SCIENCE NEWS OF THE WEEK

Hawaii's Volcanic Infant

As beachfront properties go, the warm, submarine flanks of Loihi, the youngest seamount in the Hawaiian chain, are a terrible investment. Varying estimates give the infant volcano from 2,000 to 20,000 years to rise 950 meters and blast its way through the water's surface. While scientists joke about property values, their real speculation centers on what Loihi's young lavas reveal about volcanos and about the composition of the earth. Some of the findings are causing geologists to revamp their ideas about how volcanic mountains form.

Some initial results of studies of Loihi (pronounced "Lo EE hee") presented recently in San Francisco at the meeting of the American Geophysical Union are straightforward enough. The seamount, which for years has been observed on bathymetric maps, definitely is an active volcano. Fred Klein of the U.S. Geological Survey Hawaiian Volcano Observatory described earthquake swarms in 1971-1972 and 1975 that he said were associated with volcanic events. The quakes were caused either by submarine eruptions or by intrusions, during which magma flowed through the interior of the volcano and stopped before reaching its surface. Alexander Malahoff of the National Ocean Survey in Rockville, Md., reported that detailed swath sounding sonar (SASS) bathymetry and photographs taken by the high resolution bottom camera ANGUS in October 1980 show that Loihi's surface is distinguished by two rift systems along its northern and southern flanks and by a summit crater two miles wide. Very little sediment has accumulated and lavas are fresh and glassy, proof that they are products of recent eruptions, probably within the last 200 years.

"It looks like Mauna Loa underwater," commented one geologist. Loihi's volume is only two percent that of Mauna Loa, one of Loihi's sister volcanoes in the Hawaiian chain. With Kilauea, the other still-active Hawaiian volcano, Loihi and Mauna Loa follow in a noble tradition of seamounts and island chains formed sequentially as the Pacific plate moves toward the northwest. Volcanism within a plate rather than at its margins is thought to occur when the plate moves over a fixed, or relatively fixed, hot spot in the earth's mantle (SN: 9/22/79, p. 202). Every million years or so, hot material from the mantle pokes a new hole in the crust and another volcano is formed.

Other insights gleaned from the new lavas are more surprising and run counter to accepted theory of volcano formation. For instance, when scientists first examined the lavas dredged up by USGS last January, they expected to see dense tholeiitic basalt like that emitted copiously by Kilauea about 30 kilometers away. At Loihi, however, tholeiitic basalt is joined by alkalic basalt, which has lower percentages of melted material from the mantle and greater amounts of volatile gas. Classical views of the way Hawaiian volcanoes form hold that tholeiitic magmas erupt first, forming the volcano's base. Then, a couple of million years later, during the volcano's last gasp, magmas differentiate at lower pressures to form alkalic magmas. Now it looks as though a volcano can erupt primitive and differentiated magmas at the same time, if not necessarily from the same chamber. Scientists also find that while the three volcanoes seem to share a magma source, their magmas move through separate vent systems and have different chemical compositions.

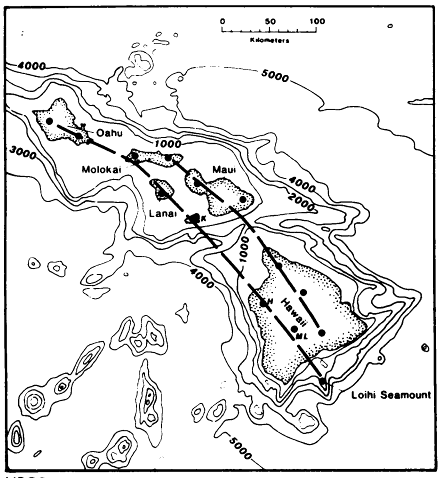
"This is the first time we've had a set of rocks where we could look at tholeiitic magmas and alkalic magmas erupted at the same time and place," said Dave Clague of USGS in Menlo Park, Calif. The higher levels of explosive gases in the lava may explain how magmas manage to break through the crust in the first place. Such robust activity would be a tough job for the thicker, less volatile tholeiitic magmas, but until Loihi was studied there was no alternative explanation.

While the sequence of eruptions, with alkalic lavas occurring early in the process as well as at the end, may provide a model for the formation of tens of thousands of seamounts found throughout the Pacific, it also may be an anomaly. The only way to observe early lavas at older volcanoes is to drill through material that probably has been altered by chemicals, pressure and heat, which make it difficult to learn how the magmas were composed when they erupted.

Other early observations at Loihi reveal the first evidence of mid-plate hydrothermal activity. Individual flows at Loihi, like the vents at mid-ocean ridges, are flanked by hydrothermal fields with "finger-like" stacks. There are no sulfides nor signs of the rich biological communities found at some hydrothermal vents at plate boundaries. However, an iron-rich clay mineral called nontronite abounds.

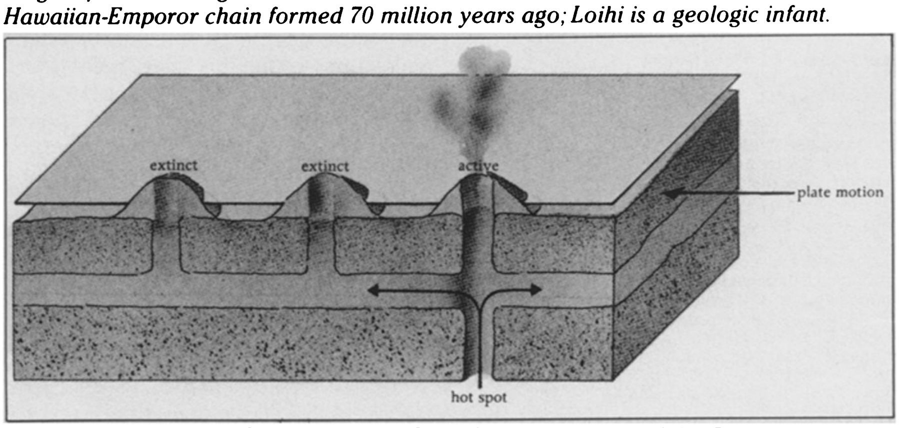
Debate is just beginning over controversial indications that Loihi's magmas emanate from a very primitive source deep in the mantle, and from a different source than magmas emitted at mid-ocean ridges. T. Kurtis Kyser of USGS in Denver reports that an oxygen isotope, O_{18}, in the Loihi samples suggests a mixture of primitive magmas and residues left behind as tholeiitic basalts moved away from mid-ocean ridges. Mark Kurz of Woods Hole Oceanographic Institution measured helium isotopes and finds higher H_3:H_4 ratios than at any currently erupting volcano. While high ratios are not unusual, Kurz said, "The source region for the Loihi magmas is among the most primitive we've ever sampled." —*C. Simon*

Loihi on Hawaii's southeast flank is the newest seamount in a linear chain.



USGS

As the Pacific plate veers northwest it passes over a hot spot in the earth's mantle. When magma pushes through the crust, a new volcano is formed. The eldest island in the Hawaiian-Emporor chain formed 70 million years ago; Loihi is a geologic infant.



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