Université de Neuchâtel
Centre d'hydrogéologie
et géothermie

MSc in Hydrogeology and Geothermics

Thesis topic proposal 2023

Investigation of a paleo-channel in an alluvial aquifer with modern technologies

Context and objectives

In Switzerland, alluvial aquifers provide approximately 40% of the drinking water. These aquifers typically contain groundwater that is partly composed of recently infiltrated river water. To comply with Swiss legislation, which requires a minimum water transit time of 10 days from a river to a drinking water well, it is essential to study the dynamics of such alluvial aquifers if they are used as source od drinking water. However, despite the importance of these aquifers, they are often oversimplified as homogeneous water bodies in advanced numerical models. The reality is that there can be significant heterogeneities within alluvial aquifers, particularly caused by the geometry of previous river channels (known as paleo-channels). These can create low-conductive sediment lenses or high-conductive formations that form preferential pathways for groundwater flow, resulting in different transit times. These different transit times can cause problems for drinking water management.

Geophysics and tracer techniques are widely used to investigate aquifer geometry, groundwater transit time, and mixing ratios. These methods are continually evolving through emerging technologies. By combining some of these novel techniques, it is possible to achieve more precise and accurate results, particularly when studying heterogeneous structures.

Methodology

The presence of an important paleo-channel is suspected in the alluvial plain of Aeschau (canton of BE), where drinking water is pumped to provide more than 100'000 inhabitants. The aim of this thesis is to conduct a geophysical survey to determine the geometry of the channel and perform tracer tests to investigate its dynamics. To achieve this, we will conduct an active geophysical survey and employ gas tracers. Time-lapse electrical resistivity tomography (ERT) will be deployed to measure the transport of a solute, enabling precise delineation of the paleo-channels. Gas tracers will be measured with a portable mass spectrometer (miniRUEDI, see picture), a new emerging technology in the tracer inventory.

This thesis will involve diverse fieldwork, data processing, and the development of a straightforward hydrogeological model of the paleo-channel. It presents an excellent opportunity to employ various hydrogeological methods, compare their effectiveness, and establish an efficient methodology for investigating paleo-channels. This thesis therefore offers the possibility to develop numerous valuable skills in hydrogeology.

Supervision and collaboration

The project will be supervised by Théo Blanc, Dr. Landon Halloran and Prof. Philip Brunner.

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