



Drought records in stalagmites from Mawmluh Cave in India's Meghalaya state are ambiguous.

IN DEPTH

EARTH SCIENCE

New geological age comes under fire

Timing and extent of ancient drought used to define the Meghalayan are uncertain

By Paul Voosen

Last month, the International Commission on Stratigraphy (ICS), the bureaucracy that governs geological time, declared we are living in a new geological age. No, it's not the Anthropocene, the much-debated proposal for a geological division defined by human impact on Earth. The new age anointed by ICS is called the Meghalayan, based on signs in the rock record of a global drought that began about 4200 years ago. It is one of three newly named subdivisions of the Holocene, the geological epoch that began 11,700 years ago with the retreat of ice age glaciers. And the name will now filter its way into textbooks.

Many scientists say, however, that the "4.2-kiloyear event" was neither a global drought nor fixed to that moment in time. "The whole idea of defining the subdivision of the Holocene with a break at 4.2 seems a bit baseless," says Raymond Bradley, a climatologist at the University of Massachusetts in Amherst. Jessica Tierney, a paleoclimatologist at the University of Arizona in Tucson, says ICS, following the lead of some paleoclimate scientists, mistakenly lumped together evidence of other droughts and wet periods, sometimes centuries away from the 4200-year-old event, to mark the beginning of the Meghalayan. This is a "paleoclimate white whale," she says.

The first clues to the Meghalayan came from archaeology. In the early 1990s, Harvey Weiss, an archaeologist at Yale University, was excavating a compelling story of drought-induced collapse in Mesopotamia. At Tell Leilan, an ancient city of the Akkadian Empire in northeastern Syria, he found evidence that drought pushed people out of the city 4200 years ago. The signal repeated across much of Mesopotamia.

It was a good starting point for Mike Walker, a geologist at the University of Wales in Lampeter who a decade ago began the effort to divide the Holocene. Scientists commonly talk about an early, middle, and late Holocene—tracking the glaciers' retreat and partial return—but with wildly different time spans in mind. ICS asked Walker to standardize those divisions for the sake of clear scientific communication. But although abrupt changes in the rock record mark earlier geological divisions, such changes are scarce in the relatively calm Holocene.

Finding a date to divide the early and middle Holocene, now dubbed the Green-

landian and Northgrippian, was easy, Walker says. About 8200 years ago, an outburst of freshwater from naturally dammed glacial lakes poured into the North Atlantic Ocean. The floods are believed to have disrupted a conveyor belt of ocean currents, leading to signals of global cooling that can be reliably found in ice cores, lakebeds, and cave rocks.

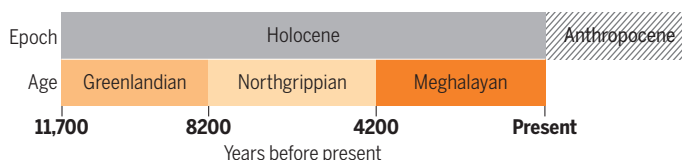
But the second division proved harder. "We were struggling," Walker says. Fortunately, some paleoclimate scientists were picking up where Weiss's archaeological work left off. Signs of a 4200-year-old drought were emerging in the Mediterranean, the Americas, and Asia, where researchers linked it to a weakened monsoon. In 2012, paleoclimatologists reported an analysis of a stalagmite from Mawmluh Cave, a limestone complex in Meghalaya state, a wet part of northeastern India. Stalagmites, calcium carbonate formations on the floors of caves, grow drip by drip as mineral-rich rainwater seeps in. In the Mawmluh stalagmite, a shift in oxygen isotopes seemed to show a stark drying around 4200 years ago, a clear signal of centuries-long drought.

Walker thought the stalagmite signal could serve as the perfect geological exemplar, or "golden spike," marking the beginning of the Meghalayan. In June, a few dozen geologists from ICS and its parent body ratified Walker's proposal for the new ages with little dissent.

Paleoclimatologist Ashish Sinha is surprised that ICS used

Rocks of ages

Geologists have divided the Holocene into three ages. One, the Meghalayan, is based on controversial evidence. A new epoch, the Anthropocene, is still under debate.



the stalagmite for its golden spike—and few know it better, as it was his lab at California State University in Dominguez Hills that found and analyzed it. His team could date only a few of the stalagmite's layers, and water had partially dissolved the rock close to the drying event, potentially blurring the record. An unpublished analysis of other Meghalayan stalagmites by paleoclimate scientists from Xi'an Jiaotong University in China adds to the doubts: It found a steady weakening of the monsoon over more than 600 years, rather than a sudden drought 4200 years ago. The closest thing to a sharp drought can be seen 4000 years ago, in a few decades-long events. These excursions could be said to match the golden spike “to an extent,” says Gayatri Kathayat, who led the research, “but not entirely.”

Elsewhere in the world, the 4200-year-old event is even less apparent, according to a team at Northern Arizona University (NAU) in Flagstaff. Over the past few years, the NAU team has amassed 550 published paleoclimate records of temperature and moisture change during the Holocene, based mainly on stalagmites, lake sediments, and ice cores. Graduate student Hannah Kolus scrutinized the records in vain for significant changes in global temperature or moisture about 4200 years ago. “You don’t see that signal at all,” Kolus says.

The archaeological evidence is also far from definitive, adds Mark Altaweel, an archaeologist at University College London. He says political collapse, not drought, may have doomed some settlements in Mesopotamia. And in ancient Egypt, Greece, and elsewhere the evidence of a global drought is even murkier, adds Guy Middleton, an archaeologist at Charles University in Prague. “Nothing happened as suddenly or as synchronously as made out.” The drought makes no sense as a marker, he says. “It is new mythmaking.”

Walker wishes Kathayat’s new stalagmite records had been published in time for their proposal. But he thinks that, though scattered in time and space, the signs of drought are good enough to define a new division that geologists can use to clarify their discussions of the Holocene. “The fact that this is extremely damned close is encouraging for us,” Walker adds. For Bradley, it shows the stark division between ICS, which studies Earth’s deep history, and scientists who study the recent past. “[We’re] on totally different pages, really totally different books,” Bradley says.

Critics of the Meghalayan will have plenty of time to bolster their arguments because for now, debate is over. To prevent continual spats, ICS freezes discussion for a decade after it ratifies a boundary. “It gives time for new ideas to bed down,” Walker says. ■

RESEARCH FUNDING

March of Dimes curtails support for researchers

Cuts at historic nonprofit leave grantees fuming

By Kelly Servick

March of Dimes, the 80-year-old nonprofit organization that helped develop the polio vaccine and has funded pioneering studies of birth defects, is abruptly scaling back some research grants amid financial struggles. Scientists have been caught by surprise.

In recent weeks, the group has told 37 of the 42 recipients of its individual investigator awards that it is ending their grants, which average \$300,000 over 3 years. It plans to maintain the remaining awards at reduced levels; all five are focused on understanding and preventing premature birth. The group, based in White Plains, New York, is also trimming grants to its prematurity research centers, which are housed at academic institutions around the United States. It will not award any new grants this year, but still plans to give out eight to 10 of its 2-year, \$150,000 awards for young scientists in 2019.

March of Dimes has trimmed about \$3 million from its annual research budget of roughly \$20 million this year, says Kelle Moley, the group’s chief scientific officer. She attributes the group’s struggles to declining donations, particularly from the organization’s signature March of Babies. “The walks were our main funding source ... and now there’s a million different kinds of walks,” Moley says. “They’re just not getting the donations that we used to get 10 or 20 years ago.” Tax filings show that the group’s expenses have exceeded revenues each year from 2012 to 2016. It announced last year that it would sell its headquarters in White Plains.

The cuts also reflect a strategic shift to focus research spending on preterm birth, which Moley calls “the biggest threat right now facing newborn babies.”

Researchers are lamenting the loss of a key funding source for an often overlooked area of research. “These sort of basic research grants in developmental biology are hard to come by,” says developmental biologist Maria

Jasin of Memorial Sloan Kettering Cancer Center in New York City, who had a \$250,000 award from March of Dimes to study a protein that influences DNA rearrangement during sperm and egg formation. “It’s really a shame that there will now be this hole.”

Jasin and other grantees say they were blindsided by the cuts, and now are scrambling to find ways to support graduate students and activities funded by the grants. “The way they’ve approached this has been completely inhumane,” says molecular biologist Andrew Holland of Johns Hopkins University School of Medicine in Baltimore, Maryland, who had a 3-year, \$250,000 grant from March of Dimes to study the role of a genetic pathway in microcephaly. A late July email from the group informed him that he would not be receiving the

remaining \$160,000 on the grant. “The lack of transparency has been nothing short of appalling,” he says.

Chromosome biologist Andreas Hochwagen of New York University in New York City, who had a March of Dimes grant to probe chromosomal mishaps during the creation of sperm and egg cells, was startled to learn in late July that the group

would pay only for project expenses incurred through June. “For the whole month of July ... they didn’t tell me that I wasn’t being supported anymore,” he says. “That I find a little outrageous.”

Moley acknowledged that the cuts have created “a little bit of a gap” for some researchers. “I understand this is difficult for them, and I know the March of Dimes has been very generous in the past,” she says. She also says the organization has been seeking more corporate donors. “I’m hoping that as we go forward, and as our plan is working ... we can go back to funding a more broad focus.”

March of Dimes has changed course before. It was founded in 1938 by then-President Franklin Roosevelt as the National Foundation for Infantile Paralysis and funded pioneering efforts to develop a polio vaccine. When such vaccines became widely available, the group shifted its focus to birth defects. ■

“The lack of transparency has been nothing short of appalling.”

Andrew Holland,
Johns Hopkins University

New geological age comes under fire

Paul Voosen

Science **361** (6402), 537-538.
DOI: 10.1126/science.361.6402.537

ARTICLE TOOLS

<http://science.sciencemag.org/content/361/6402/537>

PERMISSIONS

<http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

Science (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. 2017 © The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. The title *Science* is a registered trademark of AAAS.