

## HAWAII IS A HOT SPOT VOLCANO

JOE REILLY: Britt, we learned that the plate boundaries are a hotbed of seismic activity, this whole area around here. But Hawaii is smack dab in the middle of the plate, and it experiences loads of volcanic and seismic activity. What's going on? Why are there volcanoes in the middle of a plate?

BRITT ARGOW: Volcanoes on seven out of the eight islands no longer erupt. Once we understand what happened to these volcanoes, we'll know why Hawaii is so different from subduction zone volcanoes like Mt. St. Helens.

DAVE SHERROD: All these islands, the eight major islands, all of them are volcanic. They all grew by volcanic eruptions. We know this because they're built of lava flows. The same kind of rocks I'm sitting on today are found in Kauai, they're found on Oahu, they underlie our capital city, Honolulu, and yet none of them are erupting except the big island and its volcano Kilauea. That leads us to the question: why did those volcanoes go extinct? What's this one got going for it that those others may once have had but lost? I guess if I were the doctor wanting to put my stethoscope on this patient, I'd use a stethoscope of seismicity. I'd ask about earthquakes. The reason I'd do that is because that's a good way to see deep into the Earth's crust and mantle. When you get right down to it, when magma moves up through the crust, it breaks rock. Whenever you break rock, you get earthquakes. We've monitored this volcano in the big island with probably over 150 seismometers, and we're able to track the depths at which earthquakes occur and in some cases even monitor the upward rise of magma by the tell-tale snapping of the Earth's rocks as the magma comes to the surface.

ARGOW: On the island of Hawaii, where there is active volcanism, there are earthquakes. But where no volcanoes are erupting, earthquakes are relatively rare, like 350 miles northwest of the big island, on the island of Kauai.

CHUCK BLAY: If you're looking for earthquakes in Hawaii, you don't come to Kauai. It's a very quiet, stable island, almost no earthquakes here. If

you're looking for active volcanoes in Hawaii, you don't come to Kauai. Kauai's dead, volcanically. We have not had any obvious eruptions that we could interpret as being relatively young for a very long time.

ARGOW: Dating the rocks on the island has revealed that Kauai is between four and six million years old. As we move southeast along the chain, the islands get progressively younger until we get to the big island, where magma is still reaching the surface today. The oldest part of the big island is only about one million years old.

SHERROD: It suggests that earthquakes, heat flow, and magmatism are all related, and that whatever that phenomenon is, it has gone extinct, it has gone out, it's been snuffed, it's died away at the other islands in the volcanic chain. Whatever's driving the show ain't there, it's here. This is the place to be. Why? I guess that's the question we've got to come down to. What has kept magma from getting to the volcanoes in the other islands? Why are they starved? Why did the heat go away?

BLAY: One possible explanation would be that the source of lava that created Kauai has moved to where the big island is now. At one time it was here, and now it's here. Or maybe there were several sources that eventually died in one end, and now only one is still creating an island.

SHERROD: Another way to do it would be to have only one pipe, but have that pipe march along beneath the island chain. Fires up Kauai, and then the pipe decides it's going to somehow roll forward, and now it's going to drive up and feed the next island, Oahu. So essentially we're going to perforate the plate one at a time by moving our heat source along. It could be on a train track down there in the mantle. That's got a lot of problems associated with it because we want some source of heat down inside the Earth to be mobile. We somehow want this thing to move laterally rather than move up and down the way heat does. So, what if we tried it another way?

BLAKE: Maybe there's only one source of lava, and it hasn't moved, but maybe the islands have moved.

SHERROD: So now our heat source perforates the crust and the crust moves on, and each time it comes through and makes a new volcano while the crust moves by.

BLAY: And as the plate moves away or the crust moves away, the mountain also moves away, so as the lava continues to come up to the same place, it's now coming up behind the mountain that was there before, it builds a new mountain.

SHERROD: In this way, we can build an island chain, a string of pearls, if you will, over a fixed hot source, or hot spot.

ARGOW: Seismic evidence reveals a feature deep underneath Hawaii that is thought to be an intense plume of heat that could begin as far down as the core/mantle boundary. As the heat rises toward the crust, it melts rock. The melt is buoyant and rises to the surface, creating a volcanic island. Unlike subduction zone volcanoes, water is not a major influence on melting here. This is one of the reasons why the Hawaiian volcanoes tend to be less gaseous and erupt less explosively.

SHERROD: Based on evidence worldwide, this is what scientists think is probably going on, that the hot spot that Hawaii sits over, this hot source, whatever we want to call it, this generator of magma – that it more or less is fixed in a global scale – and that the crust under the Pacific here is moving. But the Pacific's a big, big area. And in fact, much of the Pacific is underlain by oceanic crust, and all of this crust is moving in the same direction, kind of headed towards Japan. We happen to know the rate: about 10 centimeters a year.

ARGOW: The Hawaiian islands are merely the tail end of a 6,000-kilometer chain of underwater extinct volcanoes called the Emperor Seamounts. So for tens of millions of years, it seems that this hot spot has fueled and built lots of volcanoes.

REILLY: If we follow the Emperor Seamounts, we run right into the Ring of Fire. So the plate on which Hawaii exists is being pulled down into a subduction zone. In about 100 million years, Hawaii will be recycled.

SHERROD: From a global perspective, the Hawaiian islands are moving. They're going somewhere. And each island that forms is going to become extinct, go beneath the waves, but the plate upon which it rides is headed to the subduction zone off Japan, and it's going to go down that subduction zone, which means the ultimate fate of any Hawaiian island is the Earth's mantle and melting. Once it melts, once that plate material gets subducted, it can then become part of the convection engine in the mantle and can be re-circulated, so to speak, or recycled.