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Locating New Oil in Old Carbonate Reservoirs

Carbonate reservoirs typically recover only 20 to 35 percent of the original oil in place (OOIP) using conventional recovery mechanisms. The key to increasing reserves and recovering additional oil is a realistic 3-D reservoir model that can be input into a fluid-flow simulator to test the performance of various additional recovery programs. A realistic reservoir model displays appropriate petrophysical properties in 3-D and can only be constructed by linking petrophysical properties with a geologic model. Our reservoir and outcrop studies suggest that the best method for linking engineering and geologic information is through rock-fabric facies. A rock-fabric geologic model can be easily converted to a reservoir model by using rock-fabric transforms. A key goal in building a reservoir model is retaining high and low permeability. We accomplish this by grouping permeability into rock-fabric layers in which the petrophysical properties are near-randomly distributed. Our simulation studies indicate that the layering scheme is more important than lateral variability.

Remaining oil is located by simulating reservoir history using the rock-fabric reservoir model. Simulations indicate that an additional 10 percent of the OOIP can be typically recovered from a carbonate reservoir by targeted infill drilling. Remaining oil is commonly located in lower permeability flow layers and in undrained areas between producers and tight areas. Lower permeability flow layers may be the result of lower porosity, higher porosity but smaller pore size, or higher porosity but poorly connected separate-vug porosity. Undrained areas may occur when injectors are not in communication with producers because low permeability occurs within the flow layer between injector and producer. Therefore, locating new oil in old carbonate reservoirs requires the integration of realistic reservoir models and field operations.