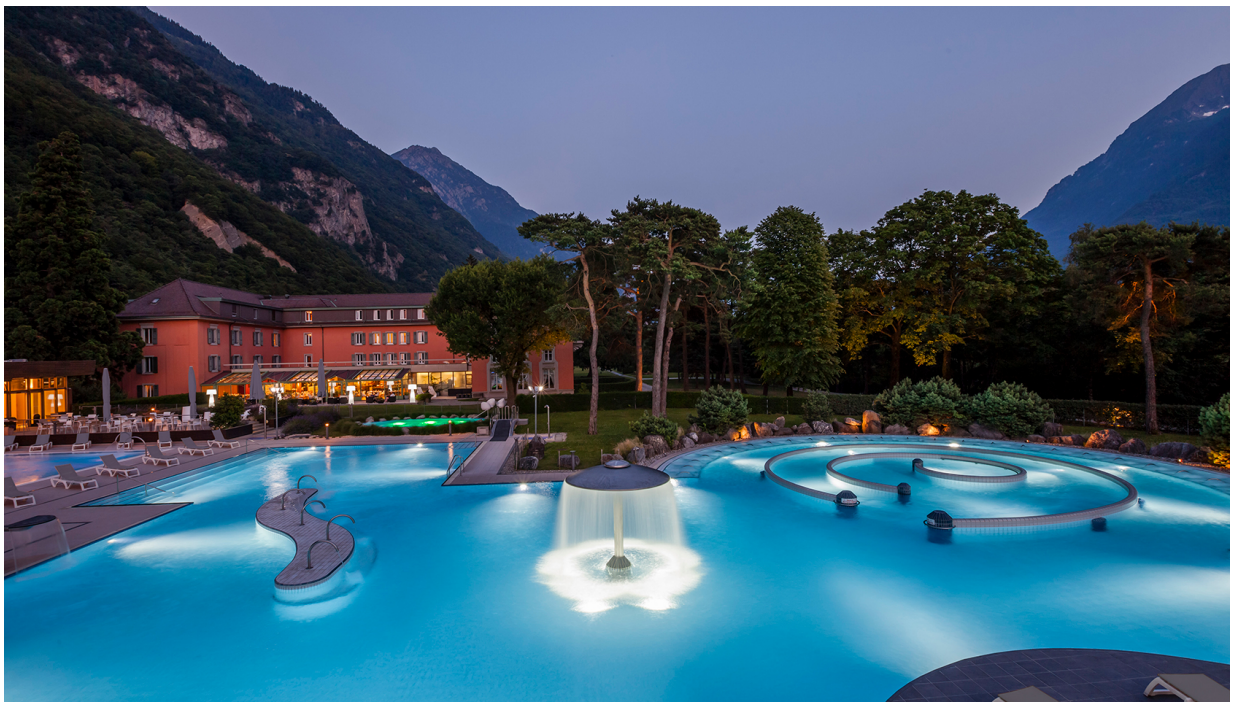

Underground microbial life more stable than expected

July 1, 2025 | Universität Texas / Eawag
Topics: Ecosystems

Microbial communities living deep underground in the groundwater of Lavey-les-Bains remain surprisingly stable throughout the year, even though the composition of the water changes seasonally. This is the finding of a study by Eawag researchers that contributes to a better understanding of geothermal systems and microbial life deep underground.

Thermal groundwater systems, such as those found in the Alps near Lavey-les-Bains, are naturally warm, underground bodies of water, some of which emerge as hot springs on the earth's surface. These systems are rich in gases and minerals. However, they also harbour ecosystems in which microbes exist without sunlight by using sulphur, iron or hydrogen for their metabolism. Nevertheless, it is difficult to study these microbial communities as their habitats are virtually inaccessible. For this reason, there is still only limited knowledge of thermal groundwater systems, which are also interesting because of their potential for climate-friendly energy production.

A study recently published in the journal "Proceedings of the National Academy of Sciences (PNAS)" now sheds light on these hidden ecosystems. In connection with his doctoral thesis, Sébastien Giroud from the Water Resources & Drinking Water department at the aquatic research institute Eawag investigated how microbes in the subsurface respond to seasonal changes in the chemical composition of the water. Giroud's team thus sampled the groundwater at depths of between 200 and 500 metres all year round. Dissolved ions, water isotopes and noble gases were measured in order to record variability in the water chemistry. DNA sequencing also provided information on changes in microbial composition.

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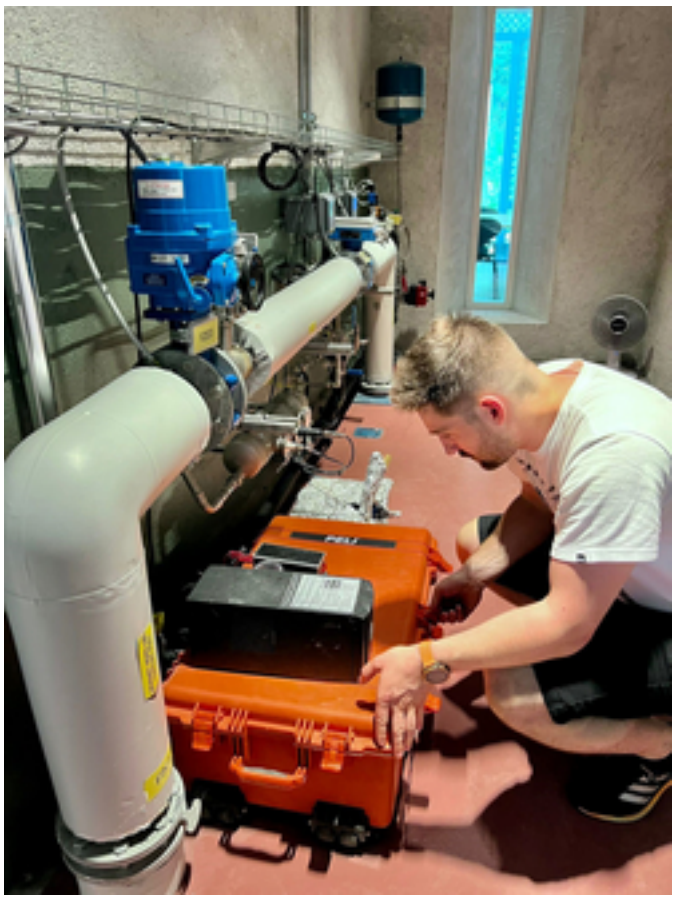

One of the measuring points in Lavey-les-Bains, where thermal water is pumped from a depth of 200 metres. The mobile gas analyser (“miniRuedi”) in the orange case analyses the gases contained in the thermal water.
(Photo: Sébastien Giroud, Eawag)

The findings are unexpected: although geochemical indicators such as electrical conductivity and the concentration of dissolved gases show clear seasonal fluctuations in the composition of the water, the microbial communities remain stable. The varying composition of the water is due to the seasonal differences in the mixture of younger, near-surface and old groundwater from the depths within the thermal system. This is mainly caused by snowmelt and the associated groundwater recharge in summer. The microbial communities, whose composition varies with depth, hardly change over the course of the year. For example, sulphur-degrading bacteria are prevalent at depths of 200 metres, while bacteria that utilise sulphate, iron or hydrogen predominate at depths of 500 metres.

These results suggest that it is not the water composition but other environmental conditions, in this case temperature, that determine microbial life in deep continental groundwater systems. The data also shows the remarkable resilience of microbial life deep in the earth. “This qualifies the assumption that all life underground is influenced by the conditions on the surface,” says Sébastien Giroud. However, according to the researcher, it is all the more important to investigate the consequences of interventions underground – such as the extraction or supply of thermal energy (see also box).

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Groundwater under pressure

Near-surface groundwater is under severe pressure, especially in densely utilised areas such as the Swiss Central Plateau. In addition to material pollution from transport, agriculture and landfill sites, there is also thermal pollution from climate change, underground structures extending into the groundwater and extraction. The extent to which deep aquifers are also exposed to this pressure and the possible consequences of interventions are the subject of a number of studies and research projects. For instance, the ARTS project on the Empa-Eawag campus in Dübendorf is investigating the effects of storing heat at a depth of around 100 metres. The federal government is also addressing the issue. One motion, on which a report is currently being prepared, asks whether the current rules on temperature changes in groundwater should also apply to lower storeys or whether they could be relaxed.

The Eawag Info Day on 4 September will also cover this topic: "Groundwater – utilising and protecting the resource of drinking water". You can register for it now.

Cover picture: The thermal spa in Lavey-les-Bains uses naturally warm groundwater (Photo: Alain Baschenis).

Original publication

Giroud, S.; Deng, L.; Lever, M. A.; Schilling, O. S.; Kipfer, R. (2025) Resilience of deep aquifer microbial communities to seasonal hydrological fluctuations, *Proceedings of the National Academy of Sciences of the United States of America PNAS*, 122(23), e2422608122 (9 pp.), doi:10.1073/pnas.2422608122, Institutional Repository

Funding / Partnerships

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https://www.eawag.ch/en/info/portal/news/news-detail/underground-microbial-life-more-stable-than-expected