Tracking hot spots beneath continents

The hot spot theory has been successful in explaining many chains of sequentially formed island volcanoes. But what can it tell us about features on the continents? Quite a lot, according to geophysicists W. Jason Morgan and Thomas Crough of Princeton University.

They presented some of their evidence and speculations last week at the Hawaii Symposium on Intraplate Volcanism and Submarine Volcanism in Hilo, Hawaii. They see a surprising number of correlations between hypothesized hot spots and features on the continents that supposedly passed above the hot spots at times in the past as the continents drifted apart on their crustal plates. You couldn't say their proposals were greeted with unanimous approval. All sorts of objections were raised. But they did provoke considerable interest in further examining the idea.

Morgan starts with an assumption that a hot spot — a fixed, warm area in the earth's mantle — was responsible for uplift of the Bermuda rise. (The Bermuda rise is a 1,000-kilometer-diameter area thrust high up above the ocean bottom. The island of Bermuda is merely a tiny bump at the top of the rise.) Then he traces its path backward in time beneath North America, based on available evidence and dates of earth plate motions. The hot spot need not have been large. The suggested effects are possible without magma activity ever pushing through to the crust.

Sixty million years ago the present coast of North Carolina would have been over the hot spot. Now it happens that at that location there is a large, unexplained subsurface feature known as the Cape Fear arch. Its top long ago eroded away to flatness, but evidence of it remains in the geology of the area. Morgan and Crough propose that the Bermuda hot spot caused that uplift.

Seventy million years ago, the southern Appalachians would have been over the hot spot. Morgan and Crough suggest that the general rise of elevation of the Appalachians apparent today from Harper's Ferry, W.Va., to Birmingham, Ala., is a result of the hot spot's subterranean influence. The mountains weren't formed by the hot spot — only raised up higher.

Farther west in Arkansas, they think the diamonds now commercially mined at one location in that state and dated at about 90 million years in age were created by connections to the earth's mantle made possible by the hot spot's presence then.

Farther back in time, they attribute the presence at two locations in Kansas of another mantle-related mineral known as kimberlite to the hot spot. The kimberlites are about 112 to 114 million years old, an age that fits with the time when Kansas was presumably over the hot spot.

Some conference participants protested that Morgan and Crough have preferentially selected data to fit their hypothesis. Crough disputes that. "I'm almost unbelievably impressed with how well it fits," he told SCIENCE NEWS.

In fact, he and Morgan have accumulated intriguing evidence of other hot spot traces beneath North America, South America and Africa in the distant past. Morgan wonders whether the huge area of exposed ancient rock known as the Canadian Shield may have been uplifted by the same hot spot that formed the New England Seamount chain. Such an uplift would have exposed all its overlying sediments to rapid erosion, stripping them away.

Crough and Morgan have been able to correlate known kimberlite deposits in space and time with their position over hot spots. In other words, by rotating the continents back to their past positions they find that kimberlite intrusions in South America and Africa were over hot spots at the times of their formation.

The proposed Bermuda host spot trace beneath the United States is the one for which they have the most diverse geological evidence. Morgan says they hope to prepare a paper for publication soon.

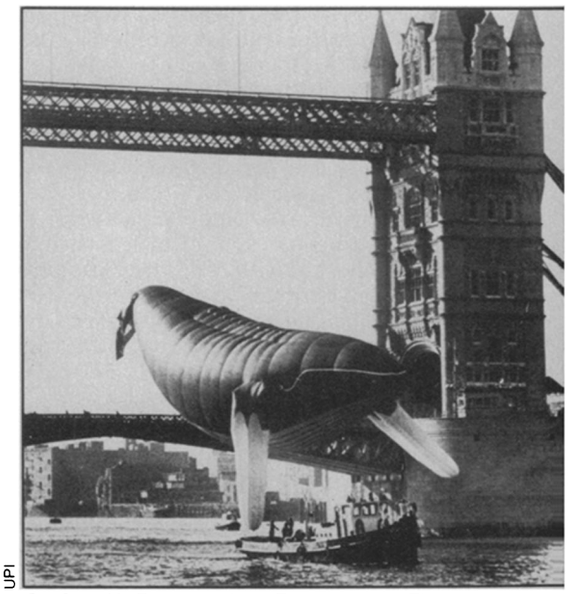
The tracking of hot spots beneath the continents in the past is controversial and filled with pitfalls. But Morgan is a respected plate tectonics theorist with a good track record. He is credited along with J. Tuzo Wilson with originating the hot spot hypothesis. And in response to an inquiry as to whether they consider their proposal just a highly tentative speculation, Crough was emphatic. "No. We absolutely believe it. It all fits." □

The week of the whale: A moratorium

The week of July 9 was a big week for whale conservation, but not big enough, say some conservationists. The 31st annual meeting of the International Whaling Commission, held in London, produced two important measures to protect whales: a limited ban on the use of factory ships (floating bases to which smaller hunting ships bring the whales they kill for processing) and the establishment of a whale sanctuary in the Indian Ocean, an area of 40 million square miles.

The Commission refused to pass a proposed three-year moratorium on hunting the endangered sperm whale, although it did reduce the allowable quota to 2,203 from 9,350 last year; allowed Spain, a new member, 143 fin whales (also endangered), raising the world quota to 604, from 407 last year; and permitted aboriginal whalers (Alaskan Eskimos, Greenlanders and Bering Sea Russians) to continue hunting bowhead, humpback and gray whales. The bowhead population is down to about 2,264 animals, and bowheads, along with humpbacks, are considered highly endangered. But Richard A. Frank, administrator of the National Oceanic and Atmospheric Administration and the U.S. whaling commissioner who strongly endorsed aboriginal hunting allowances, told SCIENCE NEWS that only 18 bowheads and 10 humpbacks can be killed by these primitive whalers. Whaling is essential to their cultures and survival, he said. And they are being urged to use more efficient hunting equipment to reduce the number of whales they lose.

The factory ship ban most severely affects the Soviet Union and Japan, who managed to get an exemption to hunt the minke whale, a smaller (30-foot) and more populous whale, with their factory ship fleets. The quota for minkes was in fact raised to 12,006, from 10,173 last year, and they will not be protected in the Indian Ocean sanctuary below 55°S. The ban essentially forbids pelagic (deep sea) whaling by IWC members, but does little to prevent "pirate whalers" — factory ships that fly flags of convenience. But Japan has agreed to stop buying whale products from pirate whalers, South Africa prohibits pirate whalers from its ports and the United States is considering retaliatory fishing bans against countries who violate IWC regulations in U.S. waters.



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On July 13, Friends of the Earth floated Flo the Whale under London's Tower Bridge.

Christine Stevens, a conservationist who attended the meeting, criticized what she called the IWC's "whaling club mentality" and the "backroom atmosphere" of the meeting. Decisions on quotas were often made in secret, she told SCIENCE NEWS, and quota reductions "were not nearly as much as we would have hoped." Even a complete ban on hunting such rare whales as the bowhead may not prevent their extinction, she said. □