Earth Science

No hiding place for Amazon refugia idea

For climate researchers, pollen grains are nothing to sneeze at. These pesky little particles can pack vast amounts of information about ancient worlds that have long since vanished. By studying prehistoric pollen from a lake in the Amazon, a team of researchers has overturned a long-held assumption about the peak of the last ice age, 18,000 years ago.

"The expectation was that the Amazon was dry during the last glacial maximum," explains Paul A. Colinvaux of the Smithsonian Tropical Research Institute in Balboa, Panama. Many researchers had assumed that the rain forest shrank then, forming small isolated patches called refugia that were separated by grasslands.

To test that theory, Colinvaux searched the Amazon basin to find an ancient lake containing pollen from the last ice age. "It's taken me 10 years of agony," he says.

The scientist and his colleagues hit pay dirt when they drilled into the sediments at the bottom of Lake Pata, just north of the equator. Carbon dating of the sediment layers reveals that they go back more than 40,000 years. In the Lake Pata sediments, pollen from grasses is extremely rare, even during the peak of the last ice age. This finding suggests that dry grasslands did not take over the Amazon at that time. Instead, the rain forest held its grip, the scientists report in the Oct. 4 SCIENCE.

Judging from the pollens present during the last ice age, Colinvaux calculates that the Amazon was 5°C to 6°C cooler then. This finding helps shore up evidence that at least the land area in the tropics cooled markedly during the ice age. These data stand in sharp contrast to evidence from ocean sediments, which indicate that little tropical cooling occurred during the ice age.

Supporters of the refugia idea contend that Colinvaux's evidence from one lake cannot address what happened to the entire Amazon. To fill in the gaps, he is planning to bore holes in many parts of the rain forest. "We're going to get the truth out of the Amazon somehow," he says.

Looking for life in the layers

Some of the earliest evidence for life on Earth comes from peculiar dome-shaped rocks called stromatolites, which go back 3.5 billion years. Geologists have long surmised that ancient microbial mats played a role in constructing stromatolites, but a new analysis shows that some of these deposits may be nonbiological structures unrelated to life.

The standard explanation for stromatolites holds that sticky microbial mats on the ocean floor captured particles of sediment and then covered them with a new layer of microbes, gradually building up large sedimentary domes. Modern stromatolites off the west coast of Australia grow this way.

John P. Grotzinger and Daniel H. Rothman of the Massachusetts Institute of Technology challenged this theory after studying 1.9-billion-year-old stromatolites from northwestern Canada. The scientists sliced through the formations and analyzed the thickness of calcite crystal layers within the rock.

Grotzinger and Rothman developed a mathematical model that includes only nonbiological processes, such as chemicals precipitating out of solution and sediments falling to the ocean floor. This model could account for the types of layers within the Canadian stromatolite, they report in the Oct. 3 NATURE. "Our result demonstrates that the morphology of at least some, and perhaps many, types of stromatolites may be accounted for exclusively by abiotic mechanisms," they suggest.

Even without stromatolites, though, the evidence for life 3.5 billion years ago remains secure. Paleontologists have recovered fossils of cyanobacteria from that age, indicating that life evolved even further back in time.

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