DEEPTHOUGHT

Evaluating nitrate transformation in aquifers using microbiologic and isotopic tools for an enhanced management of key groundwater ecosystem services

Water4All
Water security for the planet

Abstract

Aquifers serve as the primary source of drinking water for Humans worldwide. This use of groundwater mainly relies on ecosystem services provided by aquifers. Among them, natural water purification is a cornerstone ecosystem service, notably mitigating the rise of the pollutants emitted by anthropogenic activities in groundwater. Up to now, this service is poorly taken into account in aquifer management and regulating policies as exemplified by the case of nitrate. The latter is a major pollutant threatening groundwater quality at a worldwide scale. However, its impact can be mitigated by in situ denitrification.

DeepThought aims to understand the mechanisms that lead to denitrification occurring in groundwater and evaluate the impacts of pressures (anthropic and climate change) on denitrification rates. This will provide a holistic toolbox for improved aquifer management. The common goal will be achieved through the use of microbial, hydrogeological, geochemical and isotopic approaches, coupled with laboratory experiments, in situ sampling at three study sites representing different contexts and interactions with main stakeholders through workshops in each country.

More precisely, the project will

- identify the microbial communities that support denitrification and quantify in situ potentials and activities;
- link denitrification processes to hydrogeological and biogeochemical conditions and variations;
- examine and compare the diversity of denitrifying bacteria and their activities at depth profiles intersecting oxic-anoxic interfaces;
- identify the pressures (anthropic and climate change) and their impacts on denitrification thanks to the access to four test sites corresponding to different land uses and pressures; and finally;
- through co-working with stakeholders, provide and include new indicators combining biogeochemical and isotopic measurements to improve aquifer management concerning nitration contamination.

DeepThought primarily focuses on subtopic 2.1 of the Water4All Joint Transnational Call by assessing the impact of different anthropogenic pressures, including exposure to pesticides and other organic pollutants from agriculture and other human activities, on aquifer denitrification and other N-cycling processes.

Furthermore, DeepThought addresses subtopic 2.2 by improving our understanding of impacts of chemical regulation (e.g. pesticides, pharmaceuticals) on N retention in aquifers.

DeepThought will also address subtopic 3.1 as tools (microbial and isotopic) will be selected for a better integration of ecosystem services assessment into the management of groundwater resources. In addition, the project will involve, via workshops and coworking, stakeholders and users of the targeted ecosystem services (i.e. national water agencies, decision makers, drinking water distributors), to establish strategies to enhance nitrate reduction in groundwater.

In summary, DeepThought ambitions to bring new knowledge on an important aquifer nature based solution, natural nitrate depletion, which is at the basis for the provision of many groundwater ecosystem services, in particular clean water supply. DeepThought also aims to provide a pathway for implementing tools that consider these aquifer functionalities into the current frameworks used to manage groundwater.

KEYWORDS

groundwater
nitrate
global change
microbial diversity
water security

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