

The Petroleum Potential of the Pennsylvanian Age Atoka and Cherokee Age Carbonaceous Shales in the Denver Basin

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The Atoka and Cherokee formations of Middle Pennsylvanian age in the Denver Basin contain numerous thin carbonaceous shales or mudstones (one to eight ft thick) that are petroleum saturated and expelling hydrocarbons. The Denver Basin is an asymmetrical basin that produces from predominantly Cretaceous age reservoirs. Historically, Permian-Paleozoic exploration and production has been limited to the southeast side along the Las Animas Arch and the north central part of the basin. The Pennsylvanian carbonaceous shales are generally restricted to the south central and southeastern portion of the basin.

The Atokan carbonaceous shales were deposited in a lacustrine environment and the Cherokee shales were deposited in an open-marine environment. Both formations interfinger with the alluvial deposits of the Fountain Formation found on the southern and western edges of the basin. The total organic content of the Atoka and Cherokee shales varies from one percent to over 24 percent. Interlayered between the carbonaceous shales are gray-to gray-green shales, wackestones, and porous dolomites that all can be oil saturated.

The play is presently focused in Lincoln County. The lone producer in the Craig Ranch Field that produced from 300 ft of Atoka strata and produced 14 MBO before being plugged in 1995. Recent drilling at the adjacent Bolero Field has resulted in several vertical wells producing from the Lower Atoka strata with rates of 25 to 140 BOPD plus gas. Production have been established in the Tebo shale of the Cherokee Formation which is three to four ft thick and in some areas underlain by a thin porous dolomite called the Cherokee "C". The Bolero Field was originally completed in the Cherokee "C". The Bolero Field produced approximately 40 MBO from the Cherokee "C" and was plugged in the 1980s. Production rates from the Cherokee Tebo shale and underlying dolomite vary from 50 to 80 BOPD plus gas with little decline with recent six months production history. Cores collected from several of the Cherokee and Atoka shales, which are effectively carbonate rich siltstones, have hydrocarbon saturations of 40-85 percent.

The reservoirs in both the Atoka and Cherokee formations produce a sweet, 38 to 40 gravity crude with 1,600 to 2,100 BTU natural gas but significantly different pour points. Source-rock data indicates the Atoka and Cherokee carbonaceous shales are in the oil window. The Atoka and Cherokee play is similar to the Bakken requiring completion in the interlayered fractured porous carbonates. The success for producing from the Atoka and Cherokee shales are the result of using modern fracturing techniques. The Atoka and Cherokee play continues to expand and is attracting interest from several companies.