Preliminary Comparison of Upper Pennsylvanian Depositional Facies Through Core Observations - Western Edge Central Basin Platform, Ward County, Texas

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Pennsylvanian reservoirs are the second most prolific producers of oil and gas in the Permian Basin. A number of Pennsylvanian cores were taken during the development of the Wagon Wheel Field. In a time when enhanced recovery of oil and gas continues to be of increasing concern within the Permian Basin, combining early data from this older producing field with more recent technical development provides a fresh look at the reservoir geometries and production recovery for this part of the Permian Basin. This new work will provide a better understanding of the magnitude of the direction of dip above and below the porosity zones. It will help us understand what mechanisms control the porosity and permeability within the area and why there is a water productive zone in between established productive intervals.

The Wagon Wheel (Penn) Field was discovered in 1979 and lies north of the Block 34 Penn Field and to the west of the H.S.A. (Penn) Field in Ward County, Texas. The majority of the production comes from the late Pennsylvanian Cisco-Canyon (Virgilian-Missourian) Series with minor production from the middle Strawn (DesMoinesian). There is a well-known water zone separating the middle- and later-aged Pennsylvanian reservoirs. Approximately 109 wells have been drilled in the field encountering reservoir quality carbonates with average porosities of 9% and permeabilities of 2 millidarcies. Net porosity averages 55 feet per well, the OOIP for the field was calculated as 31.8 MMBO and original gas in place at 42 BCF in the late 1980's. A waterflood was implemented in July, 1987 as an

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effort to stabilize declining reservoir pressures but the field has never been placed under CO_2 flooding. Cumulative production for Wagon Wheel is approximately 11,813,126 BO, 41,792,511 MCFG and 41,295,666 BW.

Paleogeographically, the Wagon Wheel Field lies approximately two miles east and updip from the western edge of the Central Basin Platform and some five miles to the west from the uplifted, tectonically active spine of the platform. Both local tectonics and transgressive-regressive patterns associated with the glacio-eustatic sea level fluctuations played a significant role in the development of the shallow marine carbonate facies from which the field produces.

Two strike oriented cores have been described in detail and up to ten facies identified: (from basinal to tectonically forced clastic facies and paleosols):
f.1-flooding mudstone;
f.2- platy algal, fusulinid, *Tubiphytes*, bioclastic wackestone associated with maximum flooding mudstone;
f.3- crinoidal wackestone;
f.4- platy algae, fusulinid, crinoidal, skeletal, bioturbated, stylolitic, wacke/packstone (floatstone);
f.5- platy algal, *Tubiphytes* lime mound buildup;
f.6- mound crest and flank pack/grainstone;
f.7- strike oriented shoals of coarse-grained, fusulinid, crinoidal, bioclastic, coated-grain pack/grainstone;
f.8- lagoonal phylloid, dasyclad, peloid lime mud/ wackestone and/or deeper lagoonal mudstones with associated terrestrial green claystone;
f.9- microkarst diagenetic facies common with high frequency cycles;
f.10- tectonically forced clastic facies / paleosols.

Excellent reservoir quality pay is found in f.7 as isolated skeletal bars and shoals. Porosity in the key reservoir facies is interparticle, pinpoint and moldic in nature. Vertical fractures are common with many of the fractures cemented with calcite. Soil profiles and meteoric diagenesis associated with the 13 documented glacio-eustatic sea level fluctuations have influenced porosity distribution.

In addition to understanding these diverse origins of porosity and permeability, the facies model highlights depositional patterns that display both vertical stacking and lateral facies shifts within the area. Stacking pattern analy-

sis helps predict development of additional carbonate buildups. The newly defined facies and their rock fabrics can be integrated with petrophysical analysis to strengthen the log analysis for wells that have not been cored. Successful understanding of the Wagon Wheel reservoir geometries could be pertinent in the future as an analog to other similar areas of interest in oil and gas exploration and development of Pennsylvanian aged rocks or those rocks displaying similar depositional patterns.