UNIVERSITÉ DE NEUCHÂTEL

CHYN
Centre d'hydrogéologie et de géothermie

MSc in Hydrogeology and Geothermics

Thesis topic proposal 2020

NOBEL GASES AS A NEW TRACER FOR GROUNDWATER-SURFACE WATER EXCHANGE

Context and objectives

Roughly 40% of the drinking water supply in Switzerland is pumped from alluvial aquifers. As pumping wells are often placed near streams, a significant fraction of the abstracted water is composed of freshly infiltrated surface water with residence times of days to weeks. Understanding groundwater (GW) – surface water (SW) exchanges and associated timescales in such systems is thus critical for safe and sustainable water supply.

Environmental tracers are well-suited to characterize such systems, as they provide information on sources, pathways, and residence times of groundwater. New field methods have recently been developed to measure dissolved tracer concentrations at unprecedented temporal and spatial resolutions. In particular, a portable mass spectrometer has been developed at the EAWAG, which allows continuous on-site monitoring of a variety of dissolved gas species (^{4}He, ^{40}Ar, ^{84}Kr, CH_4, O_2, CO_2, N_2).

The goal of this project is to explore how high-resolution measurements of dissolved noble gases can be used to characterize GW-SW dynamics in alluvial systems. Fieldwork will take place at the Aeschau field site, in the Emmental. The site harbors an important alluvial aquifer wellfield, which supplies ~45% of the drinking water consumed in the city of Bern (average pumping rate ~26 m^3/min).

Research approach and methodology

A novel field experiment will be carried out at the Aeschau site. Gaseous helium will be injected in the Emme river over an extended period of time, effectively saturating portions of the stream. Variations of ^{4}He concentrations in groundwater will be monitored continuously in one or two piezometers at the field site. Additionally, continuous measurements of dissolved ^{222}Rn concentrations will provide information on GW residence times.

An existing numerical model simulating surface-subsurface simulating the interactions at the Aeschau site can be extended to simulate the test conditions.

Prior to the experiment, the student will be trained to use the portable mass spectrometer at the EAWAG (1 – 2 weeks). Additional training with the radon detector (RAD7) will be provided at the CHYN.

Partners and collaboration

The project is in the context of the PhD project of Morgan Peel. The project will be supervised by Prof. P. Brunner, Daniel Hunkeler, Morgan Peel and is close collaboration with Prof. R. Kipfer (EAWAG).

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