AGU MEETING

The wave that paved Hawaii 100,000 years ago

About 100,000 years ago, a giant wave surged up the southern slope of the Hawaiian island of Lanai, blanketing the island's flanks with coral fragments and limestone gravels that the churning water had ripped from the seafloor. As the wave receded it stripped off the rich soil. And on its second and final sweep it dropped pieces of island volcanic rocks from its clutches.

This was the picture painted last week at the American Geophysical Union meeting in San Francisco in a presentation given by James G. Moore, a volcanologist, and his brother George W. Moore, a marine geologist, both of the U.S. Geological Survey (USGS) in Menlo Park, Calif.

The prevailing view before the Moores began their work was that the gravels found on Lanai were deposited at several different times during the Pleistocene epoch, when the sea level rose, creating a series of ancient shorelines above the present coast. Since the melting and growth of ice sheets alone could not account for the implied large and rapid sea level changes, other ideas, including the uplift of the island due to the intrusion of magma, were proposed and debated over the past 50 years.

However, based on the ages of offshore coral reefs and other measurements, the Moores decided that the southeastern Hawaiian islands are actually sinking so fast that any past shorelines would now lie below the present coast, and hence should not be seen on dry land.

Indeed, when the researchers went to Lanai to have a closer look at the marine deposits, they discovered, instead of a series of ancient shorelines, a single gravel layer that went from the coastline up to an altitude of 326 meters. Above 326 meters, the researchers found 3 meters of soil in which pineapples were growing, while at lower altitudes there was no soil at all. Skeletons of corals and other reef organisms were found in the gravel as disordered fragments rather than as remnants of old reef systems.

The researchers also discovered that the gravel layer became thinner and the rocks and coral pieces finer with increasing altitude. A notable exception was the Kaluakapo Crater. that trapped larger fragments than those found in the surrounding gravel. Moreover, uranium dating of the coral by Barney J. Szabo at the USGS in Denver, Colo., revealed that samples from different parts of the island are all about 100,000 years old.

All of this geologic evidence, added to the finding of similar gravels spread at lower altitudes on Oahu, Molokai, Maui and Hawaii, led the researchers to conclude that a massive wave surged through the Pacific Basin sometime just before 100,000 years ago.

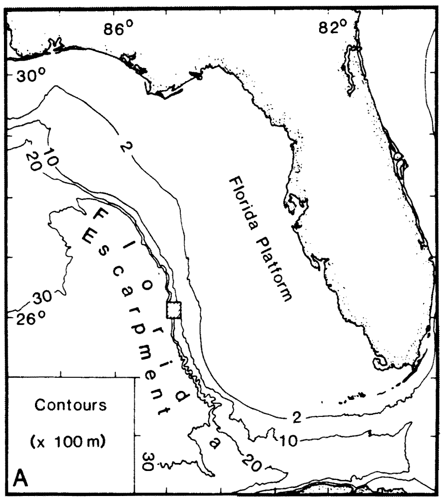
Because of the wave's large size, the Moores have ruled out an underwater earthquake as the cause, since the highest tsunami, recorded in 1946 on Hawaii, reached only 17 meters above the shoreline. A meteorite fall in the nearby sea or a subsea volcanic eruption could have triggered the wave, but the scientists think a more likely explanation is an underwater landslide over an area of about 25 square kilometers south of Lanai on the Hawaiian Ridge.

Subsea landslides had previously been observed to produce large waves; in 1958 an underwater slide in an Alaskan fjord generated the tallest recorded wave, running up 524 meters on land. And the Hawaiian Ridge, which is among the steepest and highest landforms on earth, is believed to have suffered a number of major subsea landslides in the past. The Lanai wave might have been created when a massive chunk of land rapidly fell, sending water surging into the void and up the island slope.

According to the researchers, whose work also appears in the Dec. 14 SCIENCE, if such a wave did occur, it is probably not unique. "Now we have a classic place to go," says James Moore, "to look and see what deposits like this actually look like, so they can be recognized in other places as well." *— S. Weisburd*

There's life among the seeps, too

Nine scientists set out last March with the research submarine *Alvin* to study the erosion process at the bottom of the Florida Escarpment, a range of underwater cliffs in the Gulf of Mexico that tower over the seafloor at heights greater than that of the Grand Canyon. "Rather unexpectedly, we came across communities of abundant organisms. That's quite anomalous for what one would expect for abyssal [deep-sea] biological activity," says Charles K. Paull, a graduate student at Scripps Institution of Oceanography in La Jolla, Calif. The scientists found bacterial mats, bivalves, crabs, fish, limpets and many other organisms similar to those that had been discovered thriving around hydrothermal vents along the East Pacific Rise (EPR) (SN: 1/17/80, p. 28).



Paull et al/SCIENCE

The square on the escarpment shows where the seeps and biological communities were found in the Gulf of Mexico.

"When they were first discovered on the Eastern Pacific Rise, it was felt that the EPR represented a unique environment for these communities," Paull told SCIENCE NEWS. "To find similar communities in an entirely different geologic setting took everyone by surprise."

Paull, who presented the group's findings last week at the American Geophysical Union meeting in San Francisco, believes that the survival of the escarpment community depends on a mechanism different from that at the EPR, where high temperatures drive water — containing compounds from which bacteria get energy — up to the seafloor from the crust. At the escarpment, where temperatures are not much different from that of the ambient seawater, the water laden with important compounds is thought to flow *down* from an aquifer in the Florida Platform to the base of the escarpment. The water seeps downward, the researchers suggest, because it is highly saline, and hence more dense than seawater. Indeed, wells previously drilled in the Florida Platform that penetrated layers with ages and composition comparable to that exposed on the escarpment revealed highly saline fluids that also contained hydrogen sulfide (H_2S).

Another bit of evidence supporting the idea that these fluids are flowing to seeps in the escarpment is the fact that pyrite, an iron sulfide compound, is found in much larger quantities in the escarpment sediments than could be explained if the ocean were the sole source of the sulfur.

While they have yet to work out the details of energy and food production, the researchers have found at the base of the escarpment many of the ingredients necessary to sustain a biological community. For example, core samples of sediments smelled of H_2S, they report, and sediment pore waters contained ammonia at concentrations 3,600 times higher than seawater. Both H_2S and ammonia are inorganic compounds used by sulfur-oxidizing bacteria for energy in chemosynthesis. At the same time, Paull and his colleagues found that pore waters were low in sulfate, suggesting that organic matter might be decomposed by sulfate-reducing bacteria