

# The world's deepest freshwater cave just got a whole lot deeper

By [Charlotte Hartley](#) Aug. 31, 2020

For decades, spelunkers have flocked to the flooded caverns of the Czech Republic's Hranice Abyss, which stretches farther below ground than any other freshwater cave system. Now, a scientific campaign to the cave has revealed it is 1 kilometer deep, more than twice as deep as previously thought. The researchers also say the abyss formed as groundwater seeped down from the surface, not as water percolated up, as previously believed—a finding that could call into question the origin of other deep caves.

The abyss sits in karst, a Swiss cheese-like terrain formed when soluble rock such as limestone is slowly dissolved by water. Most caves form from the surface downward, when water from rain or melted snow—slightly acidic from dissolved carbon dioxide—makes its way underground, eating into rock and creating cracks that widen over time. However, deep caves can also form from the bottom up, when acidic groundwater heated by Earth's mantle bubbles up. Researchers believed the Hranice Abyss was in this second category because its waters contain carbon and helium isotopes that come from deep inside Earth.

The Hranice Abyss is the world's deepest freshwater cave. But it is not the deepest overall. That honor belongs to Georgia's Vryovkina Cave, a 2.2-kilometer-deep incursion formed when sea levels in the neighboring Black Sea dropped dramatically millions of years ago. In 2016, researchers using a remotely operated vehicle estimated the Hranice Abyss to be 473.5 meters deep. However, the vehicle's fiber optic communication cable kept it from going deeper, and the true extent of the cave system remained a mystery.

Now, scientists have revealed a clearer picture using a combination of geophysical techniques. First, they gathered data from an aboveground array of electrodes that measured how easily the limestone conducted electricity—which can indicate regions of rocks or gaps. Next, they used sensors to look for tiny variations in the tug of gravity, which can reveal caverns. Finally, they recorded the reflections of seismic waves produced by setting off small explosive charges, a way of producing a rough underground map.

The resulting picture revealed a system of deep, trenchlike caverns—some filled with sediment—that had been carved from the limestone, says geophysicist Radek Klanica of the Czech Academy of Sciences, who led the study. Surprisingly, these sediment-covered trenches [extend to about 1 kilometer below the surface](#)—far deeper than previous estimates, the team reported this month in the *Journal of Geophysical Research: Earth Surface*. That new depth could bolster the appeal for tourists, Klanica says, which is “especially important” for the economy. But it also offers new insights into the local geology, which could have wider implications for maintaining water supplies in the region.

Klanica and his colleagues also found evidence of an ancient groundwater drainage system in the limestone, suggesting a new, aboveground origin for the abyss. The underground trenches aligned with mountains on one side and a deep basin on the other. Water would have run from the mountains into the ancient basin, carving out caverns from the top downward. The researchers think additional upwelling of water from below may have occurred later,

explaining the presence of carbon and helium isotopes. Klanica says this means scientists may need to reconsider the origins of other deep caves supposedly formed from the bottom up, such as Lagoa Misteriosa in Brazil, or Boesmansgat in South Africa.

Francesco Sauro, a geologist at the University of Bologna who was not involved in the study, praises the team's use of multiple geophysical methods. "It's a good example of how you should do things," he says. The new estimated depth of the abyss is "impressive," he adds. "It could be that other caves have the same story, or that [similarly formed] caves could be even deeper." Sauro is also curious about what types of living organisms scientists might find in the depths of the cave system: "We don't know exactly what could be down there."

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### **Hypogenic Versus Epigenic Origin of Deep Underwater Caves Illustrated by the Hranice Abyss (Czech Republic)—The World's Deepest Freshwater Cave**

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