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Characterization of Petrophysical Flow Units in Carbonate Reservoirs

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An interpretation procedure involving the identification and characterization of petrophysical flow units is used to resolve some key challenges faced in the exploration and production of carbonate reservoirs. Application of this procedure is illustrated with examples from the Middle East, Permian, and Williston Basins.

The procedure requires a multidisciplinary team to create status maps of the area of interest, in order to identify populations of similar data that can be represented by key wells. The team then reviews key wellbore data for intervals likely to have uniform pore-throat radii, resulting in consistent and predictable inflow performance (flow units). Use of an interrelated series of petrophysical cross-plots (gameboard) and the calculation of a pore-throat radius log assist in identification and quantitative characterization of flow-unit types in the key wells.

By determining water saturation versus height for each flow-unit type, free water level, oil-water contact, and hydrocarbon distribution in the reservoir are predicted. When a relationship exists between depositional facies and flow units, a common geological and engineering zonation is developed and parasequences are characterized in terms of flow-unit types. Combining Sw/h/flow-unit relationships with the interpreted sequence stratigraphy of the area provides a means for quantifying parasequence quality and predicting the location of hydrocarbon-productive stratigraphic traps. ■

Biographical Sketches

Steve Solomon is a Leader of Petrophysics in Conoco Inc.'s Technology organization in Houston. Prior to this, he worked as a geologist in operations and development/equity roles, then as Lead Geoscientist for the Conoco-operated gas fields in the UK southern North Sea. As a petrophysicist, he has worked on exploration plays in West Africa and reservoir appraisals in Equador, the Middle East, Midcontinental US, and Russia. Steve holds B.S. and M.S. degrees in Geology from the University of Aberdeen and has published papers on carbonate diagenesis, dielectric log interpretation, horizontal wells, and carbonate reservoir characterization. He is currently president of the Houston Chapter of the Society of Professional Well Log Analysts.

Dan Hartmann (B.S., Geology, New Mexico Tech, 1963) joined Pan Am. Prod. (now Amoco) as an exploration geologist, and later became supervisor of exploration and exploitation in the western U.S. and Alaska. He was Vice President/General Manager for Mitchell Energy Co. from 1981-1985, and, in 1985, formed DJH Energy Consulting. Dan has extensive worldwide experience with complex Sw models of shaly sandstones and carbonates.