Abstractions

FIRST AUTHOR

Data on historical climate changes around the globe are crucial to understanding how external factors such as long-term variations in incoming solar radiation have affected climate regimes at high and low latitudes. However, until now, few high-quality climate records had been identified for equatorial regions. Dirk Verschuren, a palaeoclimatologist at Ghent University in Belgium, and his colleagues have discovered a climate archive that provides information about the unique history of monsoon rainfall in equatorial east Africa (see page 637). Verschuren tells *Nature more.*

Why has it been difficult to find archives of purely equatorial climate dynamics?

In much of western and central equatorial Africa, climate history has been strongly influenced by environmental changes at high northern latitudes, such as the area covered by sea ice. These changes determined how much tropical heat could be exported to the poles by the Atlantic Ocean circulation, which, in turn, affected the amount of monsoon rainfall over the western side of equatorial Africa.

How did you choose your site?

To get around this strong high-northern-latitude influence on equatorial climate, we went to the Indian Ocean side of the African continent. Exploratory coring in Lake Challa on the border of Kenya and Tanzania had documented finely laminated sediments, which can yield a high-quality climate record. When probing the lake floor with seismic-reflection equipment, we found that it contains more than 250,000 years of sediment and that it could answer our questions about equatorial monsoon dynamics.

Was gathering samples a challenge?

At first, yes. In our initial visit we built a coring platform by affixing pieces of timber across two fishing canoes. But the canoes had been crafted from crooked local tree trunks. It was difficult to build a sturdy platform and row it to where we needed it. When we returned for deeper, older mud, we brought our own platform and an outboard engine.

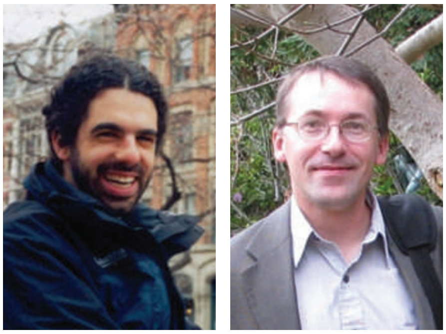
Why is your finding important?

We've learned that when high-northern-latitude influences are modest, equatorial climate history is a hybrid of tropical monsoon dynamics in the northern and southern hemispheres. The Challa climate record also shows that tropical rainfall has always varied. Because natural background conditions are so variable, it's not easy to tell by how much anthropogenic greenhouse-gas emissions have affected tropical climate. ■

MAKING THE PAPER

Ronald R. Breaker & Zasha Weinberg

A search of ocean bacteria reveals unusual RNAs.



Zasha Weinberg (left) and Ronald Breaker.

For many years, proteins were given all the credit for mediating biochemical reactions in cells. That view changed in the early 1980s with the discovery that some RNA molecules that do not encode proteins can assume intricate three-dimensional forms and catalyse reactions. Since then, many RNA catalysts have been described, the most well-known being the ribosome — the cellular machinery for making proteins — the active complex of which consists of two large RNA molecules.

However, further work suggests that we have only just scratched the surface when it comes to understanding the scope of RNA functions. "There are going to be more exotic functions for RNA in biology," says Ronald Breaker, a Howard Hughes Medical Institute investigator at Yale University in Connecticut, whose group conducted the study detailed on page 656. "We have not yet come to grips with all that will be discovered."

Breaker's journey towards his most recent work started when, in 2002, he identified a class of non-coding RNAs dubbed riboswitches. These help cells to respond to changing environmental conditions by binding to metabolites and then switching the expression of particular genes on or off. By determining key components in the sequences and the three-dimensional structures of riboswitches, Breaker's lab was able to devise bioinformatics tools to identify similar RNA molecules by scanning bacterial genome sequences.

Shortly after joining Breaker's lab in 2005, postdoc Zasha Weinberg started to further refine the lab's bioinformatics tools. In 2007, he embarked on a project to apply these tools to the extensive genome databases available for ocean bacteria collected by scientists such as Craig Venter. The bulk of the work, Weinberg says, consisted of sifting through thousands of computer predictions and selecting the most promising ones, by applying various algorithms and what Breaker calls 'RNA intuition'. "As RNA researchers, we have a good feel for what predicted structures are reasonable and which ones are unlikely to be functional," he says.

In the end, Weinberg and Breaker produced a list of more than 75 RNAs that seemed worthy of investigation. Two in particular, GOLLD and HEARO, stood out because of their sheer size, which is close to that of the bacteria ribosomal RNAs. "All the other large non-coding RNAs known were identified decades ago, so this was really exciting," says Weinberg.

Further experiments by the duo and two other postdocs whose help Weinberg enlisted revealed that GOLLD and HEARO are not only large but also assume complex three-dimensional configurations. "From the size and structural complexity of these molecules, it is likely that they catalyse biochemical reactions or are involved in equally sophisticated processes," says Weinberg. Initial evidence suggests that GOLLD helps bacteriophages — viruses that target bacteria — to burst out of infected cells, whereas HEARO is associated with mobile genetic elements, bits of DNA that can move around the genome of a cell.

Four other RNA structures, termed IMES-1–4, also caught Weinberg's attention, owing not to their size but to their abundance. On the basis of their prevalence in bacterial samples collected in the ocean near Hawaii, the IMES seemed to be expressed at levels comparable to one of the most common bacterial RNAs, the ribosomal 5S RNA, and so might have equally important functions.

To directly test the prevalence of IMES RNAs in bacteria, the group decided to search waters close to home. "We looked at maps to find deep waters close to a location that we could drive to," says Weinberg. In the end he and the other two postdocs set out for Block Island Sound, an area of the Atlantic Ocean off the coast of Long Island, New York. Thad Gruczka, the captain of the fishing boat they rented for the day, happened to have a degree in marine science and provided advice and assistance in water collection. Back in the lab, the group isolated RNA and then looked for matches to IMES. "They are very abundant in our own ocean samples," says Weinberg. "Any time you go swimming, you will probably come across bacteria containing these RNAs that, until now, no one even knew existed."

Breaker says it will take some time for his and other labs to determine the function of all of the RNAs they have identified. At the same time, they will continue to sift through other candidates and perform additional searches. And Weinberg plans to stick around to help with that work. "There will be many more RNAs to find as people sequence DNA from other environments, he says. "I am really excited about what is out there." ■

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