

200)
R 290
no. 79-1700

U.S. Geological Survey

Reports-Open file Series

TM
an
Twana/

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

OPEN FILE REPORT

USGS LIBRARY-RESTON



RADIOCARBON DATES FROM THE
HAWAIIAN ISLANDS--
A COMPILATION

By

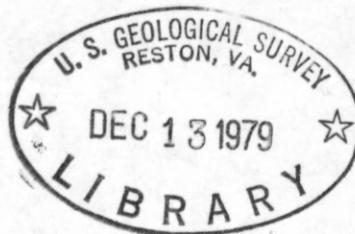
M. LEA KELLEY

A listing of all published radiocarbon dates plus a bibliography.

This report is preliminary and has
not been edited or reviewed for
conformity with Geological Survey
standards or nomenclature.

OF NO. 79-1700

301764



Contents

	Page
Introduction.....	1
Sample descriptions.....	3
I. Hawaii.....	3
A. Geologic - volcanic.....	3
Mauna Loa.....	3
Kilauea.....	11
Mauna Kea.....	15
Hualalai.....	18
B. Archaeological.....	18
II. Oahu.....	20
A. Geologic.....	20
1. Volcanic.....	20
2. Sea level.....	21
B. Archaeological.....	27
III. Maui.....	29
A. Geologic.....	29
1. Volcanic - Haleakala.....	29
2. Sea level.....	30
B. Archaeologic.....	30
IV. Kauai.....	30
A. Geologic - sea level.....	30
B. Archaeologic.....	31
V. Molokai.....	31
A. Geologic - sea level.....	31
B. Archaeologic.....	31
VI. Nihoa - archaeologic.....	31
VII. Necker - archaeologic.....	31
List of laboratories.....	32
References cited.....	34

Introduction

Radiocarbon dating has proved to be a useful tool for the correlation of events and their timing during the Quaternary. In the Hawaiian Islands, the application of this technique is providing a chronology of the geologic history that will serve as a framework for studies of volcanologic and related hazards, sea-level changes, paleomagnetism, and paleobotany. Many ^{14}C dates have also been determined for archaeological studies on the Islands.

During the last 3 years, the U.S. Geological Survey (USGS) radiocarbon laboratory at Reston, VA, has determined more than 100 ^{14}C dates from carbonized roots and other plant material collected from beneath prehistoric lava flows and ash deposits from Mauna Loa and Kilauea volcanoes. Prior to 1976, only 10 flows from these volcanoes had been dated by radiocarbon methods. Collection of dateable material has been facilitated by an improved understanding of the conditions of charcoal formation and preservation beneath basaltic lavas (Lockwood and Lipman, 1979).

The purpose of this report is to gather all published Hawaiian radiocarbon dates, except geochemical dates, together in order to spare those working on the geologic and archaeological history of the Islands the time and energy necessary to recover these dates from their various sources, as well as to prevent duplication of effort in the field and laboratory. A few unpublished dates from the Reston laboratory are also included. The listing and bibliography are as complete as possible. The U.S. Geological Survey library was used as the primary source of information.

The dates are divided by island, and, within island groups, by category of interest. Within each category, dates are listed chronologically from youngest to oldest. The letter before the lab number tells what lab ran the sample. The list of laboratories gives the addresses.

Sample descriptions

Age* (Lab No.)	Description and location
I. Hawaii	
A. Geologic-volcanic	
Mauna Loa (ML)	
<200 (W-4198)	Charcoal fragments along basal aa, at edge of Manuka flow, resting on pumice blanket from Hapaimanu, N end of prominent kipuka, NW of Pohakuloa, alt 1481m, Papa quad (Kelley <u>et al.</u> , 1979).
<200 (W-3843)	Charcoal root fragments from Pahala Ash, below pahoehoe flow of Kipuka Maunaiu, at head of gully, along contact with Keomoku flow, alt 1050m, Ohaika Rd, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
220 ± 60 (W-4186)	Charcoal, beneath thin pahoehoe toes at contact with old Mauna Kea aa around small kipuka, "Red Leg Trail," 5km SSE of Pohakuloa cabins, alt 1914m, Puu Koli quad (Kelley <u>et al.</u> , 1979).
230 ± 60 (W-3871)	Charcoal roots in ash below Keomoku aa flow, from roadcuts in Kipuka Ki, alt 1281m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
290 ± 70 (W-4006)	Charcoal roots in Pahala ash, underlying Kipuka Maunaiu flow, Ohaika Rd, alt 1095m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
300 ± 60 (W-4183)	Charcoal, SW margin of prominent red pahoehoe kipuka on W margin of Kau 1880 flow, alt 2550m, Kipuka Pakekake quad (Kelley <u>et al.</u> , 1979).
300 ± 50 (W-4175)	Charcoal underlying dark grey aa, overlain by 1880 lavas, Kulani-Mauna Loa Observatory Rd, alt 2292m, Puu Ulaula quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
330 ± 70 (W-4238)	Charcoal root fragments in olivine-rich pahoehoe, alt 689m, Puu O Lukana, Kahuku Ranch quad. Cone grew in two stages with sampled pahoehoe flow resting on weathered and vegetated first-stage cone. Sample dates late stage of old picrite activity that is widespread low on rift zone in Kahuku area. Coll and subm by P. W. Lipman, USGS, Denver, CO.
420 ± 70 (W-4049)	Vitreous charcoal from Keomoku flow, upper "K1" unit as mapped on Peterson (1967), underlying thin outlier of aa, alt 1498m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979). Possibly dates later forest fire (J. P. Lockwood, written commun., 1979).
420 ± 70 (W-3790)	Charcoal from thin soil, developed on old spatter, underlying Kulani Picrite, on high-standing dry hillock, Kulani quad (Kelley <u>et al.</u> , 1979).
450 ± 60 (W-3793)	Charcoal from water-saturated spatter underlying 2m of Kulani Picrite, Kulani quad (Kelley <u>et al.</u> , 1979).
490 ± 80 (W-4234)	Charcoal fragments in dirt and ash adjacent to flow margin, underlying aa containing small phenocrysts of plagioclase and olivine, alt 829m, Akihi, Kahuku Ranch quad. Sample dates major relatively old eruptive activity from vents at 2440m level on SW rift. Coll and subm by P. W. Lipman, USGS, Denver, CO.
530 ± 60 (W-3880)	Organic debris and sooty soil directly underlying ropy pahoehoe, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
580 ± 80 (W-4118)	Charcoal from younger phase of "KKL" unit of Keomoku Flow, as mapped by Peterson (1967), alt 2079m, Puu Ulaula quad (Kelley <u>et al.</u> , 1979).
590 ± 70 (W-3898)	Charcoal from pocket of baked ash, underlying very young pre-caldera aa flow, alt 2428m, Ainapo Trail, Mauna Loa quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
600 ± 250 (W-1047)	Charcoal fragments in sandy ash, top of Pahala Ash, just below black sandy ash, Kaoiki Pali, Wood Valley quad (Ives <u>et al.</u> , 1964).
640 ± 45 (W-4025)	Charcoal fragments at base of Pohina flow, where it rests on Pahala ash at edge of Na Manua Haalou Swamp, alt 1774m, Puu O Keokeo quad (Kelley <u>et al.</u> , 1979).
740 ± 60 (W-4156)	Charcoal roots from ash at base of Kipuka Nene flow, exposed in pothole along Hilea Gulch, alt 473m, Punaluu quad (Kelley <u>et al.</u> , 1979).
740 ± 60 (W-4012)	Charcoal roots from ash underlying thin "variable-olivine" pahoehoe flow at Kipuka Nene, Hilea Gulch, alt 305m, Punaluu quad (Kelley <u>et al.</u> , 1979).
780 ± 70 (W-4232)	Small sparse hard charcoal, in thin marginal aa near its base, where lapping on to pumice from picrite cone, Kahuku picrite cone, alt 780m, Kahuku Ranch quad. Coll and subm by P. W. Lipman, USGS, Denver, CO.
830 ± 60 (W-3879)	Charcoal from flaky roots in Pahala Ash, 15cm beneath fluid ropy pahoehoe, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
890 ± 60 (W-4137)	Charcoal roots from lens of Pahala-like ash, below thin olivine-rich pahoehoe, Kipuka Nene flow, Hilea Gulch, alt 381m, Punaluu quad (Kelley <u>et al.</u> , 1979).
910 ± 70 (W-4047)	Charcoal under olivine-rich aa flow, alt 1934m, Kipuka Pakekake quad (Kelley <u>et al.</u> , 1979).
910 ± 60 (W-4231)	Charcoal roots in Pahala ash, underlying olivine-rich pahoehoe, and overlying phenocryst-poor aa, stream bed, Hilea Gulch gaging station, alt 878m, Punaluu quad. Coll and subm by P. W. Lipman, USGS, Denver, CO.
1270 ± 60 (W-3910)	Charcoal in ash pocket underlying tree mold in tube-fed late pre-historic pahoehoe flow, Ainapo Trail, ML S flank, alt 2318m, Mauna Loa quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
1320 \pm 50 (W-4237)	Vitreous narrow rootlets under pahoehoe toes, overlying weathered phenocryst-rich aa kipuka, and overlain by Kulani Picrite, alt 1884m, Kulani quad. Dates one of oldest flows from a known vent. Coll and subm by J. P. Lockwood, USGS, Hawaii Natl. Park, HA.
1330 \pm 70 (W-3000)	Organic debris and charcoal, at uppermost part of yellow ash section, overridden by ML pahoehoe, Kaoiki Pali, alt 915m, Wood Valley quad (Kelley <u>et al.</u> , 1979).
1400 \pm 60 (W-3858)	Carbonized wood fragments (ohia lehu) in Pahala ash, beneath young prehistoric ML pahoehoe flow, Kaalaala Gulch, alt 457m, Pahala quad (Kelley <u>et al.</u> , 1979).
1470 \pm 60 (W-3857)	Charcoal fragments of a different, but unidentified, plant species, same location as W-3858 (Kelley <u>et al.</u> , 1979).
1810 \pm 80 (W-3850)	Charcoal in Pahala ash, overlain by phenocryst-poor ML pahoehoe from SW rift zone, Moaula Gulch, alt 137m, Pahala quad (Kelley <u>et al.</u> , 1979).
1840 \pm 60 (W-4116)	Charcoal at contact of pahoehoe-aa thin soil, alt 1940m, Kipuka Pakekake quad (Kelley <u>et al.</u> , 1979).
1860 \pm 70 (W-4022)	Charcoal fragments at base of plagioclase-phyric aa--flow, Punaluu Kahawai, alt 1891m, Punaluu quad (Kelley <u>et al.</u> , 1979).
1980 \pm 80 (W-4163)	Charcoal roots in Pahala ash, at base of flow, underlying phenocryst-poor aa flow, collected where aa cascaded through small lava tube, Kauhuhuula Gulch, alt 2036m, Keaiwa Reservoir quad (Kelley <u>et al.</u> , 1979).
2000 \pm 70 (W-4161)	Charcoal fragments from basal Hionamoa flow, a large phenocryst-poor unit, head of Makaka Ravine, alt 2060m, Keaiwa Reservoir quad (Kelley <u>et al.</u> , 1979).
2010 \pm 70 (W-4017)	Charcoal fragments from Pahala-like ash, underlying weathered phenocryst-poor pahoehoe, Hionamoa Gulch, alt 2074m, Keaiwa Reservoir quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
2000 ± 250 (W-477)	Charcoal of ohia buried in cinders of prehistoric vent of the last group of lavas of ML, Kau volcanic series, Waiakea Homesteads. Indicates Kau volcanic series mostly erupted in last few thousand years (Rubin and Alexander, 1958; Macdonald and Eaton, 1964).
2070 ± 250 (W-478)	Charcoal of tree fern same location as W-477.
2180 ± 60 (W-4015)	Charred log, base of young aa flow containing large olivine phenocrysts, alt 534m, Naalehu quad (Kelley <u>et al.</u> , 1979).
2190 ± 70 (W-3876)	Charcoal from root underlying ML NE rift aa flow, covering Pahala ash on E extension of Kaoiki fault, Puu Oo Trail, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
2300 ± 60 (W-4008)	Carbonized wood fragments in ash at base of the plagioclase-phyric Ninole aa flow, one of the last flows from this sector of ML to flow into ocean, Ninole Gulch, alt 316m, Punaluu quad (Kelley <u>et al.</u> , 1979).
2440 ± 60 (W-4142)	Charcoal fragments in Pahala-like ash, base of Ninole aa flow, Ninole Gulch, alt 53m, Punaluu quad (Kelley <u>et al.</u> , 1979).
2830 ± 60 (W-3836)	Carbonaceous soil below aa of the Keomoku flow, alt 1064m, Kilauea Crater quad. Anomalously old age according to P. W. Lipman (Kelley <u>et al.</u> , 1979).
2880 ± 70 (W-3845)	Charcoal root fragments, top of Pahala ash below olivine-rich ML pahoehoe flow, where draped over Kaoiki fault scarp, Kaoiki Pali, alt 1083m, Wood Valley quad (Kelley <u>et al.</u> , 1979).
2890 ± 70 (W-4174)	Amorphous sooty material underlying Panaewa flow, Hilo side of Allied Aggregates quarry, alt 111m, Hilo quad (Kelley <u>et al.</u> , 1979).
2950 ± 80 (W-3841)	Charcoal root fragments from Pahala ash, overlain by olivine-rich pahoehoe, probably same flow as W-3845, Puu Kuanene area, alt 793m, Wood Valley quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
3600 ± 70 (W-4223)	Charcoal roots in Pahala ash, overlain by transitional aa-pahoehoe, containing sparse large olivine and plagioclase phenocrysts, roadcut, Mountain House tunnel road, alt 983m, Punaluu quad. Coll and subm by P. W. Lipman, USGS, Denver, CO.
3620 ± 250 (W-2016)	Charcoal, depth 417cm, underlying surface pahoehoe lava flow, Bishop Museum cesspool excavation, Waiohinu, Naalehu quad (Sullivan <u>et al.</u> , 1970; Coe <u>et al.</u> , 1978; May, 1979).
3740 ± 250 (W-856)	Charcoal, under pahoehoe flow in churchyard, Waiohinu, Naalehu quad (Rubin and Alexander, 1960; Berry, 1973; Coe <u>et al.</u> , 1978; May, 1975, 1979).
3750 ± 70 (W-4164)	Charcoal fragments, base of aa flow which contains abundant small plagioclase phenocrysts, Puu Kinikini, alt 1996m, Keaiwa Reservoir quad (Kelley <u>et al.</u> , 1979).
3800 ± 90 (W-4152)	Charcoal fragments from thin lens of Pahala-like ash below transitional hummocky pahoehoe-aa flow, Highway 11 roadcut, alt 84m, Punaluu quad (Kelley <u>et al.</u> , 1979).
3900 ± 90 (W-4132)	Charcoal roots from thin lens of Pahala-like ash, below pahoehoe flow, Ninole Gulch, alt 372m, Punaluu quad (Kelley <u>et al.</u> , 1979).
3900 ± 80 (W-4009)	Carbonized wood, base of Punaluu aa flow, Punaluu Gulch, alt 488m, Punaluu quad (Kelley <u>et al.</u> , 1979).
4030 ± 350 (W-1046)	Charcoal in sandy silty ash, top of Pahala ash, Mamalahoa Highway, coll 1926 by T. A. Jaggar and W. C. Mendenhall, Kaoiki Pali, Wood Valley quad (Ives <u>et al.</u> , 1964).
4050 ± 50 (W-3803)	Soil rich in organic matter and containing bits of charcoal, from cesspool excavation, Kaumana area of Hilo, Hilo quad (Kelley <u>et al.</u> , 1979).
4210 ± 90 (W-3855)	Charcoal from Pahala ash, below phenocryst-poor aa flow draped on Kaoiki fault scarp, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
4340 ± 80 (W-3844)	Charcoal fragments from soil zone below aa flow, draped over Kaoiki fault scarp, Halfway House, alt 921m, Wood Valley quad (Kelley <u>et al.</u> , 1979).
4770 ± 90 (W-4224)	Charcoal roots in Pahala ash, overlain by phenocryst-poor pahoehoe flow, roadcut on Mountain House tunnel road, alt 1044m, Punaluu quad. Coll and subm by P. W. Lipman, USGS, Denver, CO.
5160 ± 100 (W-4135)	Charcoal roots from thin layer of Pahala-like ash, overlain by phenocryst-poor pahoehoe flow, Ninole Gulch, alt 369m, Punaluu quad (Kelley <u>et al.</u> , 1979).
5650 ± 90 (W-3862)	Charcoal fragments, top of Pahala-type ash overlain by young ML aa flow, SW of Mountain View, alt 528m, Mountain View quad (Kelley <u>et al.</u> , 1979).
6160 ± 110 (W-3930)	Charcoal root fragments in ash, overlain by transitional pahoehoe-aa ML flow, Alapai Gulch, alt 567m, Naalehu quad (Kelley <u>et al.</u> , 1979).
7300 ± 100 (W-4117)	Carbonaceous soil from ash at base of top ML flow, bay S of Kahukupoko Point, alt 21m, Naalehu quad (Kelley <u>et al.</u> , 1979).
7950 ± 110 (W-3813)	Black carbonaceous soil at top of Pahala ash, Puehu quarry, alt 76m, Punaluu quad (Kelley <u>et al.</u> , 1979).
8550 ± 100 (W-3853)	Charcoal root fragments from soil zone, overlain by ML pahoehoe flow, interbedded with Pahala, or reworked, ash, Kaoiki Pali, alt 1122m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
9170 ± 100 (W-4201)	Charcoal roots in Pahala ash, overlain by phenocryst-poor pahoehoe flow, part of flow sequence from ML that laps out against eroded Ninole Hills, Upper Moaula Gulch, alt 652m, Punaluu quad (Kelley <u>et al.</u> , 1979).
9500 ± 140 (W-3840)	Charcoal rootlets and carbonaceous soil from Pahala ash between two ML aa flows, draped over Kaoiki fault scarp, Kaoiki Pali, alt 1144m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
10,140 \pm 300 (W-907)	Carbonaceous ash exposed in sea cliff, S of Honuapu, top of Pahala ash which is under- and overlain by basalt, Maniani Pali, Naalehu quad (Rubin and Berthold, 1961; Coe <u>et al.</u> , 1978; Doell and Cox, 1965; May, 1975, 1979).
10,290 \pm 150 (W-4160)	Charcoal roots in Pahala ash, overlain by phenocryst-poor pahoehoe flow, Honuapu, alt 186m, Naalehu quad (Kelley <u>et al.</u> , 1979).
10,820 \pm 90 (W-4014)	Charcoal roots in uppermost main Pahala ash, near tree molds in overlying pahoehoe flow sequence, Hilea Gulch, alt 229m, Punaluu quad (Kelley <u>et al.</u> , 1979).
11,780 \pm 100 (W-3487)	Charcoal fragments in Pahala ash overlain by an intercalated basalt flow, W side of Kaaluala Bay, 9.2km NE of South Point, Ka Lae quad (Kelley <u>et al.</u> , 1979; Fornari <u>et al.</u> , 1979).
13,210 \pm 190 (W-4121)	Carbonaceous soil from ash at base of middle flow sequence, bay S of Kahukupoko Point, alt 15m, Naalehu quad (Kelley <u>et al.</u> , 1979).
26,410 \pm 390 (W-4019)	Thin carbonaceous mat, scraped from base of pahoehoe flow of the Ninole volcanic rocks, Hilea Gulch, alt 183m, Punaluu quad (Kelley <u>et al.</u> , 1979).
31,100 \pm 900 (W-3935)	Charcoal roots in Pahala-like ash, at base of tree mold in overlying ML aa flow, base of sea cliff in bay S of point, Kahukupoko Point, alt 1.5m, Naalehu quad (Kelley <u>et al.</u> , 1979).
31,400 \pm 1600 (W-4128)	Charcoal fragments in ash, overlain by small pahoehoe lobe of mainly aa flow, along prominent main ash bed exposed along Pali Kapu O Keoua, Kealakekua scarp, alt 4.6m, Honaunau quad (Kelley <u>et al.</u> , 1979).

Dates indicate that the brief recorded history of Mauna Loa eruptive activity, beginning 1843, has documented an exceptionally active period. For example, five flows from the SW rift zone of Mauna Loa reached the ocean between 1868 and 1950, but in the preceding 500 years, only three flows appear

*In years Before Present as reported by the dating laboratory.

to have reached the sea. The dates also demonstrate that the surface flows on Mauna Loa tend to be older than those on Kilauea. Flows several thousand years old are common on Mauna Loa, but flows more than a few hundred years old are rare on Kilauea.

Age* (Lab No.)	Description and location
Kilauea	
Modern (W-2999)	Humus layer in yellow ash, overlying pahoehoe flow of prehistoric age, Thurston Lava Tube, Volcano quad (Kelley <u>et al.</u> , 1979).
Modern (W-3486)	Wood (ohia) from fallen tree in kipuka, overlying pahoehoe, alt 1257m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
Modern (W-3481)	Wood (koa) from fallen tree in ohia-koa forest, in aa and ash, alt 1076m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
<200 (W-3480)	Wood (ohia) from kipuka of older aa lava surrounded by the finer, fresher aa of the Keamoku flow, alt 1079m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
<200 (W-3483)	Wood (ohia) from standing tree in ohia-koa forest, alt 1076m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
<200 (W-3485)	Wood (ohia) from standing tall giant, in Ainahou Ranch pahoehoe, alt 920m, Makaopuhi Crater quad (Kelley <u>et al.</u> , 1979).
<200 (W-4184)	Charcoal underlying tube-fed pahoehoe in large kipuka, Ainahou Range, alt 765m, Makaopuhi Crater quad (Kelley <u>et al.</u> , 1979).
<200 (W-3468)	Charcoal in root mold where lava flowed into crack, underlying fountain-fed pahoehoe, E rift zone, Makaopuhi Crater quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
<200 (W-3467)	Charcoal underlying fountain-fed pahoehoe flow, SE side of small crater SE of Napau, E rift zone, Makaopuhi Crater quad (Kelley <u>et al.</u> , 1979).
<200 (W-2970)	Wood from Kapoho Cone, E rift, Kapoho quad (Kelley <u>et al.</u> , 1979).
<200 (W-3886)	Charcoal fragments in weathered brown ash, from pit, Kipuka Ki, alt 1283m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
<200 (W-359)	Charcoal in tree mold in prehistoric pahoehoe, Puna (Rubin and Alexander, 1958; Macdonald and Eaton, 1964).
<200 (W-3937)	Charcoal from tree mold where lava ponded rapidly against the base of a fault scarp, Wood Valley quad (Kelley <u>et al.</u> , 1979).
210 ± 60 (W-3938)	Charcoal in tree mold, 3m from eruptive fissure, Wood Valley quad (Kelley <u>et al.</u> , 1979).
260 ± 70 (W-3881)	Charcoal root fragments in ash below phenocryst-poor Kilauea pahoehoe, in Fern Acres, alt 415m, Mountain View quad (Kelley <u>et al.</u> , 1979).
310 ± 70 (W-4162)	Charcoal roots from ash at base of Kilauea pahoehoe flow, SE side of Wung Ranch quarry, alt 784m, Volcano quad (Kelley <u>et al.</u> , 1979).
330 ± 60 (W-3811)	Charcoal fragments from Kilauea pahoehoe flow, beneath young prehistoric ML pahoehoe flow exposed in gully, Pahala quad (Kelley <u>et al.</u> , 1979).
340 ± 60 (W-3849)	Carbonaceous soil and charcoal, base of pyroclastic sequence, underlying basal reticulite of Keanakakoi ash, in pit in Olaa Forest Reserve, depth 50cm, Wright Rd, alt 1177m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
350 ± 150 (W-3800)	Carbonaceous debris under prehistoric aa flow, depth 2m, in cesspool excavation, Puna, Pahoa South quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
350 ± 60 (W-3870)	Clay rich in organic matter and containing charcoal fragments near base of Keanakakoi Ash, Kileaua Crater quad (Kelley <u>et al.</u> , 1979).
450 ± 60 (W-3018)	Charcoal, Wahaula Heiau, Kalapana quad (Kelley <u>et al.</u> , 1979).
450 ± 60 (W-3842)	Charcoal fragments from soil below phenocryst-poor pahoehoe flow from Kilauea along base of Kaoiki Pali, old quarry, SW rift, alt 792m, Wood Valley quad (Kelley <u>et al.</u> , 1979).
450 ± 60 (W-3941)	Charcoal from top of ash layer beneath tube-fed pahoehoe flow partly filling old stream channel between 2 kipukas of ash-covered aa apparently derived from Mauna Loa, Mountain View quad (Kelley <u>et al.</u> , 1979).
670 ± 60 (W-3860)	Charcoal in Pahala ash, below thin pahoehoe (one of the last major prehistoric Kilauea SW rift flows), along small gully, tributary to Kaalaala Gulch, alt 399m, Pahala quad (Kelley <u>et al.</u> , 1979).
730 ± 80 (W-3999)	Carbonaceous soil containing small charcoal fragments from beneath toe of pahoehoe flow, alt 1134m, Volcano quad (Kelley <u>et al.</u> , 1979).
1040 ± 70 (W-3856)	Carbonaceous clay and ash at base of pyroclastic base-surge sequence, just N of Kilauea summit, in pit in Olaa Forest Reserve, depth 80cm, Wright Rd, alt 1177m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
1130 ± 60 (W-3827)	Charcoal beneath Kilauea basalt flow, overlying Hilina Series rocks exposed in Poliokeawe Pali, Kau Desert quad (Kelley <u>et al.</u> , 1979).
1800 ± 80 (W-4119)	Carbonaceous baked ash containing charred root fragments beneath aa flow mantling Pahala ash on rim of Kukalauula Pali, Naliikakani Point quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
2080 \pm 70 (W-3859)	Carbonaceous clay and ash, underlying base-surge sequence, just N of Kilauea summit, from pit in Olaa Forest Reserve, depth 130cm, alt 1177m, Kilauea Crater quad (Kelley <u>et al.</u> , 1979).
2160 \pm 70 (W-3885)	Charcoal around base of tree mold in crystal-poor Kilauea pahoehoe, Wung Ranch quarry, alt 786m, Volcano quad (Kelley <u>et al.</u> , 1979). Anomalously old; see 310 \pm 70 (W-4162).
2170 \pm 200 (GX-394)	Disintegrated charcoal in ash, depth 70cm, Kipuka Ki, Kilauea Crater quad (Krueger and Weeks, 1966).
2500 \pm 250 (W-201)	Fern mold underlying basaltic pumice, excavation for N wing of Volcano House, Keanakakoi ash, Kilauea Crater quad (Rubin and Suess, 1956; Coe <u>et al.</u> , 1978; May, 1975, 1979). Anomalously old date, according to P. W. Lipman (written commun., 1979).
3480 \pm 80 (W-3831)	Charcoal beneath Kilauea basalt flow overlying rocks of the Hilina Volcanics, exposed in Poliokeawe Pali, Kau Desert quad (Kelley <u>et al.</u> , 1979).
3610 \pm 60 (W-3884)	Charcoal in ash below olivine-rich pahoehoe flow, Pahala vent, alt 177m, Pahala quad (Kelley <u>et al.</u> , 1979).
3690 \pm 70 (W-4177)	Charcoal beneath pahoehoe exposed in trench, Puna Sugar Field #20, SE from Keaau, alt 142m, Mountain View quad (Kelley <u>et al.</u> , 1979).
4820 \pm 90 (W-3798)	Carbonized charcoal tree fern (hapu'u) from ash directly above lava dated by W-3809 (10,680 \pm 130), from new scar formed during 1975 earthquake, Hilina Pali, Kau Desert quad (Kelley <u>et al.</u> , 1979).
6620 \pm 150 (W-3873)	Organic-rich ash containing charcoal fragments from uppermost level of thick Pahala Ash sequence, W side Kaena Bihopa Arroyo, Hilina Pali, Kau Desert quad (Kelley <u>et al.</u> , 1979).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
10,680 ± 130 (W-3809)	Charcoal beneath basalt and ash in upper Hilina Pali section, from new scar formed during 1975 earthquake, Kau Desert quad (Kelley <u>et al.</u> , 1979).
17,360 ± 650 (W-905)	Carbonaceous ash from contact of lower Pahala Ash with overlying basalt, SE end of seaward-facing Kaone fault scarp, Kaone Pali, Kau Desert quad (Rubin and Berthold, 1961; Coe <u>et al.</u> , 1978; Doell and Cox, 1965; May, 1975, 1979).
22,500 ± 300 (W-3801)	Charcoal from top of Pahala ash section on Puu Kaone, Kau Desert quad (Kelley <u>et al.</u> , 1979).
22,800 ± 340 (W-3814)	Charcoal exposed in fresh outcrop created by massive slumping during 1975 earthquake, Puu Kaone, Kau Desert quad (Kelley <u>et al.</u> , 1979).

Flank eruptions along the E rift zone appear to have been more extensive before about 200 years ago than since that time. Surface flows on Kilauea tend to be much younger than those of Mauna Loa. Flows more than a few hundred years old are scarce on the surface of Kilauea.

Mauna Kea (MK)

Modern (UW-197)	Shells, <u>Patella</u> , from adze quarry (Fairhall <u>et al.</u> , 1976).
80 ± 60 (UW-214)	Charcoal from fire-reddened zone in roadcut overlying 3m weathered bedded ash, N side of MK, near Makahalau (Fairhall <u>et al.</u> , 1976).
100 ± 200 (W-1521)	Heartwood from mamani tree cut in 1960 from slopes of MK, at 8560 ft alt, near Puu Kole. Coll and subm by W. U. Ault, Nanuet, NY.
570 ± 70 (UW-189)	Charcoal from fire-reddened zone in soil overlying weathered ash beds (Fairhall <u>et al.</u> , 1976).
845 ± 95 (I-5291)	Charcoal from base of modern solum above Puu Loaloa tephra, 2265m on Hale Pohaku Rd, 0.5km SE of Puu Hookomo (Porter, 1971, 1973; Coe <u>et al.</u> , 1978).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
1970 ± 200 (W-1519)	Exterior of ohia tree trunk in water tunnel into Puu Oo cinder cone, Puu Oo Ranch. Should date ashfall in area. Coll and subm by W. U. Ault, Nanuet, NY.
2190 ± 50 (UW-215)	Charcoal, depth 30 to 40cm, in modern solum, capping colluvial-alluvial fill just below Kemole Cabin, W side of MK (Fairhall <u>et al.</u> , 1976).
2270 ± 500 (W-1834)	Blue-green algae planktonic spicules and frustules from ash and clastic sediment from core, bottom of Lake Waiau, depth 1m (Ives <u>et al.</u> , 1967; Woodcock <u>et al.</u> , 1966).
4130 ± 135 (I-2637)	Volcanic ash and plankton debris from Lake Waiau, alt 3970m, depth 1.5m below lake bottom (Buckley and Willis, 1969; Porter, 1971).
4180 ± 600 (W-1968)	Volcanic ash and planktonic debris, from alpine Lake Waiau, alt 3970m, depth 1.55m from lake bottom (Marsters <u>et al.</u> , 1969).
4400 ± 110 (I-5292)	Top of Humuula paleosol beneath Puu Kole flow, 2195m in gully, 1.8km NE of Puu Loaloa on N side of Keanakolu Rd (Porter, 1971, 1972, 1973, 1975, 1979a, 1979b; Porter <u>et al.</u> , 1977; Berry, 1973; Coe <u>et al.</u> , 1978; May, 1975, 1977, 1979).
4420 ± 110 (I-5294)	Top of Humuula paleosol beneath Puu Kole tephra, 2390m in gully, 1km SSE of Puu Kole (Porter, 1971, 1972, 1973, 1975; Porter <u>et al.</u> , 1977; Berry, 1973; Coe <u>et al.</u> , 1978).
4460 ± 110 (I-5293)	Top of Humuula paleosol beneath Puu Kole tephra, 2231m in gully, 1.8km NE of Puu Loaloa on N side of Keanakolu Rd (Porter, 1971, 1972, 1973, 1975; Porter <u>et al.</u> , 1977; Coe <u>et al.</u> , 1978).
4470 ± 70 (UW-165)	Charcoal from top of Humuula paleosol, beneath Puu Loaloa tephra, 2024m in gully, 0.8km E of Humuula Sheep Station (Fairhall <u>et al.</u> , 1976; Porter, 1971, 1972, 1973, 1975; Porter <u>et al.</u> , 1977; Coe <u>et al.</u> , 1978).
4500 ± 100 (UW-188)	Charcoal from buried soil, 0.5km E of Hale Pohaku Rd, alt 2020m (Fairhall <u>et al.</u> , 1976).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
4560 ± 110 (I-5295)	Colluvium between Puu Kole and Puu Loaloa tephra, 2396m in gully, 1km SSE of Puu Kole (Porter, 1971, 1972, 1973, 1975; Porter <u>et al.</u> , 1977; Coe <u>et al.</u> , 1978).
4790 ± 70 (UW-166)	Charcoal from top of Humuula paleosol, beneath Puu Kole tephra, 2158m in gully on W side of Keanakolu Rd, 0.8km N of Puu Huikau (Fairhall <u>et al.</u> , 1976; Porter 1971, 1972, 1973, 1975, 1979a, 1979b; Porter <u>et al.</u> , 1977; Coe <u>et al.</u> , 1978).
5500 ± 500 (W-1941)	Volcanic ash and planktonic debris, from alpine Lake Waiau, alt 3970m, depth 1.8m (Marsters <u>et al.</u> , 1969).
5910 ± 170 (I-2635)	Volcanic ash and plankton debris from Lake Waiau, alt 3970m, depth 2m below lake bottom (Buckley and Willis, 1969; Porter, 1971).
6520 ± 300 (W-1991)	Core sediment, Lake Waiau, bottom 8cm of core. Coll and subm by Meyer Rubin, USGS, Reston, VA.
7160 ± 500 (W-1833)	Blue-green algae planktonic spicules and frustules from ash and clastic sediment bottom of Lake Waiau, depth 2m (Ives <u>et al.</u> , 1967; Woodcock <u>et al.</u> , 1966).
7540 ± 220 (I-2634)	Volcanic ash and plankton debris from Lake Waiau, alt 3970m, depth 3m below lake bottom (Buckley and Willis, 1969; Porter, 1971).
7790 ± 270 (I-2633)	Volcanic ash and plankton debris from Lake Waiau, alt 3970m, depth 2.5m below lake bottom (Buckley and Willis, 1969; Porter, 1971).
9080 ± 200 (I-2636)	Algal sediment from Lake Waiau, alt 3970m, depth 3.4m below lake bottom (Buckley and Willis, 1969; Porter, 1973, 1975, 1979a, 1979b; Porter <u>et al.</u> , 1977).
22,150 ± 250 (UW-270)	Charcoal in silt, below cinder layer from Nohonaohae cinder cone. Dates latest eruptive phase on lower NW rift of MK (Fairhall <u>et al.</u> , 1976; Porter <u>et al.</u> , 1977; Porter, 1975, 1979b).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
29,700 \pm 500 (UW-213)	Charcoal underlying uppermost of 3 tephra layers on Saddle Rd, W rift zone of MK, alt 1660m (Fairhall <u>et al.</u> , 1976; Porter, 1975, 1979a, 1979b; Porter <u>et al.</u> , 1977).
31,900 \pm 550 (UW-220)	Charcoal between lower and middle tephra layers on Saddle Rd, W rift zone of MK alt 1650m (Fairhall <u>et al.</u> , 1976; Porter, 1975, 1979a, 1979b; Porter <u>et al.</u> , 1977).
37,200 \pm 1400 (UW-219)	Charcoal underlying lowermost tephra layer on Saddle Rd, W rift zone of MK, alt 1650m (Fairhall <u>et al.</u> , 1976; Porter, 1975, 1979a, 1979b; Porter <u>et al.</u> , 1977).
>40,000 (UW-271)	Charcoal underlying buried soil developed in alluvium and overlain by loess on lower NW rift zone, alt 1320m (Fairhall <u>et al.</u> , 1976; Porter, 1975).

Most of the lava flows were erupted about 4500 years ago and cover a regionally extensive paleosol, which developed largely during the last glaciation (Porter, 1971). Dates at about 30,000 years BP provide upper limit for end of early Makanaka glacial episode.

Hualalai

2030 \pm 80 (W-4171)	Charcoal in soil zone on top of trachyte cinders, under olivine-bearing basalt flow, N flank of Puu Waa Waa quarry, alt 866m, Puu Anahulu quad. Coll and subm by J. P. Lockwood and R. B. Moore, USGS, Hawaii Natl. Park, HA.
------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

B. Archaeological

+62% modern (P-1120)	Charcoal, depth 24 to 25 in. within Phase II, Waiahukini shelter, South Point (Stuckenrath, 1967).
<200 (M-538)	Charcoal from fireplace under ancient house floor, depth 14 to 17 in. below top of deposit, South Point (Crane and Griffin, 1958).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
Recent (GrN-2061)	Charcoal from shelter cave, depth 33 to 38 in., South Point (Vogel and Waterbolk, 1964).
180 ± 40 (GrN-2835)	Wooden canoe from surface of cave shelter, South Point (Vogel and Waterbolk, 1964).
185 ± 150 (W-3017)	Charcoal from Anu'u Platform of Wahaula Heiau, from what is believed to be the refuse pit of the temple, Kalapana quad. Coll and subm by R. I. Tilling, USGS, Reston, VA.
200 ± 150 (M-667)	Charcoal from surface hearth on floor of refugee cave, Kilae, South Kona (Crane and Griffin, 1959).
220 ± 150 (M-920)	Charcoal from bottom of cultural deposit, depth 38 in., Holualoa Cave (Crane and Griffin, 1960).
200 ± 200 (M-479)	Charcoal from ground oven apparently under an ancient house floor buried by a sand dune at South Point (Crane and Griffin, 1958).
200 ± 42 (P-1119)	Charcoal, depth 13 to 14 in., within cultural phase, Waiahukini shelter, cave site, South Point (Stuckenrath, 1967).
227 ± 46 (P-1118A)	Charcoal, depth 12 in., Waiahukini shelter, cave site, South Point (Stuckenrath, 1967).
300 ± 200 (M-478)	Charcoal from large lava-tube shelter named Makalai, depth 48 in., in cultural deposit, South Point (Crane and Griffin, 1958).
350 ± 40 (GrN-2149)	Charcoal from cave shelter depth 34 in., South Point (Vogel and Waterbolk, 1964).
350 ± 60 (GrN-2901)	Charcoal, depth 17 to 21 in., same location as GrN-2149 (Vogel and Waterbolk, 1964).
450 ± 200 (W-3018)	Charcoal from structure C, depth 13 in., Wahaula Heiau, Kalapana quad. Coll and subm by R. I. Tilling, USGS, Reston, VA.
460 ± 40 (GrN-2062)	Charcoal from sand dune, depth 41 in., in middle of rich cultural deposit, South Point (Vogel and Waterbolk, 1964).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
490 ± 60 (GrN-2237)	Charcoal, depth 48 in., same location as GrN-2062 (Vogel and Waterbolk, 1964).
580 ± 150 (M-863A)	Charcoal from hearth, Puu Alii, South Point (Crane and Griffin, 1959).
600 ± 100 (M-1245)	Charcoal from Waiahukini shelter cave, depth 17 to 21 in. (Crane and Griffin, 1963).
610 ± 80 (GaK-153)	Charcoal, depth 35 to 41cm, below top of cultural layer, bottom of thick ash deposit, Puu Alii site, South Point, Kau (Kigoshi et al., 1962).
730 ± 200 (M-863B)	Charcoal from Waiahukini shelter, depth 17 to 21 in. (Crane and Griffin, 1959).
1000 ± 200 (M-666)	Charcoal from bottom of cultural deposit in Waiahukini shelter, depth 25 to 27 in. (Crane and Griffin, 1959).
1660 ± 60 (GrN-2225)	Charcoal from sand dune, depth 52 to 62 in., South Point (Vogel and Waterbolk, 1964).

Dates on archaeological findings range from present day to 1660 years BP, and include the oldest in the Islands.

II. Oahu

A. Geologic

1. Volcanic

>32,000 (W-250)	Coral head from tuffs, seaward flanks of Coco Crater, E of Hanauma Bay (Rubin and Suess, 1956; Macdonald and Abbott, 1970).
>32,000 (W-251)	Limestone from nearly contemporaneous tuffs along shore road at Hanauma Bay turnoff—may be from an older limestone that was broken through by eruption and mixed thereby with pyroclastics (Rubin and Suess, 1956; Macdonald and Abbott, 1970).

Limestones from tuffs date eruption of the Coco Head - Coco Crater complex.

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
2. Sea level	
5% \pm 2.4% modern (X-100)	Algae, core 10, top of section, depth 0-3 ft, Hanauma Bay (Easton and Olson, 1976).
<200 (X-81)	Algae, core 8, depth 2 to 4 ft, Hanauma Bay (Easton and Olson, 1976).
480 \pm 100 (X-111)	Algae, core 10-A, top of section, depth 0 to 3 ft, Hanauma Bay (Easton and Olson, 1976).
490 \pm 180 (X-101)	Algae, core 10, bottom of section, depth 0 to 3 ft, Hanauma Bay (Easton and Olson, 1976).
670 \pm 100 (I-869)	Organic muck, depth 1.2m below MSL (mean sea level), land bay, SW of Waipahu. Until 670 years ago, the bay was a protrusion of West Loch. This is the Kapakahi surface (Ruhe, Williams, Shuman, and Hill, 1965).
840 \pm 80 (X-72)	Algae, core 7, depth 3 to 6 ft, Hanauma Bay (Easton and Olson, 1976).
970 \pm 100 (X-117)	Algae, inner part, core 10-A, bottom of section, depth 0 to 3 ft, Hanauma Bay (Easton and Olson, 1976).
1050 \pm 100 (X-117)	Algae, outer part, same as above.
1070 \pm 90 (X-118)	<u>Pocillopora</u> , core 10-A, bottom of section, depth 0 to 3 ft, Hanauma Bay (Easton and Olson, 1976).
1200 \pm 190 (X-53)	Beach rock, core 5, depth 11.7 to 15 ft, Hanauma Bay (Easton and Olson, 1976).
1250 \pm 90 (X-35)	<u>Pocillopora</u> , core 3, depth 20 to 23 ft, Hanauma Bay (Easton and Olson, 1976).
1740 \pm 70 (X-33)	<u>Porites</u> , core 3, depth 14 to 17 ft, Hanauma Bay (Easton and Olson, 1976).
1790 \pm 110 (X-54)	<u>Porites</u> , core 5, depth 11.7 to 15 ft, Hanauma Bay (Easton and Olson, 1976).
2100 \pm 120 (X-82)	Algae, outer part, core 8, depth 4 to 6 ft, Hanauma Bay (Easton and Olson, 1976).
2270 \pm 100 (X-82)	Algae, inner part, same as above.

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
2340 ± 110 (GX-Diamond Head)	Carbonate aggregate from beach conglomerate at tide level, type locality of Leahi II shoreline at Diamond Head (Stearns, 1972, 1974).
2400 ± 200 (X-11)	Algae, core 1, depth 7.3 to 10 ft, Hanauma Bay (Easton and Olson, 1976).
2510 ± 90 (X-61)	Algae, core 6, top section, depth 6.8 to 9.8 ft, Hanauma Bay (Easton and Olson, 1976).
2670 ± 220 (X-90)	Algae, inner part, core 9, depth 0 to 2 ft, Hanauma Bay (Easton and Olson, 1976).
2760 ± 70 (X-102)	Algae, core 10, depth 9 to 11 ft, Hanauma Bay (Easton and Olson, 1976).
2910 ± 70 (X-12A)	<u>Cyphastrea</u> , core 1, top of section, depth 10 to 14 ft, Hanauma Bay (Easton and Olson, 1976).
2910 ± 80 (X-71A)	Algae, core 7, depth 0 to 3 ft, Hanauma Bay (Easton and Olson, 1976).
3040 ± 110 (X-71)	Algae, rerun of X-71A (Easton and Olson, 1976).
2960 ± 100 (X-91)	Algae, outer part, core 9, depth 2 to 4 ft, Hanauma Bay (Easton and Olson, 1976).
3000 ± 130 (X-91)	Algae, inner part, same as above.
3110 ± 110 (X-13B)	Algae, core 1, bottom of section, depth 14 to 17 ft, Hanauma Bay (Easton and Olson, 1976).
3180 ± 100 (X-61B)	Algae, core 6, depth 3.8 to 6.8 ft, Hanauma Bay (Easton and Olson, 1976).
3170 ± 120 (X-90)	Algae, outer part, same as X-90 (2670 ± 220) (Easton and Olson, 1976).
3360 ± 100 (X-62)	Algae, core 6, bottom of section, depth 6.8 to 9.8 ft, Hanauma Bay (Easton and Olson, 1976).
3485 ± 160 (GX-2673)	Fossil corals from beach conglomerate, 1.5 to 3m above MSL on lava flow on Hanauma Bay bench. This Kapapa 5-ft stand is now considered to be Holocene (Stearns, 1974, 1977; Easton, 1977).
3530 ± 80 (X-56)	<u>Porites</u> , core 5, depth 18 to 21 ft, Hanauma Bay (Easton and Olson, 1976).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
3640 ± 120 (I-1618)	<u>Porites</u> , core 1, middle of section, depth 14 to 17 ft, Hanauma Bay (Easton, 1973; Easton and Olson, 1976).
3780 ± 150 (I-1509)	<u>Porites</u> , core 5, depth 18 to 19 ft, Hanauma Bay (Easton, 1973; Easton and Olson, 1976).
3840 ± 120 (X-73)	<u>Pocillopora</u> , core 7, depth 6 to 9 ft, Hanauma Bay (Easton and Olson, 1976).
3960 ± 100 (X-63)	<u>Algae</u> , core 6, depth 12.8 to 15.8 ft, Hanauma Bay (Easton and Olson, 1976).
3980 ± 130 (X-13)	<u>Algae</u> , core 1, top of section, depth 14 to 17 ft, Hanauma Bay (Easton and Olson, 1976).
4100 ± 140 (X-82B)	<u>Algae</u> , core 8, depth 10 to 12 ft, Hanauma Bay (Easton and Olson, 1976).
4170 ± 130 (X-84)	<u>Cyphastrea</u> , core 8, depth 14 to 16 ft, Hanauma Bay (Easton and Olson, 1976).
4240 ± 150 (I-1619)	<u>Porites</u> , core 1, depth 23 to 26 ft, Hanauma Bay (Easton, 1973; Easton and Olson, 1976).
4270 ± 90 (X-14)	<u>Cyphastrea</u> , core 1, depth 20 to 23 ft, Hanauma Bay (Easton and Olson, 1976).
4375 ± 210 (I-1080)	Mollusk shells from sediments having low organic-carbon content, depth 5 to 6m, bay SW of Waipahu (Ruhe, Williams, Shuman, and Hill, 1965).
4445 ± 210 (I-1081)	Mollusk shells, same location as I-1080, depth 6 to 7m (Ruhe, Williams, Shuman, and Hill, 1965).
4490 ± 200 (X-104)	<u>Algae</u> , core 10, depth 19 to 21 ft, Hanauma Bay (Easton and Olson, 1976).
4650 ± 110 (X-74)	<u>Algae</u> , core 7, depth 9 to 12 ft, Hanauma Bay (Easton and Olson, 1976).
4820 ± 120 (X-64)	<u>Porites</u> , core 6, depth 15.8 to 18.8 ft, Hanauma Bay (Easton and Olson, 1976).
4900 ± 150 (X-75)	<u>Algae</u> , core 7, depth 14 to 17 ft, Hanauma Bay (Easton and Olson, 1976).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
4820 ± 100 (X-92)	<u>Cyphastrea</u> , outer part, core 9, depth 20 to 22.1 ft, Hanauma Bay (Easton and Olson, 1976).
5000 ± 120 (X-92)	<u>Cyphastrea</u> , inner part, same as above.
5020 ± 210 (X-77)	<u>Algae</u> , core 7, depth 17 to 19 ft, Hanauma Bay (Easton and Olson, 1976).
5180 ± 140 (X-78)	<u>Algae</u> , core 7, depth 19 to 21 ft, Hanauma Bay (Easton and Olson, 1976).
5300 ± 160 (X-108)	<u>Porites</u> , core 10, depth 42 to 44.5 ft, Hanauma Bay (Easton and Olson, 1976).
5300 ± 110 (X-15)	<u>Porites</u> , core 1, depth 29.3 to 31 ft, Hanauma Bay (Easton and Olson, 1976).
5420 ± 160 (X-105)	<u>Porites</u> , core 10, depth 25 to 27 ft, Hanauma Bay (Easton and Olson, 1976).
5440 ± 130 (X-18)	<u>Pocillopora</u> , core 1, depth 35 to 37 ft, Hanauma Bay (Easton and Olson, 1976).
5500 ± 210 (X-107)	<u>Porites</u> , core 10, depth 39 to 41 ft, Hanauma Bay (Easton and Olson, 1976).
5540 ± 80 (X-97)	<u>Coral</u> , shell mixture in sand, core 9, depth 31 to 32 ft, Hanauma Bay (Easton and Olson, 1976).
5550 ± 80 (X-106)	<u>Porites</u> , core 10, depth 31 to 33 ft, Hanauma Bay (Easton and Olson, 1976).
5570 ± 110 (X-65)	<u>Porites</u> , core 6, depth 28.8 to 31.8 ft, Hanauma Bay (Easton and Olson, 1976).
5570 ± 110 (X-17)	<u>Pocillopora</u> , core 1, depth 33 to 35 ft, Hanauma Bay (Easton and Olson, 1976).
5580 ± 300 (W-1211)	Wood from well, 600 ft E of shoreline, 60 ft below MSL, Makua Valley (Levin <u>et al.</u> , 1965).
5570 ± 220 (X-93)	<u>Porites</u> , core 9, depth 23 to 25 ft, Hanauma Bay (Easton and Olson, 1976).
5600 ± 110 (X-93)	
5870 ± 160 (X-93)	
6050 ± 150 (X-93)	
6060 ± 130 (X-93)	

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
6080 ± 140 (X-94)	<u>Porites</u> , core 9, depth 25 to 27 ft, Hanauma Bay (Easton and Olson, 1976).
6900 ± 170 (X-86)	<u>Porites</u> , core 8, depth 31.6 to 33.6 ft, Hanauma Bay (Easton and Olson, 1976).
6970 ± 100 (X-85B)	<u>Porites</u> , core 8, depth 29.6 to 31.6 ft, Hanauma Bay (Easton and Olson, 1976).
7010 ± 120 (X-85A)	<u>Pocillopora</u> , core 8, depth 25.4 to 27.6 ft, Hanauma Bay (Easton and Olson, 1976).
18,000 ± 600 (LJ-899)	Cone shells, alt 3.5m on emerged algal and coral reef at Puu O Hula Kai, coast S of Waianae (Hubbs <u>et al.</u> , 1965).
19,600 ± 1500 (GX-1947)	Gastropods, Leahi II beachrock on top of Kawela soil, alt 2 ft above MSL, Kahuku Point (Stearns, 1972, 1974).
21,600 ± 80 (GX-1948)	Turban shells of Leahi II age in top of Kawela soil, 1 ft below MSL, Kahuku Point (Stearns, 1972, 1974).
23,220 ± 1200 (GX-2838)	Shells and coral from Leahi II beachrock under lithified dunes, 5 ft above MSL, Makai Range Pier, near Sea Life Park (Stearns, 1974).
24,140 ± 800 (LJ-253)	Cowry shells from raised coral reef at NE end of Waialua Bay, on the "5-ft" terrace (Hubbs <u>et al.</u> , 1962; Shepard, 1961; Ruhe, Williams, and Hill, 1965; Macdonald and Abbott, 1970).
26,640 ± 1100 (LJ-322)	Cowry shells from same "5-ft" terrace same location as LJ-253 (Hubbs <u>et al.</u> , 1962; Ruhe, Williams, and Hill, 1965).
28,200 ± 1300 (LJ-205)	Cowry shells, same "5-ft" terrace and location as LJ-253 (Hubbs <u>et al.</u> , 1962; Ruhe, Williams, and Hill, 1965).
31,540 ± 1300 (LJ-254)	Cowry shells from raised coral reef, on "12-ft" terrace, 0.5km NE of Waimea Bay (Hubbs, <u>et al.</u> , 1962; Shepard, 1961; Ruhe, Williams, and Hill, 1965; Macdonald and Abbott, 1970).
31,840 ± 1000 (LJ-323)	Rerun of LJ-254 (Hubbs <u>et al.</u> , 1962; Ruhe, Williams, and Hill, 1965).
39,100 ± 1500 (LJ-948)	Gastropod shells from emerged coral reef, 1.5m above MLW (mean low water), Popaia Island (Hubbs <u>et al.</u> , 1965).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
>38,000 (W-886)	Shells and loose silty marl, from upper part of oyster bed, 14 ft above MSL, from embankment in Wailani Tract, Waipahu (Rubin and Berthold, 1961; Ruhe, 1965; Ruhe, Williams and Hill, 1965; Ruhe, Williams, Shuman, and Hill, 1965).
>38,000 (W-885)	Oysters from continuation of bed from which W-886 was taken. Analyzed to date the 25-ft (Waimanalo) stand of sea in Hawaii (Rubin and Berthold, 1961; Ruhe, 1965; Ruhe, Williams, and Hill, 1965; Ruhe, Williams, Shuman and Hill, 1965).
>40,000 (LJ-569)	Mollusk shells in beach conglomerate or reefrock from Kahe Point Quarry on Kona Coast, S of Nanakuli, alt 2.7 to 3.1m (Hubbs <u>et al.</u> , 1962).
>40,000 (LJ-597)	Clam valves, near contact between reef and underlying basalt, near Waimea Bay, alt 3.4 to 3.7m (Hubbs <u>et al.</u> , 1962).
>40,000 (LJ-598)	Cowry shell, alt 2.1 to 2.4m above MLW on sloping end of reef, just W of Pupukea Beach near Waimea Bay. Both algae and coral occur in this reef (Hubbs <u>et al.</u> , 1962).
>50,000 (LJ-910)	Small shells, alt 2.7m at top of emerged coral reef at Kahuku Point (Hubbs <u>et al.</u> , 1962).
>42,000 (LJ-937)	Coral from emerged reef, alt 15m, Kahuku Point (Hubbs <u>et al.</u> , 1962).
>50,000 (LJ-946)	Shells from top of emerged coral reef, alt 1.5m, Kahuku Point, N of airfield (Hubbs <u>et al.</u> , 1962).
>50,000 (LJ-947)	Shells from near top of emerged reef, alt 3.7 to 4.0m, 0.8km E of Kaena Point (Hubbs <u>et al.</u> , 1962).
>30,000 (I-1144)	Shells from coral limestone overlain by Kaloi alluvium, Waipio Peninsula (Ruhe, 1965; Ruhe, Williams, and Hill, 1965; Ruhe, Williams, Shuman, and Hill, 1965).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
>37,000 (I-870)	Oyster shells overlain by Kaloi sediments, 17 ft above MSL in scarp, E shore of West Toch, Pearl Harbor, near mouth of Kapakahī stream (Ruhe, 1965; Ruhe, Williams, and Hill, 1965; Ruhe, Williams, Shuman, and Hill, 1965).
>32,000 (GX-2946)	Shells from weakly cemented beach sand, 12 ft above MSL, SW of Pukauloa Point on Ulupau Head (Stearns, 1974).
>37,000 (GX-2945)	Limestone containing coral from outcrop of beach conglomerate cemented in solution cavity in reef of Waimanalo age, NE end of sand beach at Mokapu Landing, 5 ft above MSL (Stearns, 1974).

Aberrant dates

7540 \pm 300 (LJ-570)	Limpets from beachrock overlying standard coral reef at alt 1.5m, Kahuku Point, N of airfield. This measurement is discordant with others (Hubbs <u>et al.</u> , 1965).
18,070 \pm 450 (LJ-206)	Cowry shells from same location as LJ-253 and LJ-322. Date does not agree with these two (Hubbs <u>et al.</u> , 1962; Ruhe, Williams, and Hill, 1965).

Hanauma Reef began to grow in the craters of tuff cones erupted near the end of volcanism on Oahu about 6000 to 7000 years ago. Koko bench was formed 4100 (-5m) to 5800 (-8m) years BP. The Haleiwa 5-foot stand dates at 24,000 to 26,640 years BP; the Waimea 12-foot dates at 31,000 years BP. The Waimanalo stand is of Sangamon age.

B. Archaeologic

<185 (I-5270)	Charcoal from layer of scattered fragments of charcoal, beneath superficial wall of terrace, depth 20 to 40 cm, upper Kamananui Valley, Moanalua (Buckley, 1973).
<185 (I-4826)	Charcoal from below terraced platform, depth 30 to 45cm, upper Makaha Valley (Buckley and Willis, 1972).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
< 205 (I-4306)	Charcoal from fireplace, lower Makaha Valley (Buckley and Willis, 1972).
< 210 (I-4120)	Charcoal, NW firepit, outside wall, lower Makaha Valley (Buckley and Willis, 1972).
220 ± 75 (M-564)	Charcoal from Kuliouou shelter cave, in cultural deposit, depth 18 to 24 in. (Crane and Griffin, 1963; Emory and Sinoto, 1961).
200 ± 95 (I-4823)	Charcoal from walled agricultural terrace, depth 60cm, upper Makaha Valley (Buckley and Willis, 1972).
230 ± 95 (I-4310)	Charcoal from fireplace, lower Makaha Valley (Buckley and Willis, 1972).
250 ± 90 (I-4311)	Charcoal from fireplace, lower Makaha Valley (Buckley and Willis, 1972).
270 ± 90 (I-4122)	Charcoal from fireplace, lower Makaha Valley (Buckley and Willis, 1972).
335 ± 90 (I-5271)	Charcoal from thin layer of charcoal and burned earth, depth 23cm, upper section of Kamana-nui Valley, Moanalua (Buckley, 1973).
370 ± 100 (I-4200)	Charcoal from fireplace, lower Makaha Valley (Buckley and Willis, 1972).
370 ± 90 (I-4121)	Charcoal from rectangular fireplace, lower Makaha Valley (Buckley and Willis, 1972).
380 ± 120 (I-4718)	Charcoal from temple, depth 60cm, lower Makaha Valley (Buckley and Willis, 1972).
445 ± 95 (I-4824)	Charcoal from walled agricultural terrace, 1.15 to 1.42m depth, upper Makaha Valley (Buckley and Willis, 1972).
405 ± 90 (I-4827)	Charcoal from walled agricultural terrace, 85 to 111cm depth, upper Makaha Valley (Buckley and Willis, 1972).
445 ± 90 (I-5269)	Charcoal from firepit, 22cm depth, upper section of Kamana-nui Valley, Moanalua (Buckley, 1973).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
410 ± 90 (I-5272)	Charcoal from firepit, 39cm depth near suspected floor level of house structure (Buckley, 1973).
565 ± 110 (I-4825)	Charcoal from behind wall of terrace, 37 to 93cm depth, upper Makaha Valley (Buckley and Willis, 1972).
615 ± 140 (I-4961)	Charcoal from 30cm depth in small rock enclosure, lower Makaha Valley (Buckley and Willis, 1972).
730 ± 100 (I-4199)	Charcoal from fireplace, lower Makaha Valley (Buckley and Willis, 1972).
720 ± 105 (I-4201)	Charcoal from fireplace, lower Makaha Valley (Buckley and Willis, 1972).
946 ± 180 (C-540)	Charcoal from earliest Polynesian culture in Hawaii, found in Kiliouou Bluff shelter, Kiliauaw (Libby, 1951, 1955; Emory and Sinoto, 1961).

Dates on archaeological samples indicate human occupation of Oahu for the past 1000 years.

III. Maui

A. Geologic

1. Volcanic-Haleakala

<100 (I-Pimoe)	Charcoal from tree mold, Pimoe flow (Reber, 1959; Oostdam, 1965).
200 ± 15 (I-Kalua o Lapa)	Charcoal from tree mold, Kalua o Lapa flow (Reber, 1959; Oostdam, 1965).
590 ± 120 (I-Makua)	Charcoal from tree mold, Makua flow (Reber, 1959).
600 ± 300 (M-361)	Tree mold, Ulupalakua (Crane, 1956).
650 ± 140 (I-Keonehunehune)	Charcoal from tree mold, Keonehunehune flow (Reber, 1959).
890 ± 170 (I-Kamahina)	Charcoal from tree mold, Kamahina flow (Reber, 1959; Berry, 1973).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
9400 \pm 300 (W-3945)	Charcoal, overlain by a late lava flow of the Hana Volcanic Series, upper E rift zone, N rim of Kipahulu Valley, alt 1666m, Nahiku quad. Subm by G. A. Macdonald, Univ. of Hawaii at Manoa, Honolulu, HA.
22,550 \pm 400 (W-4005)	Charcoal, from ash deposits previously mapped as Kula age. Date shows that these deposits belong to Hana Volcanic Series and are the most recent voluminous ash deposits on the W flank of Haleakala. Coll and subm by D. R. Crandell, USGS, Denver, CO.

Dates on charcoals from Haleakala lava flows range from <100 years BP on SW rift to 22,500 years BP on E rift.

2. Sea level

3570 \pm 250 (W-1489)	Coral, from base of black coral growing on 55m submerged shelf, off Lahaina. Coll and subm by H. S. Ladd, Smithsonian Inst., Washington, D.C.
-------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------

B. Archaeologic

200 \pm 150 (M-1184)	Charcoal from bottom of midden deposit of sea shells and fishbones, Analuahine shelter (Crane and Griffin, 1962).
295 \pm 90 (I-4926)	Wood housepost, <u>in situ</u> in stone wall house foundation, Palauea (Buckley and Willis, 1972).

IV. Kauai

A. Geologic - sea level

1600 \pm 160 (LJ-917)	Beachrock, upper foreshore of exposed Oomano Point (Hubbs <u>et al.</u> , 1965).
8370 \pm 250 (LJ-753)	Coral, <u>Porites</u> , from 18m submarine terrace, Kaheko Reef (Hubbs <u>et al.</u> , 1965; Inman and Veeh, 1966; Stearns, 1974).
15,000 \pm 600 (LJ-916)	Cemented sandstone from large sea cave, 0.9 to 1.8m above MSL, Napali coast (Hubbs <u>et al.</u> , 1965).

*In years Before Present as reported by the dating laboratory.

Age* (Lab No.)	Description and location
B. Archaeologic	
300 ± 200 (M-477)	Charcoal from bluff shelter, bottom of cultural deposit, depth 8 to 106cm, Haeleele (Crane and Griffin, 1958, 1960).
580 ± 50 (GrN-2293)	Charcoal, Nualolokai, Napali district, depth 224 to 249cm (Vogel and Waterbolk, 1964).
570 ± 150 (M-906)	Charcoal from Nualolokai Bluff shelter, depth 183 to 223cm (Crane and Griffin, 1960).
720 ± 200 (M-565)	Charcoal from Haeleele Bluff shelter, depth 107 to 117cm (Crane and Griffin, 1960).
V. Molokai	
A. Geologic - sea level	
25,150 ± 1000 (HIG-35)	Fossil land snails from lithified calcareous dune, in which fossil goose skeleton was found, Desert Strip, West Molokai (Stearns, 1973, 1974).
> 27,000 (GX-2672)	Shells, from outcrop 60cm stratigraphically below HIG-35, Desert Strip, West Molokai (Stearns, 1973).
B. Archaeologic	
425 ± 150 (M-1183)	Charcoal from bottom of heavy midden deposit of shells and fishbone, Kalani shelter, depth 61 to 76cm (Crane and Griffin, 1962).
550 ± 300 (M-767)	Charcoal, depth 114cm, at bottom of cultural deposit in Moomomi shelter (Crane and Griffin, 1959).
VI. Nihoa - archaeologic	
520 ± 200 (M-480)	Charcoal from bluff shelter, depth 35 to 46cm (Crane and Griffin, 1958).
VII. Necker - archaeologic	
0 ± 250 (C-832)	Wood, (wiliwili) Bowl Cave, in association with stone artifacts of ancient Hawaiian type (Libby, 1954, 1955).
166 ± 200 (C-831)	Charcoal, Bowl Cave (Libby, 1954, 1955).

*In years Before Present as reported by the dating laboratory.

List of Laboratories

*C Chicago

Dr. W. F. Libby
Institute of Geophysics
University of California
Los Angeles, California 90024

GaK Gakushuin University

Prof. K. Kigoshi
Gakushuin University
Mejiro, Toshima ku
Tokyo, Japan

GrN Groningen

Dr. W. G. Mook
Natuurkundig Laboratorium der Rijks Universiteit
Westersingel 34
Groningen, Netherlands

GX Geochron Laboratories

Harold W. Krueger
Geochron Laboratories Division
Krueger Enterprises, Inc.
24 Blackstone Street
Cambridge, Mass. 02139

HIG Hawaii Institute of Geophysics

Robert W. Buddemeier
Hawaii Institute of Geophysics
University of Hawaii
2525 Correa Road
Honolulu, Hawaii 96822

I Teledyne Isotopes

James Buckley
Teledyne Isotopes
50 Van Buren Avenue
Westwood, New Jersey 07675

LJ University of California, San Diego

Dr. H. E. Suess
Mt. Soledad Radiocarbon Laboratory S-003
University of California, San Diego
La Jolla, California 92093

*M Michigan

Dr. James B. Griffin
University Museums Building
The University of Michigan
Ann Arbor, Michigan 48104

*Inactive laboratories

P Pennsylvania
Dr. Elizabeth K. Ralph and Barbara Lawn
Radiocarbon Laboratory
University of Pennsylvania
Department of Physics, DRL/EI
Philadelphia, Pennsylvania 19104

UW University of Washington
Dr. A. W. Fairhall
Department of Chemistry
University of Washington
Seattle, Washington 98195

W U.S. Geological Survey
Dr. Meyer Rubin
U.S. Geological Survey
National Center, 971
Reston, Virginia 22092

X Whitworth College
Dr. Edwin A. Olson
Department of Earth Science
Whitworth College
Spokane, Washington 99218

References cited

Berry, A. L., 1973, Thermoluminescence of Hawaiian basalts: *Journal of Geophysical Research*, v. 78, p. 6863-6867.

Buckley, J. D., 1973, Isotopes' radiocarbon measurements X: *Radiocarbon*, v. 15, p. 280-298.

Buckley, J. D., and Willis, E. H., 1969, Isotopes' radiocarbon measurements VII: *Radiocarbon*, v. 11, p. 53-105.

Buckley, J. D., and Willis, E. H., 1972, Isotopes' radiocarbon measurements IX: *Radiocarbon*, v. 14, p. 114-139.

Coe, R. S., Gromme, Sherman, and Mankinen, E. A., 1978, Geomagnetic paleointensities from radiocarbon-dated lava flows on Hawaii and the question of the Pacific nondipole low: *Journal of Geophysical Research*, v. 83, no. B4, p. 1740-1756.

Crane, H. R., 1956, University of Michigan radiocarbon dates I: *Science*, v. 124, p. 664-672.

Crane, H. R., and Griffin, J. B., 1958, University of Michigan radiocarbon dates II: *Science*, v. 127, p. 1098-1105.

Crane, H. R., and Griffin, J. B., 1959, University of Michigan radiocarbon dates IV: *Radiocarbon*, v. 1, p. 173-198.

Crane, H. R., and Griffin, J. B., 1960, University of Michigan radiocarbon dates V: *Radiocarbon*, v. 2, p. 31-48.

Crane, H. R., and Griffin, J. B., 1962, University of Michigan radiocarbon dates VII: *Radiocarbon*, v. 4, p. 183-203.

Crane, H. R., and Griffin, J. B., 1963, University of Michigan radiocarbon dates VIII: *Radiocarbon*, v. 5, p. 228-253.

Doell, R. R., and Cox, Allan, 1965, Paleomagnetism of Hawaiian lava flows: *Journal of Geophysical Research*, v. 70, no. 14, p. 3377-3405.

Easton, W. H., 1973, Submarine bench at 5m, Oahu, Hawaii: *Geological Society of America Bulletin*, v. 84, p. 2275-2280.

Easton, W. H., 1977, Radiocarbon profile of Hanauma reef, Oahu, Hawaii: Reply to Discussion by Stearns, H. T.: *Geological Society of America Bulletin*, v. 88, p. 1535-1536.

Easton, W. H., and Olson, E. A., 1976, Radiocarbon profile of Hanauma reef, Oahu, Hawaii: *Geological Society of America Bulletin*, v. 87, p. 711-719.

Emory, K. P., and Sinoto, Y. H., 1961, Hawaiian archaeology: Oahu excavations: Bernice P. Bishop Museum Special Publication 49, 77p.

Fairhall, A. W., Young, A. W., and Erickson, J. L., 1976, University of Washington dates IV: Radiocarbon, v. 18, p. 221-239.

Fornari, D. J., Peterson, D. W., Lockwood, J. P., Malahoff, Alexander, and Heezen, B. C., 1979, Submarine extension of the southwest rift zone on Mauna Loa Volcano, Hawaii: Visual observations from U.S. Navy deep submergence vehicle DSV Sea Cliff: Geological Society of America Bulletin, v. 90, p. 435-443.

Hubbs, C. L., Bien, G. S., and Suess, H. E., 1962, La Jolla natural radiocarbon measurements II: Radiocarbon, v. 4, p. 204-238.

Hubbs, C. L., Bien, G. S., and Suess, H. E., 1965, La Jolla natural radiocarbon measurements IV: Radiocarbon, v. 7, p. 66-117.

Inman, D. L., and Veeh, H. H., 1966, Dating the 10-fathom terrace off Hawaii (abs.): American Geophysical Union Transactions, v. 47, p. 125.

Ives, P. C., Levin, Betsy, Robinson, R. D., and Rubin, Meyer, 1964, US Geological Survey radiocarbon dates VII: Radiocarbon, v. 6, p. 37-76.

Ives, P. C., Levin, Betsy, Oman, C. L., and Rubin, Meyer, 1967, US Geological Survey radiocarbon dates IX: Radiocarbon, v. 9, p. 505-529.

Kelley, M. L., Spiker, E. C., Lipman, P. W., Lockwood, J. P., Holcomb, R. T., and Rubin, Meyer, 1979, US Geological Survey, Reston, Virginia, radiocarbon dates XV: Mauna Loa and Kilauea volcanoes, Hawaii: Radiocarbon, v. 21, p. 306-320.

Kigoshi, Kunihiko, Tomikura, Yoshio, and Endo, Kunihiko, 1962, Gakushuin natural radiocarbon measurements I: Radiocarbon, v. 4, p. 84-94.

Krueger, H. W., and Weeks, C. E., 1966, Geochron Laboratories, Inc. radiocarbon measurements II: Radiocarbon, v. 8, p. 142-160.

Levin, Betsy, Ives, P. C., Oman, C. L., and Rubin, Meyer, 1965, US Geological Survey radiocarbon dates VIII: Radiocarbon, v. 7, p. 372-398.

Libby, W. F., 1951, Radiocarbon dates III: Science, v. 114, p. 291-296.

Libby, W. F., 1954, Chicago radiocarbon dates V: Science, v. 120, p. 733-742.

Libby, W. F., 1955, Radiocarbon dating: Chicago, University of Chicago Press, p. 135, 139.

Lockwood, J. P., and Lipman, P. W., 1979, Recovery of charcoal for ^{14}C dating from beneath lava--lessons from Hawaii: Journal of Volcanology and Geothermal Research, v. 4.

Macdonald, G. A., and Abbott, A. T., 1970, Volcanoes in the Sea: University of Hawaii Press, Honolulu, Hawaii.

Macdonald, G. A., and Eaton, J. P., 1964, Hawaiian volcanoes during 1955: US Geological Survey Bulletin 1171, p. 156-157.

Marsters, Beverly, Spiker, Elliott, and Rubin, Meyer, 1969, US Geological Survey radiocarbon dates X: Radiocarbon, v. 11, p. 210-227.

May, R. J., 1975, Thermoluminescence dating of Hawaiian basalts: Ph.D. dissert., Stanford University, 156 p.

May, R. J., 1977, Thermoluminescence dating of Hawaiian alkalic basalts: Journal of Geophysical Research, v. 82, p. 3023-3029.

May, R. J., 1979, Thermoluminescence dating of Hawaiian basalt: US Geological Survey Professional Paper 1095, 47 p.

Oostdam, B. L., 1965, Age of lava flows on Haleakala, Maui, Hawaii: Geological Society of America Bulletin, v. 76, p. 393-394.

Peterson, D. W., 1967, Geologic map of Kilauea Crater Quadrangle: US Geological Survey GQ Map 667.

Porter, S. C., 1971, Holocene eruptions of Mauna Kea volcano, Hawaii: Science, v. 172, p. 375-377.

Porter, S. C., 1972, Buried caldera of Mauna Kea volcano, Hawaii: Science, v. 175, p. 1458-1460.

Porter, S. C., 1973, Stratigraphy and chronology of late Quaternary tephra along the south rift zone of Mauna Kea volcano, Hawaii: Geological Society of America Bulletin, v. 84, p. 1923-1940.

Porter, S. C., 1975, Late Quaternary glaciation and tephrochronology of Mauna Kea, Hawaii: Royal Society of New Zealand Bulletin 13, p. 247-251.

Porter, S. C., 1979a, Quaternary stratigraphy and chronology of Mauna Kea, Hawaii: A 380,000-yr record of mid-Pacific volcanism and ice-cap glaciation: Summary: Geological Society of America Bulletin, v. 90, p. 609-611.

Porter, S. C., 1979b, Hawaiian glacial ages: Quaternary Research, v. 12, p. 161-187.

Porter, S. C., Stuiver, Minze, and Yang, I. C., 1977, Chronology of Hawaiian glaciations: Science, v. 195, p. 61-63.

Reber, Grote, 1959, Age of lava flows on Haleakala, Hawaii: Geological Society of America Bulletin, v. 70, p. 1245-1246.

Rubin, Meyer, and Alexander, Corrinne, 1958, US Geological Survey radiocarbon dates IV: Science, v. 127, p. 1476-1487.

Rubin, Meyer, and Alexander, Corrinne, 1960, US Geological Survey radiocarbon dates V: Radiocarbon, v. 2, p. 129-185.

Rubin, Meyer, and Berthold, S. M., 1961, US Geological Survey radiocarbon dates VI: Radiocarbon, v. 3, p. 86-98.

Rubin, Meyer, and Suess, H. E., 1956, US Geological Survey radiocarbon dates III: Science, v. 123, p. 442-448.

Ruhe, R. V., 1965, Relation of fluctuations of sea level to soil genesis in the Quaternary: Soil Science, v. 99, p. 23-29.

Ruhe, R. V., Williams, J. M., and Hill, E. L., 1965, Shorelines and submarine shelves, Oahu, Hawaii: Journal of Geology, v. 73, p. 485-497.

Ruhe, R. V., Williams, J. M., Shuman, R. C., and Hill, E. L., 1965, Nature of soil parent materials in Ewawaipahu area, Oahu, Hawaii: Soil Science Society of America Proc., v. 29, p. 282-287.

Shepard, F. P., 1961, Sea level rise during the past 20,000 years: Zeitschrift fur Geomorphologie Supp. 3, p. 30-35.

Stearns, H. T., 1972, C14 vs. uranium series dating of late Pleistocene shore deposits, Oahu, Hawaii (abs.): Geological Society of America Abs. with Programs, v. 4, no. 3, p. 242.

Stearns, H. T., 1973, Geologic setting of the fossil goose bones found on Molokai Island, Hawaii: Bernice P. Bishop Museum Occasional Papers, v. XXIV, no. 10, p. 156-163.

Stearns, H. T., 1974, Submerged shorelines and shelves in the Hawaiian Islands and a revision of some of the eustatic emerged shorelines: Geological Society of America Bulletin, v. 85, p. 795-804.

Stearns, H. T., 1977, Discussion on Easton, W. H., and Olson, E. A., Radiocarbon profile of Hanauma reef, Oahu, Hawaii: Geological Society of America Bulletin, v. 88, p. 1535.

Stuckenrath, Jr., Robert, 1967, University of Pennsylvania radiocarbon dates X: Radiocarbon, v. 9, p. 333-345.

Sullivan, B. M., Spiker, Elliott, and Rubin, Meyer, 1970, US Geological Survey radiocarbon dates XI: Radiocarbon, v. 12, p. 319-334.

Vogel, J. C., and Waterbolk, H. T., 1964, Groningen radiocarbon dates V: Radiocarbon, v. 6, p. 349-369.

Woodcock, A. H., Rubin, Meyer, and Duce, R. A., 1966, Deep layer of sediments in alpine lake in the tropical Mid-Pacific: Science, v. 154, p. 647-648.



3 1818 00074847 3