Stratigraphic Control on the Lateral Distribution of Hydrothermal Dolomites away from Major Fault Zones

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Hydrothermal dolomite (HTD) reservoirs are known as prolific hydrocarbon producers in many parts of the world. In many cases, exploration strategies focus on the seismic expression of a sag related to Reidel shear along basement rooted faults, with the general model being that reservoir quality dolomites are centered near the fault zones. Evaluation of published examples of these reservoirs, however, suggests there is a secondary control on the lateral development of reservoir quality rock away from the major fault zones. Detailed core analysis of HTD reservoirs in the Albion-Scipio trend of the southern Michigan Basin suggests that the lateral development of reservoir quality away from the faults is due to a combination of primary facies and the sequence stratigraphic framework.

Production from the Ordovician Trenton and Black River formations (T/BR) in the Albion-Scipio trend has exceeded 125 MMBO since the mid-1950's and nearly 40 new discoveries have been made around the trend in the past 3 years. Exploration methods continue to be centered on seismic sags observed in 3-D surveys, but initial development and subsequent enhanced production of these reservoirs will require detailed geological interpretation to avoid the close step-out dry holes often associated with these reservoirs. Initial evaluation of some 30 T/BR cores in and around the Albion-Scipio trend indicates that reservoir quality dolomitization moves laterally away from the major fault planes primarily in the TST of probable 4th order high frequency sequences. Reservoir quality is best developed in bioturbated open ramp wackestones to packstones where the burrow galleries have been differentially filled with coarser-grained sediment due likely to storm deposition (i.e. tubular tempestites). The Cruziana-type burrows have been preferentially dolomitized with coarsely crystalline sucrosic dolomite, resulting in high permeability pore networks that are distributed in 3 dimensions throughout the depositional facies. Secondary reservoirs exist in grainstones interpreted as more localized carbonate shoals. Isotopic and fluid inclusion analyses in both units support the interpretation of the dolomitizing fluids being related to the major, fault centered HTD events. Understanding of how HTD fluids can migrate laterally along preferential facies or stratigraphic intervals should aid in the development of production and enhanced-production strategies for these types of reservoirs.