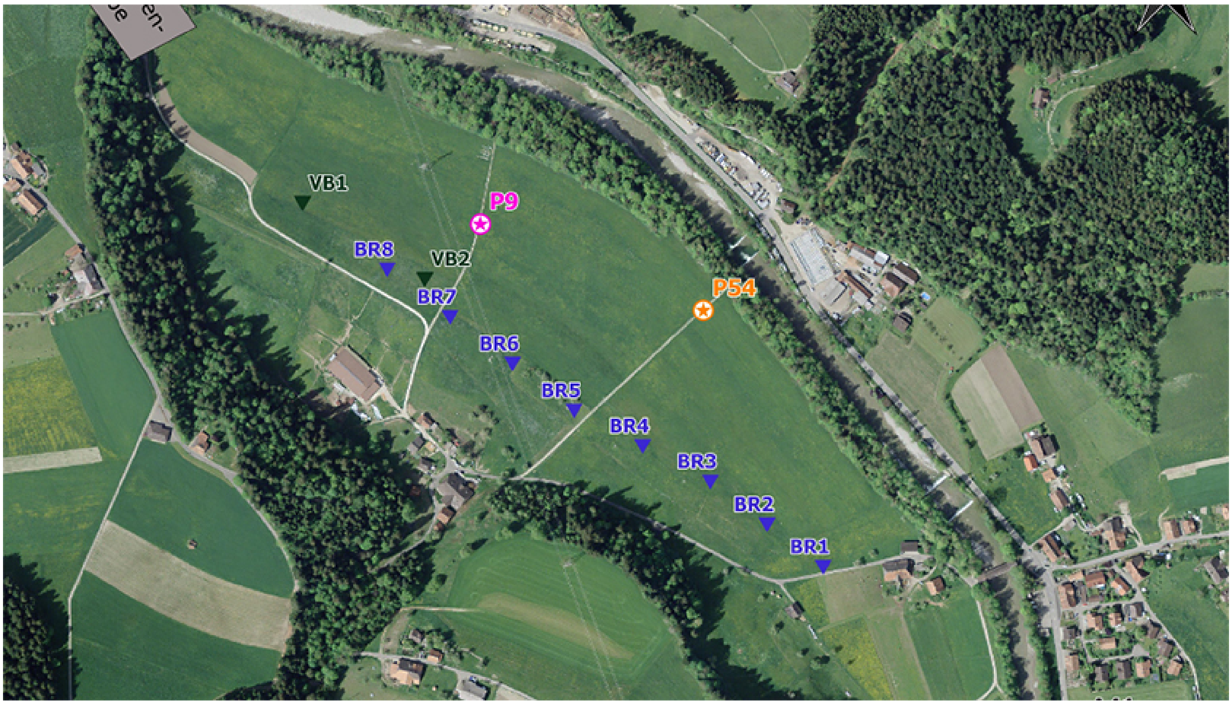

Noble gases used to sniff out the pathways of the Emmental's groundwater

May 21, 2021 | Kaspar Meuli, Andri Bryner
Topics: Drinking Water | Water & Development | Pollutants

An Eawag researcher has helped to develop a new approach to tracking how river water enters the groundwater. In the test area within the Emmental, the flow time within the aquifer has been shown to be much shorter than previously assumed. This has potential consequences during dry spells.

An Eawag researcher has helped to develop a new approach to tracking how river water enters the groundwater. In the test area within the Emmental, the flow time within the aquifer has been shown to be much shorter than previously assumed. This has potential consequences during dry spells.

Catchment area of the river Emme on the Brienzer Rothorn.
(Image: Wikipedia Free Commons)

It is easy to see why the topic of groundwater formation is such an important one for researchers. “If we want to secure a reliable water supply, we need to understand how surface water and groundwater mix in vulnerable aquifers and how quickly the water moves there,” says hydrologist Andrea Popp, who recently completed her thesis at Eawag and ETH Zurich and is developing a new methodological approach in order to gain a better understanding of groundwater. The method was recently presented in the journal Water Resources Research.

Help from a portable mass spectrometer

The key innovation here is that the new method untangles fractions of recently infiltrated river water and regional groundwater within the aquifer and determine the flow times of infiltrated river water within this groundwater-bearing layer. Until now, these times were determined based on non-specific groundwater samples with the help of dating techniques. The team led by Andrea Popp took in-situ measurements of noble gases dissolved in the water, which can be “sniffed out”, so to speak, using a portable mass spectrometer (video) developed at Eawag. The results are then combined using model calculations.

Field work at the measurement hut in Aeschau in January 2019.
(Image: Andrea Popp)

70 percent of the groundwater comes from the river Emme

The method was first used as part of a case study within the Emmental (the valley of the river Emme). Samples were taken from the groundwater wellfield in Aeschau, where water is pumped into a number of well chambers aligned in parallel to the river. This drinking water is used to supply a large part of the city of Bern, among others. The key findings of the pumping tests carried out in early 2019 are as follows: around 70 per cent of the groundwater comes from the river Emme, and the river water moves through the aquifer relatively quickly, with a flow time of between 7 and 14 days. “We can think of the Emmental as a bathtub filled mainly with sandy gravel and crushed stones,” explains Andrea Popp. “This explains the rapid flow times."

Field work in the streambed of the Emme at Aeschau.
(Image: Andrea Popp)

Annual discharge is decreasing

These are important findings, not least when it comes to the impact of climate change. A previous study found that the annual discharge of the river Emme is decreasing. Between 1999 and 2018, it fell by over 10 per cent per decade, and projections for the years 2070–2099 indicate that the discharge in summer will decrease by between 25 and 45 per cent due to rising air temperatures.

This matches estimates from the report entitled "Effects of climate change on Swiss water bodies", which was recently published by the Swiss Federal Office for the Environment (FOEN) in relation to the Hydro-CH2018 project. The report states that: "In general, the hydrological scenarios show that there will be a significant reduction in water levels in summer and autumn. This applies both to surface waters and to groundwater." At the same time, the report states, summer dry periods and heat waves will be more frequent and last longer in the future. "Without climate change mitigation, the low summer flows into areas at altitudes of less than 1,500 metres will fall by 30 per cent during dry periods."

Studying drinking water from the Emmental: the groundwater wells in Aeschau.
(Illustration: Andrea Popp)

Better management of drinking water resources

This trend will not only affect drinking water supplies in the Emmental, but also globally. According to Andrea Popp, her method could help to improve the management of drinking water resources. For example, it may be possible to interconnect various catchment areas in preparation for dry spells. “Our approach,” says the hydrologist, “can highlight the risks and vulnerabilities of drinking water supplies derived from groundwater.”

Cover picture: Andrea Popp

Original article

Popp, A. L.; Pardo-Álvarez, Á.; Schilling, O. S.; Scheidegger, A.; Musy, S.; Peel, M.; Brunner, P.; Purtschert, R.; Hunkeler, D.; Kipfer, R. (2021) A framework for untangling transient groundwater mixing and travel times, *Water Resources Research*, 57(4), e2020WR028362 (16 pp.), doi:10.1029/2020WR028362, Institutional Repository

Feature article «Tracing Water from River to Aquifer» in den Science News der American Geophysical Union (AGU): https://eos.org/research-spotlights/tracing-water-from-river-to-aquifer

Andrea Popp
Postdoctoral Fellow, Department of Geosciences at the University of Oslo, Norway
andrea.popp@geo.uio.no

Contact

Andri Bryner
Media officer
Tel. +41 58 765 5104
andri.bryner@eawag.ch

https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/noble-gases-used-to-sniff-out-the-pathways-of-the-emmentals-groundwater