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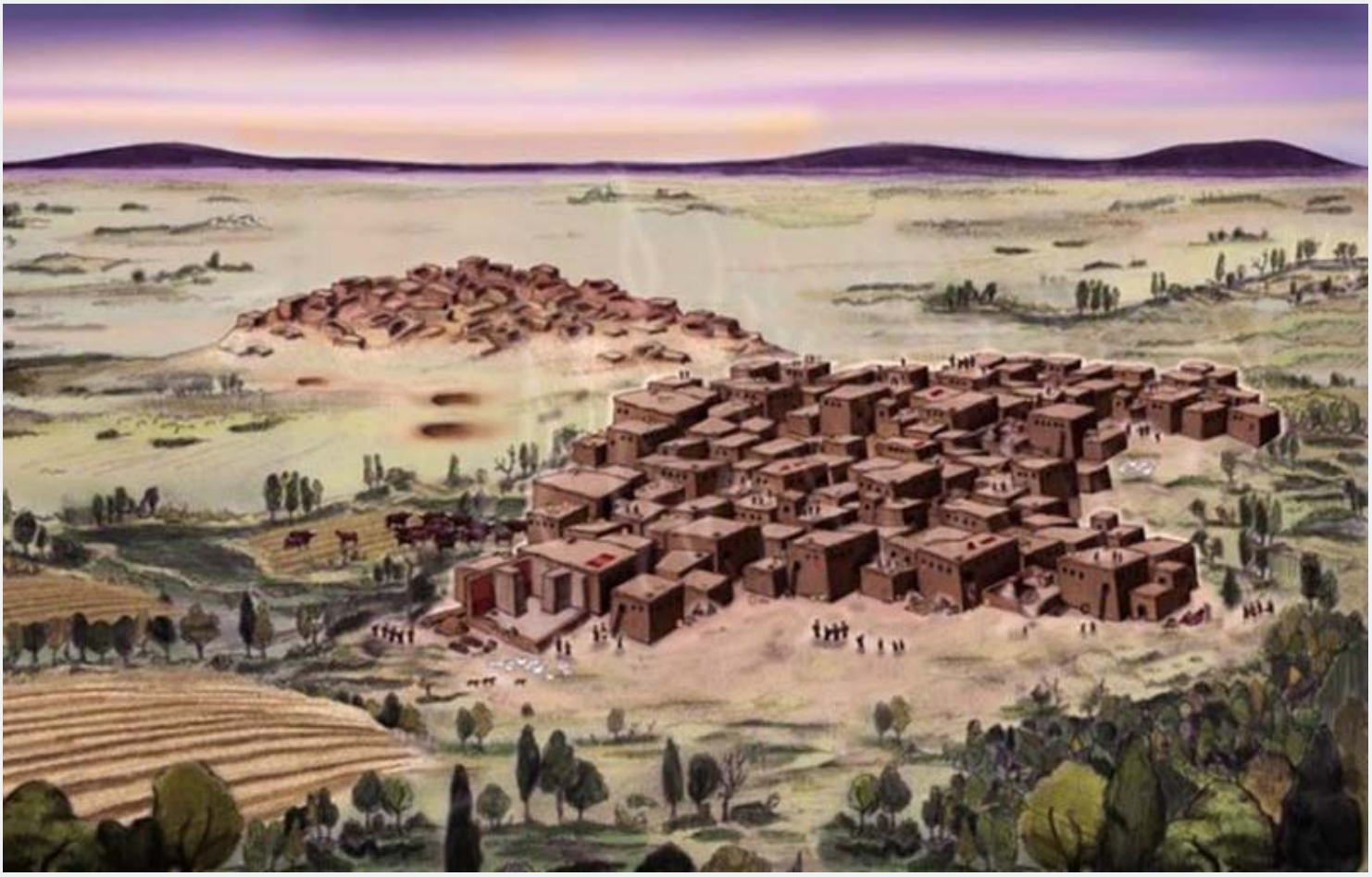
NEVER LICK THE POTSHERDS —

Archaeologists use ancient dirty dishes to reconstruct climate shifts

Hydrogen isotope analysis reconstructed the impact of a Neolithic climate shift.

KIONA N. SMITH - AUG 13, 2018 7:35 PM UTC



Çatalhöyük Research Project

Enlarge / Artist's reconstruction of the east and west mounds at Çatalhöyük. In the foreground, you can see the newer west mound, with the older east mound decaying in the background.

Around 8,200 years ago, melting glaciers poured fresh, cold water into the North Atlantic, causing the climate in Europe and Southwest Asia to turn suddenly colder and drier for about the next 160 years. Evidence of that event shows up in ice cores from Greenland, tree rings and lake sediments in Europe, and lake sediments and peat deposits in Southwest Asia.

How did it affect people who were only beginning to adapt to agriculture? Archaeologists can't confidently link what was happening at an archaeological site, like Çatalhöyük in Turkey, with what pollen and oxygen isotopes say was happening 160km (99.4 miles) away at Lake Nar, because local conditions can vary.

New chemical analysis of animal-fat residue in broken pottery has now given us a clearer look at how changes in the North Atlantic impacted life at Çatalhöyük. Local climate turned slightly cooler year-round and noticeably drier in the summer, which would have reduced crop yields and food availability for local farmers' cattle and goats. Equipped with direct evidence of local climate shifts, archaeologists examined artifacts at the site to understand how people coped with the lean times.

Slightly colder, with much less rain

Early farmers settled at Çatalhöyük around 9,050 years ago; by the time the cold snap rolled around, they had long since domesticated cattle, goats, and some grain crops. The site was a substantial town where people lived in large, communal houses with multiple rooms and interior structures, and the inhabitants buried their dead nearby. Over the centuries, they left behind layers of buried evidence about the details of life here: the remains of their homes and hearths, the graves of their dead, bits of the animals and plants they ate, stone tools, and more than 13,000 fragments of broken pottery once used for cooking and storing food.

And some of those pottery fragments still hold residue from those ancient meals—specifically, fatty acids usually found in animal fats. The ratio of deuterium (an isotope of hydrogen with a proton and a neutron in its nucleus, instead of just a proton) to other hydrogen isotopes in those fats can reveal information about the ancient climate. Generally, local water supplies tend to have more deuterium than regular hydrogen when there's less precipitation; plants and animals integrate those hydrogen ratios into their own bodies, and millennia later, archaeologists can use them to learn about ancient rainfall.

Combine that with the fact that the layers of artifacts at Çatalhöyük are very precisely radiocarbon-dated, and archaeologists can reconstruct people's responses to ancient climate shifts at a very specific location instead of making broad statements about general trends across a whole region.

Chemist Mélanie Roffet-Salque of the University of Bristol and her colleagues found that, during the period from 8,295 to 8,110 years ago, deuterium ratios were about nine-percent higher than those found in earlier and later layers of Çatalhöyük.

That lines up well with climate-modeling studies in which Roffet-Salque and her colleagues combined the results of 10 climate models for Greece and Turkey, predicting about a 10- to 15-percent drop in summer precipitation during the cool period (winter precipitation didn't change much, resulting in an annual average just four-percent drier). The models also showed a drop of about 1º to 2º Celsius (1.8º to 3.6º Fahrenheit) in average annual temperatures. The resulting increase in deuterium ratios lines up well with what archaeologists saw in animal fat residues from the period.

Verity Cridland

Enlarge / The modern-day fields around the archaeological site of Çatalhöyük.

Lean times for livestock

The abruptly cooler, drier climate must have been bad news for both crops and livestock in Southern Turkey. Less rain means lower crop yields, and it also means scarcer foraging for cattle and goats. Colder winters usually mean livestock need more calories to stay warm and maintain bodily functions—up to twice as many if the weather is cold enough. Cattle bones from the layers of Çatalhöyük corresponding to the climate shift show signs of malnutrition.

“Livestock was severely impacted at Çatalhöyük, and the early farming community had to show resilience and adaptability in a period of abrupt climate change,” Roffet-Salque and her colleagues wrote. Most noticeably, the inhabitants of Çatalhöyük switched to raising more goats than cattle. Studying livestock bones at the site, archaeologists found that, around the time of the century-and-a-half cold snap, cattle herds at Çatalhöyük got smaller while goat herds got larger. Goats are more efficient milk producers than cows and can graze smaller areas, so the shift may have been an effort to make the best use of scarce resources.

Around the same time, archaeologists noticed that bones from butchered animals showed more slice marks than those from earlier layers, which indicates that either people had learned better butchering techniques or they were making more effort to get every scrap of meat off the bones—more likely, a combination of the two. And archaeologists started finding the bones that contain grease and marrow broken more often, which is usually a sign that people are struggling with food scarcity.

A changed society

Faced with lean times, the people at Çatalhöyük made drastic changes in how they lived and how they built their homes. The large, multi-roomed communal houses of the first thousand years or so shifted to what Roffet-Salque and her colleagues describe as “light shelters with large open space” during the cold snap.

And in the following centuries, those shelters eventually gave way to a different form of multi-roomed home, with a central living space surrounded by smaller work and storage rooms. While pre-crisis homes had housed several families, based on the artifacts found within and the large numbers of burials associated with them, these post-crisis homes housed smaller, more independent households. Archaeologists aren't sure why people would have shifted their living arrangements so drastically in response, but ultimately, it wasn't enough to sustain the settlement.

"They proved to be unsustainable, and the previously flourishing settlement rapidly shrunk, unavoidably leading to its relatively abrupt and sudden collapse and ultimate abandonment in 7925-7815 cal BC," Roffet-Salque and her colleagues wrote.

Where did they all go? Roffet-Salque and her colleagues speculate that the climate crisis may have played a role in the migration of farmers from Anatolia into Eastern and Central Europe. Of course, it's likely that climate change alone can't explain all of the differences in how people lived at Çatalhöyük or their eventual migration elsewhere.

"Our ability to detect such changes linked to climate changes are just the beginning of the story, not the end," University of Bristol chemist Richard P. Evershed told Ars Technica. "Now we can begin to explore the other factors."

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