

**Characterizing Vadose Zone Heterogeneities at Scales Controlling
Contaminant Transport using PneuLog®**

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A new characterization technology in the vadose zone has been applied across the United States to accelerate cleanup, reduce long-term operational costs, and support closure of SVE systems. The technology, known as PneuLog[®], utilizes in-well instrumentation to continuously measure air permeability and contaminant concentrations on the scale of centimeters along well screens during vapor extraction in the vadose zone. Preferential flow paths produced by soil heterogeneities are clearly observed allowing the quantification of mass transfer coefficients. Correlating PneuLog data from a representative number of wells and utilizing historical SVE data allow three-dimensional estimates for contaminant and permeability distributions and mass transfer between adjacent soil layers. This detailed data set yields a more realistic conceptual site model than conventional characterization data. The result is optimized implementation of SVE by focusing remediation on source areas and accurately forecasting performance. The improved conceptual site model also generates more realistic transport modeling for setting risk-based clean up goals. For instance, the technique easily identifies low permeability materials with high moisture contents often missed in geologic logs. Such intervals pose a tremendous barrier to vaporous diffusion and are rarely included in conventional modeling despite their dominant impact on transport. Case studies are provided.