Notes from the
JOIDES Resolution

ODP Leg 197: Pursuing Pele, Goddess Of Hawaiian Volcanos

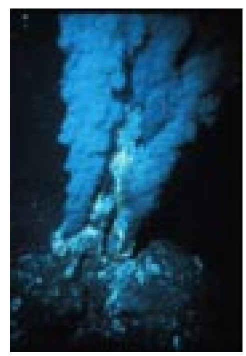
Anyone who has looked at a map of the floor of the Pacific Ocean has been struck by the remarkably linear chain of underwater mountains that trail west and then north from the Hawaiian Islands some 3000 miles. How did they get there? What do they tell us about the deep inner workings of our planet? The answers to these and other questions were the mission of Ocean Drilling Program Leg 197.

According to legend, the goddess Pele lives within the island of Hawaii and has built the volcanoes, one after the other, in a sequence. The accepted scientific explanation for the arrangement of these giant volcanoes in a line, and their progressively increasing age away from the currently active island of Hawaii, is not too different: The floor of the ocean (the Pacific plate) is in slow but steady westward motion across a focused, warmer-than-usual region of the underlying, more stationary interior (the mantle), called a "hotspot." This is analogous to the trail of smoke carried away by a breeze across the top of a chimney. The Emperor Seamounts are the oldest, deepest and most northerly of these Hawaiian-built volcanoes. They are named after the emperors of Japan.

Hotspots occur in many other places: Iceland, Yellowstone, and the Galapagos Islands are familiar examples. When people first compared the orientations and measured the ages of volcanoes in different hotspot tracks, it appeared that the hotspots did not move much with respect to one another. If this were true then the global array of hotspots would form a very convenient means to measure plate motions anywhere on the surface of the Earth — each volcanic trail signals the direction while the rate at which volcanos age along the trail gives the velocity of the plate. Such a stable configuration of hotspots would also mean that the deep mantle is stagnant, and not much involved in plate motions.

There is a very simple way to discover if Pele or any of her hotspot sisters have moved over the lifetime of these volcanic chains. Lava, when it cools, contains tiny magnetic particles that act like compass needles that dip at the angle corresponding to the latitude of the volcano. These are then "frozen" into place when the lava solidifies. Millions of years later, after the volcano has drifted away from the hotspot with the moving plate, its lava flows still record the precise dip of the magnetic particles acquired at the latitude of the hotspot.

The main objective of Leg 197 was to drill into several of the oldest volcanoes in the Hawaiian hotspot track, now far removed from Hawaii and sunk beneath the ocean surface, to recover cores from ancient lava flows. These will be measured to determine the latitude at which the lavas cooled. If the hotspot has not moved we should measure identical dips, all the same as that recorded at Hawaii today. But, if we find otherwise it will mean that Pele has roamed. Early results from measurements of these ancient magnetic directions (called "paleomagnetics") aboard the ship using an advanced superconducting magnetometer tell us that several volcanos formed well north of the present location of Hawaii and tell us that the hotspot has moved south. And this means that all estimates of plate motions based on hotspot trails have to be adjusted for the movement of the hotspots themselves, and our ideas about an



inactive deep mantle need to be rethought. Scientists will now return to their home institutions to study the cores recovered in much more detail. They will probe more of Pele's secrets and report results over the next two years.

For more information about Leg 197 or other ODP Legs, please visit the ODP web site at: www.oceandrilling.org.