Use of Subsurface Heat Fluxes to Evaluate Continuous Loss Rates of LNAPL

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Abstract. Petroleum hydrocarbons, in the form of Light Nonaqueous Phase Liquids (LNAPLs), are commonly found beneath petroleum facilities. Natural loss rates of LNAPLs via aerobic and anaerobic processes are emerging as a critical factor in making management decisions. Work has been ongoing on the hypothesis that temperature measurements about LNAPL bodies can be used to estimate natural LNAPL loss rates. Continuous subsurface temperature measurements are currently being collected at various depths about an LNAPL body at five field sites. A two-dimensional energy balance approach is utilized to determine the heat produced by LNAPL degradation. Heating and cooling due to phenomena other than the biodegradation of LNAPL is accounted for using a background correction method. Using the change in enthalpy (ΔH) of the redox reaction, as well as the thermodynamic efficiently of the reaction, the heat produced by the LNAPL degradation is converted into an equivalent LNAPL loss rate in gallons/acre/year. Results using this heat flux method suggest seasonal variations in natural loss rates and total loss rates on the order of thousands of gallons per acre per year, consistent with data acquired using current CO_2 efflux methods. Results also suggest that subsurface temperatures are highest in the areas with highest LNAPL impacts, and lowest in unimpacted areas. Additionally, a laboratory column study is being conducted to verify these methods in a controlled setting.