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Structural Traps along the Frontal Ouachitas-Arkoma Basin Transition Zone, Southeastern Oklahoma

We have studied the lower Atokan Spiro gas reservoirs along the Frontal Ouachitas-Arkoma Basin transition zone between the Wilburton gas field and Wister Lake in terms of their structural geometry, small-scale structures, pressure-depth gradient and mineralogy. In this area, the footwall block of the Choctaw Fault illustrates a transitional structural style into a foreland basin. The deep Woodford Detachment ramps up to the stratigraphically higher Springer Detachment and serves as the floor to the duplex that contains all the structural traps of the Spiro reservoirs. The Lower Atokan Detachment splays from the Springer Detachment forming both a roof to the duplex structure and a floor for a triangle zone. A north-dipping backthrust bounds the San Bois Syncline to the south, and serves as the northern boundary of the triangle zone. The thrust is at the surface in the Wilburton gas field area where it is called the Carbon Fault. Eastward along the strike of the transition zone, the backthrust becomes a blind backthrust and the duplex structure contains fewer horses. When restored to their position at the time of the Spiro deposition by using the 'key-bed' restoration method, our balanced structural cross-sections indicate about 60% shortening in the Wilburton area but about 40% shortening in the Wister Lake area. In the duplex structures, the Spiro reservoirs that were brought to structurally higher positions by the thrust faults generally exhibit higher pressure-depth gradients. The Spiro sandstone contains well-developed deformation bands along the Choctaw fault zone. Considering that this may also be true for the thrust faults in the duplex structure, permeability barriers for gas accumulation in the Spiro may have been created by the thrust faults. These suggest to us that thrust faults of the duplex structure may have provided sealing for structural traps of the Spiro reservoirs.