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Science

Sea change had major effect on coral reefs

Ocean chemistry led to death, rebound, JHU student finds

By DENNIS O'BRIEN
SUN STAFF

Using eerie blue lights and modern formulas for ancient seawater, Justin Ries has re-created the oceans of 120 million years ago in 10 gallon tanks in an East Baltimore lab.

The graduate student at the Johns Hopkins University is trying to figure out why prehistoric generations of coral reefs died off for 85 million years — and then bounced back.

MONICA LOPOSSAY : SUN STAFF

Justin Ries, a graduate student and scuba diver, with some of his coral.

The water in Ries' tanks looks no different from what flows out of most faucets, but its appearance is deceiving. That's because Ries has replicated the chemistry of the ancient seas by adjusting the amounts of magnesium and calcium — two key ingredients for life.

To find out what happened long ago, Ries dumped three species of *Scleractinian* corals, today's major reef builders, into the tanks. He kept them at tropical temperatures and equipped the lab with special blue spotlights to mimic sunrise and sunset wavelengths.

He tried six different seawater chemistries, based on recent theories about ancient [*See Reef, 8D*] sea ingredients, and spent two months measuring the coral growth in each tank. He also documented the chemical content of skeletons that the corals produced.

The results, presented at a scientific conference this month, show that subtle variations in ocean chemistry have had major effects on sea corals throughout the ages. The coral reefs disappeared 120 million years ago and reappeared 85 million years later largely because of ocean chemistry.

"It shows that these things really are at the mercy of their environments," said Steven Stanley, a Hopkins paleontologist who is Ries' adviser.

The work fascinates Ries, a native Baltimorean, scuba diver and former schoolteacher pursuing a doctorate in geobiology. The oceans are constantly changing, he says, and corals are a kind of canary in the coal mine — a reference to the birds that 19th-century miners kept underground and watched because they were so sensitive to potentially deadly gas releases.

"People never thought to explore this because they thought the ocean was the ocean and nothing could ever change it," said Ries, 28. "Nobody ever believed that seawater changed, but it does."

Experts blame many of the changes in seawater chemistry on undersea volcanic activity.

Over millions of years, shifting plates are constantly spreading the ocean floor apart and slowly altering the seas by exposing them to hot, underwater volcanic rocks. As the water mixes, it soaks up and releases different chemicals, experts say.

"The chemistry of the rocks changes in the process and it changes the seawater significantly," said Lawrence Hardie, a Johns Hopkins geochemist and one of Ries' mentors who developed the theory in the 1990s. Ries used recipes for ancient seawater based on Hardie's work.

Ries said his experiments confirmed that coral growth rates and the types of skeletons they produce are determined by the amounts of magnesium and calcium in the water.

When magnesium levels are high and calcium levels low — as in today's oceans — the corals thrived and produced a crystalline byproduct in their skeletons known as aragonite. But when magnesium levels drop, leaving a high proportion of calcium — as it was 120 million years ago — the corals grow more slowly and produce calcite.

The cycle is slow but never-ending: The corals shift back and forth, producing aragonite and then calcite, every 100 million years, Stanley said.

Changes in ocean chemistry also wreaked havoc with ancient populations of plankton, mollusk and sea urchins, said David Jablonski, an expert on evolutionary biology at the University of Chicago.

"There's this eerie correlation between ocean chemistry and these boom and bust cycles of different aquatic organisms," Jablonski said. "We're just starting to look at what it's all about."

There is more at stake than ancient history.

Corals are tiny aquatic organisms that secrete skeletal material that becomes the limestone framework for reefs. They grow in seas everywhere — and not just on reefs. For example, much of the coral used in jewelry comes from the Pacific and the Mediterranean and is a different species than the reef-building coral.

Coral reefs are often compared to tropical rainforests because of their diversity and fragility. They survive only in clean, clear water near shorelines, won't grow in waters deep-

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