Pore Space Inversions for Petrophysical Rock Type Identification: Application to a Large Carbonate Reservoir

Gregory N. Boitnott, *New England Research, Inc, 331 Olcott Drive, Ste L1, White River Junction, VT 05001-9263, phone: 802-296-2401 ext 118, fax: 802-296-8333, boitnott@ner.com, William T. Lauten, New England Research, Inc, D. H. Jones, ABQ Reservoir Management, Saudi Aramco, Dhahran, 31311, Saudi Arabia, E. A. Clerke, Reservoir Characterization Department, Saudi Aramco, P.O. Box 10607, Dhahran, 31311, Saudi Arabia, and J. J. Funk, Saudi Aramco Lab Research & Development Department, Dhahran, 31311, Saudi Arabia.*

Carbonate reservoir characterization is commonly hampered by difficulty in relating dynamic reservoir properties to a geologically consistent rock type classification system. Traditional approaches of log and core analysis do not produce satisfactory definition of rock type or flow performance. Furthermore, the geological models of carbonate reservoirs are typically not well linked to the reservoir flow units. We present a case study from a complex carbonate reservoir with large vertical variability in production. By combining routine laboratory measurements with an integrated pore space inversion analysis, we constructed detailed pore structure models and identified rock types from the calibration suite of plugs. The analysis led to a fundamentally different rock type classification scheme, yielding meaningful correlation with the geologic model of the reservoir and allowing identification of dual pore system samples and composite samples. The dual porosity samples themselves were divided into multiple rock types based on crossplots of inferred pore structure parameters. We show that systematic use of a pore structure based approach leads to a classification which is fundamentally different from traditional schemes using permeability, porosity, and capillary pressure alone. Owing to the broad based petrophysical and data-driven nature of the approach, the resulting classification system automatically inherits direct ties to a wide range of petrophysical properties. The pore structure inversion method thus satisfies requirements of linking the classification scheme to static and dynamic reservoir properties, as well as to the geophysically measurable properties used in log based characterization.