Regional Variation and Stratigraphic Development of the “Atoka” Clastics in the Midland Basin, West Texas

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Abstract

The productive interval of the Midland Basin historically identified as “Atoka” and Strawn is the focus of this study. Although several publications have discussed the geology of the “Atoka” clastics and Strawn carbonates, the regional and stratigraphic variations within the “Atoka” clastic section and clastics at the base of the Atoka Lime and Strawn have not been widely published. In this study, a set of regional maps were created using various resistivity and neutron porosity cut-offs from well logs. Maps were created to understand and highlight the depositional patterns of these intervals and what role they play in development of the basin during the Upper Mississippian to Lower Pennsylvanian. The “Atoka” and Strawn intervals of the Midland Basin have produced oil and gas from various structural and stratigraphic traps. These reservoirs span depositional environments including organically lean shales, basinal gravity flows, clastic lowstand deposits filling structural lows, and transgressive to highstand carbonate deposits. In addition to the myriad of depositional environments, the stratigraphic nomenclature is ambiguous. Osterlund (2010) used palynology data to date the previously identified Pennsylvanian “Atoka Clastic” interval as Mississippian aged Upper Barnett. A second order maximum flooding event within the basin is expressed in the underlying Mississippian interval. As base level began to drop in response to the approaching Ouachita-Marathon orogeny, background sedimentation included basin wide organic lean shale. Sporadic gravity flows, both clastic and carbonate in origin, were transported downslope into the basin and encased within the organic lean shales. Mauck (2017), demonstrated

that carbonate gravity flows of the Two Finger Sand of the northern Midland Basin were derived from the adjacent carbonate platform. As the response to the approaching Ouachita-Marathon orogeny intensified, faulting developed at the margins of the basin and funneled clastic material into the subsiding basin, filling in the structural lows. In many instances, clastic input kept up with fault activation causing thick narrow areas of clastic sedimentation. In the center of the basin, well log character highlights the interaction between basin subsidence and clastic sedimentation whereas in other areas of the basin, the transition from clastic to carbonate is more abrupt. As the basin filled and subsidence waned, carbonate deposition dominated within the basin and kept pace with subsidence, creating thick intervals with porosity stringers representing exposure surfaces (Sivils, 2002). This cycle (clastic to carbonate dominated deposition) repeated again from the end of the Atoka Lime to the end of the Strawn Lime.