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The Tannehill Sandstone of Northwest Texas: Depositional Environments and Hydrocarbon Migration from the Basin to the Shelf

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ABSTRACT

The Middle Wolfcampian aged Tannehill Sandstone holds one of the most extensive oil-producing trends in Northwest Texas. Production from this system extends over 100 miles across the Eastern Shelf and into the Northeastern Midland Basin. This productive trend has yielded over 80 million barrels of oil and remains an active exploration target. This study focuses on the western half of the productive Tannehill trend, a region of very active exploration and development.

The Tannehill Sand was deposited in diverse environments by a westward prograding fluvial-dominated system. Deposition of these sands was greatly influenced by high frequency, low magnitude, transgressive-regressive, sea level cycles. These cycles resulted in the deposition of two independent, progradational clastic sequences bounded by transgressive carbonate sequences. High-stand, shelf deltaic environments dominate the eastern portion of the productive trend. Low-stand, incised fluvial channels are prevalent in the central region. Low-stand, shelf distributary channels, basin-prograding shelf edge deltas, slope and submarine fan complexes are present on the western end of the trend.

The Tannehill has a notable lack of associated hydrocarbon source rocks and the sediments are thermally immature. Crude oil geochemistry documents a common oil type throughout the system that correlates to oils produced from two major structures on the northeastern Horseshoe Atoll. Basinal Tannehill Sands downlap onto one of the largest Pennsylvanian Reef structures of the prolific Horseshoe Atoll complex. This relationship resulted in an ineffective seal, which allowed vertical hydrocarbon migration from the reef into these overlying Wolfcampian Sands. A continuous Tannehill aquifer and monoclinal structural dip has allowed for long-range hydrocarbon migration. Hydrocarbon migration progressed up regional dip from west to east, filling stratigraphic traps to spill point. Regional aquifer pressure depletion due to production indicates communication throughout the system.

The majority of Tannehill production and exploration has occurred on the shelf. Significant discoveries have been made on the western end of the trend that have not been formally recognized as basinal deposits of the Tannehill. The application of sequence stratigraphy and crude oil geochemistry has significantly aided the understanding of this complex depositional system. These concepts have led to the development of new exploration objectives and proper time-stratigraphic identification of significant oil and gas reservoirs in the basin province.