Contaminant Fate and Transport in Gulf Coast Sediments: A Case Study

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ABSTRACT

Unlined waste storage pits were used throughout most of the 20th century, and many of them remain uncharacterized today. Contaminant transport mechanisms in unconsolidated formations of the Gulf Coast region necessitate the use of high-resolution site characterization (HRSC) techniques in order to determine how chlorinated hydrocarbons can continue to impact soil and groundwater long after the waste storage pits have been closed. Experts in geochemistry, mobile laboratory analysis, hydrogeology, subsurface investigation technologies, and three-dimensional visualization comprised the Triad team assembled by the Louisiana Department of Environmental Quality to characterize two previously closed waste storage pits near Sulphur, Louisiana. The investigation illustrates how constituents can migrate in various physical states, taking numerous migration pathways. Hydrocarbons from the waste storage pits can directly enter groundwater in dissolved phase and migrate according to Darcy's laws of porous media transport, creating down-gradient groundwater plumes. The plumes experience retardation and decay by several mechanisms: dispersion, natural attenuation through microbial processes, and back-diffusion of constituents in fine-grained stratigraphic lenses. Non-aqueous phase liquids represent the most potent long-term source material, both within and outside the waste storage pits. Their tendency to migrate through naturally occurring and man-made preferential pathways can compartmentalize the bulk of mass movement of constituents into discrete hydrostratigraphic units. Targeting such units while enhancing natural attenuation processes is a cost-effective remediation strategy. This paper uses a HRSC case study to illustrate current capabilities of mapping the distribution of different phases of chlorinated hydrocarbons that act as sources of groundwater contamination.