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Application of High-Resolution Geologic Modeling to Environmental Remediation in Coastal Plain Sediments

Preferential flow pathways in heterogeneous sediments are highly influenced by depositional facies. A detailed study was performed on an environmental remediation site at the Savannah River Site in SC to evaluate the relationship between observed contaminant migration and simulated depositional facies and associated permeability fields in nearshore marine coastal plain sediments. This was accomplished by using a three-dimensional high-resolution geological model created with advanced spatial modeling techniques and software that have been deployed in the petroleum industry. Characterization information consisted of cone penetrometer logs and depth-discrete contaminant (tritium) data. Depositional facies and mud fraction simulations for individual formations were ranked by proportion of muddiest facies and mud content, respectively. Key realizations were then combined in a manner to provide optimistic, nominal, and pessimistic 3-D permeability realizations with respect to contaminant travel time and depth. High permeability connectivity analyses, groundwater streamline simulations, and tracer plume simulations were compared to plume characterization data and prior coarse-resolution flow and transport models. The high resolution geological model produces more realistic plume simulations by reproducing the observed level of subsurface variability. Certain permeability realizations correlate well with observed plume data, and suggest improved strategies for ranking realizations. The study also provides insights into optimal clean-up strategies at the remediation site.