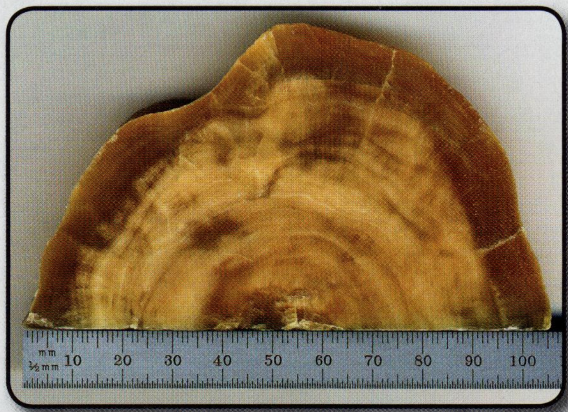
DROUGHT TO BLAME FOR ROME'S DECLINE?

Wars and invasions may not be solely to blame for ending the Roman and Byzantine empires. A highly precise rainfall record coaxed from a stalagmite in an Israeli cave reveals a period of increasing dryness in the region from A.D. 100 to 700. Those dates correspond with the wane of both Roman and Byzantine rule in the Eastern Mediterranean and may indicate that climate also played a role in the empires' downfalls in the region, according to new research.

For more than 40 years, geologists have used speleothems — cave growths also known as stalactites and stalagmites — as recorders of past climate. Oxygen isotope patterns derived from calcite in these formations can provide estimates of temperature and rainfall at the time the speleothems were growing.

But the methods used to obtain these samples — drilling through speleothems with dental drills — can only reveal climate averages over tens of hundreds or even tens of thousands of years, as even a tiny spot on a stalagmite can correspond to a lengthy period of growth. In the last few years, however, researchers have used a new technology, called ion microprobe analysis, to obtain microscopic samples. The samples, as small as one-hundredth of a millimeter, are so miniscule that their geochemical contents can represent annual or even seasonal changes in climate.



Like a tree ring, growth bands from a stalagmite from a cave in Israel point to drier or wetter periods in history.

Ian Orland, a graduate student at the University of Wisconsin at Madison, teamed with his advisor, geologist John Valley, and researchers in Israel to apply the new technology to calcite samples from a stalagmite that grew from approximately 200 B.C. to A.D. 1100 in Israel's Soreq Cave, located just southwest of Jerusalem.

When rain falls above a shallow cave, such as Soreq, it can pass through the ground and carry organic materials. Water that makes it through the cave wall drips down, forming the growths over thousands of years. Using confocal laser fluorescent microscopy, Orland and colleagues noticed light and dark bands in the speleothem, much like a tree's rings. The bands correspond to wet and dry seasons, when the concentration of organic materials that flushed into the cave fluctuated with rainfall, they reported in the journal Quaternary Research. Meanwhile, the researchers established a baseline for comparing oxygen isotopes to annual rainfall at Soreq, which they used to reveal rainfall levels for each year the stalagmite grew.

New research suggests that prolonged droughts may have contributed to the downfall of the Roman Empire.

Combining the oxygen isotope analysis with measurements of the differences between the light and dark bands over time, the team concluded that rainfall amounts were slashed in half from A.D. 100 to 700. The years around A.D. 100 and 400 saw particularly steep drop-offs in precipitation; these periods coincide with drops in the Dead Sea's water levels.

Researchers hope to use the newly acquired data to draw connections between geology, climate and changes in human society. "Usually one year that is dry doesn't make a drought," Valley says, "but if you have multiple dry years, food supplies get exhausted and horrible things can go on." He notes that climate is likely only one of the reasons for the downfall of the empires in the Eastern Mediterranean, working in concert with military and trade conflicts as well as disease. "We're trying not to overstate what we've done, but we have established a very interesting correlation."

Patrick Mickler, a lecturer at California State University at Bakersfield, agrees, calling the work "a great leap forward." Many more geologists will likely find annual growth bands in speleothems once they start looking, Mickler says.

Valley and Orland are next planning to analyze older speleothems to obtain precise records of older climate trends. That way, climate modelers will have an arid counterpart to the ice core records that have been used to model and forecast climate in the past. "If we're settling in for some rapid climate changes of our own," Orland says, "the records could tell us what we might expect to see where."

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