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Geometry of Thrusting in the Wilburton Gas Field and Surrounding Areas, Arkoma Basin, Oklahoma: Implications for Gas Exploration in the Spiro Sandstone Reservoirs: Abstract

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ABSTRACT

The Arkoma basin is an arcuate structural feature located in southern Oklahoma and western Arkansas. It is recognized as a foreland basin of the Ouachita fold and thrust belt and is one of the most prolific gas producing basins in North America. The Choctaw fault is the leading-edge thrust of the Ouachita frontal belt. Several south-dipping leading imbricate fan thrust faults are present in the hanging wall block of the Choctaw.

The Wilburton gas field is located in the central part of the basin and produces mostly from the Pennsylvanian (Atokan) Spiro Sandstone. We have constructed many balanced structural cross sections in the Wilburton gas field and adjacent areas to determine the detailed geometry and structural history of the thrusting. The cross sections are perpendicular to the tectonic transport direction and are based on updated surface geology by the Oklahoma Geological Survey, wire-line well log data, and our interpretation of several seismic profiles donated by the EXXON oil company. The restored cross sections suggest about 40% shortening in the Wilburton gas field area. There is a good correlation between the presence of Chamosite clay and the porosity and permeability in the Spiro Sandstone. The original distribution of the Chamosite bearing facies in the Spiro sandstone was plotted on the cross sections to determine the extent of potential reservoir rock.

In the Wilburton area, the cross sections suggest a shallow triangle zone floored by the Lower Atokan detachment and flanked by the south-dipping Choctaw thrust to the south and north-dipping Carbon fault to the north. The foot wall of the Choctaw contains duplexes that are located between Springer detachment (the lower detachment) and the Lower Atokan Detachment (the upper detachment). These duplexes contain overpressured Spiro sandstone gas reservoirs. There is a rough correlation between the pressure data in the Spiro reservoirs and the duplex structures. The highest pressure-depth gradients are found in the Spiro reservoirs that were brought to structurally higher positions by the thrust faults in the duplex structures. Structurally lower reservoirs exhibit lower pressure-depth gradients. Therefore, we suggest that the thrusting in the duplex structures may have formed seals that isolated the Spiro Sandstone gas reservoirs.

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