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Geological 3-D Modeling of Southeastern Tertiary Coastal Plain Sediments, Savannah River Site, South Carolina— An Applied Geostatistical Approach

A geological model of the 25 km² General Separations Area at Savannah River Site, SC was constructed using geostatistical modeling tools of the petroleum industry. The main objective of the study was to assess the viability of using petroleum technologies for environmental applications related to geological and hydrogeological characterization, and groundwater modeling. A three-dimensional high resolution geological model was produced and subsequently used to evaluate the relationship between low and high permeability geological facies.

The study was performed on Tertiary coastal plain sediments consisting of non-marine fluvial/deltaic sequences, and nearshore marine siliciclastic and calcareous depositional sequences. Bounding surfaces were established using 115 boreholes with core data and geophysical logs. Core data and cone penetration tests were used for petrophysical evaluations.

Key stratigraphic surfaces were constructed using Kriging and advanced spatial modeling techniques. These techniques are more powerful than standard methods allowing for the preservation of subtle ancient topographic and structural features associated with nearshore marine depositional environments (e.g. tidal inlets and flats, offshore sand bars).

Depositional facies were distributed throughout a 3-D grid using sequence stratigraphic principles and indicator based conditional simulation. The P50 depositional facies realization was utilized in subsequent petrophysical simulations. Petrophysical realizations from core and cone data were distributed separately within the depositional facies. P10, P50, and P90 simulations were converted to permeability. Results are currently being analyzed using connectivity and streamline simulation techniques to enhance understanding of groundwater flow and contaminant transport patterns related to depositional facies.