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Reservoir Simulation Using Fractal-Based Petrophysical Models of Heavy Oil Sands in West Coalinga Field, California

New reservoir simulation models of steam injection into heavy oil sands of the West Coalinga Field, California incorporate detailed stratigraphic control and fractal-based distributions of permeability. Geological modeling software was used to merge petrophysical properties of the wells in the simulation area with the stratigraphy. The grid design of the models was based on stratigraphic architecture of the following depositional facies tracts: incised valley, estuarine, tide- to wave-dominated shoreline, and shallow-marine subtidal. These facies tracts were recognized from extensive core and outcrop studies of the Miocene Temblor Formation, the major heavy-oil reservoir in West Coalinga Field.

Within the facies tracts, discrete lithologic groupings were identified by their geological characteristics and by well-to-well correlations. For each lithologic grouping, the fractal structure of the permeability distribution was determined by integrating the stratigraphically controlled models with core data provided by Chevron Production Company. These fractal properties, combined with the detailed stratigraphic layering, were used to populate three-dimensional permeability models that were then used for multiphase flow simulation.

Numerical simulations of steam injection into three adjacent 5-spot well configurations in the Coalinga field were performed to assess the relative merit of three categories of models generated during the geological and fractal modeling process. The three categories evaluated are the traditional facies tracts, the more complex lithologic groups, and the fractal distribution model. The value of constructing increasingly complex models is assessed using simulated versus observed oil and water production histories as the basis for comparison.