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Structural Style and Evolution of the Ardmore Basin

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The structural style of the Ardmore Basin has long been considered by many workers to provide conclusive evidence of large-scale wrench fault tectonics. A detailed inspection of the data calls into question this traditional interpretation and instead suggests the possibility that basement-involved contraction was an important part of the structural evolution of the basin. The newer hypothesis is based on a series of transverse structural cross sections constructed across several of the more significant geologic features in the basin. The cross sections were constrained utilizing subsurface control provided by greater than forty-thousand wells which have been drilled in and around the Overbrook, SW Ardmore, Lone Grove, Hewitt-Healdton, Sho-Vel-Tum, and Eola oilfields. Subsurface maps on several different horizons have been generated, with the map data projected into the cross sections. The sections were then scanned and loaded into the LithoTect structural modeling software and palinspastically restored. The restoration process reveals that most of the cross sections can only be validated utilizing a flexural slip mechanism. Wrench-fault models employing a positive "flower structure" or "upthrust" geometry in cross section cannot be validated. Interpretations of "flower structures" are sometimes associated with poorly imaged seismic data. Modern reprocessing of high fold 2-D data along with the acquisition of 3-D data can allow structural interpretations to be less tenuous. At the largest scale, the structural style along the mountain-front areas more closely resembles a hybrid between classic fault-bend folding and fault-propagation folding. Both ramp and flat geometries and fault-fold interchanges are in evidence, many times along the same cross section. Along most of the mountain front areas a significant component of "basement-overhang" is evidenced by numerous deep wells. At the smaller scale, folds display a concentric to complex fold style. Numerous volumetric crowd features are evidenced in the oilfields. Many of these smaller-scale folds are detached at the boundary between the ductile Simpson shale and the more competent and massive Arbuckle Group carbonate. High angle faults with either a vertical, reverse, normal, oblique slip or strike slip sense of motion are also noted in the basin. Mapping suggests that these faults are usually oriented oblique or normal to the axis of the major folds, and have a much smaller magnitude than do the mountain-bounding thrusts. Some of these oblique-trending, high-angle faults may have resulted from re-activation of an older set of basement-involved faults and fractures. During Pennsylvanian contraction these sometimes acted to compartmentalize the deformation. Some of the older faults may have also influenced the depositional patterns of Pre-Pennsylvanian stratigraphic units. Most however appear to be non basement-involved and have resulted from tension due to longitudinal curvature or plunge of the major folds.