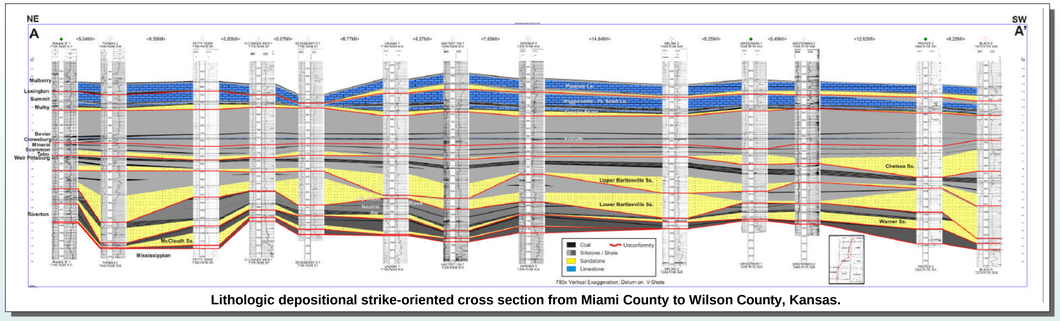
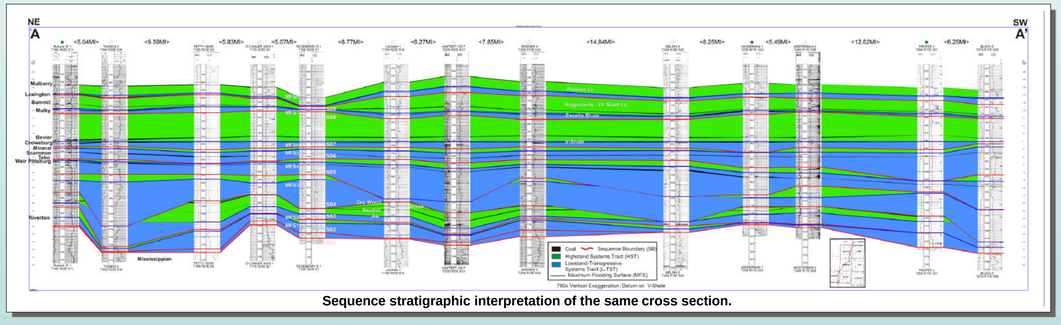


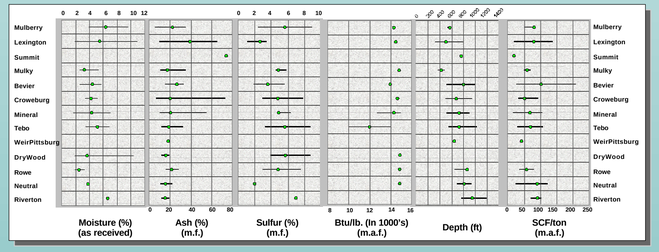
Lithologic depositional strike-oriented cross section from Miami County to Wilson County, Kansas.



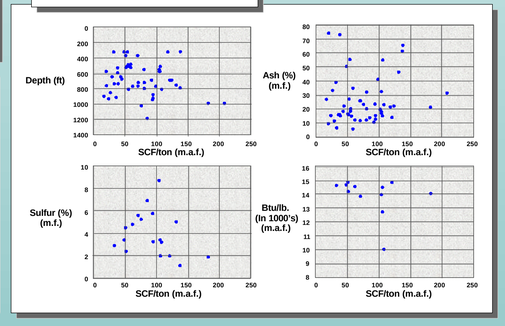
Sequence stratigraphic interpretation of the same cross section.

The chart below gives the average (green circles) and range of values of moisture (%; as received), ash and sulfur (%; both moisture free), calorific value (in thousands of Btu/lb; moisture-, ash-free basis), depth (in feet), and gas content (scf/ton; moisture-, ash-free basis) for coals across the Bourbon Arch region. Data are from core and drill cuttings samples from the Kansas Geological Survey and private operating companies, as well as from previous mine surveys in the area (Wedge and Hatch, 1980; Erten and Bostic, 1990). Coals are in stratigraphic order from youngest (top) to oldest (bottom).

The second set of graphs to the right show trends of gas content vs. ash and sulfur content, depth, and calorific value.



COAL QUALITY

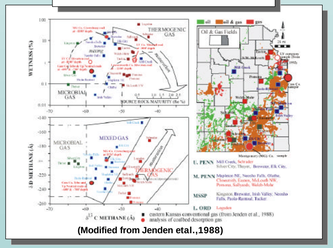


SEQUENCE STRATIGRAPHY

The placement of Middle Pennsylvanian strata into a sequence stratigraphic framework provides a better understanding of the variability in coal distribution, thickness, quality, and gas content. Determining the depositional history of an area is the first step to sequence stratigraphic analysis. Conditions that encourage thick peat accumulation include accommodation, rising base level, and sediment bypass. The period of maximum transgression is ideal for these conditions. Late transgressive systems tracts (TSTs) and early highstand systems tracts (HSTs) are therefore where the thickest coals will be found. Coals tend to thicken, have lower ash, and higher BTU values upwards through the TST to a maximum at the beginning of the HST. Coals tend to thin, have more ash content, and have lower BTU values from the maximum flooding surface (MFS) through the HST. Widespread coals tend not to develop during the lowstand given the lack of accommodation and have low preservation potential during the highstand due to high rates of sedimentation (Aitken, 1994).

The two figures to the left are twin strike-oriented cross sections: one showing a lithologic interpretation, and the other a sequence stratigraphic interpretation of Desmoinesian strata across the study area. Eight possible maximum flooding surfaces and nine sequence boundaries are recognized between the Mississippian-Pennsylvanian unconformity and Mulberry coal, and more of both are possible above this coal. Coals such as the Riverton, 'Aw', Tebo, Mineral, Croweburg, and Mulky--all close to MFS's--are considered thick, extensive, "major" coals in this area.

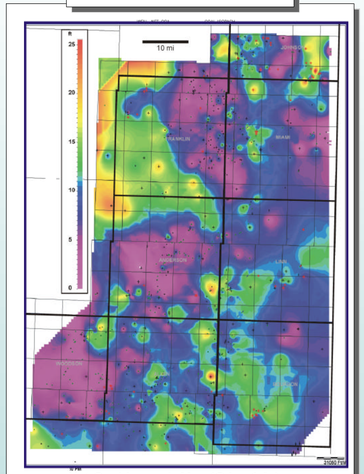
GAS ANALYSIS



Jenden et al. (1988) plotted the methane δD vs. methane $\delta^{13}C$ values (lower graph) of several conventional gas samples from around Kansas, concluding that eastern Kansas Pennsylvanian gases are of three different origins (thermogenic, microbial CO_2 reduction, and microbial). Coalbed gas samples from eastern Kansas plot within a zone of mixed thermogenic-microbial origin. The upper graph of % wetness vs. methane $\delta^{13}C$ also supports a mixed origin for coalbed gas.

Preliminary results of ongoing research at the Kansas Geological Survey suggest that separate dominantly thermogenic and dominantly mixed microbial gas fairways may exist in the deeper and shallower parts, respectively, of eastern Kansas.

RESOURCE ASSESSMENT



Net Coal Isopach Map (C.I. = 1 ft.)

The net coal isopach (shown above) includes "major," laterally correlative coals in the region.

The volumetrics report below is a summation of volumetric calculations of all "major" coals as in the net coal isopach map above. The Scammon, Dry Wood, and Aw coals are not included due to insufficient desorption data.

Volumetrics of Bourbon Arch Region, Eastern Kansas

Total Volume Coal >1.5 ft.	13,411,228 acre-ft 1800 short tons/acre 2.414×10^{10} short tons
Avg Gas Content (range)	20-102 scf/ton avg.
OGIP	**1,728.9 bcf**

This poster will be available online at www.kgs.ku.edu/PRS/publication/MidAAPG2003-1

CONCLUSIONS

& Peat-forming environments have little relation with underlying strata. However, depositional environments can influence coal-seam characteristics (thickness, geometry, quality).

& The Lexington coal developed as a low-lying mire during initial trangression, prograding over tidal flat deposits on an exposed carbonate surface.

& The Bevier coal possibly formed locally, as a raised mire behind an accreting, prograding, muddy shoreline.

& The Croweburg coal may have formed as a raised or low-lying mire behind a tide-influenced coastline with possible barrier island sands.

& The Neutral coal is not as extensive as other coals, due to erosion by the overlying lower Bartlesville sandstone. Lithologic evidence suggests that it was one of a series of mires forming behind a prograding, tidal-estuarine shoreline.

& Sequence stratigraphic concepts provide better understanding of depositional variability of coal thickness, distribution, and quality. Coals near the maximum flooding surface can be expected to be thicker and more extensive.

& Gas-isotope analysis indicate a mixed microbial and thermogenic origin for coalbed gas in eastern Kansas.

& The Bourbon Arch region of eastern Kansas may hold approximately 1.7 tcf of coalbed gas.

REFERENCES

Aitken, J.F., 1994, Coalinasequencestratigraphicframework: Geoscientist, v.4, no.5, p.9-12.

Brady, L.L., 1997, Kansascoalresourcesandtheirpotentialforcoalbedmethane: Transactionsofthe 1997 AmericanAssociationofPetroleumGeologistsMid-ContinentSectionMeeting, p.150-163.

Coleman, J.M., Gagliano, S.M., andSmith, W.G., 1970, SedimentationinaMalaysianhightidetropicaldelta, *in* Morgan, J.P., (ed.), Deltasedimentation, modernandancient: SocietyofEconomicPaleontologistsand Mineralogists, SpecialPublication15, p.185-197.

Erten, M.H., andBostic, J.L., 1990, Beneficiationanddesulfurization of Missouricoals, *in* Finkelman, R.B., Friedman, S.A., andHatch, J.R., (eds.), Coalgeologyoftheinteriorcoalprovince, westernregion: Geological Society ofAmerica, 1990AnnualMeetingCoalGeologyDivisionfieldtrip, p.260-301.

Golonka, J., Ross, M.I., andScotese, C.R., 1994, Phanerozoicpaleogeographicandpaleoclimaticmodelingmaps, *in* Emery, A.F., Beauchamp, B., andGlass, D.J., (eds.), Pangea: globalenvironmentsandresources: Canadian Society of Petroleum Geologists, Memoir17, p.1-47.

Jenden, P.D., Newell, K.D., Kaplan, I.R., andWatney, W.L., 1988, Compositionandstable-isotopegeochemistryof naturalgasesfromKansas, mid-continent, USA: ChemicalGeology, v.71, p.117-147.

Jewett, J.M., 1951, Geologicstructuresin Kansas: KansasGeologicalSurveyBulletin90, pt.6, 172p.

Jewett, J.M., O'Conner, H.G., andZeller, D.E., 1968, ThePennsylvaniansystem, *in* Zeller, D.E. (ed.), The stratigraphicsuccessioninKansas: KansasGeologicalSurvey, Bulletin189, p.21-43.

McCabe, P.J., 1984, Depositionalmodelsofcoalandcoal-bearingstrata, *in* Rahmani, R.A., andFlores, R.M. (eds.), Sedimentology ofcoalandcoal-bearingsequences: InternationalAssociationofSedimentologists, Special Publication7, p.13-42.

McCabe, P.J., 1991, Geologyofcoal; environmentsofdeposition, *in* Gluskoter, H.J., Rice, D.D., andTaylor, R.B., (eds.), TheGeologyofNorthAmerica, EconomicGeology: GeologicalSocietyofAmerica, v.P-2, p.469-482.

Newell, K.D., Brady, L.L., Lange, J.P., andCarr, T.R., 2002, Coalbedgasplayemergesineastern Kansasbasins: Oil andGasJournal, v.100, no.52, p.36-41.

Rascoe, B.A., andAdler, F.J., 1983, Permo-Carboniferoushydrocarbonaccumulations, mid-continentUSA: AmericanAssociationofPetroleumGeologistsBulletin, v.67, no.6, p.979-1001.

Staub, J.R., andCohen, A.D., 1979, TheSnuggedySwampofSouthCarolina; aback-barrierestuarinecoal-forming environment: JournalofSedimentaryPetrology, v.49, p.133-144.

vanAndel, T.J.H., 1967, TheOrinocoDelta: JournalofSedimentaryPetrology, v.37, p.297-310.

Wedge, W.K., andHatch, J.R., 1980, ChemicalcompositionofMissouricoals: MissouriDepartmentofNatural Resources, ReportofInvestigations63.

Wells, J.T., andColeman, J.M., 1981, Periodicmudflatprogradation, northeasterncoastofSouthAmerica; a hypothesis: JournalofSedimentaryPetrology, v.35, p.1069-1075.

Zeller, D.E., 1968, Thestratigraphicsuccessioninkansas: KansasGeologicalSurvey, Bulletin189, 81p.

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