

Seismic and Structural Analysis of a Hydrothermally Dolomitized Trenton-Black River Reservoir, Saybrook, Ohio

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ABSTRACT

Trenton-Black River reservoirs in the Appalachian Basin are typically associated with fault-related hydrothermal dolomites that are sealed by unaltered host rocks, however the details of how faulting and fluid flow have interacted remain poorly documented. Integration of 3-D seismic, wireline and production data from Saybrook Field in northeastern Ohio has shown that the productive trend is controlled by a 5 km long, NW-SE oriented basement fault that was probably reactivated during the Taconic Orogeny in the Mid- to Late Ordovician. The far-field stresses of this compressional activity resulted in strike-slip movement of the pre-existing fault to create a complex positive flower structure that branches 1350ft upward into the Trenton-Black River interval. Circular collapse structures within splays of the flower structure are the primary drilling targets. Faults were mapped using amplitude and coherency versions of the seismic data. Curvature analysis of horizons mapped in the seismic data allowed us to further constrain the location and orientation of subtle structures. Fault morphology provides insights into the path of the dolomitizing fluids, whereas the distribution of porosity, and thus the location of the reservoir, has been mapped in 3-D using a seismic attribute study. We integrated wireline log-based measurements of porosity with seismic attributes to predict the distribution of porosity throughout the 3-D volume. Advanced visualization technologies allowed us to integrate faults and porosity predictions, thereby gaining fundamental insights into the relationships between faulting, fluid flow and reservoir development. Our results, and the methodology that we employ, have application in analog settings elsewhere.