# ELEVATED FOSSIL CORAL DEPOSITS IN THE HAWAIIAN ISLANDS:

# A MEASURE OF ISLAND UPLIFT IN THE QUATERNARY

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

OCEANOGRAPHY

AUGUST 1993

By

Anthony T. Jones

Dissertation Committee:

Richard W. Grigg, Chairperson
Fred T. Mackenzie
Alexander Malahoff
Gary McMurtry
Johanna Resig

## ABSTRACT

The origin of emerged marine fossils in the Hawaiian Islands is investigated. Three alternative hypotheses tested are: (1) The Hawaiian Islands are stable and sea level fluctuations during the Late Pleistocene are responsible for the emerged marine terraces; (2) A set of giant waves swept up to 326 m on Lanai and neighboring islands depositing marine fossils 105 ka; (3) The islands have undergone uplift due to lithospheric flexure and therefore, the elevated marine terraces record interglacial periods. Fossil corals from the islands of Oahu, Molokai, and Lanai are dated by the electron spin resonance method. On Oahu, a double high stand for the last interglacial period is interpreted from ESR dates and stratigraphy; one at ~130 ka and one at ~118 ka. The Waialae reef at 14 m elevation is dated at 200 $\pm$ 20 ka. The 30-m Kaena stand is dated at 490 $\pm$ 40 ka. Based on the elevation and age of the deposits compared with geological records from elsewhere, Oahu is interpreted as having been uplifted 30 m in the last 500 ka at a mean rate of 0.06 mm $yr^{-1}$.

Three geomorphic terraces are identified on the south coast of Molokai. The lower two terraces at ~2 m and 10.5-12 m are assigned an age of 3.4 ka and 125 ka, respectively. The highest terrace at 20-30 m is dated at 300 $\pm$ 30 ka. The mean uplift rate there is calculated at 0.10 mm $yr^{-1}$.

On Lanai, corals collected from elevations of 12-74 m

correlate with the interglacial at approximately 200 ka and are interpreted as evidence for uplift during the last 300 ka.

The overall pattern of increasing elevation with age of the deposits is interpreted as uplift. The proposed mechanism for uplift is lithospheric flexure. The loading of the Hawaiian hot spot, centered under the island of Hawaii, causes local downward deformation of the lithosphere. Compensating upward lithospheric flexure occurs over a radius of approximately 200 km to 400 km, resulting in uplift of the islands of Lanai, Molokai, and Oahu that lie within this zone. This model is consistent with several independent data sets for flexure including geometry of the Hawaiian moat and arch, gravity anomalies, and seismic profiles. Therefore, the "stable island" and "giant wave" hypotheses are no longer tenable.