South Africa's desert-like interior may have been more inviting to our human ancestors

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Flowering Karoo Desert in spring, near Willowmore, Eastern Cape, Southafrica. Credit: Winfried Bruenken (Amrum)/Wikimedia Commons, CC BY-SA

Lining the Cape of South Africa and its southern coast are long chains of caves that nearly 200,000 years ago were surrounded by a lush landscape and plentiful food.

During a glacial phase that lasted between 195,000 to 123,000 years ago, these caves served as refuge to a group of humans that some researchers think were the only people to survive this ice age, called Marine Isotope Stage Six, or MIS6. And in this coastal region, a lot of archaeological research has taken place. Of less interest to archaeologists has been the interior of South Africa, which was thought to be an uninhabited, inhospitable place during at least two waves of ice ages, MIS3 and 2.

Now, a study has shown that the region might have been more fertile and temperate during these two glacial periods than previously thought, and that the region likely played host to human populations living around a series of paleolakes. The study, led by University of Michigan archaeologist Brian Stewart, provides a more comprehensive timeline of the age and stages of these lakes, and shows human fingerprints across the region. The research is published in *Proceedings of the National Academy of Sciences*.

"There's this perennial assumption that human population centers were always along the coast and that the interior, especially the southern interior of the Karoo Desert, were largely depopulated for long stretches of time," Stewart said. "The funny thing is that one just has to go into the interior and walk around and notice that there's archaeology everywhere."

But to flag the region as worthy of archaeological attention, the researchers needed to show that humans could have actually lived there. The research team, an international group including researchers from South Africa, the United Kingdom and France, examined a series of super flat areas of land ringed by higher ground. They showed that these

regions, called "pans" in Afrikaans, are ancient lake beds, while the areas of higher elevation that encircle them are erosional landforms and sedimentary deposits left over from their ancient shorelines.

This suggests that these time periods were not as dry in this region as previously thought: there would have needed to have been sustained rainfall and humidity to keep these lakes full. The more temperate climate required to sustain lakes also meant the landscape was also able to sustain both vegetation and animals required to support human populations.

Reconstructing the paleolakes

The researchers used a variety of technologies to date and reconstruct these ancient lakes, shorelines and lake bottom deposits, and to recreate the landscape of the region.

These include radiocarbon dating and a technique called luminescence, which measures the radioactivity of tiny crystals of quartz or feldspar that haven't seen the light of day since they were covered by sediment tens of thousands of years earlier. While buried, electrons from radioactive elements common to all sediments get trapped in these crystal matrices at a constant rate. By measuring how many electrons accumulated in the sample and comparing that to the degree of background radioactivity, the researchers can predict its age.

The researchers used these techniques to date columns of sedimentary lakeshore and lake bottom deposits, called lacustrine deposits, found surrounding and within a series of three pans dotted across a region some 100,000 square miles, about the size of Texas. They also aged the shells of freshwater mollusks found scattered throughout the region and embedded within the sedimentary lake deposits.

An aquatic gastropod, Tomichia ventricosa, found at a pan called Swartkolkvloer, was embedded in a column of lacustrine deposits. Together, the deposits and shells were radiocarbon dated to two time periods: approximately 39–55 thousand years before present, and approximately 31–34 thousand years before present.

At another pan called Grootvloer, the researchers found a freshwater mollusk called Unio caffer, which required "perennial freshwater" and the presence of fish to reproduce. These shells and lacustrine deposits in this pan were dated to between approximately 20–22 thousand years before present.

The researchers were also able to predict the area of land the lakes encompassed, as well as how deep they were, based on the height of the lacustrine deposits ringing their shorelines. For example, they determined that the paleolake at Swartkolkvloer was about 83 miles square and 59 feet deep, while the paleolake at Grootvloer was likely about 17 miles square and 62 feet deep. Another pan called Alexanderfontein, some 300 miles northeast near the town of Kimberley, held a lake about 13.5 miles square and 48 feet deep.

Based on these parameters, the researchers knew the lakes would have required a climate drastically different from the one that exists in South Africa's interior today. Using a hydrological model, they determined that evaporation rates within the region were between 20% and 25% lower than what they are today, while precipitation would have been more than 200% higher at Swartkolkvloer and 88% higher at Alexanderfontein.

"In various parts of the interior, between about 60 to about 12,000 years ago, we can see that there were enduring phases of pretty large bodies of water kicking around what used to be thought of as an arid and inhospitable environment," Stewart said. "This was a period that used to be thought of as notoriously dry and freezing cold in the winter. But

we've got this evidence for these large lakes existing during this time period."

The researchers say current day regions that have similar climates and rates of precipitation and evaporation are likely northern Botswana, Zambia and Zimbabwe. Based on this estimation and data found from a contemporaneous site called Equus Cave, the researchers think large grazing and browsing mammals would have thrived in this region.

A complex, prehistoric people

Scattered alongside the lakes are human artifacts such as triangular points, bladelets, weathered ostrich shells and other assemblages. Much of these are from the Middle Stone Age, which ranged from about 280,000 years ago to about 25,000 years ago, and the Later Stone Age, which lasted from 25,000 years ago right up to European contact in the 15th century.

"There's Middle Stone Age archaeology just everywhere," Stewart said. "You can't drive anywhere and open the car door and not step on it. It's astounding how much there is."

Stewart says their findings could also expand the region where archaeologists think humans became more behaviorally complex. Over the past decades, researchers have found evidence that humans living in coastal South Africa started making the leap into complex thought, showing some of the earliest signs of behavioral complexity. It was thought that both climate and nutrient stability—including the rich omega fatty acids gleaned from seafood—allowed humans here to become behaviorally modern.

The group's work may challenge this idea by suggesting that favorable conditions for hunter-gatherers were not confined to the coastline but

probably characterized many regions as climates changed, including the interior, current-day desert.

"Ours is a basin-wide study with much more macro scale implications. It also involves some of these areas that are just inland of this coastal and mountain belt that's dominated the archaeological narratives for so long," Stewart said. "Just inland of this area is a region that has been, for a long time, portrayed as hostile, and it just simply appears not to have been the case for big chunks of time—with the caveat that we need information on temperature depressions to understand how humans dealt with that."

Stewart says next steps will be to return to the pans to study the archaeology throughout the region to understand better how humans lived in the area.

More information: Andrew S. Carr et al, Paleolakes and socioecological implications of last glacial "greening" of the South African interior, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2221082120

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