Natural Rate of LNAPL Losses under Anaerobic Conditions

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Abstract. Natural source zone depletion is emerging as a critical factor in selecting remedies for subsurface petroleum liquids. This research examines the hypothesis that natural depletion of subsurface petroleum liquid is a zero order process for field-relevant concentrations. Laboratory column studies are ongoing to test this hypothesis. Eleven glass columns were filled with homogenized field soil from a former refinery. Columns contain concentrations of petroleum liquid ranging from 9,000 to 33,000 mg/kg soil. To simulate water table fluctuations, column water levels are being alternated between saturated and unsaturated conditions (two weeks each condition). The columns are being kept anaerobic via addition of oxygen scavenging minerals (marcasite and magnetite) to the influent. Monthly water samples and twice a month gas samples are analyzed via gas chromatography for organic and inorganic carbon leaving the system as well as shifts in petroleum composition. Electron acceptor concentrations are characterized using liquid ion chromatography. Results to date show natural losses of petroleum liquid that are independent of concentrations of petroleum liquid, and thus support the hypothesis. Observed degradation rates are in the range of 0.09 to 0.34 ± 0.07 moles carbon/day/m^3 reactor volume (i.e. m^3 pore space). Results have been included in a petroleum liquid longevity model. The longevity model evaluates the merits of active remedies given ongoing natural source zone depletion. Applications of the model to a field site will be presented.