
Petroleum Systems in Late Paleozoic Elevator Basins, Southern Ancestral Rocky Mountains

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ABSTRACT

The Tucumcari, Estancia, Carrizozo, and Vaughn basins are located in northeast and central New Mexico. These basins were tectonically active from the early Pennsylvanian through the early Permian. They were formed along the flanks of the late Paleozoic Sierra Grande and Pedernal uplifts in a strike-slip setting.

These basins were dominated by shallow-shelf deposition. Along their boundaries with adjoining uplifts, however, they have component elevator basins. Elevator basins are long, narrow, and structurally deep troughs bounded by high-angle faults. Most are elongate parallel to the axes of adjoining uplifts and separate the uplifts from areas of shelf deposition. The bounding faults have vertical offsets that can exceed 5,000 feet. Basin width ranges from two to ten miles.

Early to Middle Pennsylvanian strata in these elevator basins are mature source rocks. Deposition was dominated by shales and sandstones. Total organic carbon can exceed 9% in dark-gray to black shales. Kerogens are gas-prone and oil-prone types. Greater depth of burial in the elevator basins as compared to adjoining uplifts and shelves resulted in increased levels of thermal maturation within the basins. Shales within the basins are within the oil window and shales on adjoining shelves are less mature. Hydrocarbons generated within the basins have migrated upward along the bounding faults and into strata on adjacent shelves and uplifts. Sandstones within the elevator basins may be targets for exploratory drilling, but carbonates and sandstones on the shelves are major targets that should not be overlooked.

Three models of elevator basins have been developed from the New Mexico basins that have been studied. These models are based on two variables: 1) the orientation of the basin relative to the bordering late Paleozoic uplift, and 2) the relationship between the rate of sedimentary accretion in the basin and the rate of basin subsidence. Elevator basins that are oriented so that they cut obliquely into the uplift are analogous to fjords; water circulation patterns resulted in a density stratified water column characterized by deposition of extremely rich source rocks in the deepest parts of the basin. Basins where subsidence was less than the rate of sedimentary accretion were characterized by nonmarine environments and sedimentary bypass during deposition; source rocks are characterized by nonmarine, gas-prone kerogens. Basins where subsidence exceeded the rate of sedimentary accretion acted as traps for sediment shed from the adjacent uplift; these basins are characterized by marine shales whose kerogens have a marine oil-prone fraction and a nonmarine gas-prone fraction.