

Resource Play Potential of the Phosphoria Formation in Western Wyoming

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ABSTRACT

The USGS estimates the source rocks of the Permian-age Phosphoria Formation have generated more than 225 billion barrels of oil. The Phosphoria Total Petroleum System (TPS) is stratigraphically defined by the Phosphoria Formation and surrounding sub-Cretaceous reservoirs. Migration from this system is extensive and encompasses the western portion of Wyoming and the edges of surrounding states. Although this system contains some of the most prolific source rocks and migration pathways in the western US it is yet to be developed into a major resource play. The Phosphoria can be divided into three primary sequences - the Grandeur at the base, the Franson in the middle and the Ervay at the top. The Meade Peak and the Retort Shale members are composed of organic claystones and siltstones. These members are rich in Type-IIIS kerogen with total organic contents as high as 10 weight percent. The Phosphoria gets its name from the high percentage of phosphate in the rock and phosphorite is mined in southern Idaho. The Ervay sequence has the best reservoir characteristics and geographically the upper Ervay can be divided into three general lithotypes west to east into dominantly organic black shales (Idaho), cyclic ramp cherty carbonates and some sandstones in the middle (western to central Big Horn and Wind River Basins) and redbed evaporate deposits to the east (eastern Big Horn and Wind River Basins). Hydrocarbon generation occurred during the Late Cretaceous and migration was primarily west to east from the shale facies to the Ervay carbonate reservoirs. The dominant migration pipeline was through the ubiquitous Pennsylvanian Tensleep Formation. During the Laramide orogeny oil migrated into Phosphoria and Tensleep reservoirs along the numerous thrust structures in the Wind River and Big Horn basins. Phosphoria and Tensleep reservoirs became forever linked through production and were often treated as one reservoir with a common oil-water contact as defined in the Tensleep. One great exception is the Cottonwood Creek Field in Washakie County in the southeastern Big Horn Basin. This giant stratigraphic trap has a EUR of 100 million barrels of oil mostly from the Phosphoria. Petrophysical examination of Ervay reservoirs show a very complex carbonate with diagenetic imprints of anhydrite followed by chert. Original depositional facies is critical in defining the best reservoir characteristics. Examination of the fluid properties from the Ervay show they are distinctly different from the fluid properties of the underlying Tensleep reservoir to which they are often tied and requires an adjustment in log analysis. Generally the oil-water contact in the Cottonwood Creek to Worland field complex is thought to be around -6500 ft. subsea; however, there is deeper production which may indicate a broader and deeper hydrocarbon column in the Phosphoria in the Big Horn Basin. Re-examination of depositional trends, petrophysics and fluid dynamics is key in evaluating the Ervay for a resource play.