Chapter 6: Conclusions

The Cherokee basin of southeast Kansas is part of the western region Interior Coal Province, and is a hydrocarbon-bearing foreland province. Abundant resources of deep coal [>30m burial depth] are contained within the Cherokee Group (Desmoinesian Stage, Middle Pennsylvanian Series) of eastern Kansas. The following conclusions can be made regarding the stratigraphic and depositional controls on coal development relating to the coalbed gas potential of the Cherokee basin.

1. The Cherokee Group and Fort Scott Limestone can be divided into ten lithofacies. The phosphatic black shale, dark gray shale, and bioclastic mudstone to wackestone lithofacies were deposited in open marine environments, below fair-weather wave base. The bioclastic packstone to grainstone, and cross-laminated lithofacies were deposited in restricted to open marine, above fair-weather wave base, in a relatively shallow environment. The sideritic gray shale and interlaminated sandstone and siltstone lithofacies were deposited in a marginal marine environment, probably estuarine (central bay and bay head delta, respectively). The blocky mudstone lithofacies is interpreted as a paleosol formed under swampy conditions. The pyritic black shale and coal to carbonaceous shale lithofacies were formed in non-marine environments including swamps, mires, marshes and peatlands.
2. Sequence stratigraphic concepts provide a framework to explain and predict the lateral distribution, relative thickness and quality of coal beds in the Cherokee Group. Within the study area, seven sequences were identified. Each sequence contains multiple coals and portions of the transgressive and highstand systems tract resulting from changes in relative sea level.
3. Thicker and laterally extensive coals developed toward the end of the transgressive systems tract and beginning of the highstand systems tract as a consequence of increasing accommodation, back stepping of a destructive fluvial system, and preservation by an extensive marine flooding surface. Coals formed during the upper transgressive systems tract and lower highstand systems tract are typically of higher quality (low ash, low sulfur, and higher adsorbed gas content).
4. Cherokee Group coals accumulated in a variety of depositional settings, such as marshes, open and back barrier coastlines, estuaries, and fluvial flood basins. Coals formed in mires associated with the coastal plain are commonly thicker and laterally continuous, while coals associated with estuarine and fluvial floodbasin environments are thinner and laterally discontinuous. On average, coals accumulated within the coastal setting have lower ash contents, lower sulfur content, and higher adsorbed gas contents than other coals. Coastal plain mires are best developed during the late transgressive or early highstand systems tract, and under more stable shoreline conditions.
5. The differences in raised and low-lying mires probably had a significant influence on the distribution and quality of coal formation. The type of mire is a significant factor in ash content, where raised mires are typically of lower ash due to protection from marine and fluvial processes. Raised and low-lying mires can form in any of the coal accumulation settings, but raised mires require persistence of coal forming conditions for longer periods of time. Raised mires and coal forming conditions appear to be better maintained during periods of rising base level.
6. Pre-existing topography played a major role in the growth, distribution and quality of peatlands that developed into coal. Variation in thickness appears related to subtle changes in topography, where shallower areas emerge and lead to the development of peat swamps prior to deeper areas. These slight topographic highs provide some protection from the marine

influence, resulting in a lower ash coal rather than a carbonaceous shale or high-ash coal that formed from an admixed marine setting in the lows. Conversely, pre-Pennsylvanian topographic lows provided many areas in which coal is interpreted to have accumulated in raised and low-lying mires above marsh and lake environments associated with the karstic Mississippian limestone lows. Mires influenced by pre-Pennsylvanian lows resulted in coals that thicken into lows and thin on highs.

7. Based on preliminary gas isotopic analysis, Cherokee basin coal gas samples represent a mixed thermogenic and microbial origin. Considering degree of maturation and gas geochemistry, natural conventional and coal gases in eastern Kansas are likely a combination of indigenous dry microbial methane, and either indigenous or migrated early thermogenic methane. An additional source for indigenous thermogenic methane is sourcing from the black shales that typically overlie coal seams.
8. Desorption data indicates that coals of the central part of the study area have higher methane contents than coals in the eastern portion of the basin where coals are shallower. Desorption of coal samples also indicate a general relationship of increasing gas content with depth. There may be a minimum depth for economic coal gas based on this relationship and the relative thickness of Cherokee coals.
9. An estimated 6.6 tcf of original gas in place from twelve coals and two black shales exists in the study area of the Cherokee basin. This resource is contained within the Cherokee Group and Fort Scott Limestone, which have net coal thickness ranging from 2 to more than 25 feet (0.6 to 7.6 m) at depths of less than 2,500 ft (762 m).
10. With moderate gas saturation, high resolution mapping, and an understanding of depositional controls of coals, ease of water disposal, and relatively inexpensive drilling, the Cherokee basin has the potential to provide successful coal gas plays and significant quantities of natural gas for Kansas and the nation.

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