Rift Shoulder Erosion and Basin Deformation Associated with the Wichita Uplift (Mountain Front): Anadarko Basin, Oklahoma and Texas, U.S.A.

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ABSTRACT

The ancestral Wichita uplift (Mountain Front) forms the southern margin of the Anadarko Basin in the Panhandle of Texas and Oklahoma. We used well logs and regional 2D and 3D seismic datasets to evaluate the tectonic history of the Mountain Front and to assess its impacts on trap formation and hydrocarbon accumulation, particularly within the Pennsylvanian age Granite Wash play.

The southern boundary of the Anadarko Basin in Texas is the Amarillo Uplift, a buried mountain range (Wichita Mountains) bounded by the Mountain View fault zone with a left lateral transpression sense of movement. Clastic detritus of the Granite Wash interval was derived from erosion of Paleozoic strata and Proterozoic basement of the Amarillo uplift to the south, carried northward across the trace of the Mountain View fault by fluvial systems, and deposited in fan-deltas within the basin axis.

The Granite Wash was deposited during mid-Atokan to mid-Desmoinesian time, which coincides with the early stages of the Arbuckle orogeny. It is speculated that headward erosion and integration of drainages likely occurred during the early Atokan “tectonic lull”, leading to flushing of impounded sediments (stored terraces, piggy-back basins, etc.) from the Amarillo uplift to feed the Granite Wash fan-delta system.

Locally some structures were active within the basin during Granite Wash deposition, most notable within the Old Mountain Front zone and within a broad zone of detached transpressional structures that lay to the north.

This study highlights how integrating tectonic history and seismic stratigraphy can improve the understanding of: (1) source to sink sedimentology and reservoir quality prediction; (2) variations in deformation timing impact trap formation; (3) and how uplift/ subsidence impact reservoir deposition. An example from Texas is where the Arbuckle orogeny involved a southward shift in the locus of deformation and uplift, whereas in Oklahoma the Arbuckle deformation front migrated basinward, uplifting and destroying the older Wichita deformation belt. Our findings suggest that oil-prone traps were in place during early charge in Texas, whereas gas-prone Mountain Front traps in Oklahoma were formed later. This methodology is applicable to other foreland basins where erosion of older rift shoulder sediments provides the provenance for later deposits and where episodic deformation along a broad tectonic front produces variations in trap timing.