	M28, L.III	M
Beta-16401	Hopukani Rockshelter	520	60	-23.37	M28, L.IV	M
Beta-15646	Hopukani Rockshelter	470	60	-24.92	M28, L.V	M
Beta-15649	Liloe Spring	500	90	-25.23	Workshop 1	M
I-9742	Waikahalulu Shelter	430	75	-25.0†	C4, III, F.1	M
W-4538	Waikahalulu Shelter	370	60	-25.0†	D4, V, F.3	M
Beta-23417	Pu'u Kalepeamoa	100.2%[1]	0.9%	-24.3	H8,II	M
Beta-23418	Pu'u Kalepeamoa	250	70	-24.9	H8,II	M
Beta-26377	Pu'u Kalepeamoa	120	50	-25.8	II	M
MAUNA KEA ADZE QUARRY (all Carbon-14 Determinations)						
I-9128	Ko'oko'olau Shelter	355	80	-25.0†	B2, IV, F.1	M
I-9743	Ko'oko'olau Shelter	470	75	-25.0†	B3, VI, F.3	M
I-9744	Ko'oko'olau Shelter	775	80	-25.0†	B3-4, VIII,F.4	M
I-9070	'Ua'u Shelter	190	80	-25.0†	C5, II, F.2	M
I-9069	'Ua'u Shelter	490	80	-25.0†	B5, IV, F.3	M
I-9071	'Ua'u Shelter	425	80	-25.0†	G5, VI/3	M
I-9072	'Ua'u Shelter	355	165	-25.0†	E5, VIII	M

I-9929	'Ua'u Shelter	655	80	-25.0†	E5, VIII,F.15	M
I-9741	Ahinahina Shelter	345	75	-25.0†	C3, II, F.2	M
W-4539	Ahinahina Shelter	<200	-	-25.0†	Surface	M

Sample material is unidentified wood charcoal in all cases
Note [1]. These values quoted are percent Modern

Status of delta 13C values:
-25.0† = assumed but not verified that value was estimated

Sources:
- AK Athens and Kaschko 1989
- H Haun 1986
- M McCoy, 1984, 1985, 1986
- RS Reinman and Schilz pers. comm.
- S Streck, 1985b, 1986a, 1986b
- WA Watanabe 1986
- W Welch 1991