THE MAUNA KEA ADZ QUARRY COMPLEX, HAWAII: A FIRST ANALYSIS

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Abstract

Distributed over an area of roughly 7½ square miles, at the 8,600 to 12,400 ft. elevation on a landscape that today can be described as an alpine stony desert, the Mauna Kea Adz Quarry Complex is the largest known adz-making locality in Polynesia. The quarries assume further significance in their remoteness from coastal settlements and the inferred organization and preparatory arrangements needed to undertake work at a high altitude. Results of fieldwork conducted in the summers of 1975-76 at the Mauna Kea Adz Quarry Complex are described in relation to a set of primary objectives aimed at developing a technological model of Hawaiian adz manufacture. Sites are defined in terms of constellations of activity areas, using topography to delimit boundaries. The site distribution pattern is examined in terms of bedrock exposures of a single basalt flow and downslope glacial outwash deposits. Lithic, vegetal, and faunal remains from two stratified rock-shelters are briefly discussed in a temporal context of short term, intermittent adz production.

INTRODUCTION

The first systematic archaeological investigation of the Mauna Kea Adz Quarry, a National Historic Landmark, was undertaken by the Bernice P. Bishop Museum in the summers of 1975-76, comprising seven months of fieldwork. A detailed summary of the 1975 fieldwork is presented elsewhere (McCoy, in press) and the reader is referred to that paper for a fuller explication of the project's background, research design, field procedures, and preliminary results, including the first radiocarbon dates obtained for the quarry.

At this stage of the project, with the field research just completed, it is possible to do little more than present a general description of the quarry--its location, environmental setting, and makeup (types and spatial relationships of activity components). Beyond this, the limited aims of

this paper are to examine briefly the site distribution pattern in terms of differing levels of exploitation, and to discuss the implications of excavated material and deposits for posited intermittent, short-term, seasonal adz manufacture.

RESEARCH OBJECTIVES AND METHODOLOGY

The primary objective of the research is the development of a technological model of Hawaiian adz manufacture that details manufacturing techniques, core-reduction processes, and the patterning of activities in the quarry. The Mauna Kea Adz Quarry is the largest, most complex, and best-preserved adz-making locality in the Hawaiian Islands, and thus is most likely to yield the types and quantity of data needed to achieve this goal.

The research is also addressing questions such as the possible cultural constraints influencing the demand for adzes, and the possibilities of trade in adzes outside the island of Hawai'i. The size of the quarry and the volume of rejected adz preforms and waste flakes has led to the formulation of a hypothesis that adz production on Mauna Kea exceeded local needs, thereby representing a commercial venture in a commodity that, probably, would have had a high trade value. It is expected that the completed research will also provide important new data on change, or the lack of it, in Hawaiian adz forms through time.

Field investigations have included reconnaisance survey, intensive site survey and recording (detailed mapping and description), excavation, and surface collection. The broad-based organization of field activities reflects the ultimate goals of the project and paucity of knowledge about the quarry prior to 1975.

Emphasis was placed on recording and sampling of surface remains over the entire quarry area in order to document the range and possible areal variability in adz manufacture, and to aid in developing a general preservation plan. Excavation of selected rock-shelters was equally important in recovering: (1) datable materials for developing a quarry chronology; (2) faunal and floral materials to interpret dietary patterns; and (3) artifacts utilized by the adz makers in maintaining themselves during the period of work. The program of excavation was expanded to include soil-profile trenches outside rock-shelters. Analysis of sediments from rock-shelter environments and open slopes is being undertaken as part of a preliminary effort at reconstruction of environmental conditions immediately prior to, during, and after the abandonment of the quarry.

An integral part of the project is lithic experimentation, an approach that is becoming increasingly popular in the study of stone tool assemblages. The rationale for this goes beyond the satisfaction gained in successfully replicating an adz, or simple familiarization with the raw material--its inherent properties and constraints. Such experiments provide information on the mechanics of fracture and probable behavior of reducing and shaping a piece of material to an intended final form and size. Controlled experimentation will provide quantified data to formulate a model of manufacturing stages against which field data can be compared.

LOCATION AND ENVIRONMENTAL SETTING

The quarry is an area of roughly 7½ square miles on the south slope of Mauna Kea (Fig. 1). The main activity was concentrated in a zone that is 1-to-1½ miles wide between the 11,000 and 12,400 ft. elevation. Below 11,000 ft. activity was confined to two narrow strips along Wai-ka-halulu and Pohaku-loa gulches. The gulches are the effective east-west boundaries of the quarry at the lower elevation extremity. Adz manufacturing sites have been found down to 8,600 ft. at Liloe Spring on the west bank of Pohaku-loa Gulch. Archaeological remains (shrines), believed to be related to the operation of the quarry, have been located as high as Lake Wai-au (13,020 ft. elevation).

A large part of the quarry is located on a broad summit plateau encircling the mountain between 11,000 and 12,000 ft. The landscape is dotted with numerous cinder cones, the principal one of which in the quarry area is Pu'u Ko'oko'olau. The upper slopes of Mauna Kea have been described as a stony alpine desert (Ugolini, 1974). There is little vegetation and the ground surface has the appearance of a desert pavement. The modern climate is both dry and cold. It is sufficiently cold that periglacial features, such as patterned ground, are actively maintained. Evidence of formerly colder conditions can be seen in the summit region in the form of glacially scoured bedrock and surficial glacial drift deposits.

This brief summarization of location and environment is presented as background for a further consideration of the level of organization and environmental adaptation required of Hawaiians to undertake work at this remote locality. In prehistoric times the nearest permanent settlements on the Hamakua coast would have been at least 25 miles distant by foot. Because of the quarry's location, it would have been necessary to transport food and warmer clothing, remnants of which we have found in pieces of tapa cloth cloaks and possible ti leaf rain capes. These inferred preparatory arrangements and subjection to an alien and frequently inhospitable

climate are testimony to the importance of adzes in the Hawaiian tool kit. There are numerous sources of adz-quality basalt on the island, but obviously the choice was made in favor of exploiting more fully an isolated locality instead of more accessible coastal ones. The determining factor was undoubtedly the quality and quantity of basalt at this one location on Mauna Kea.

THE QUARRY COMPLEX: AN OVERVIEW

The Mauna Kea Adz Quarry Complex is an unusually large complex of clustered and dispersed adz-making localities, designated as sites and constituting a site complex. With several unique exceptions, sites are isolated workshops or, more commonly, constellations of several functionally linked activity loci, termed site components. These include habitation rock-shelters, overhang shelters that were probably used for sleeping, open-air walled shelters, religious shrines, and workshops. To this list of commonplace components our 1976 fieldwork added single, unique occurrences of petroglyphs and pictographs (rock paintings), and a workshop where small tools were made from a nearby source of basaltic glass.

Rock-shelters are small, natural overhangs utilized for habitation. All but two, at lower elevations on Pōhaku-loa and Wai-ka-halulu gulches, exhibit stacked-stone enclosing walls across the mouth. Four rock-shelters were excavated; initial radiocarbon dates for two of these, in the upper quarry area, ranged between A.D. 1424 and 1657 (McCoy, in press). The floor areas of rock-shelters are small, suggesting that other nearby overhangs, lacking midden deposits and fire hearths, were additional resting places. Open-air shelters are low, walled enclosures occurring on or at the base of talus slopes that were workshop locations, with one special exception. A group of 25 such shelters, occurring in three discrete clusters, was found in an area where virtually no evidence exists for adz manufacture. Workshops vary considerably in size and internal complexity. Some are thin scatters of flakes, cores, adz rejects, and hammerstones, while others are massive accumulations of these items, forming piles 20 to 30 meters across and perhaps 3 to 4 meters deep. Shrines are simple constructions, usually of long, narrow, thin, and flat slabs set in an upright position on a high point on or very near a workshop. A few non-workshop-associated shrines were found near the open-air shelter complex, at Lake Wai-au, and near the western flank of Pu'u-Lilinoe.

THE SITE DISTRIBUTION PATTERN

Completion of an extensive and intensive survey provides the opportunity to examine and interpret the distribution of sites in terms of levels of exploitation. The discussion is

limited to geological parameters and lacks a consideration of the temporal factor, since a quarry chronology is not yet fully developed.

Quarry location and site distribution have a clearly defined, multifaceted geological basis. Site survey data indicate that exploitation of raw material was both extensive and intensive. Intensification, characterized by site clustering, large site size and internal complexity, subsurface mining, and the largest accumulations of debitage (waste by-products), is a function of the localization of a fine-grained vitreous basalt along a flow margin at the 12,200 to 12,400 ft. elevation. Along this general contour level the best quality basalt is found in the largest quantity. Maximal geographical limits of the adz quarry and locations of smaller, more dispersed, and less complex sites below 12,200 ft. are related to the effective lateral (roughly east-west) and downslope limits of surficial glacial drift deposits. Selective utilization of scattered boulder erratics characterizes the extensive exploitation pattern, which only in rare instances at the lower elevations also became a somewhat intensified and presumably longer term pattern of repeated adz making. Sites down to c. 8,600 ft. on Pōhaku-loa Gulch and c. 10,000 ft. on Wai-ka-halulu Gulch are exemplary of this broad ranging search for adz-quality basalt.

The massiveness of debitage deposits in the upper quarry area suggests that sites there are the oldest. Lower elevation sites also might be early, but the limited quantity of usable boulders, and general absence of adz-quality basalt exposures on ridges and walls of the two gulches, would have prevented long-term exploitation in these areas.

SEASONALITY AND INTERMITTENT USE

One of the questions of greatest concern in comprehending the magnitude of the quarry is the length of time that it was in use, the regularity of exploitation, and time and duration of the work period in a year. Answers to each of these questions are not yet available and may never be as precise as one would wish. The first radiocarbon age-determinations indicate that the quarry dates to at least the early 15th century A.D. and probably 200 to 300 years earlier. Climatic conditions and data from rock-shelter excavations are used in a preliminary discussion of seasonality and intemittent use.

Assuming for the moment that the general climatic conditions of Mauna Kea's upper slopes have been moderately uniform since A.D. 1000, it is reasonable to expect that

coastal-adapted Hawaiians would have worked in the area only in the warmer, snowfree, summer months. Annual temperature and snowfall fluctuations undoubtedly occurred, but in all probability the usual period of use would have been restricted to the months between July and October. Bones of a few immature dark-rumped petrel ('ua'u--*Pterodroma phaeopygia sandwichensis)* in rock-shelter middens is supporting evidence for summer habitation and adz production. William Bryan (1914:156) reported Hawaiians taking young ua'u from burrows always in September and October. Fish bones and scales and plant remains have not been analyzed, but additional data on seasonality might be forthcoming from such studies.

Duration of the seasonal work period is difficult to establish with any degree of certainty because of our inability to isolate seasonal occupation floors within major stratigraphic units and the lack of precision in archaeological dating methods. Stratigraphic layers are homogeneous deposits of sequential occupations spanning a number of years. The best we can do at the present time is to make estimates based on quantity of food remains and a general assessment of maintenance activites.

Weights for shellfish, fish, and bird midden can be used as a rough index of length of occupation, using floor area to estimate numbers of people that a rock-shelter could accomodate. There are limitations to this approach, however, since it is likely that fish, birds, and shellfish constituted only a fraction of the diet. It is conjectured that prepared foods, such as poi and dried bananas, were quantitatively more important.

Recovery of birdbone awls and basaltic-glass flake tools, probably used for cutting and scraping wood and fiber, indicates performance of maintenance activities. These material items and quantities of unprepared pandanus leaves suggest that items such as mats and carrying baskets were made or repaired, thereby hinting at residency greater than a week or two.

There are additional considerations such as the length of time required to: (1) acclimatize to the high altitude; (2) sharpen manufacturing skills which may have been used infrequently or not at all during the remainder of the year; and (3) procure raw material, which at some time extended to the more involved process of mining. The quantity of food that could be transported from the coast would have effectively limited the length of stay, unless, of course, there were other people who formed task groups responsible for supplying the craftsmen and also, for carrying down selected preforms for finishing by grinding and polishing. The combination of these factors with archaeological reasoning based on excavated evidence suggests seasons no shorter than two to three weeks.

Gaps in the cultural sequences of stratified rock-shelters, represented by sterile (non-cultural) soils, are evidence for intermittent exploitation. Periods of abandonment were sufficiently long for the development of B2 horizon soils. In two of the upper-elevation rock-shelters, there are three or more such soil developments suggesting general quarry abandonment rather than quitting of just one locality. Two B2 horizon soils in the upper part of one rock-shelter are bracketed by radiocarbon dates of A.D. 1424 and 1657. Reasons for abandonment are not certain, but we suspect that climate is a likely factor. Year-round snowcaps on Mauna Kea are reported in historic times, and we can expect short term cycles of increased cold, and thus snow, in the past.

CONCLUDING REMARKS

The Mauna Kea Adz Quarry Complex is probably one of the nation's least known but most important National Historic Landmarks, from both a research and interpretive point of view. It is the only Landmark of its kind in the United States. Moreover, it is probably one of the largest and most complex stone tool quarries in the world.

Prior to the inception of the current project, the quarry was imperfectly known archaeologically; the boundaries had not even been established. As a consequence little had been done to insure its protection. As a result of the 1975-76 research we are now in a position to evaluate the full significance of the quarry and to recommend measures to be taken to maintain its integrity. A preservation plan is being prepared for the Department of Land and Natural Resources and the National Advisory Council on Historic Preservation.

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LITERATURE CITED

Bryan, William Alanson. 1914. "Hunting the Uau on Molokai." The Mid-Pacific Magazine. 8(2):153-157

McCoy, Patrick C. In press The Mauna Kea Adz Quarry Project: A Summary of the 1975 Field Investigations. Journal of the Polynesian Society.

Ugolini, F. C. 1974. "Hydrothermal Origin of the Clays from the Upper Slopes of Mauna Kea, Hawaii." Clay and Clay Minerals, 22:189-194.