Great Basin: History of water supply in one of the driest regions in the US

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Using an underwater drill specially developed for the expedition to Devils Hole, the researchers took samples from the calcite deposits in the cave. Credit: Robbie Shone

An international team including Simon Steidle from the Quaternary

Research Group at the Department of Geology at the University of Innsbruck has reconstructed the evolution of groundwater in the Great Basin, U.S.—one of the driest regions on Earth—up to 350,000 years into the past with unprecedented accuracy.

The results shed new light on the effects of climate change on water supply and provide important insights for the sustainable use of groundwater resources. The study was published in the journal *Communications Earth & Environment*.

The team led by Christoph Spötl has been investigating the famous "Devils Hole" cave system in Nevada since 2010—during spectacular expeditions. Using the calcite deposits in the cave, the researchers have already reconstructed the development of the water level in the cave up to several hundred thousand years ago. In the current study, this information has now been combined with a numerical groundwater model for this arid region.

"Based on our extensive sampling in Devils Hole, we have a large amount of data that provides information on the evolution of the water table. By combining this with groundwater models from the US Geological Survey, we can now draw quantitative conclusions about changes in precipitation for the entire region over the last 350,000 years using the precise data from the cave," explains the geologist Simon Steidle.

In drylands like the southwest of the U.S., precipitation is particularly important and groundwater data is a mirror of changes in the hydroclimate. "The results can be useful for developing water management strategies and sustainable use of groundwater resources, such as how much water can be withdrawn for agricultural purposes," says Steidle.

Drought increases sensitivity

The new data suggest that the elevation of the water table in Devils Hole was three to four times more sensitive to groundwater recharge during dry climates than during wetter climates of the past. "Given that drought conditions will likely increase even more in the future due to the ongoing climate crisis, our results highlight the vulnerability of large aquifers, and thus the alteration of the most important freshwater resource in this area of the United States," Steidle said.

The minimum groundwater level in Devils Hole during the peak of the interglacial warm periods was no more than 1.6 meters below today's level, which corresponds to a decrease in groundwater recharge of less than 17% compared to today's conditions. During the glacial periods, however, the level was at least 9.5 meters above today's level, which means an increase in groundwater recharge of almost 250% compared to today's conditions.

The new information is relevant especially for the already highly endangered Devils Hole pupfish, a fish measuring just a few centimeters whose only habitat is the water in Devils Hole. The habitat of this species is thus the smallest of all known vertebrates (about half the size of an average classroom). Even small changes in water availability triggered by abstraction of groundwater for irrigation purposes or by climate change are of utmost importance for its survival.

More information: Tracie R. Jackson et al, A 350,000-year history of groundwater recharge in the southern Great Basin, USA, *Communications Earth & Environment* (2023). DOI: 10.1038/s43247-023-00762-0

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