Application of cryogenic core collection at non-aqueous phase liquid (NAPL) contaminated sites

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Abstract: Collection of high-quality subsurface data at contaminated sites is essential to optimize site management before, during, and after remediation. Grab soil samples from contaminated zones cannot provide data of all phases (aqueous, non-aqueous, vapor, and sorbed). Withdrawal of soil samples from unconsolidated formation can lead to drainage of pore fluids, volatilization of volatile compounds, and loss of sample from the core barrel. Here we show application of cryogenic core collection of unconsolidated formations at two NAPL contaminated sites; FE Warren Air Force Base (FEW AFB) in Cheyenne, Wyoming as a DNAPL contaminated (chlorinated solvents) site and a former Chevron refinery in Evansville, Wyoming as an LNAPL contaminated (petroleum hydrocarbons) site. Cryogenic core collection uses direct-push or hollow stem augur drilling methods and circulation of liquid nitrogen through a chilling coil or chilling dual-wall barrel around the soil core after the core barrel is filled at the desired depth. The results indicate that cryogenic core collection improves soil recovery from the subsurface during sample withdrawal and storage. Also, this method preserves critical properties of soil cores including the distribution of pore fluids and volatile compounds within the soil cores. Moreover, freezing soil cores conserves samples for microbial analysis. Overall, application of cryogenic core collection provides an improved basis for site characterization and management, which can lead to lower costs and more rapid cleanup.