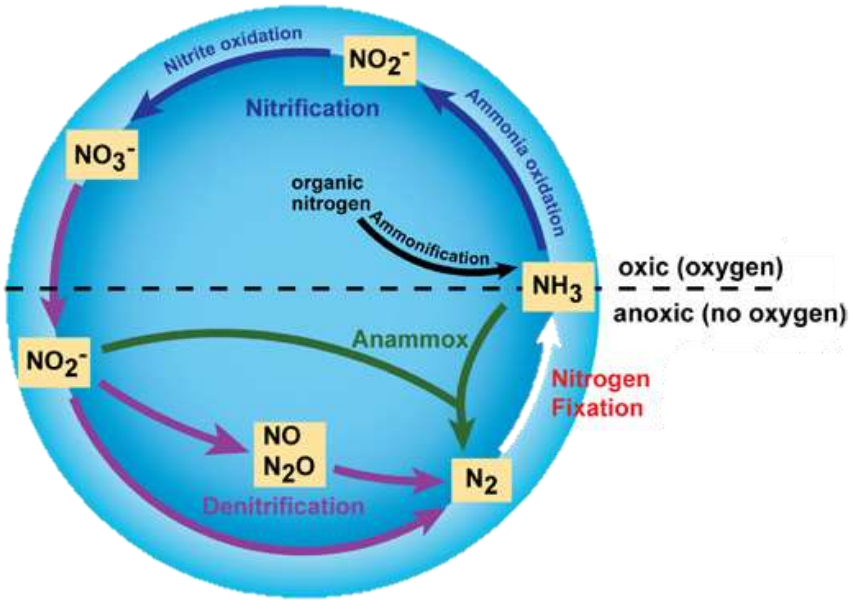
Reduction of nitrogen discharges in mining processes and mitigating its environmental impact

Overall objective

To use innovative, cost-efficient approaches to remove nitrogen from mine site drainage so that nitrogen concentrations in the receiving waters are maintained at reference-level concentrations



mining

Partners and project period

Partners

Swedish University of Agricultural Sciences (SLU Uppsala, Coordinator)
Luleå University of Technology
Uppsala University

LKAB
Boliden Mineral AB

Rock Tech Centre

Project period

2013-09-01 to 2017-12-31

mining

Project idea

- To develop a series of treatment systems that can be used independently or in combination to remove nitrogen from mine discharge waters

- The systems will involve passive or semi-passive treatment methods that require minimal amounts of energy to maintain in operation

- The systems rely on the activity of efficient microbial communities that transform nitrogen compounds into harmless nitrogen gas (N_2)

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Three main research objectives

1. Barrier system for nitrogen removal from mine waters through denitrification (Uppsala University)

1. System for optimizing microbial denitrification in tailings ponds (LTU)

2. Wetland systems for nitrogen removal through phytoremediation by macrophytes and algae (SLU, Uppsala)

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Main experimental field site at the Kiruna mine

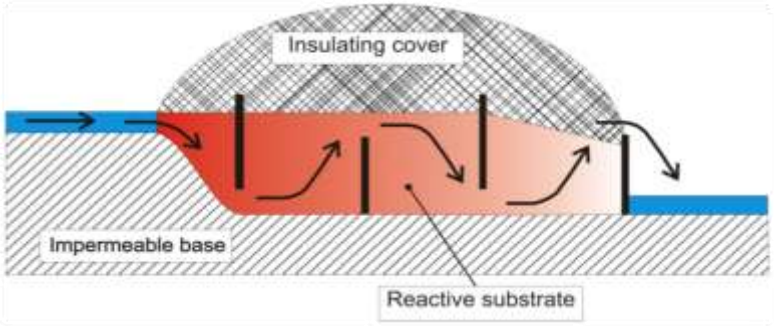
Floating wetlands: Nitrogen removal by plant uptake and microbial reactions

Mesocosms: 1000 L water containers where denitrification in ponds is simulated

- Phosphorus concentration
- Light conditions
- Presence of organic matter
- Temperature

Reactive barrier with denitrification

$5CH_2O + 4NO_3^- \rightarrow 2N_2 + CO_2 + 4HCO_3^- + 3H_2O$



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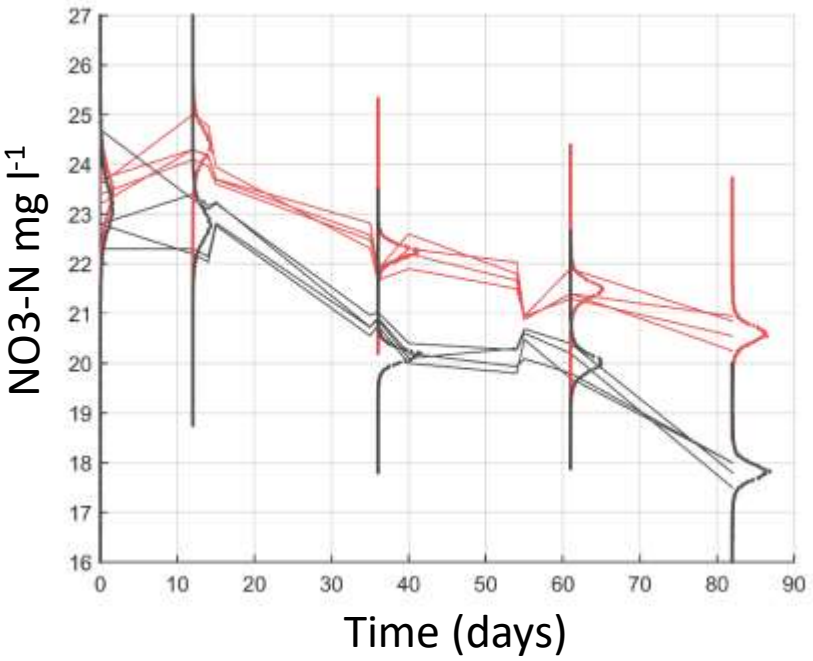
Clarification ponds at Kiruna and Aitik

Denitrification

$$5(CH_2O) + 4\,NO_3^- + 4\,H^+ \rightarrow 5\,CO_2 + 2\,N_2(g) + 7\,H_2O$$

- The study will provide a better understanding of the possibilities to optimize the conditions for nitrogen removal in clarification ponds
- The possibilities to generate an internal source of organic substrate for denitrification by promoting algal growth in clarification ponds is studied
- Algal growth and denitrification are studied in experimental mesocosms
- Nitrogen reactions and removal mechanisms in clarification ponds are modelled and numerically simulated



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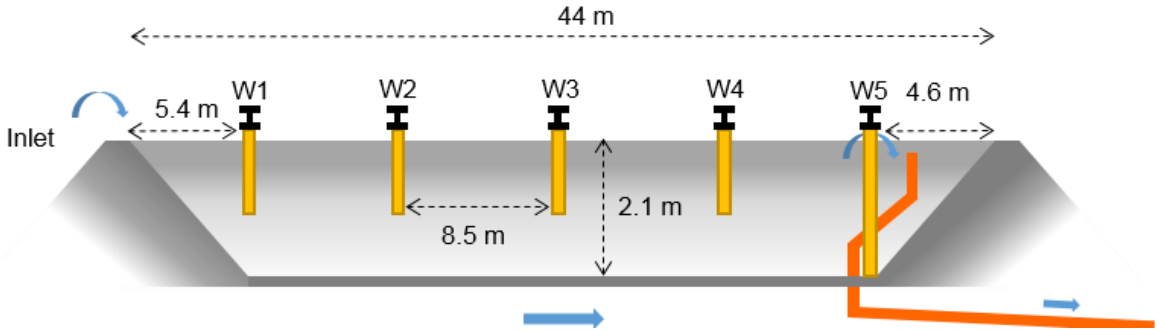
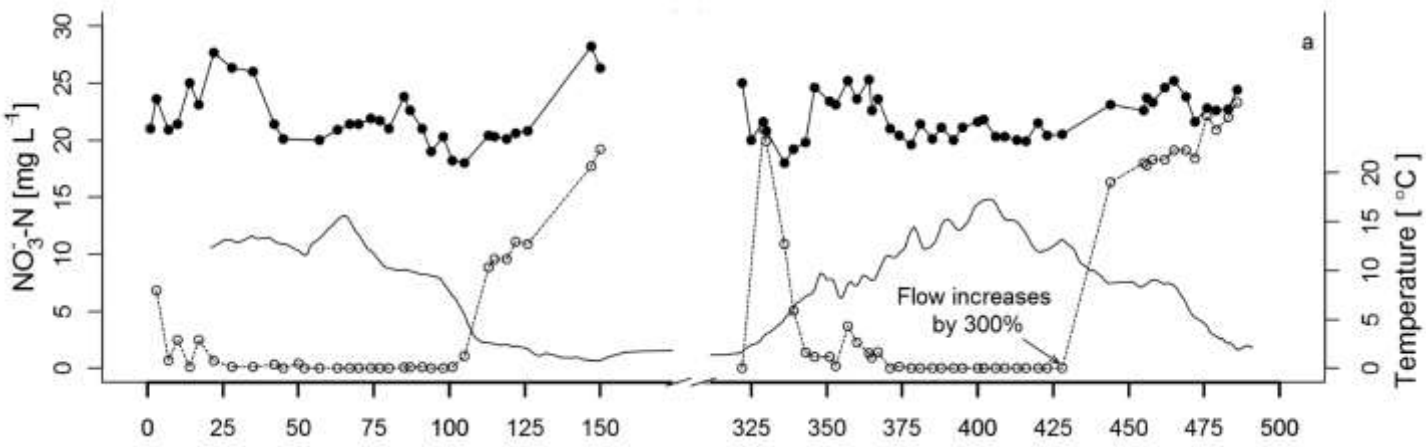
Pilot-scale bioreactor in Kiruna



- Bioreactor filled with wood chips (pine, carbon source for bacteria) and digested sewage sludge (source of bacteria)
- Inlet water pumped from sedimentation pond during 2015 and 2016



NITREM

Up-scaling project with funding from EIT RawMaterials and significant in-kind funding from LKAB

” NITREM establishes a service for the passive removal of nitrogen from waste rock leachate with a bioreactor technology, in conjunction with long-term waste rock management. Technology development has been driven by EUs Water Framework Directive and will enable the industry to meet current and future discharge requirements. The outcome is a low cost and low maintenance technology that is ready for market introduction and customer testing.”