Innovative explorations of subsurface redox conditions for future targeted N regulation

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Abstract

N regulations of intensive agriculture at national or regional scales have succeeded in lowering the N impact on the aquatic environment. However, further actions are still required to improve the state of the aquatic environment in a cost-effective manner for the society and the farming industry. A new direction is to tailor the N regulations depending on the site-specific conditions at the field level called targeted N regulations. This approach requires detailed knowledge about the subsurface hydrogeological and biogeochemical conditions, especially the redox conditions, to understand N fate and transport in the aquatic environment.

Keywords: agriculture, groundwater, redox conditions, nitrate reduction

1. Background

The escape of reactive N from agricultural soils results in adverse environmental and human health impacts, including eutrophication of freshwater and estuarine ecosystems and groundwater and drinking water nitrate contamination.

Since the 1980'ies increasing prosperity and growth in the Danish society and reduced environmental impacts have been accomplished through mostly national one-fit-all regulation of the N management in agriculture by introducing different N-mitigation measures (Hansen et al., 2017). However, the latest monitoring results on very young groundwater shows signs of deterioration due to increasing and relative high nitrate trends and concentrations (Hansen et al., 2019).

2. The way forward

Therefore, currently there is an environmental, and economically need to create new knowledge and find new solutions for future more efficient N-regulation of Danish agriculture. This is the research focus of the Danish projects rOPEN and MapField (www.ropen.dk & www.mapfield.dk)

We suggest that the way forward is targeted regulation adjusted to site-specific hydrogeological and geochemical characteristics of the subsurface of the catchment motivated by new techniques and advances in hydrogeochemical system understanding (Figure 1, Kim et al., 2019).

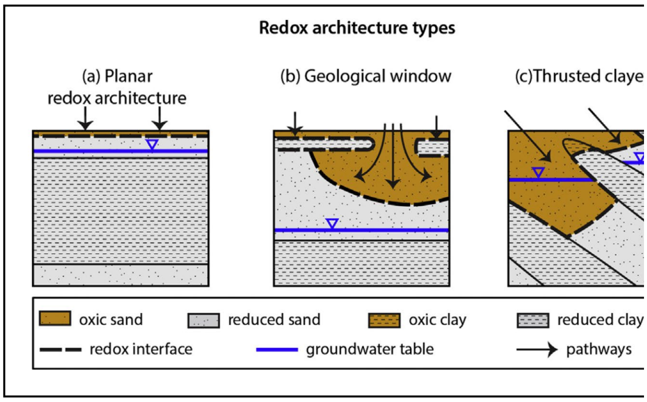

Fig. 1: Conceptual models for three types of redox architectures in the subsurface (Kim et al., 2019).

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