Influence of nitrate addition on bioremediation of ethylene glycol contaminated sediments – a laboratory study

TOBIAS LIENEN[1], CORDULA DOERR[2], ANKE WESTPHAL[1], RALF KOEBER[2], HILKE WUERDEMANN[1,3*]

[1] GFZ German Research Centre for Geosciences, Section 5.3 Geomicrobiology, Telegrafenberg, 14473 Potsdam, Germany

[2] Christian-Albrechts-Universität zu Kiel, Institute of Geosciences, 24118 Kiel, Germany

[3] Merseburg University of Applied Sciences, Department of Engineering and Natural Sciences, 06217 Merseburg, Germany

[*] correspondence: hilke.wuerdemann@hs-merseburg.de

Ground heat exchangers are operated with heat transfer fluids that can contain environmentally relevant components such as ethylene glycol. Leakages of these fluids lead to a contamination of the ambient environment. The presented study aims at analyzing the natural attenuation of contaminated soils at different nitrate concentrations with a focus on changes in the microbial community composition. Therefore, two nitrate inflow concentrations (100 and 400 mg L^{-1}) and one approach without nitrate addition were tested to investigate the degradation of ethylene glycol in contaminated sediment columns. Besides geochemical analyses, genetic fingerprinting and quantitative PCR were performed to characterize the microbial community composition and their abundance. All approaches showed a fast decrease in ethylene glycol concentrations with fermentation as the main process for degradation in the approaches without nitrate and denitrification in the approaches with nitrate. Changes in the bacterial community composition were detected over the experimental runtime. Nitrate reducing, sulfate reducing and fermentative bacteria dominated in the approaches without nitrate addition and at nitrate inflow concentrations of 100 mg L^{-1}, whereas at 400 mg L^{-1} mostly nitrate reducers were found. The fermentation products acetate and hydrogen in the approaches without nitrate addition and at 100 mg L^{-1} of nitrate allowed for methanogenic activity. Accordingly, the methanogenic community was characterized by aceticlastic and hydrogenotrophic archaea. This study shows that soil and sediment inhabiting microorganisms can quickly deal with changes in the environmental conditions such as a contamination by heat transfer fluids.