Calciclastic and Siliciclastic Submarine Fan Comparison: Classification and Implications for Reservoir Variability, Delaware Basin, Southeast New Mexico and West Texas

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Abstract

The Permian Basin houses significant unconventional reservoirs in deep-water mudstones and sandstones distal from carbonate slopes. Numerous calciclastic submarine fans building into the basin play a significant role in the distribution of reservoir and non-reservoir units in these deep-water systems. The recent identification large fan and fan complexes underscores the need for reassessment of the basinal stratigraphy. The basinal characterization involved significant subsurface mapping using approximately 8000 well-logs with integration from core analysis. Multiple maps aided in identification calciclastic and siliciclastic fans from the Wolfcamp through Bone Spring Formation. Within identified fans, mapping and assessment of continuity of internal stratigraphic horizons guided interpretation of confined and unconfined sub-environments within each fan. Both calciclastic and siliciclastic fans follow similar entry points into the basin and in many cases are comparable in size. Each contains mappable internal depositional elements that rarely downlap and pinch out. However, they do have significant depositional differences: 1) Carbonate fans transition from coarser-grained fan axes to mudstone and siltstone-dominated fringes. Siliciclastic fans have a much lower total volume of mudstone facies and transition off-axis to high net volume of siltstone and sandstone lobe and levee deposits. 2) Siliciclastic dominated intervals form more significant canyon systems which may enhance flow confinement and transport

coarser material a significant distance while coarser carbonate deposition is initially more dispersed with shorter runouts. 3) Siliciclastic fans are dominated by frictional flow deposits and transition to frictional and mixed rheology hybrid flows in the distal extent of the systems. Calciclastic fans contain abundant cohesive flow deposits as well was frictional flow event beds. Cohesive flows may hydroplane and aid in preservation of underlying organic-rich mudstones. This work indicates calciclastic fans exert significant influence on reservoir distribution at both the exploration and production scale with full characterization necessary for optimizing field development. It also highlights the necessity of updating depositional models for carbonate fans as they can be much larger than previously described and may vary from siliciclastic counterparts.