UPPSALA UNIVERSITET

CNDS
Centrum för naturkatastrofslära

Inactivation of bacteriophages and the effects of natural organic matter

Artificial recharge of groundwater is a very important part of the drinking water portfolio in Northern and Western Europe and is projected to become ever important the world over. Artificial recharge of groundwater is the process used to supplement groundwater resources by diverting surface water into the ground in a non-natural and/or accelerated manner and the quality of the effluent is entirely reliant on the natural cleaning mechanisms of the soil within which the water is infiltrated. The efficiency of the process is very sensitive to chemical variability which can generate large uncertainty regarding the viral concentrations in the effluent water. Viruses are removed from water through a combination of inactivation and adsorption. Virus adsorption has been shown to be the primary mechanism for virus removal in groundwater. There have been countless studies examining the extent of virus removal in soil related to different physical and chemical characteristics of the soil—water system but very few general relationships have been discovered leading to very high predictive uncertainty. Natural organic matter has been shown to add considerable uncertainty as its effects on the efficiency of virus removal are not completely understood. This study aims to highlight the uncertainty of virus removal mechanisms by reviewing previous works on the subject while paying special attention to the confounding effects of natural organic matter.

Batch-reactor experiments will be conducted in order to determine the inactivation rate of a model virus in water at low temperature (5—7^{o}C) as affected by soil organic matter, dissolved organic matter and pH. Literature has shown (albeit less conclusively) that soil organic matter and dissolved organic matter will slow the inactivation rate of viruses. My hypothesis states that a model virus (MS2 and/or φx174) will experience slowed inactivation when in the presence of soil organic matter and/or dissolved organic matter. The effects of pH on virus inactivation are not exactly known but intuitively it makes sense that a decreased pH will increase the inactivation rate as the protective viral proteins are more easily dissolved. Temperature, water/soil chemistry and batch-agitation (how often the batches are "shaken") should be held constant.

Proper execution of this study will require the student to efficiently and effectively perform the following:

- A brief literature review on batch inactivation experiments outlining where the current position of cutting-edge research as well as general procedures and experimental design.
- Consistent, orderly and well-documented laboratory work (including work in a class-2 laboratory investigating viral viability)
- Thorough statistical analysis of results

As your advisor, I will work quite close with you as these experiments can be quite time-consuming and logistically complicated. However, through close cooperation and shared responsibility of duties this study is assured to produce meaningful information to be used in a larger study on virus fate and transport in Swedish drinking water as well as provide valuable experimental tools to the student.

If interested, please contact:

Jean-Marc Mayotte
Jean_marc.mayotte@geo.uu.se