



Quantification of nitrate reduction potential and kinetics of soil samples obtained from sandy aquifers, Germany

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Many areas of Germany are intensively used by agriculture and in the latest decades, nitrate contamination of groundwater has become a significant environmental issue. Intense agricultural activity has led to increasing fertilizer utilization and as a consequence, nearly 30 % of the shallow groundwater bodies in Germany show high nitrate concentrations above the 50 mg/l threshold value set by the Drinking Water Directive 98/83/EC. In general, denitrification is a microbiology-driven process that contributes to nitrate attenuation in soil and groundwater. Nevertheless, with continuing input of nutrients, energy sources for bacteria can be depleted and denitrification potential can be significantly decreased. In this context, we investigated the content of denitrification capacity (sulfide-/disulfide sulfur and organic carbon) and reactivity of different aquifer sediments from northern Germany. The sediment samples were collected within the upper groundwater layer up to 12 m depth. Furthermore, using scanning electron microscope (SEM) analysis, different structures of iron- and sulfur rich compounds were observed and in some cases, pyrite framboids could be identified. Denitrification potential was investigated from laboratory batch experiments that contained sediments with different concentrations of the above-mentioned electron donors. Another interest was the investigation of the reactivity of framboidal pyrite. Therefore we synthesized the mineral in the laboratory and set up separate batch experiments. Isotopic analyses ($\delta^{15}\text{N}$ and $\delta^{18}\text{O-NO}_3$) were conducted to monitor nitrate reduction and the N and O isotopic enrichment factors. The reactions were modelled and the kinetic rates were determined with the usage of the hydrogeochemical transport model, PHREEQC.