Atlantis of the iguanas found in Pacific

Call it Darwin's version of sunken treasure. A team of German scientists has discovered ancient predecessors of the Galápagos Islands now resting more than 1,000 meters below the ocean surface off the west coast of Costa Rica. The drowned islands may help biologists explain the biological riches of the modern Galápagos, where the father of evolutionary theory gained his most important insights.

The find "shows that the Galápagos archipelago existed in its present [form] since at least 14.5 million year ago. That is important for evolutionary studies," says Reinhard Werner of Geomar in Kiel, Germany, whose team reported the discovery this month in GEOLOGY.

The Galápagos is a collection of volcanic islands about 1,000 kilometers west of South America. The islands sit above a so-called hot spot in Earth's interior, where a stream of blistering rock rises from the mantle and melts its way through the crust to form volcanoes.

These mountains don't stay put, however, because they are riding on top of mobile tectonic plates—the pieces of Earth's broken outer shell. Over millions of years, the older of the Galápagos islands migrate toward Central and South America while newer ones rise up over the hot spot. The oldest of the existing Galápagos islands dates back only 3 million years, a relatively short geologic span.

To trace the history of the Galápagos, Werner and his colleagues dredged up samples of rocks along the Pacific coast of Costa Rica. On the Cocos Ridge and other submerged mountains, they found volcanic rocks with a mix of elements similar to those found in the present Galápagos—evidence that the near-shore seamounts had formed over the same rising plume of hot rock.

The German team found these rocks on mountain peaks currently 1,000 to 3,000 m below the surface. In the past, however, these volcanoes had reached above sea level, according to the researchers.

The geologists found rounded rocks welded together, structures that form only when blobs of liquid lava shoot into the air and harden on the way down. The rocks have also lost most of their sulfur, a process that doesn't occur deep underwater, says Werner. Furthermore, one of the submerged volcanoes, the Quepos Plateau, has a flat top reminiscent of old islands, which rain and waves have worn down.

By dating radioactive elements in the underwater mountains, the German researchers determined that these volcanoes formed 14.5 million years ago. As the islands drifted away from the Galápagos hot spot, the seafloor on which they rode slowly sank and the peaks of these older volcanoes withdrew beneath the waves, Werner and his colleagues propose.

Geologists had previously found an isolated Galápagos seamount that would have been an island 9 million years ago. The new work has revealed the remnants of an entire archipelago reaching back significantly earlier, says Werner.

The extra 5 million years may help explain the evolution of Galápagos iguanas, says Hampton L. Carson, a geneticist at the University of Hawaii at Manoa in Honolulu. Land and marine iguanas on the islands appear to have descended from a single species that floated over from South America on branches and other debris. Studies of the two living species suggest that they split apart 15 million to 20 million years ago, so there must have been Galápagos islands that far back. Heirs of those early settlers would have gone on to populate the newer volcanoes as they formed.

"The present Galápagos Islands are just a snapshot of a long-term process that has been producing islands in that region for over 15 million years," says Robert A. Duncan of Oregon State University in Corvallis, who has studied the Galápagos hot spot. Some available evidence may even push the record of former Galápagos islands back to the days of the dinosaurs, as much as 90 million years ago, he says. *—R. Monastersky*

Polluted air chokes northern Indian Ocean

A sooty haze hovered over the northern Indian Ocean this spring, outstripping the worst expectations of an international team of scientists that spent 6 weeks in the area studying the pollution.

The haze stretched from the ocean surface to an altitude of more than 2 kilometers. Surveying the atmosphere from a research aircraft, James A. Coakley of Oregon State University in Corvallis was astounded by the scope of the pollution. "We had a devil of a time finding clean air," he says.

Scientists believe that every year, cooking fires, vegetation burns, and industrial fuel combustion in urban areas of south Asia spawn the buildup of airborne sooty particles, or aerosols. Although summer monsoons probably wash away the aerosols, they quickly mount again, say researchers.

The work is part of an ongoing international effort called the Indian Ocean Experiment, or INDOEX. In February and March, more than 150 scientists from the United States, Europe, and India gathered data from weather satellites, ships, aircraft, and island observatories.

The work found that the aerosols reached as far south as the Intertropical Convergence Zone, close to the equator, where trade winds swirl together and shoot hot air to high altitudes. These winds can sweep pollution to far-flung areas.

"It's very disturbing," comments Anthony S. Wexler of the University of Delaware in Newark. The data suggest that human activity is doing major damage to the environment, he asserts. "The more large-scale perturbations that we see, the more chance that we're doing larger damage," he says.

On one ship, Russell R. Dickerson of the University of Maryland in College Park used paper filters to collect particles. "You didn't need any analytical instruments to know that there was a greasy, black soot all over the filters," he says.

Ramanathan

A polluted haze blankets the northern Indian Ocean, including the Arabian Sea and the Bay of Bengal.

Dickerson was surprised to find that despite the pervasiveness of the haze, it contained very little ozone, a prime component of Los Angeles–type smog. "It suggests that there's some fairly major aspect of atmospheric chemistry that we don't understand yet," he says.

The INDOEX project is the first to experimentally study the effects of the Indian Ocean region's persistent urban pollution on climate, rather than relying on theoretical models of the influence of aerosols, says Coakley.

In this area, sooty, dark aerosols absorb sunlight and contribute to climate warming. Brighter aerosols such as sulfates and nitrates reflect light back into space, exerting a cooling effect. Additionally, the particles seed large and long-lasting clouds, which also scatter light and promote cooling. The researchers are eager to learn which influence dominates.

If the pollution proves to have a net cooling effect, could it be an environmental blessing in disguise?

"Not by a long shot," says V. Ramanathan of the Scripps Institution of Oceanography in La Jolla, Calif., one of the project's chief scientists. He notes that the pollution alters the cycle of rain and evaporation from the ocean. Moreover, he observes, the aerosols don't remain aloft indefinitely. They return to the surface as acid rain. *—S. Carpenter*