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In-Situ Stimulated Attenuation and Geophysical Monitoring of TPH and Nitrate Contamination in Groundwater

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Total petroleum hydrocarbon (TPH) is a mixture of various oil substances composed of alkane, alkene, cycloalkane, and aromatic hydrocarbons (benzene, toluene, ethylbenzene, xylene, etc.). Also, nitrate, one of the most commonly detected pollutants in groundwater, can cause cyanosis in infants and cause carcinogenesis if the concentration of drinking water is high. Reverse osmosis, ion exchange, adsorption, and biological processes are used to remove both TPH and nitrate in groundwater. Succinate, acetate, and fumarate were used as carbon sources for enhancing microbial growth. The injecting concentration of each carbon source was determined using MbT-Tool based on the energetics model, which stoichiometrically expresses the metabolic process of microorganisms. After sterilizing field groundwater for homogeneous environmental simulation, the 4.9 x 10^8 CFU / mL *Paracoccus Denitrificans.* For field-remediation application we selected nitrate-contaminated site where 200~600 mg/L of nitrate is continuously detected. To determine the possibility of nitrate-degradation by stimulated-natural attenuation, groundwater was sampled in two different wells of the site and nitrate concentration of the samples was 300 mg/L and 616 mg/L, respectively. Acetate for different C/N ratio was added into microcosm bottles containing the groundwater to examine denitrification rate depending on carbon concentration. In the result, once 1.5 times more than amount of acetate stoichiometry required was added, the 616 mg/L of nitrate and 300 mg/L of nitrate were completely degraded in 8 days and 30 days.The bulk conductivity was measured using in situ vertical resistivity probes. Microbial activity was verified using terminal electron acceptors, dissolved inorganic carbon, and major ion chemistry. Peaks in bulk conductivity in the aquifer overlapped with zones where nitrates and sulfates were depleted, total petroleum hydrocarbon, iron, manganese, dissolved ions, and DIC were elevated, suggesting a link between higher electrical conductivity and zones of enhanced microbial activity stimulated by the presence of hydrocarbon. Thus the subsurface expression of microbial activity is apparently recorded in the bulk conductivity measurements. Our results argue for combining geophysics with biogeochemistry studies to delineate subsurface zones of enhanced microbial activity.

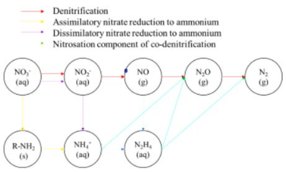

Figure 1. Nitrate decomposition mechanism in nitrogen cycle