

Modeling CO₂ Sequestration in Saline Aquifer and Depleted Oil Reservoir to Evaluate Regional CO₂ Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas Project Number (DE-FE0002056)

W. Lynn Watney & Jason Rush (Joint PIs)

Kansas Geological Survey

Lawrence, KS 66047

U.S. Department of Energy
National Energy Technology Laboratory
Carbon Storage R&D Project Review Meeting
Developing the Technologies and
Infrastructure for CCS
August 20-22, 2013

Brighton 1&2
2:40 August 20, 2013



Presentation Outline

- Benefits to the Program
- Project Overview
- Technical Status
- Accomplishments to Date
- Summary

DOE project team -- DE-FE002056

Principal Investigators

Jason Rush -- Joint PI
W. Lynn Watney - Joint PI

UNIVERSITY OF KANSAS

Kansas Geological Survey

Co-Principal Investigators

Kerry D. Newell -- stratigraphy, geochemistry
Jason Rush -- Petrel geomodeling and data integration
Richard Miller -- geophysics
John Doveton-- log petrophysics and core-log modeling
Jianghai Xia -- gravity-magnetics modeling & interpretation
Marios Sophocleous --geohydrology

Key Personnel

John Victorine -- Java web app development
David Laflen -- manage core & curation
Mike Killion -- modify ESRI map service for project
Jennifer Raney -- asst. project manager
Debra Stewart, Dan Suchy -- data management
Yevhen 'Eugene' Holubnyak, Petroleum Engineer
Fatemeh "Mina" FazelAlavi, Engineering Research Assistant

KU Department of Geology

Co-Principal Investigators

Evan Franseen --sedimentology, stratigraphy
Robert Goldstein -- diagenesis, fluid inclusion
David Fowle -- reactive pathways, microbial catalysis
Jennifer Roberts -- reactive pathways, microbial catalysis
George Tsoflias -- geophysics

Grad Research Assistants

Aimee Scheffer (graduated) -- biogeology & geochemistry
Breanna Huff -- biogeology
Christa Jackson -- biogeology and geochemistry
Ayrat Sirazhiev (graduated) -- geophysics
Yousuf Fadolalkarem -- geophysics
Brad King -- diagenesis

SUBCONTRACTS

Berexco, Beredco Drilling -- Wichita, KS

Wellington Field access; drilling, coring, completion and testing; modeling and simulation

Key Personnel

Dana Wreath - manager, reservoir and production engineer
Randy Koudele - reservoir engineer
Bill Lamb - reservoir engineer

Bittersweet Energy, Inc., Wichita, KS

Tom Hansen, Principal, Wichita, Geological Supervision - regional data, Arbuckle hydrogeology
Paul Gerlach -- regional data acquisition, 2 yrs.
Larry Nicholson -- regional data acquisition, 2 yrs.
Anna Smith -- regional data acquisition, 2 yrs.
Ken Cooper, Petrotek Engineering, Littleton, CO- engineer, well injection, hydrogeology
John Lorenz, Scott Cooper, FractureStudies, Edgewood, NM -- core fracture study

Kansas State University

Seismic and Geochemical Services

Co-Principal Investigators

Saugata Datta -- reactive pathways and reaction constants
Abdelmoneam Raef -- seismic analysis and modeling

Grad Research Assistants

Robin Barker (graduated)
Derek Ohl - seismic analysis and modeling
Randi Isham -- seismic
Brent Campbell - aqueous geochemistry

Services

LOGDIGI, LLC, Katy, TX - wireline log digitizing
David G. KOGER, Dallas, TX - remote sensing data and analysis
Weatherford Laboratories, Houston, TX -- core analyses
CMG - Simulation Services, Calgary, Alberta --greenhouse gas simulation and software
Halliburton, Liberal, KS -- wireline logging services
Hedke-Saenger Geoscience, LTD., Wichita, KS - geophysical acquisition, interpret & design
Susan E. Nissen, McLouth, KS -- Geophysical Consultant, volumetric curvature
Lockhart Geophysical, Denver, CO -- acqui & interpret 2D shear wave, gravity & mag
Fairfield Industries, Inc., Denver, CO -- 2D, 3D multicomponent seismic processing
Paragon Geophysical Services, Wichita, KS -- 3D seismic acquisition
Echo Geophysical, Denver, CO -- 3D seismic processing
Converging Point - QC seismic acquisition
Noble Energy, Houston, TX; Denver, CO -- collaborating co., fields adjoining Wellington

Southwest Kansas CO2 EOR Initiative - Chester Morrow

Martin Dubois, IHR, LLC -- team lead, geomodeling
John Youle, Sunflower Energy -- core and depositional models
Ray Sorenson, consultant -- data acquisition and advising
Eugene Williams, Williams Engineering -- reservoir modeling

Benefit to the Program

- **Goal–**
 - **Predict geologic CO₂ storage capacity within ±30%**
- **Project benefits --**
 - Refine CO₂ storage capacity of the Arbuckle saline aquifer (currently 9-75 billion tonnes, 200 yrs. KS emissions)
 - Regional characterization integrated with *Interactive Project Mapper* and *NATCARB*
 - Efficacy of CO₂ storage at Wellington and Cutter fields
 - Validate structural, stratigraphic, and well based analysis using regional 3D seismic, gravity-magnetics, and remote sensing
 - CCUS feasibility and risk at five oil fields and eight regional sites
 - Resolve heterogeneity in ~500-1000 ft thick Lower Ordovician Arbuckle saline aquifer
 - Evidence for geologic conditions best suited for CO₂ management

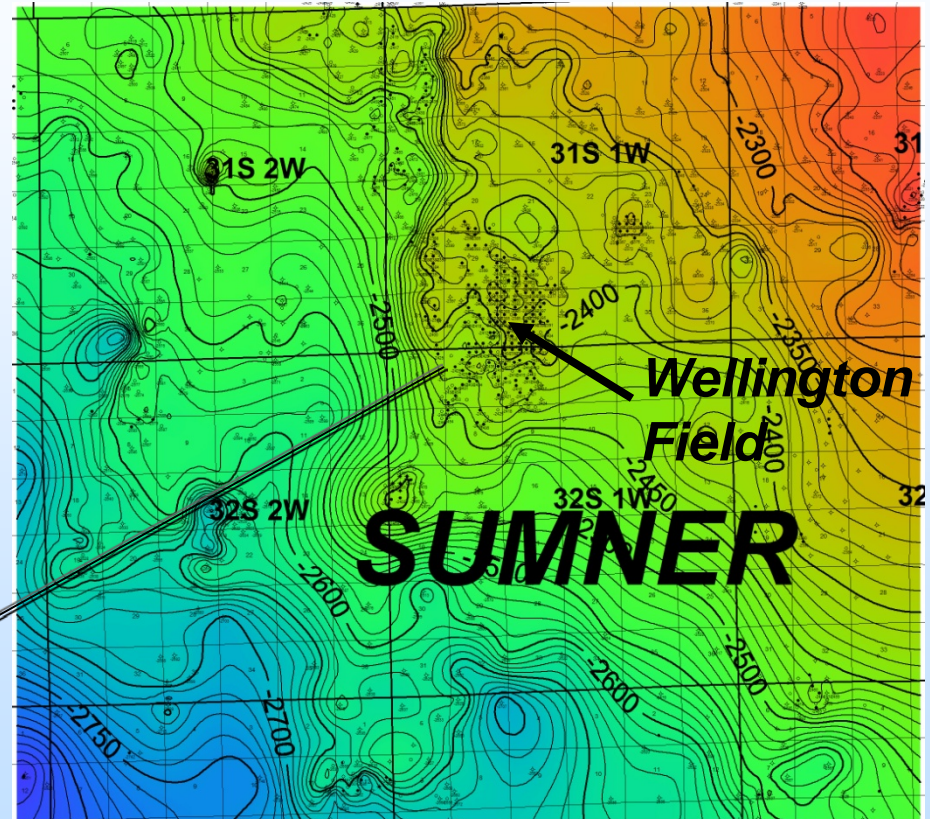
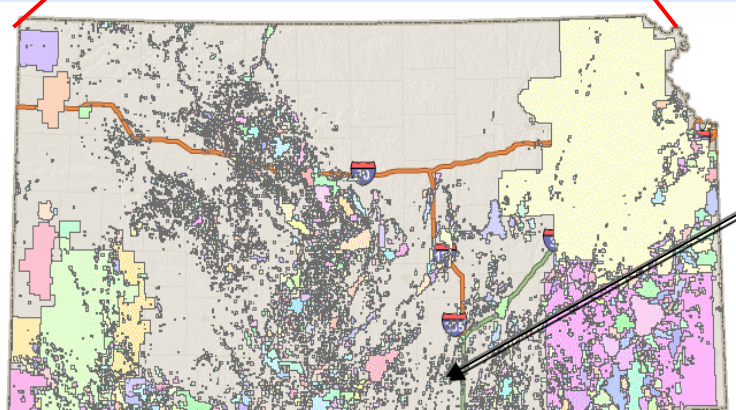
Project Overview: Goals and Objectives

- Characterize the Lower Ordovician Arbuckle Group in 25,000 mi² area (*Predict CO₂ storage within ±30 percent*)
 - **Success** -- Scan, digitize, and correlate key wells; New correlations for key parameters; Storage and risk evaluation maps
- Model carbon dioxide injection within the Arbuckle Group saline aquifer and the overlying Mississippian siliceous dolomite oil reservoir at Wellington Field (Sumner County, KS) (*Calibration site for CO₂ injection and storage*)
 - **Success** – Drill, core (1528 ft), and test in two 5200' basement tests; acquire, process, interpret 12 mi² of multicomponent 3D seismic; model for CCUS
- Evaluate CO₂ sequestration potential in saline aquifer and CO₂-EOR in four southwestern Kansas fields (*Calibration site for CO₂ injection and storage*)
 - **Success** – Drill, core (1024 ft), test 7700' basement test at Cutter Field, Stevens County, KS; acquire 10 mi² of multicomponent 3D seismic, LiDAR/remote sensing
 - Simulate CO₂-EOR @ four fields -- Cutter, South Pleasant Prairie, Eubanks North, and Shuck fields

Wellington Field

Site of proposed Small Scale Field Test

Top Mississippian Structure, 10 ft C.I.



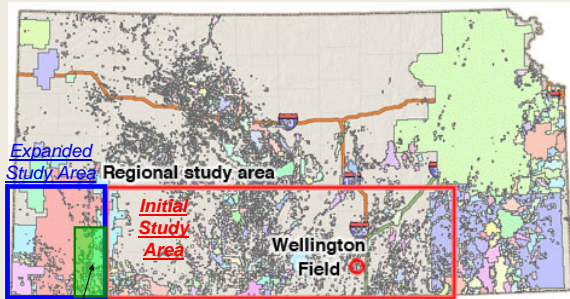
6 miles

Technical Status

Evaluate CO₂ sequestration potential in Arbuckle Group saline aquifer and CO₂-EOR in four fields in southwestern Kansas

Southwest Kansas CO₂ Consortium (Western Annex)

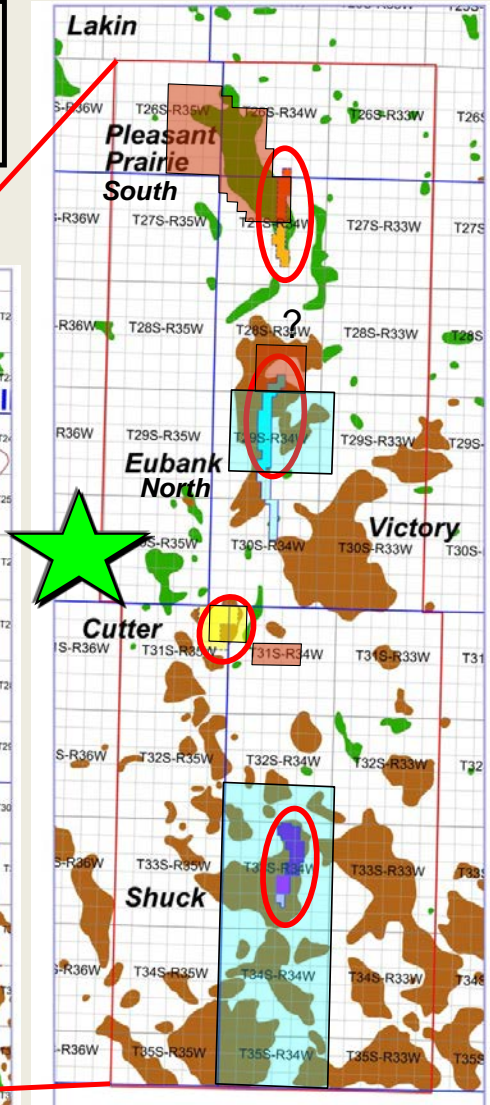
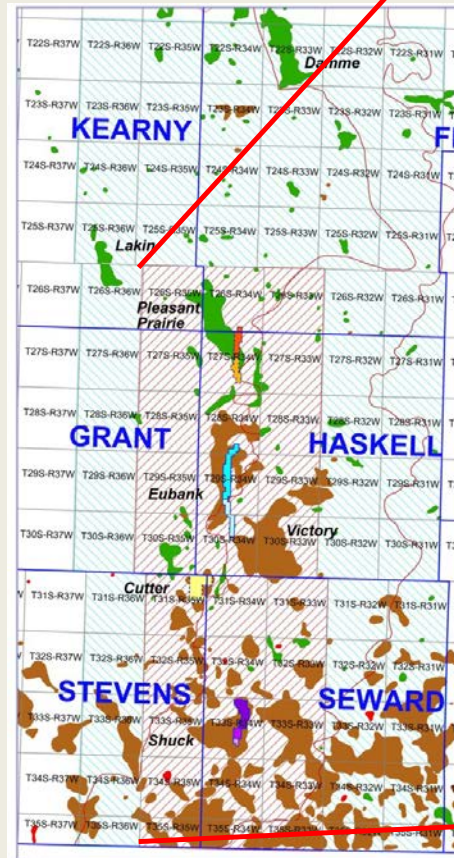
Seismic blocks are color coded by operator
(~120 mi² of 3D seismic)



CO₂ EOR Study

Chester/Morrow Sandstone (IVF) &

Deep saline Arbuckle aquifer



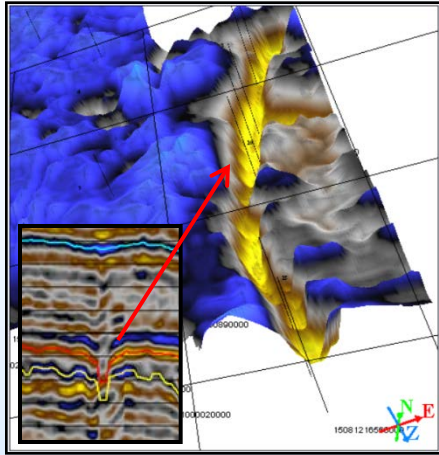
Southwest Kansas CO₂-EOR Initiative

Integrated Multi-Discipline Project for CO₂-EOR Evaluation

Static Model

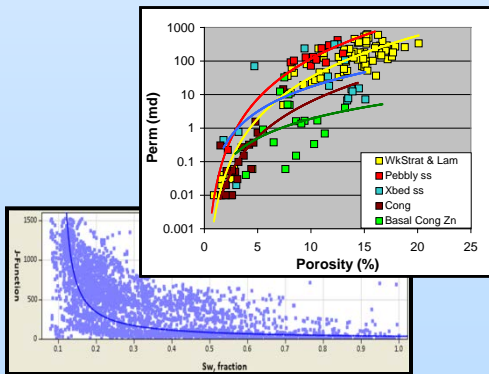
Geophysics:

structure, attributes, faults



Petrophysics:

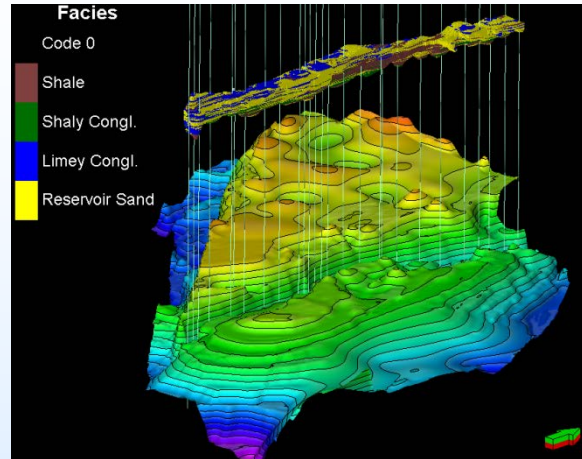
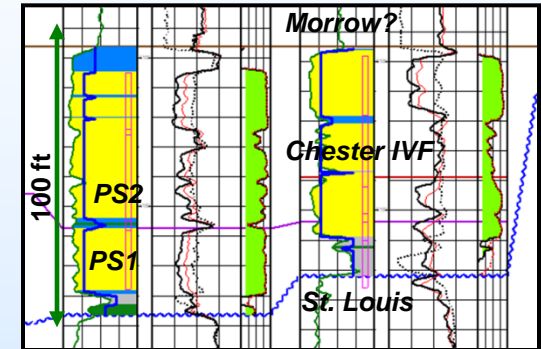
Core K-Phi, corrected porosity, free water level, J-function



Dubois, 2012

Geology:

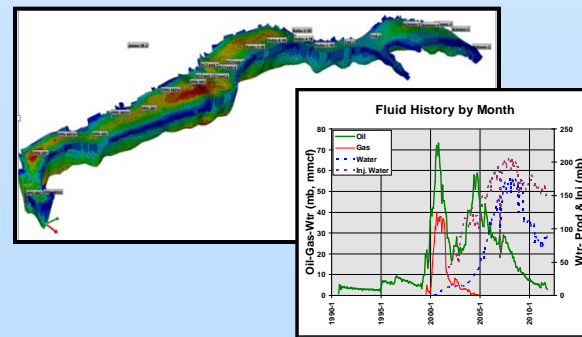
Formation tops, sequence stratigraphy, core lithofacies, lithofacies prediction (NNet)



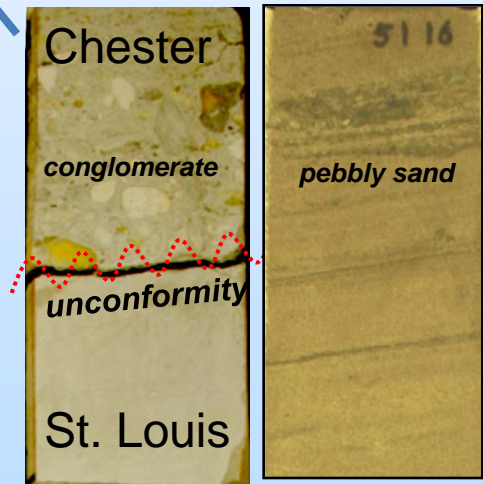
Engineering:

PVT and fluid analysis, recurrent histories, dynamic modeling

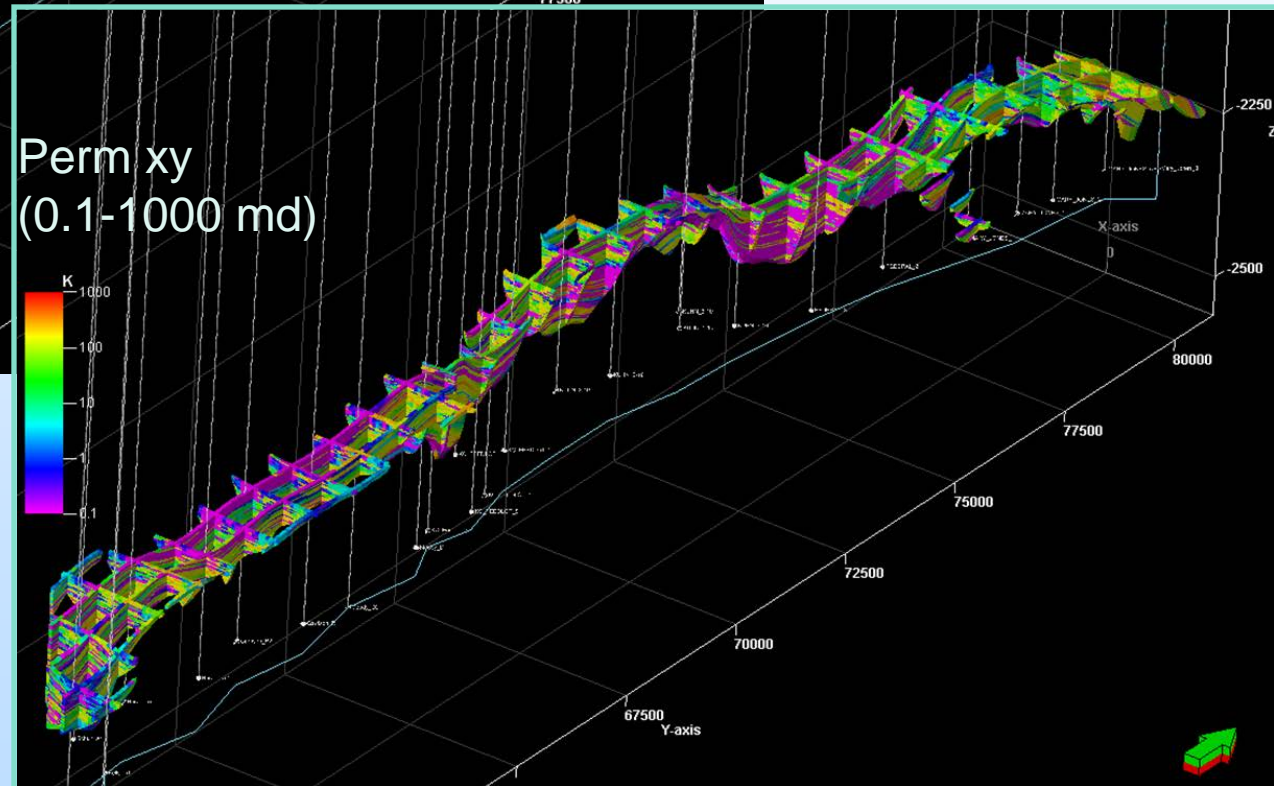
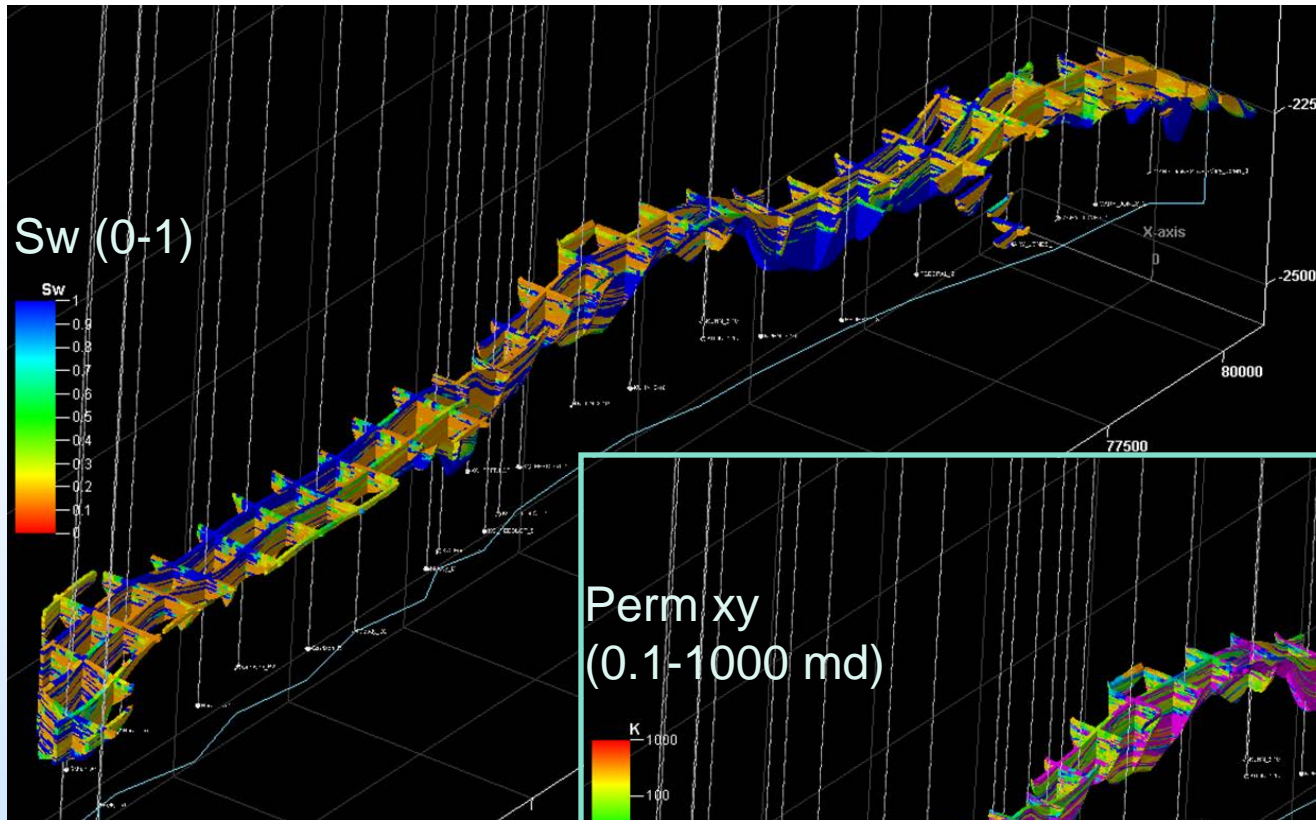
Dynamic Model



Example from modeling of Pleasant Prairie South



Water Saturation and Permeability



April 16, 2013
KGS, Wichita KS

Pleasant Prairie South Field

CO₂ EOR Projections – Pleasant Prairie South Field

Assumptions:

1. Convert WIW to CO₂ IW
2. Oil wells as is
3. Inject 5 mmcf/d CO₂, not exceeding bhp 2600 psi
4. Continuous CO₂, no WAG
5. Injection = production
6. No optimization

Projections:

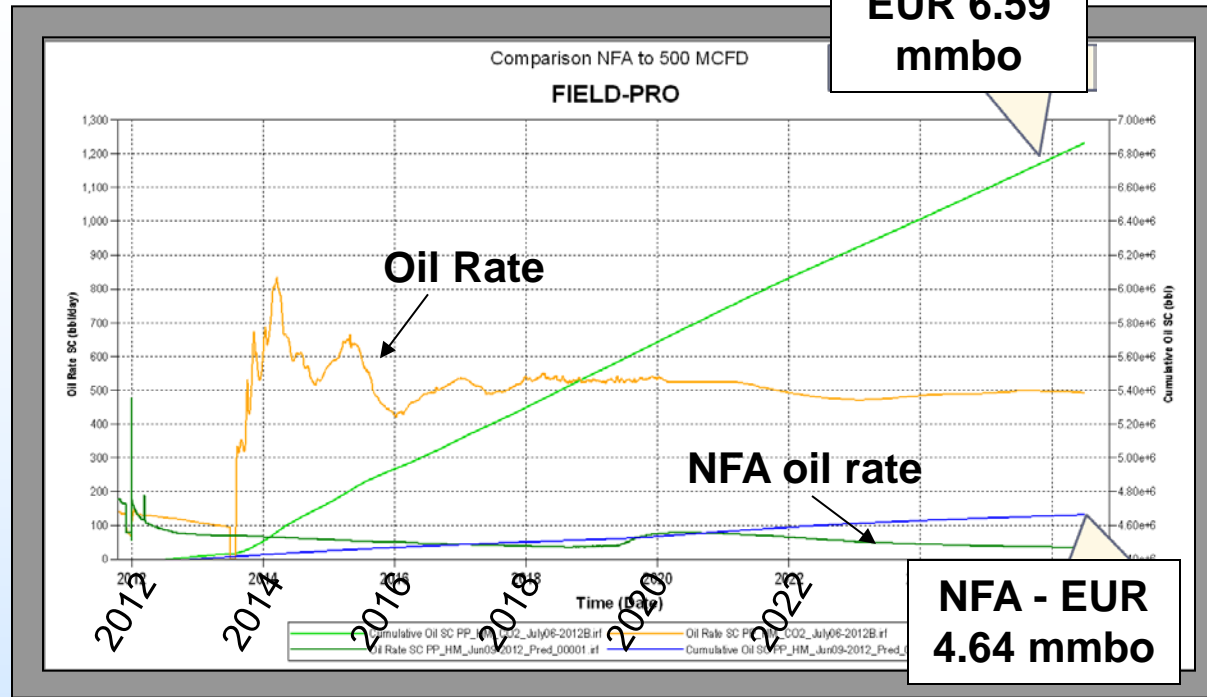
OIL (mmbo)

Cumulative 2011	4.48
NFA cum. 2026	4.64
CO ₂ case cum.	6.59
Increment. CO ₂	1.95
Cum. 2012-2026	2.11

CO₂

		<i>mm tons</i>
CO ₂ injected (mmcf)	23.7	1.38
CO ₂ produced (mmcf)	13.2	0.77
CO ₂ sequestered (mmcf)	10.5	0.61
Gross utilization (mcf/bo)	11.2	
Net utilization (mcf/bo)	5.0	

Assume 56%
CO₂ is recycled

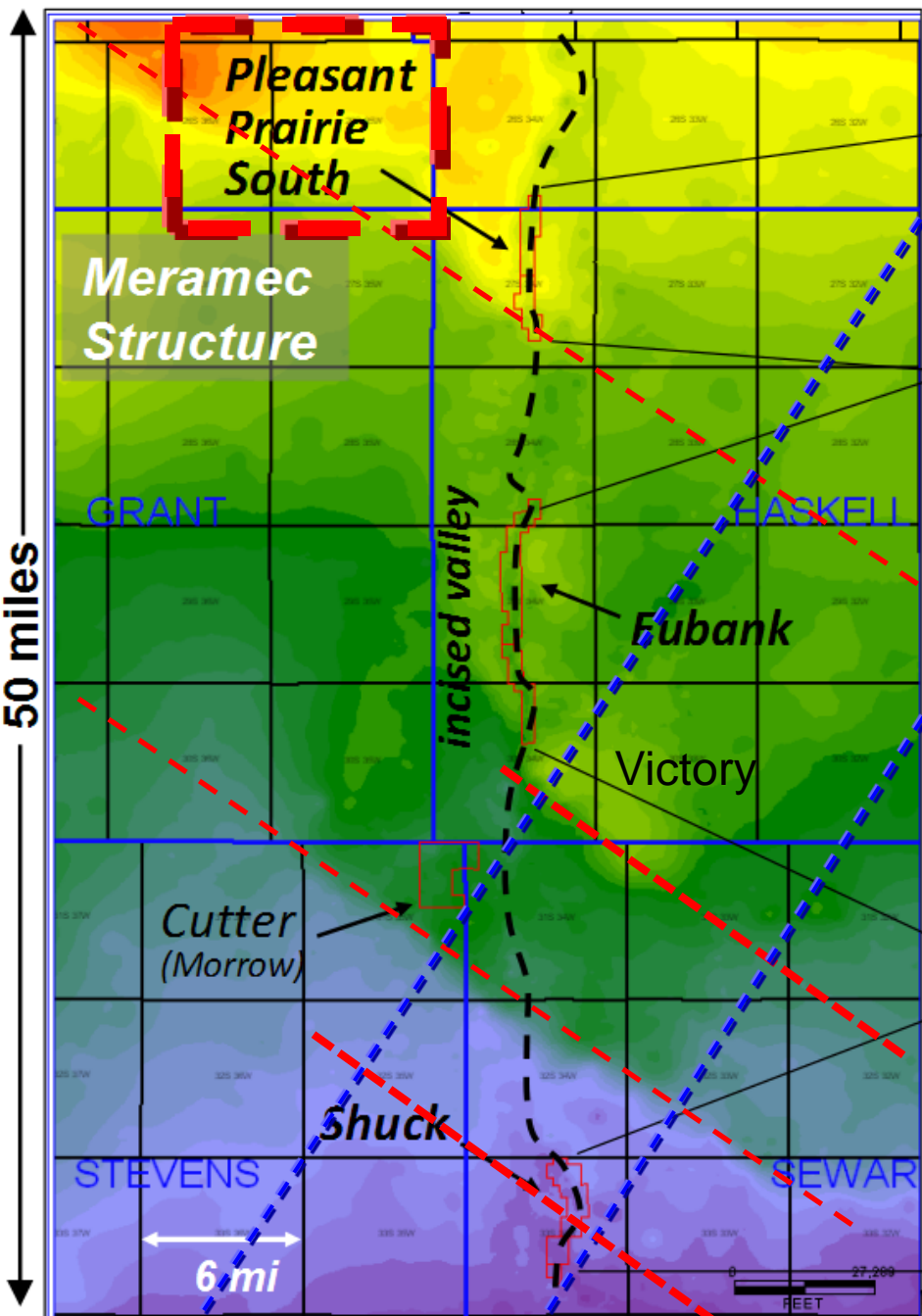


13 years injection

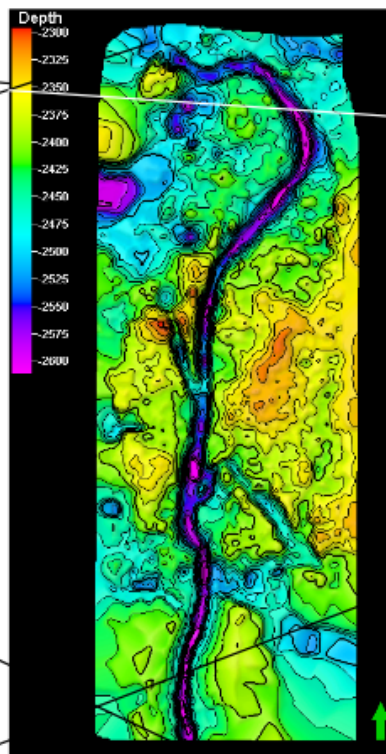
RF as f(OOIP)

Primary	15.8%
Secondary	15.8%
CO ₂	13.3%
	45.0%

Chester Incised Valley in Kansas

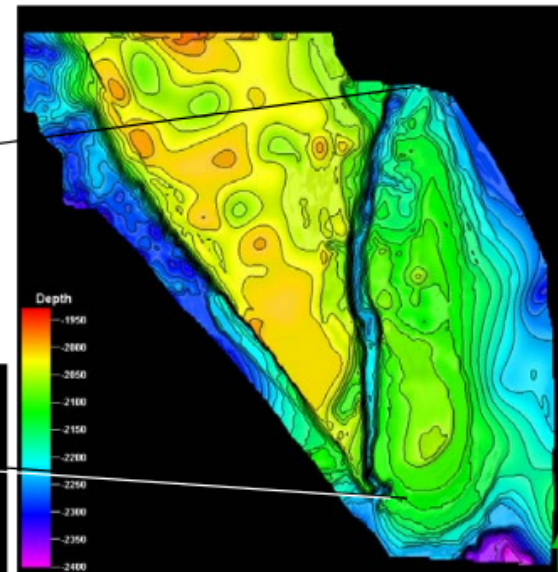


Eubank



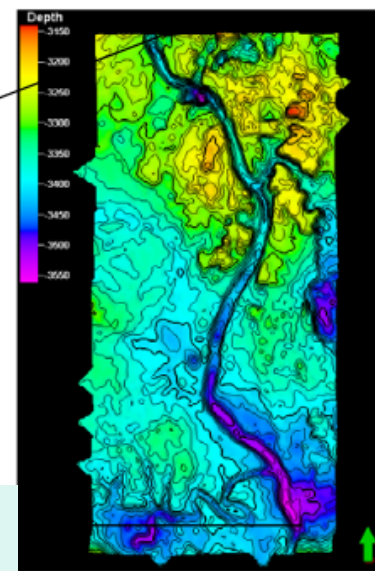
Seismic depth-converted Meramec surfaces (by Hedke)

Modified from Dubois (DOE/KGS-CO2)



Pleasant Prairie South

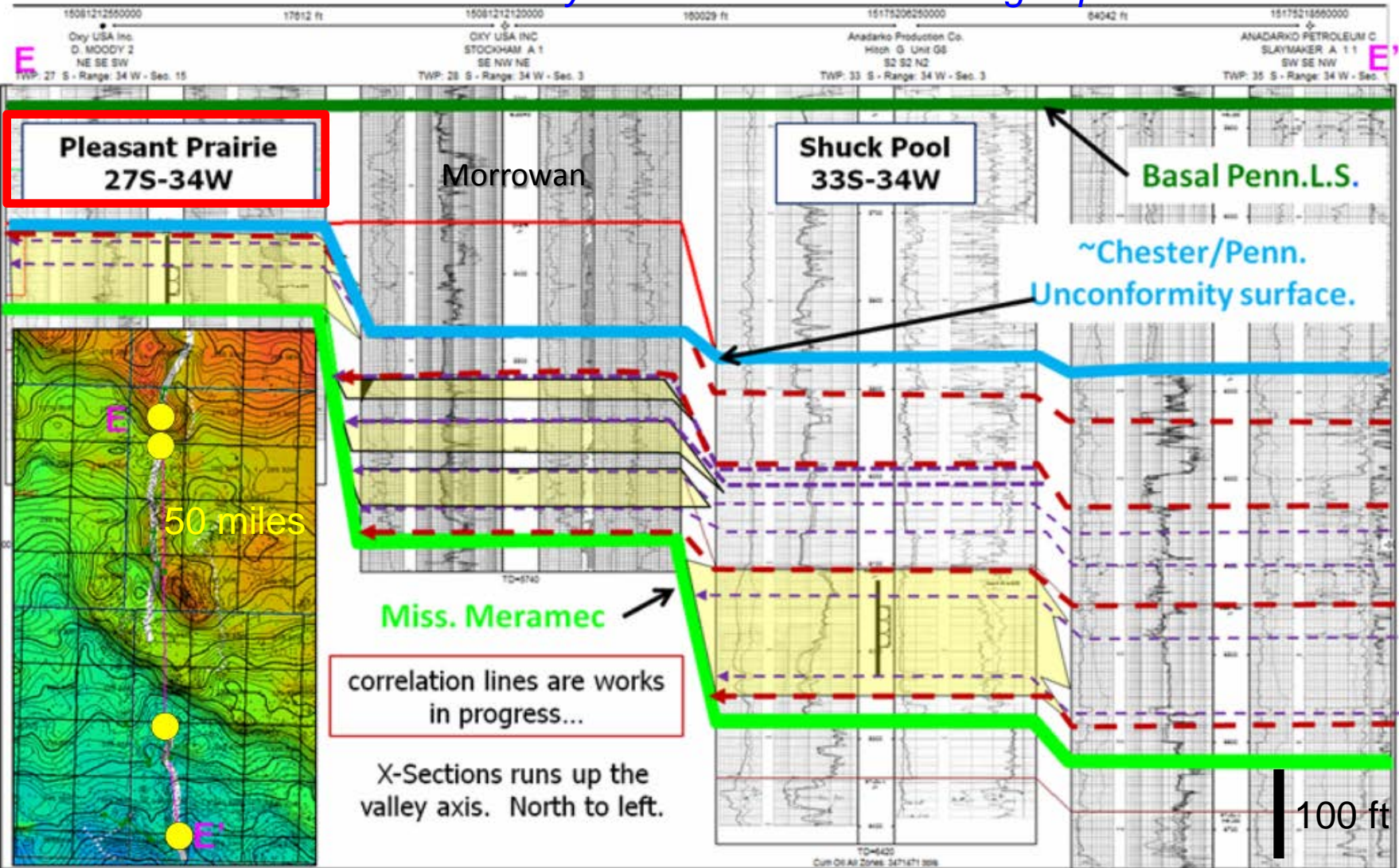
Shuck



5 mi
all views at same scale

Chester Sequence Stratigraphy

-Influence of structurally controlled fall lines during deposition?

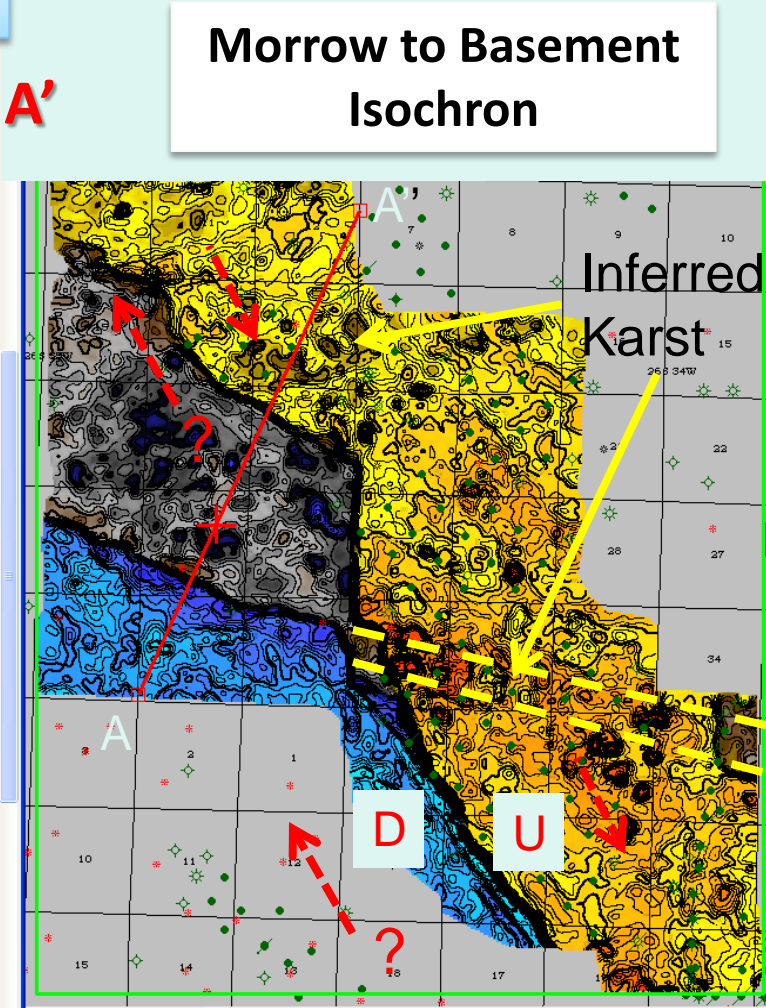
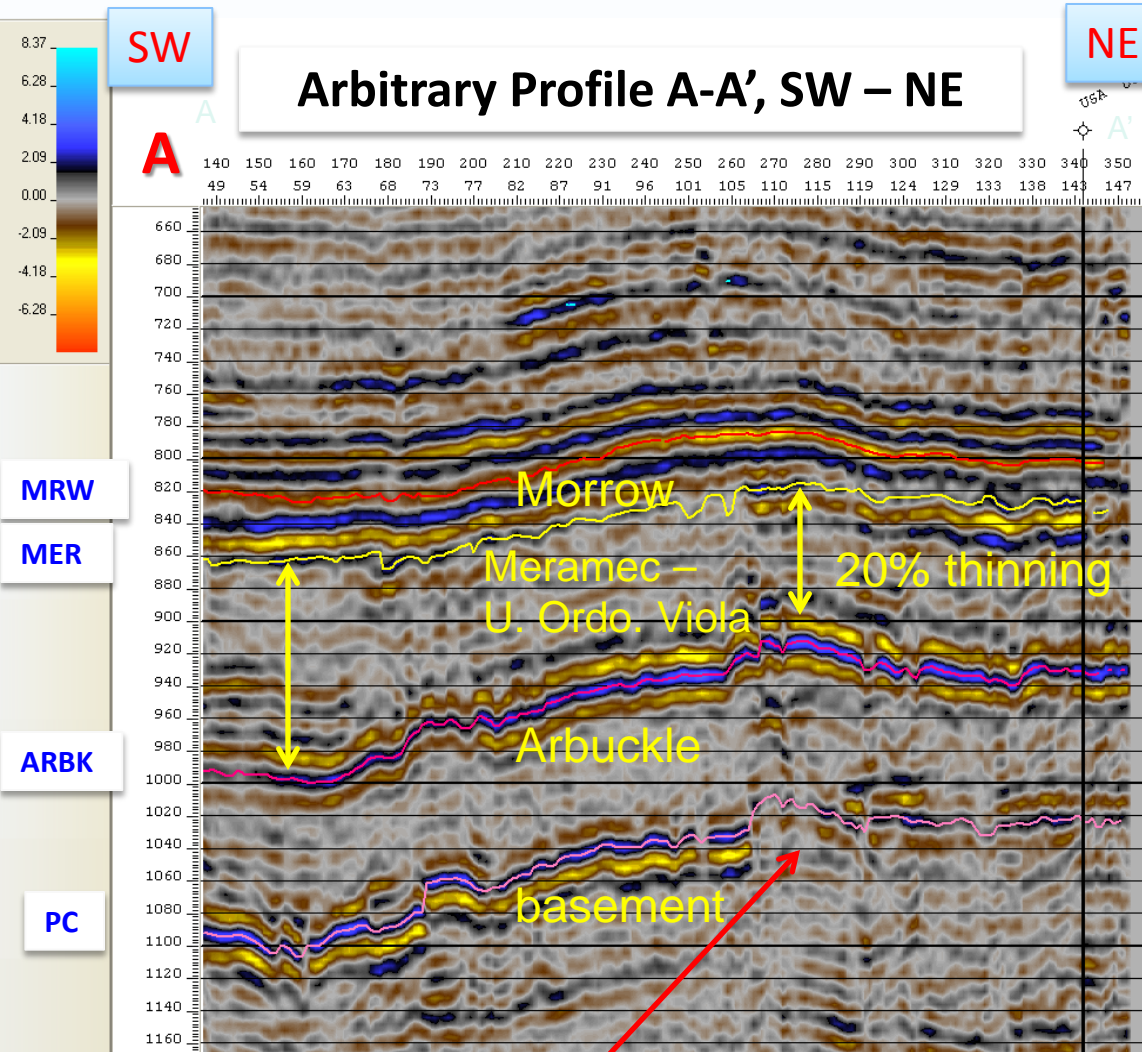


work by John Youle

The cyclic retrogradational nature of Chester shoreline advances into Kansas are interpreted to have filled incised valleys with a series of 'back-stepping' stacked estuarine sandstone reservoirs. Red dashed lines are postulated sequence boundaries, and purple lines are possible parasequences. (Youle)

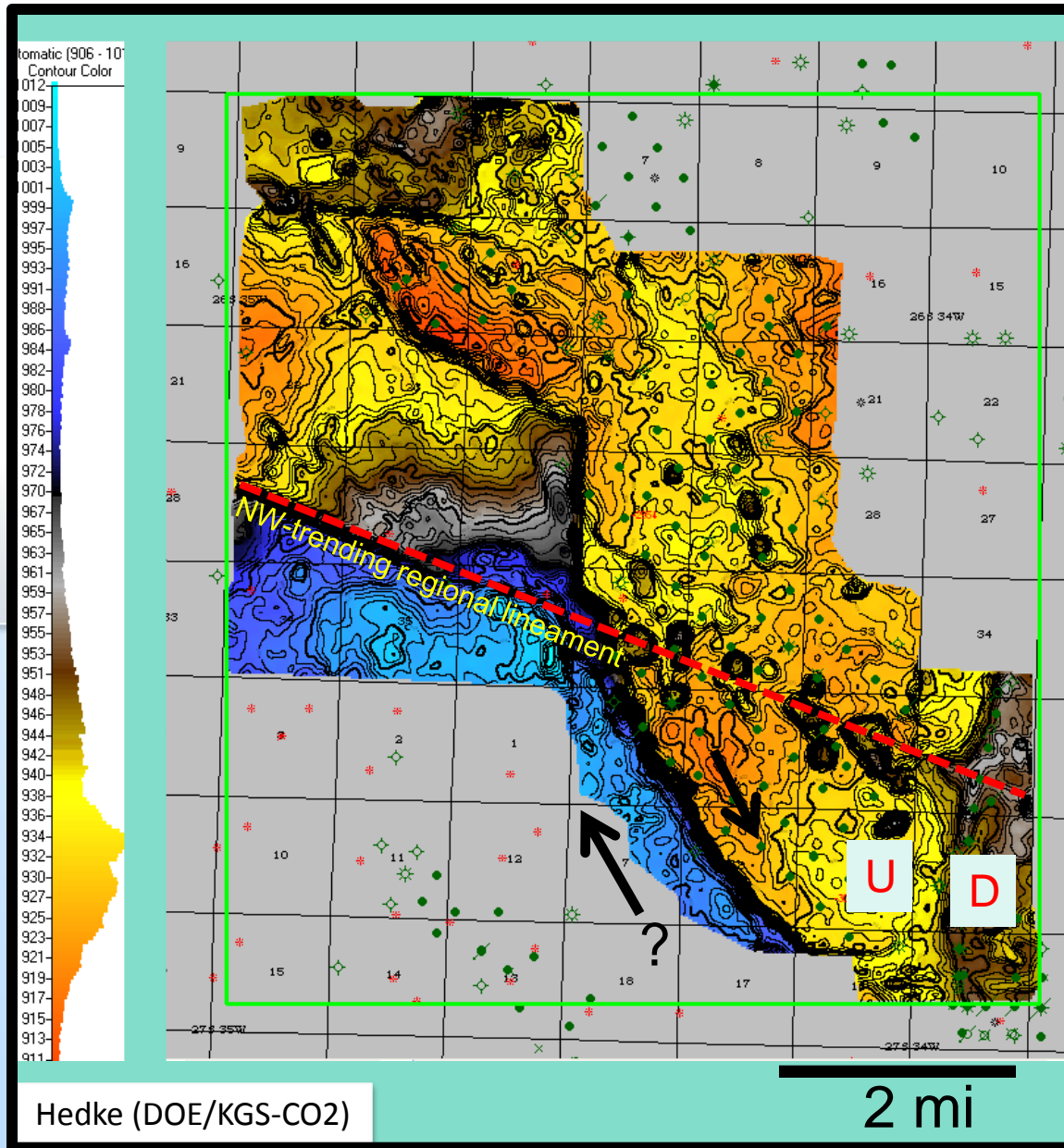
Pleasant Prairie structural block

Fault orientation - *right lateral component along restraining bend*



Flower structure-
Right lateral fault?

Arbuckle Time Structure (Pleasant Prairie Field)



Fault bounded
orthogonal
structural block:

-Regional NW-trending
lineament

-Paleo Arbuckle karst
(Ordovician)

- Meramec age karst partly defines Chester incised valley location
- Intersecting with NW-trending Arbuckle karst trend with north-trending fault corresponding with location of Chester IVF

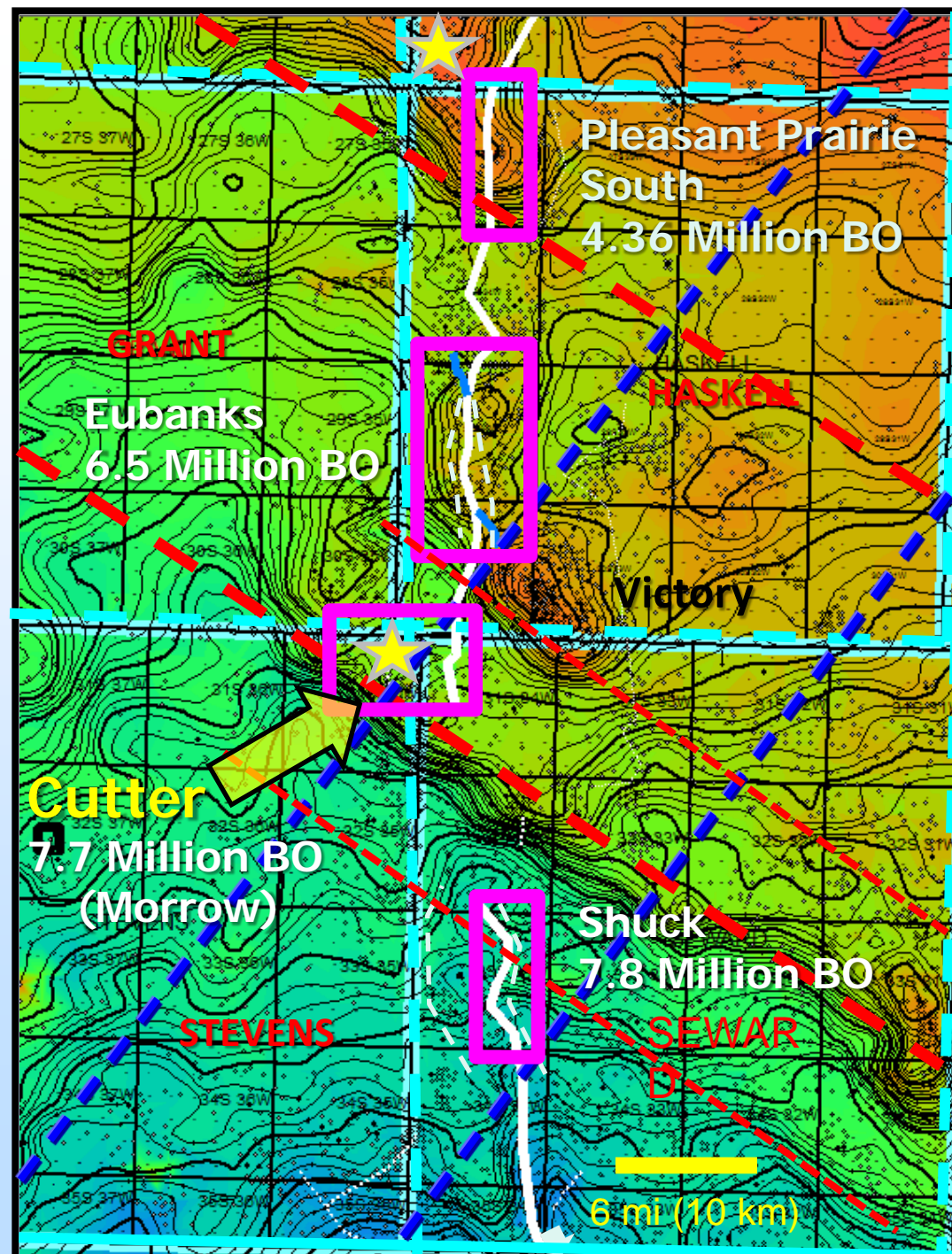
Subsea structure on top of Mississippian Meramec (mostly Ste. Gen.)

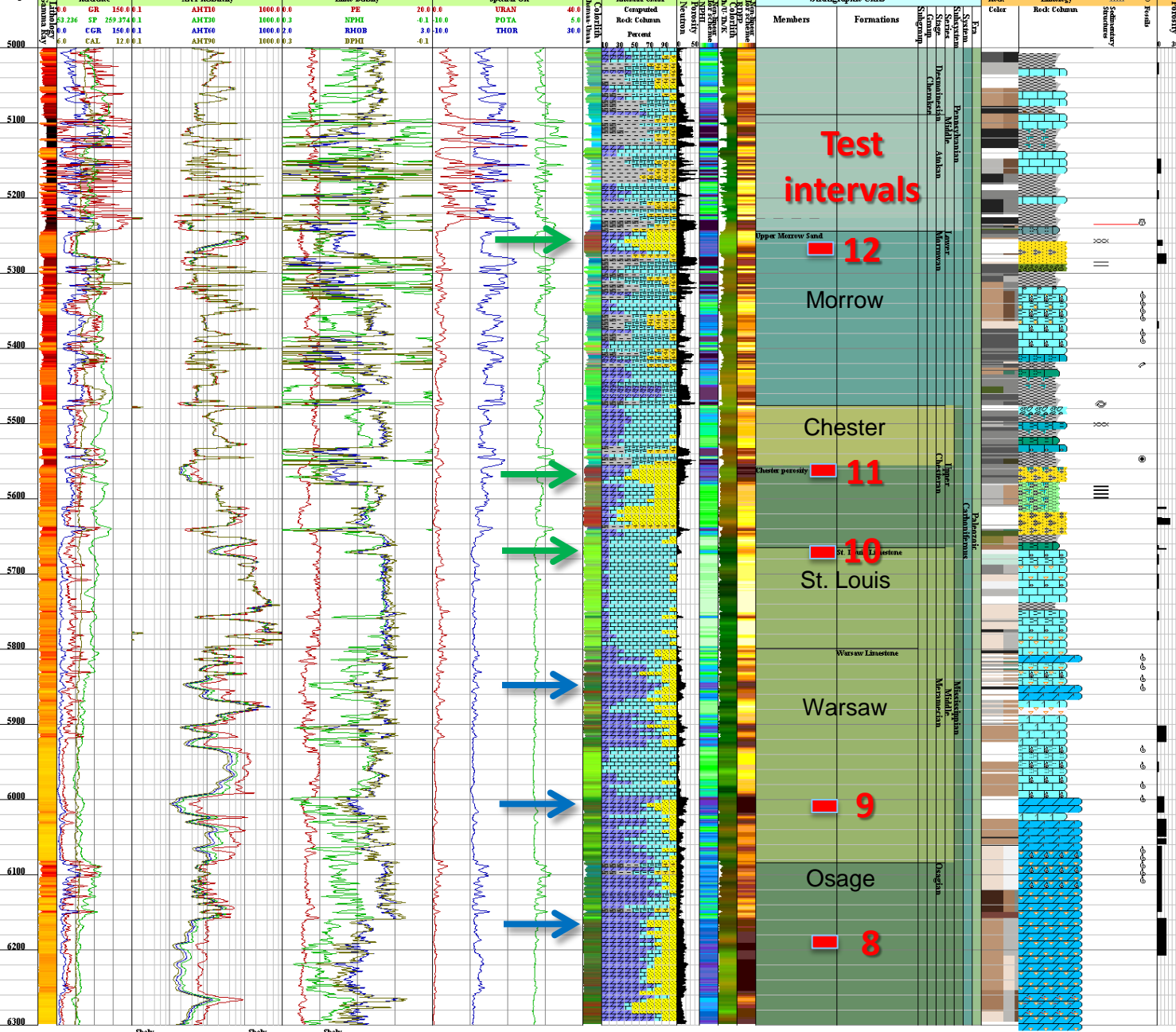
Chester incision and fill predated post-Mississippian – pre-Middle Pennsylvanian Ouachita structural events

- However, traps in valley fill sand pools sprung by Ouachita events.
- No channel deflection
- Ubiquitous fractures in Chester IVF cores.
- Antecedent paleogeomorphology – stepwise subsidence and slope to south controlled regional drainage

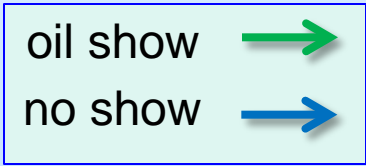
- *Horst blocks* : Cutter, Victory-Eubank and Pleasant Prairie (faulted on south and west flanks)
- *Horst blocks* : north sides of regional NW-trending lineaments
- *Contour Interval*: 25' (smoothed)
- *White line*: Chester incised valley axis
- *Pink Rectangles*: Chester valley fill fields (DOE investigated)

Youle (DOE/KGS-CO2)



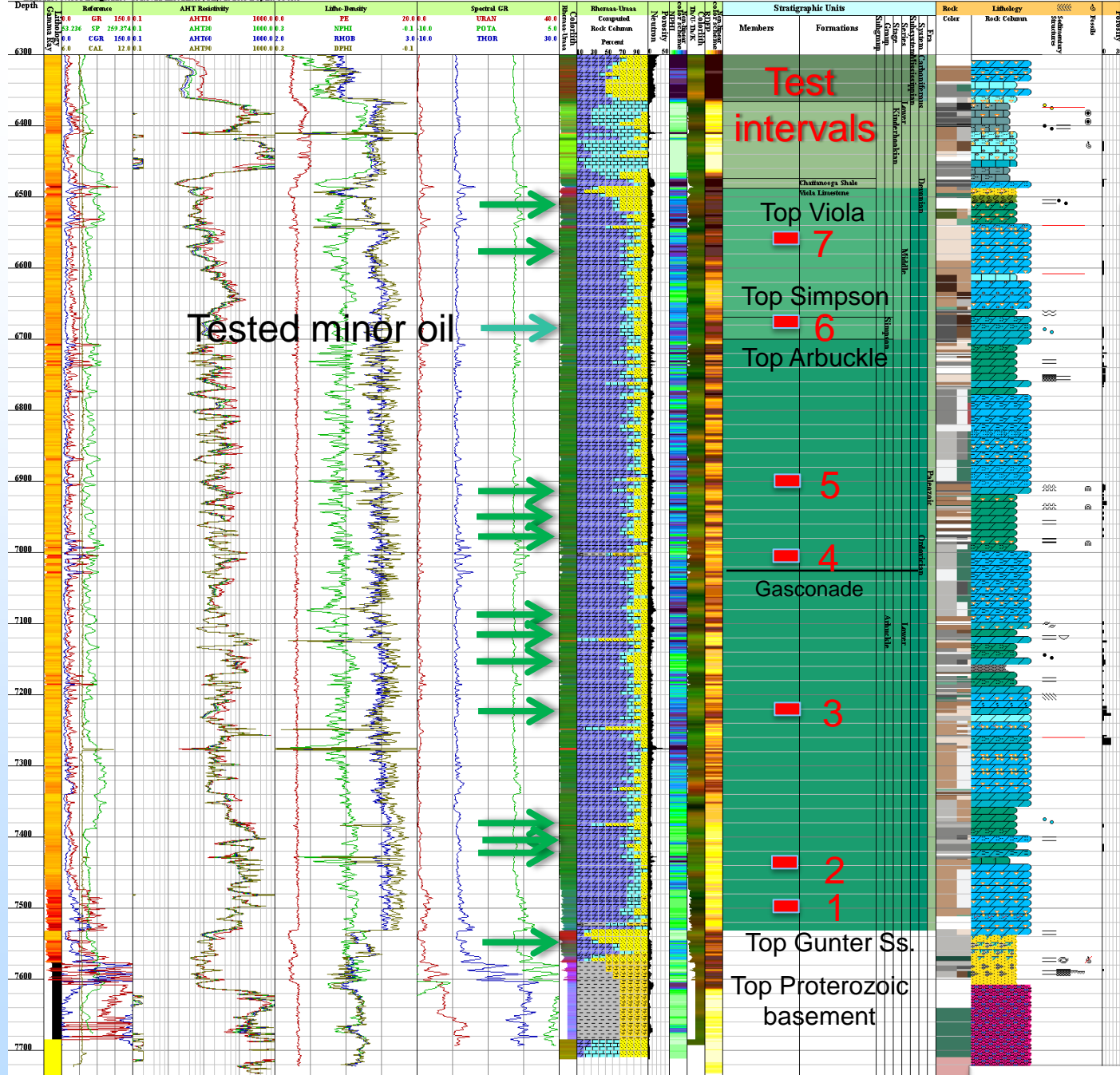


Berexco Cutter KGS #1 Cutter Field Multiple pay & shows



200 ft

Upper half of cored interval



Berexco Cutter KGS #1 Cutter Field

- Extended oil shows (fluorescence) in lower Paleozoic
- Upthrown structural block near regional fault
- Prior work: Chester oil in Hitch Field has Ordovician source (Kim et al., 2010)

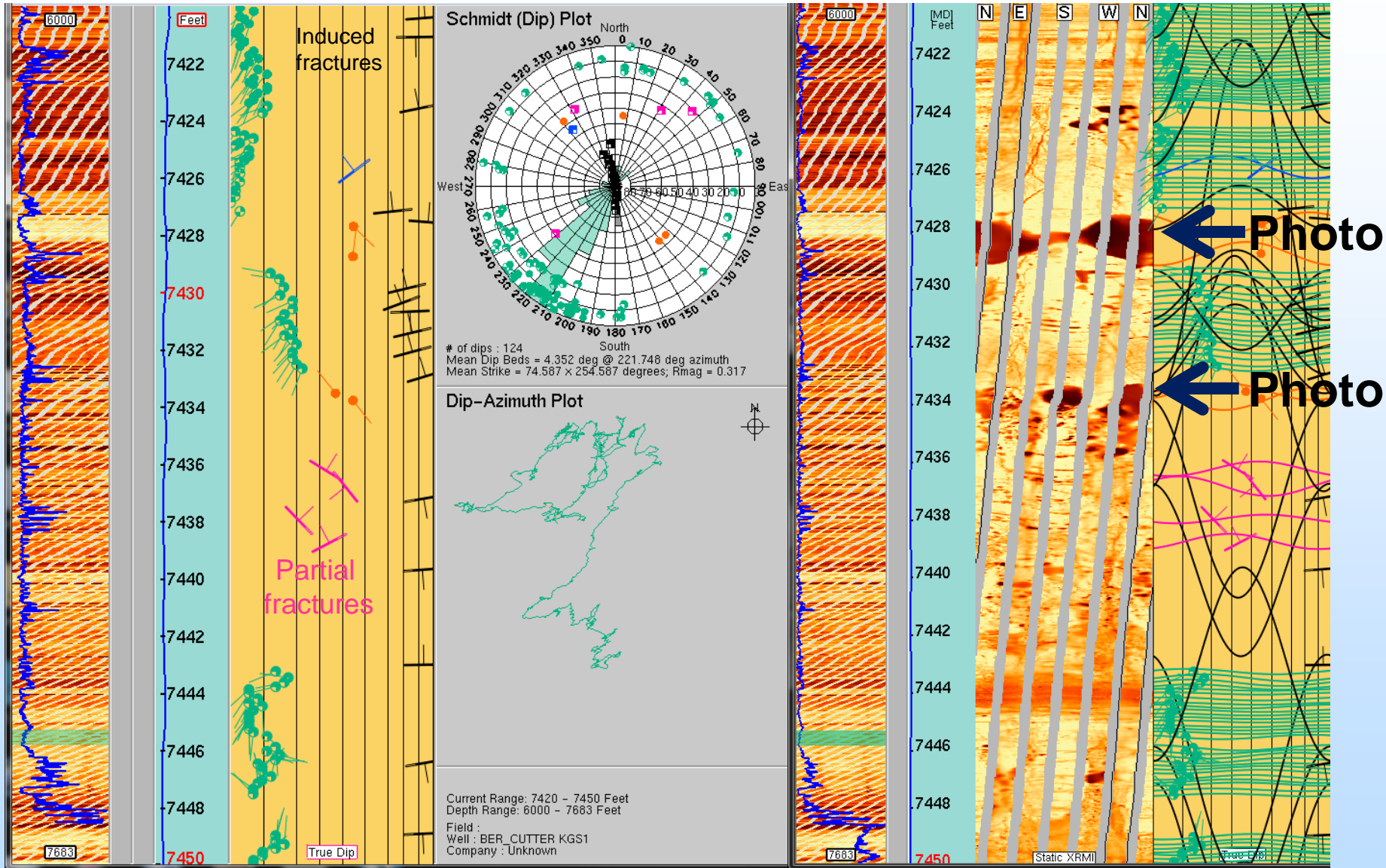
oil show →
 No oil on perf
 and swab

200 ft

Lower half of cored interval

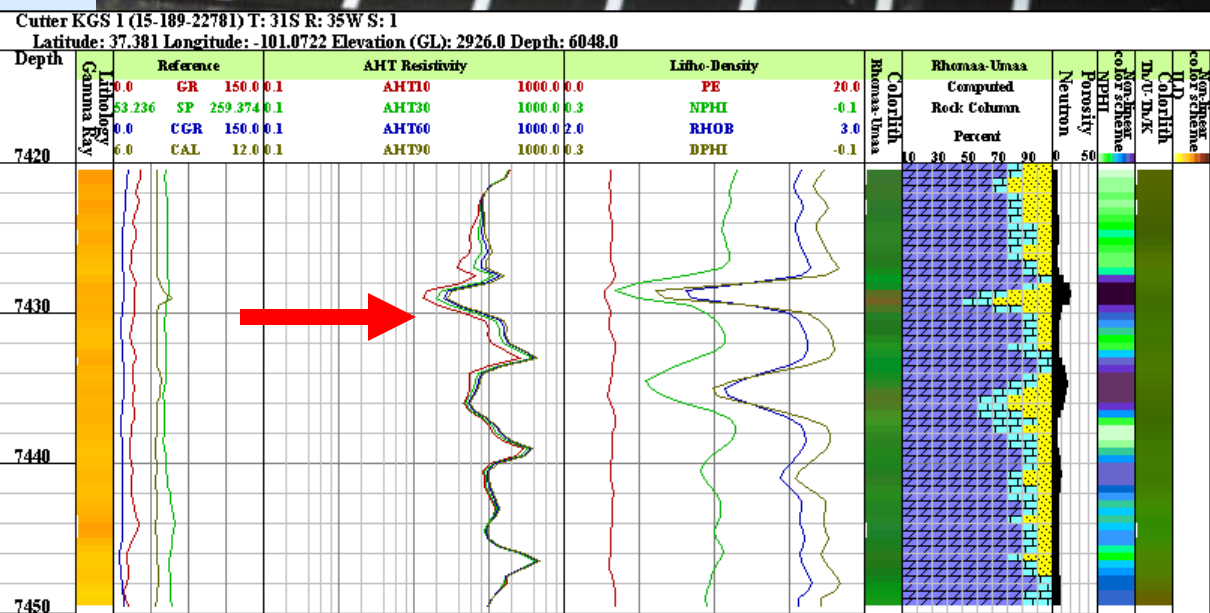
Lower Gasconade Dolomite, 7420-50 ft

-Equivalent to injection interval at Wellington Field (225 miles east)



Lower Gasconade, 7427 ft

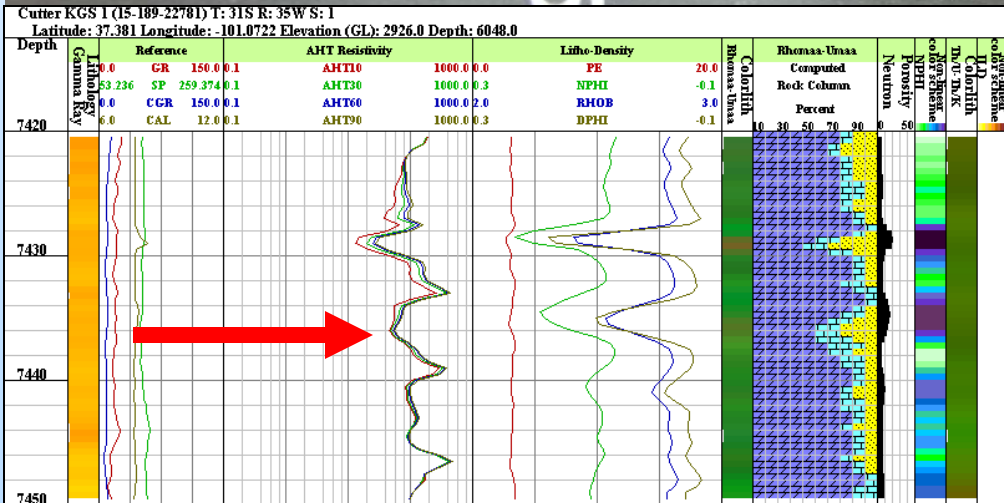
(core depth 3 ft high to log)



Dolomitic packstone-grainstone, medium to coarse grained vugs, occ. diagonal fractures

Lower Gasconade, 7433 ft

(core depth 3 ft high to log)



Gray-brown, packstone with quartz sandstone, cm sized vugs interconnected cut across core, saddle dolomite, very porous breccia

Type Log Project Well Inventory



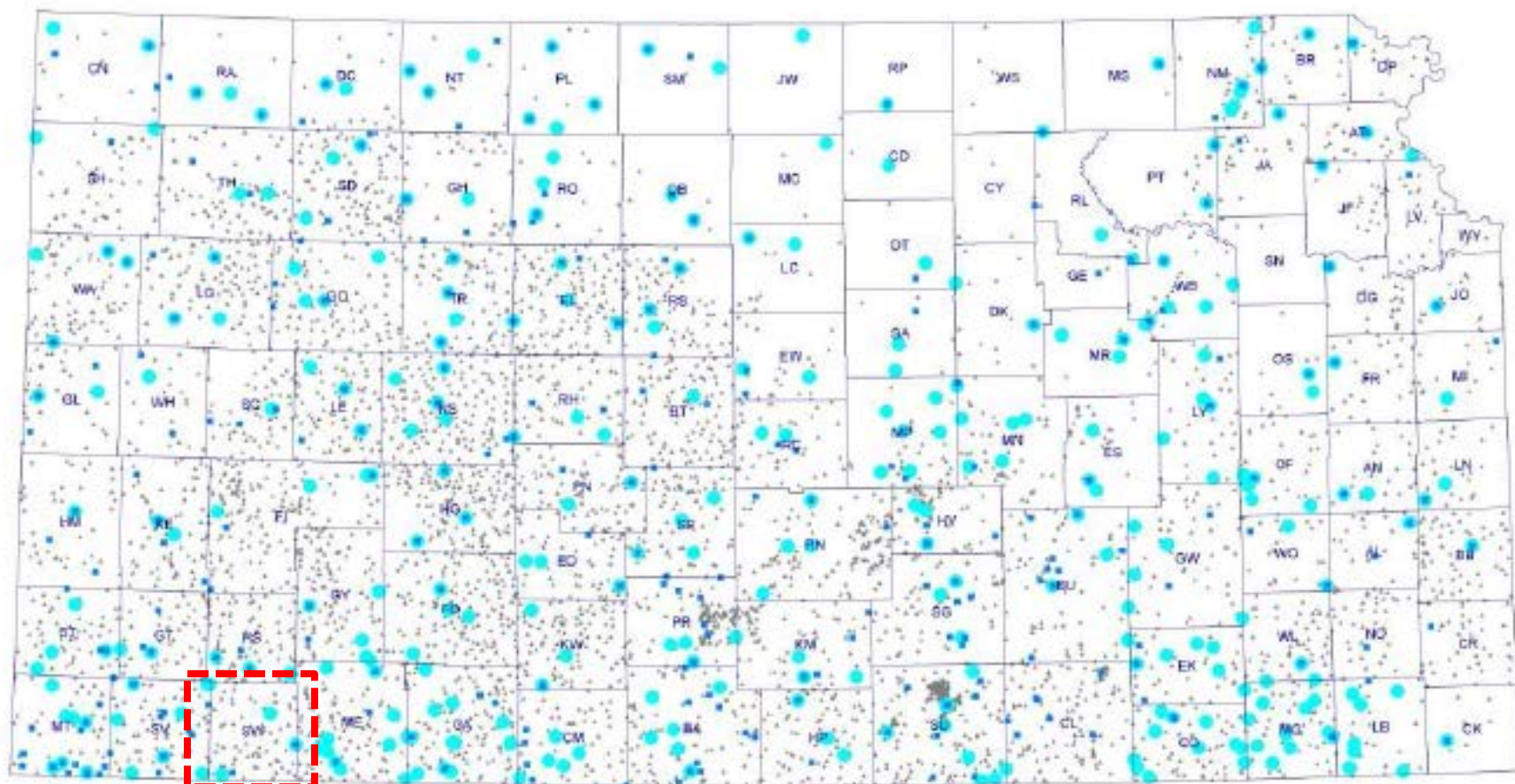
Strat Type Well
modern log suite
inventory: 205



Super Type Well
penetrates >400 feet
modern log suite
inventory: 268



Type Well
Arbuckle test
modern log suite
inventory: 1625



Seward County

Interactive map

-Compare control well with well to be classified

Control

File Well Status Symbols

Filter Wells By:

Show All Wells Show Well Symbols Only

Reference Well: Click Well Symbol in Map (View Data Only) Show Well Name

Show Wells with LAS Files Show API-Number

Step 1: Select Wells in Map

Reference Well: Click Well Symbol in Map (View Data Only)

Edit Tops Well: Click Well Symbol in Map

Reference Well

Reference Well

Name: Tucker 'M' 1 Status: O&G

15-175-21772 Lat: 37.0285967 Long: -100.9511037

Depth: 9050.0 GL: 2870.2 KB: 2882.0 DF:

Step 2: Load "Reference" Well Data by KGS Icon.

Load Well Data Clear Well Data

Log ASCII Standard (LAS) Files:

0: 1042553286.las

1:

2:

GR	OBM	NPPI	DPHI	PE	Sonic	Tops	GEO
YES	YES	YES	YES	YES	YES	YES	NO

Edit Tops Well

Edit Tops Well

Name: HELEN SLEEPER 'A' 1 Status: OIL

15-175-20550 Lat: 37.14648 Long: -100.64299

Depth: 8370.0 GL: 2722.0 KB: 2737.0 DF:

Step 3: Load "Edit Tops" Well Data by KGS Icon.

Load Well Data Clear Well Data

Log ASCII Standard (LAS) Files:

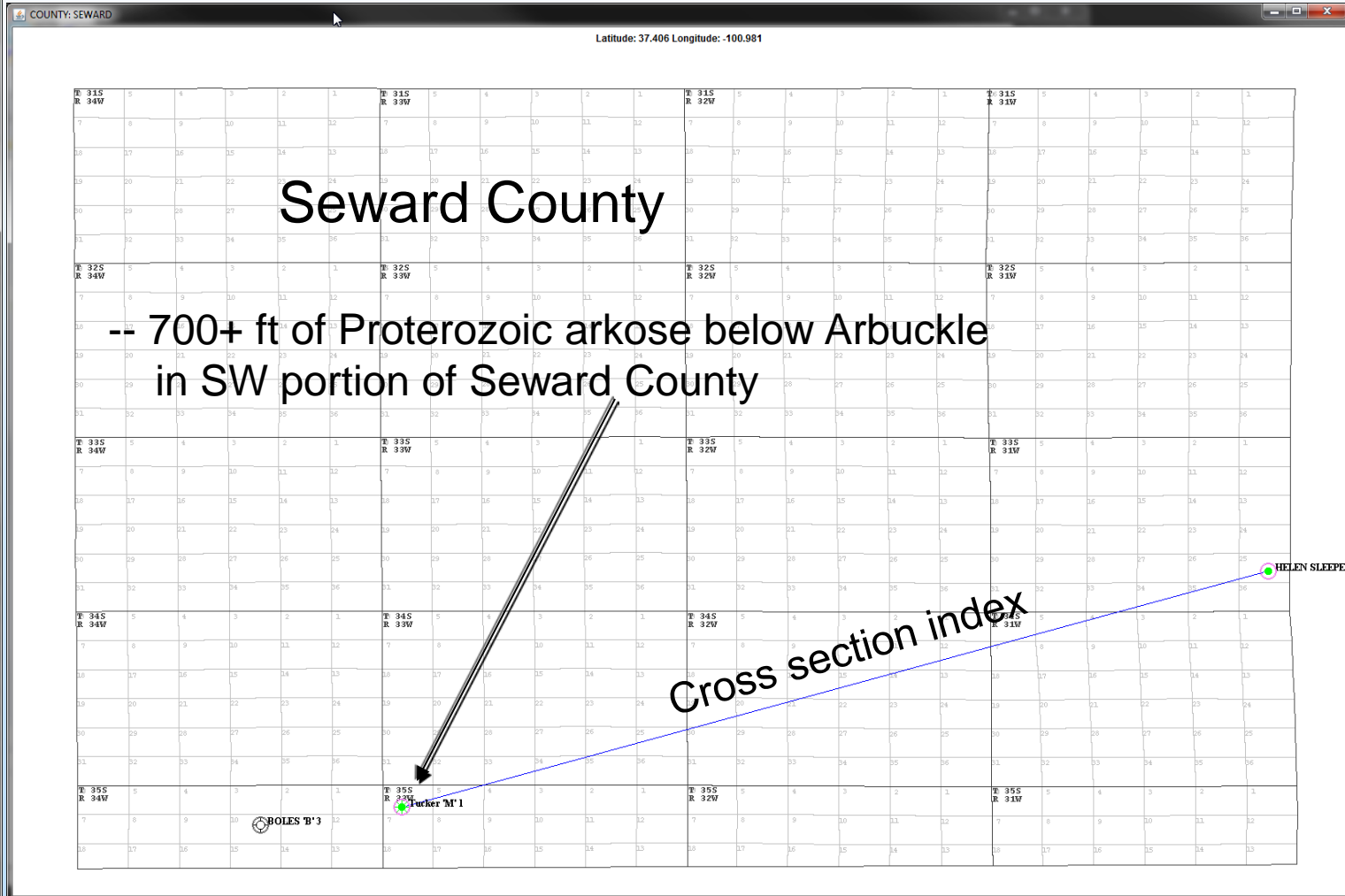
0: 1042553286.las

1:

2:

GR	OBM	NPPI	DPHI	PE	Sonic	Tops	GEO
YES	YES	YES	YES	NO	NO	YES	NO

Step 4: Plot Cross Section Data



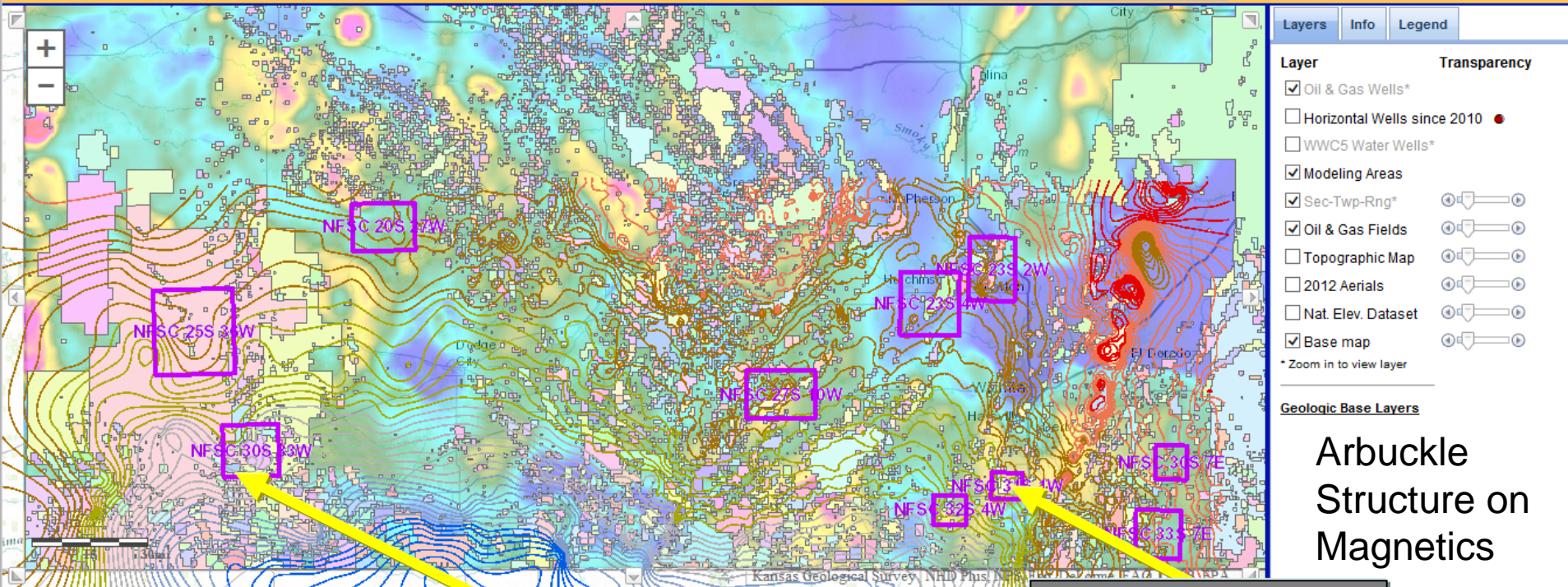
Drilling, Coring, and Seismic Data at Cutter and Wellington Western Calibration for Regional CO₂ Storage Assessment

Modeling Carbon Dioxide Sequestration Potential in Kansas

Kansas Geological Survey

Study Area | Zoom to Location | Filter Wells | Label Wells | Download Wells | Print to PDF | Clear Highlight | Help

Cross Section Tools



Cutter Field
Stevens Co.

Wellington Field
Sumner Co.

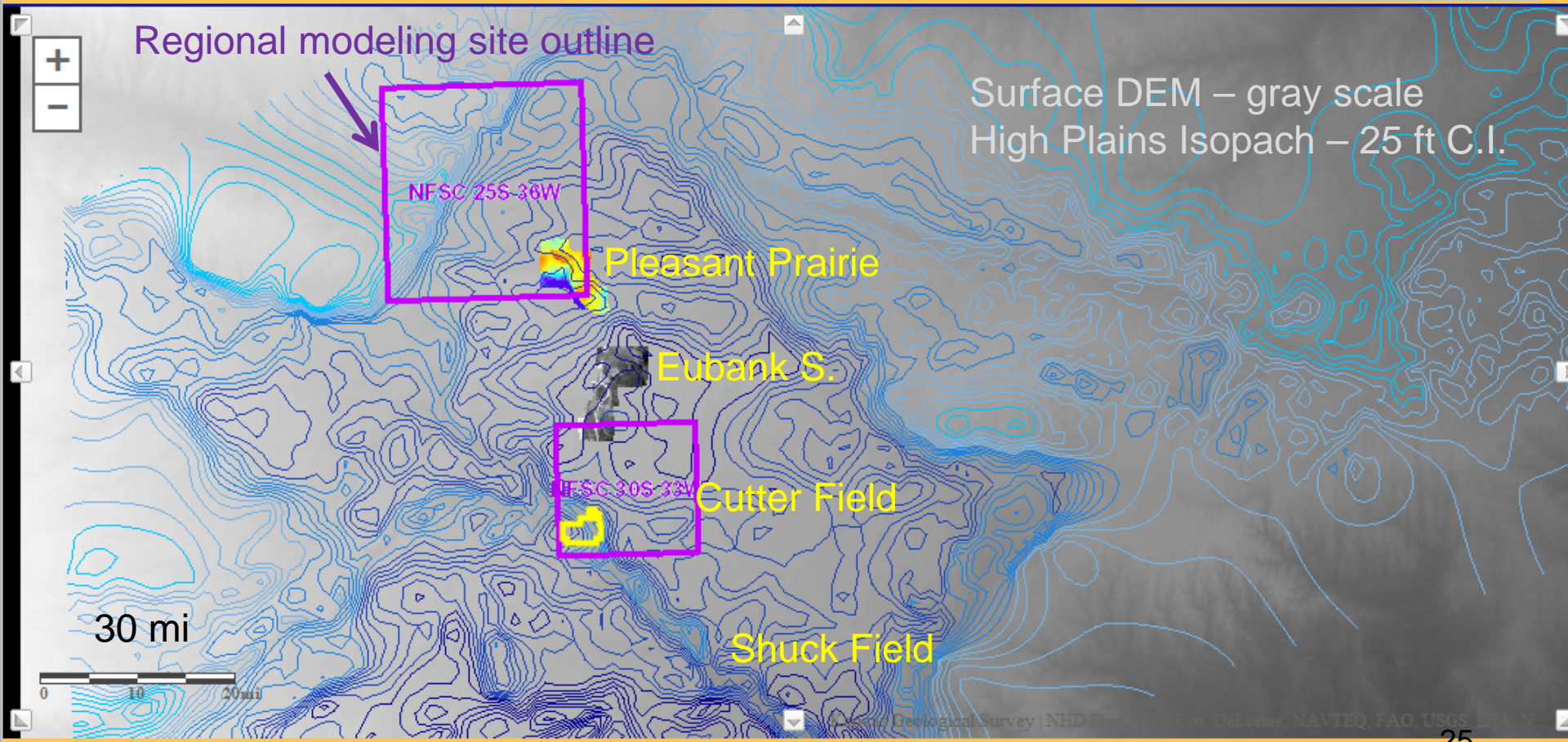
Risk Assessment –

Correlation between high Plains Aquifer Isopach and Surface Low in Southwest Kansas

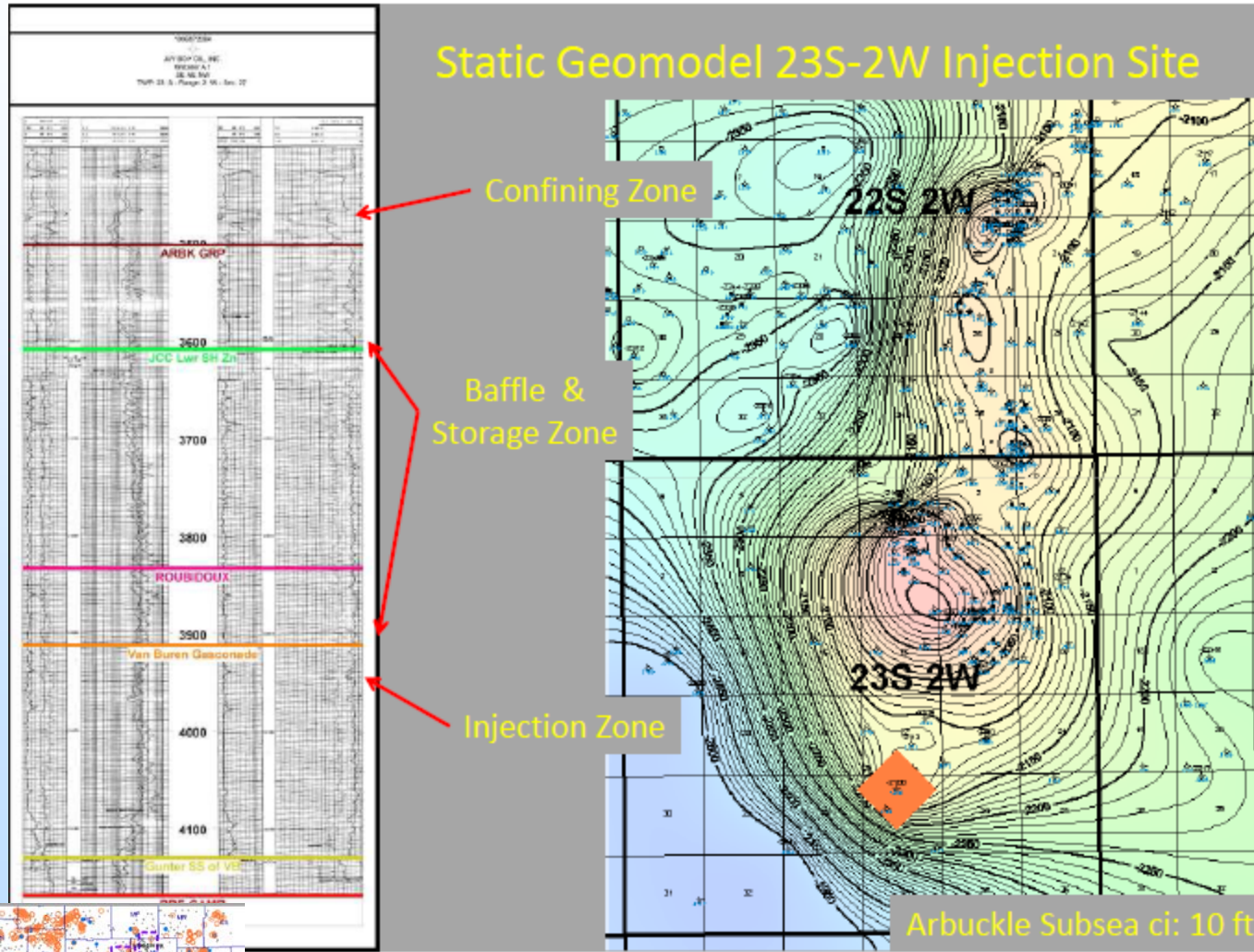
Modeling Carbon Dioxide Sequestration Potential in Kansas

Study Area | Zoom to Location | Filter Wells | Label Wells | Download Wells | Print to PDF | Clear Highlight | Help

Cross Section Tools

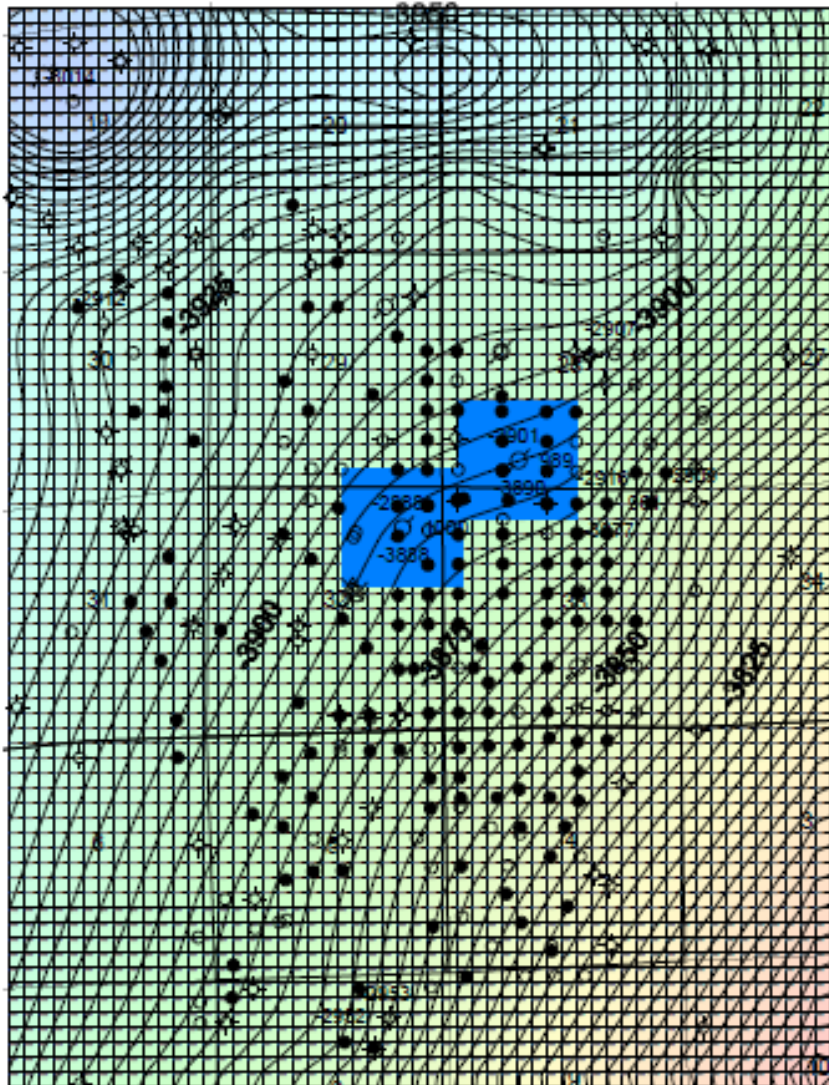


10 Static-Dynamic Modeling Sites in Assessment Area



Coarse Grid Simulations - Arbuckle Saline Aquifer

Improve Assessment of CO₂ Sequestration Capacity



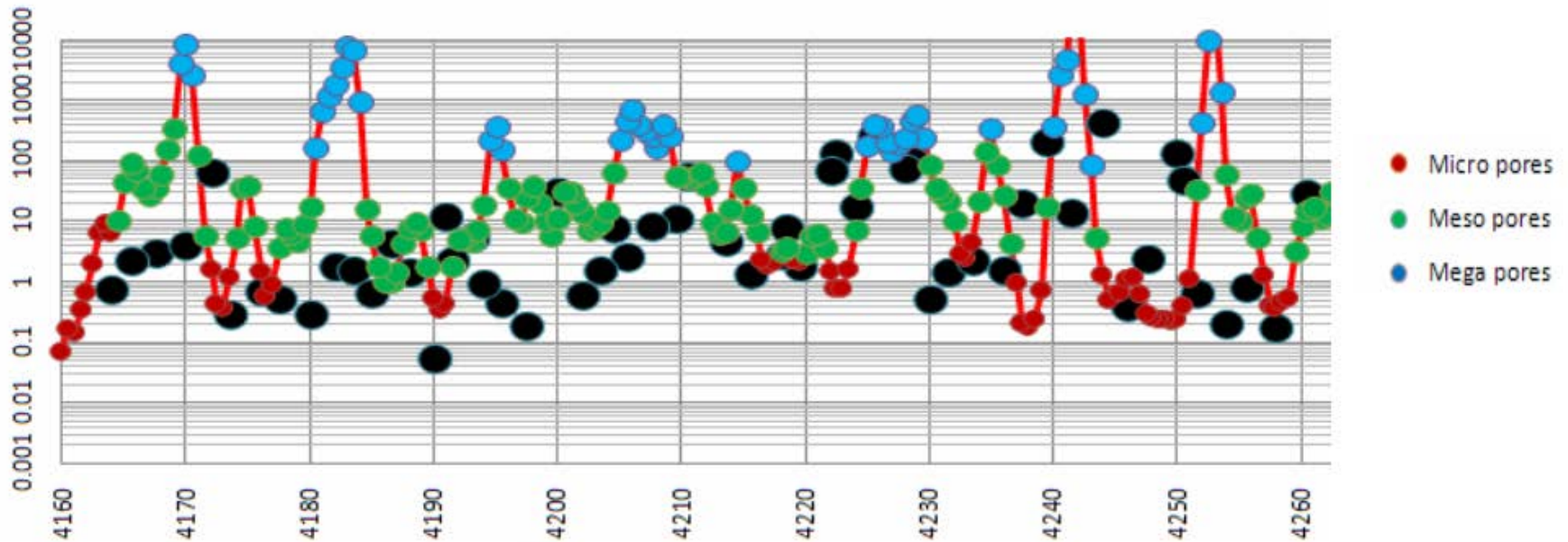
Geomodel input format for coarse grid simulation prior to final regional assessment

Grid Cell Size: 330 ft, Col: 56, Row: 73, total cells: 4088

- Info on Grids in Zmap based on stratigraphic divisions, lithofacies, and pore types
- Parameters assigned by fuzzy logic correlations from core and log data from Cutter and Wellington fields --
 - Phi
 - K and relative permeability
 - Capillary pressure for supercritical CO₂

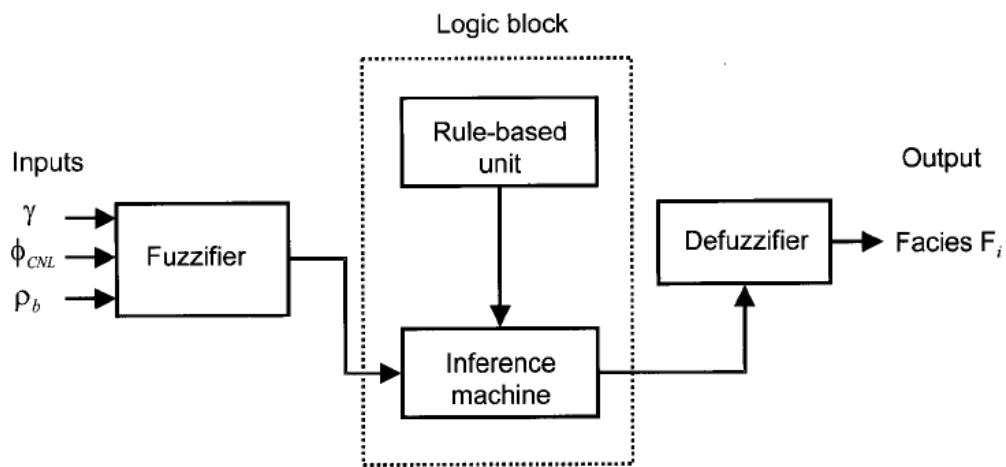
Improved permeability estimation in Wellington #1-32:

- micro, meso, and mega groups defined
- core FZI and irreducible water saturation (from MRI log)
- permeability computed from FZI value

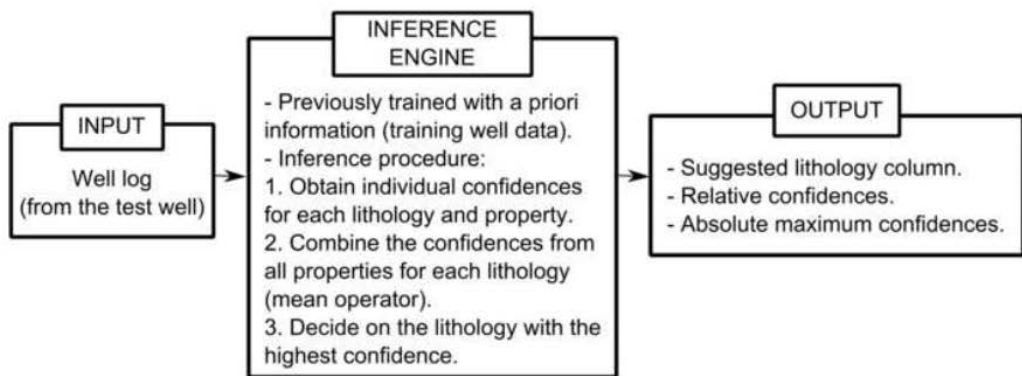


Black points = core measured permeability

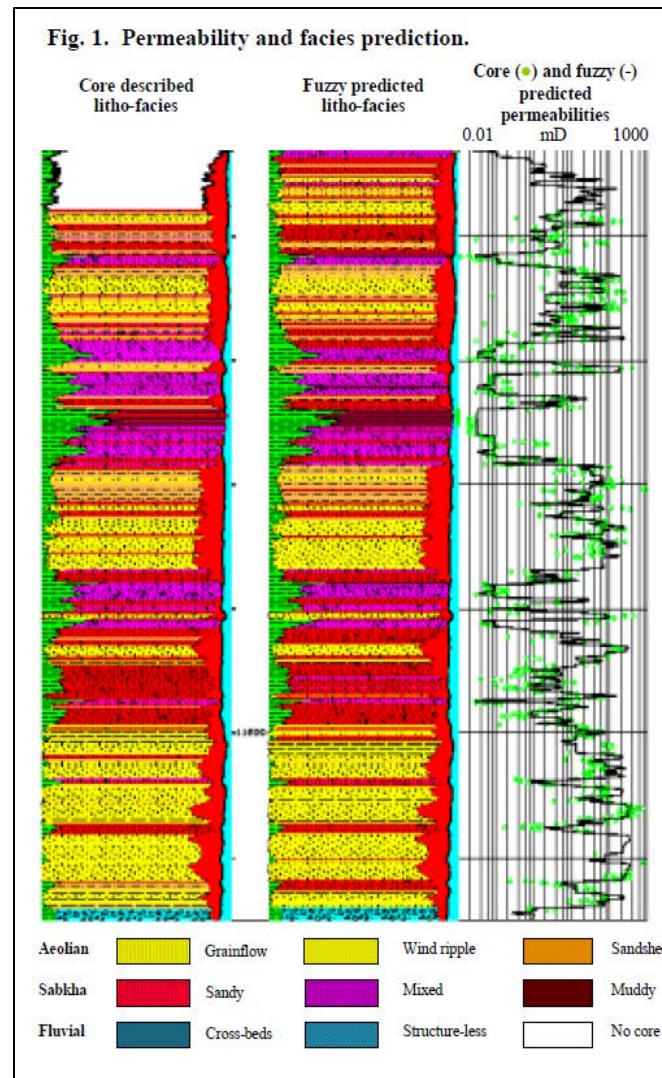
Fuzzy Partitioning Systems for Electrofacies Classification



Finol et al. (2001)



Bosch et al., in press



Cuddy and Glover (2002)

Accomplishments to Date

- KGS Milestone 1.2: Acquire/analyze seismic, geologic and engineering data - Wellington field -- **COMPLETED**
- KGS Milestone 1.3: Develop initial geomodel for Wellington field -- **COMPLETED**
- KGS Milestone 1.4: Locate and initiate drilling of Well #1 at Wellington field -- **COMPLETED**
- KGS Milestone 2.1: Complete Well#1 at Wellington - DST, core, log, case, perforate, test zones -- **COMPLETED**
- KGS Milestone 2.2: Complete Well#2 at Wellington - Drill, DST, log, case, perforate, test zones -- **COMPLETED**
- KGS Milestone 2.3: Update Wellington geomodels - Arbuckle & Mississippian – **90%**
- KGS Milestone 2.4: Evaluate CO₂ Sequestration Potential of Arbuckle Group Saline Aquifer - Wellington field – **85%**
- KGS Milestone 3.1: CO₂ sequestration & EOR potential - Wellington field – **85%**
- KGS Milestone 3.2: Characterize leakage pathways - Risk assessment area – **85%**
- KGS Milestone 3.3: Risk assessment related to CO₂-EOR and CO₂-sequestration – **70%**
- KGS Milestone 3.4: Regional CO₂ Sequestration Potential - 33 Counties – **50%**

Summary

- **Key findings**

1. Initial estimates of CO₂ P10 & P90 Arbuckle aquifer storage are 8.8 and 75.5 billion metric tons.
2. Core, logs, seismic, DST, geochemical and microbial analysis, and step-rate test at Wellington Field indicate that lower Arbuckle is a *primary injection interval* (~150 ft thick) overlain by widespread thick (400 ft) *baffle/barrier in mid Arbuckle*.
3. Geochemical and microbial analyses indicate that upper and lower portions of the Arbuckle saline aquifer are not in hydraulic communication.
4. Thick (~120 ft) primary caprock in lower Mississippian (“Pierson Fm.”) augments the Chattanooga Shale and Simpson Group in south-central Kansas.

- **Future Plans**

- Complete geomodels and simulations in SW Kansas fields and Wellington
- Refine regional CO₂ storage estimates from quantitative analysis of LAS log files and static and dynamic modeling at 10 sites
- Complete project by February 2014

Appendix

ORGANIZATION STRUCTURE

Modeling CO₂ Sequestration in Saline Aquifer and Depleted Oil Reservoir to Evaluate Regional CO₂ Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas

Principal Investigators

Jason Rush -- Joint PI
W. Lynn Watney - Joint PI

DOE project -- DE-FE002056

UNIVERSITY OF KANSAS

Kansas Geological Survey

Co-Principal Investigators

Kerry D. Newell -- stratigraphy, geochemistry
Jason Rush -- Petrel geomodeling and data integration
Richard Miller -- geophysics
John Doveton-- log petrophysics and core-log modeling
Jianghai Xia -- gravity-magnetics modeling & interpretation
Marios Sophocleous --geohydrology

Key Personnel

John Victorine -- Java web app development
David Laflen -- manage core & curation
Mike Killion -- modify ESRI map service for project
Jennifer Raney -- asst. project manager
Debra Stewart, Dan Suchy -- data management
Yevhen 'Eugene' Holubnyak, Petroleum Engineer
Fatemeh "Mina" FazelAlavi, Engineering Research Assistant

KU Department of Geology

Co-Principal Investigators

Evan Franseen --sedimentology, stratigraphy
Robert Goldstein -- diagenesis, fluid inclusion
David Fowle -- reactive pathways, microbial catalysis
Jennifer Roberts -- reactive pathways, microbial catalysis
George Tsoflias -- geophysics

Grad Research Assistants

Aimee Scheffer (graduated) -- biogeology & geochemistry
Breanna Huff -- biogeology
Christa Jackson -- biogeology and geochemistry
Ayrat Sirazhiev (graduated) -- geophysics
Yousuf Fadolalkarem -- geophysics
Brad King -- diagenesis

SUBCONTRACTS

Berexco, Beredco Drilling -- Wichita, KS

Wellington Field access; drilling, coring, completion and testing; modeling and simulation

Key Personnel

Dana Wreath - manager, reservoir and production engineer
Randy Koudele - reservoir engineer
Bill Lamb - reservoir engineer

Bittersweet Energy, Inc., Wichita, KS

Tom Hansen, Principal, Wichita, Geological Supervision - regional data, Arbuckle hydrogeology
Paul Gerlach -- regional data acquisition, 2 yrs.
Larry Nicholson -- regional data acquisition, 2 yrs.
Anna Smith -- regional data acquisition, 2 yrs.
Ken Cooper, Petrotek Engineering, Littleton, CO- engineer, well injection, hydrogeology
John Lorenz, Scott Cooper, FractureStudies, Edgewood, NM -- core fracture study

Kansas State University

Seismic and Geochemical Services

Co-Principal Investigators

Saugata Datta -- reactive pathways and reaction constants
Abdelmoneam Raef -- seismic analysis and modeling

Grad Research Assistants

Robin Barker (graduated)
Derek Ohl - seismic analysis and modeling
Randi Isham -- seismic
Brent Campbell - aqueous geochemistry

Services

LOGDIGI, LLC, Katy, TX - wireline log digitizing
David G. KOGER, Dallas, TX - remote sensing data and analysis
Weatherford Laboratories, Houston, TX -- core analyses
CMG - Simulation Services, Calgary, Alberta --greenhouse gas simulation and software
Halliburton, Liberal, KS -- wireline logging services
Hedke-Saenger Geoscience, LTD., Wichita, KS - geophysical acquisition, interpret & design
Susan E. Nissen, McLouth, KS -- Geophysical Consultant, volumetric curvature
Lockhart Geophysical, Denver, CO -- acqui & interpret 2D shear wave, gravity & mag
Fairfield Industries, Inc., Denver, CO -- 2D, 3D multicomponent seismic processing
Paragon Geophysical Services, Wichita, KS -- 3D seismic acquisition
Echo Geophysical, Denver, CO -- 3D seismic processing
Converging Point - QC seismic acquisition
Noble Energy, Houston, TX; Denver, CO -- collaborating co., fields adjoining Wellington

Southwest Kansas CO₂ EOR Initiative - Chester Morrow

Martin Dubois, IHR, LLC -- team lead, geomodeling
John Youle, Sunflower Energy -- core and depositional models
Ray Sorenson, consultant -- data acquisition and advising
Eugene Williams, Williams Engineering -- reservoir modeling

Bibliography

Watney, W.L., Newell, K.D., Holubnyak, E., and Raney, J., 2013, "Oil and Gas in Central Kansas Potential for Enhanced Oil Recovery Using CO₂", regarding use of petroleum coke in refinery that would include CO₂ generation: to McPherson Kansas Development Corporation hosted meeting, April 3.

Watney, W.L., 2013, Analysis of the Late Devonian to Early Carboniferous (Fransnian-Tornaisian) Woodford (Chattanooga) Shale, presentation to AAPG Forum Woodford, Oklahoma City, April 11. This is an important caprock in Kansas and Oklahoma.

Watney, W.L., 2013, Petrophysical Analyses and Integrated Approaches, April 16-19, AAPG Short Course, Austin, TX. Centerpiece of the course material comes from the DOE-CO₂ project

Watney, W.L., 2013, Mississippian Exploration: Stratigraphy, Petrology, and Reservoir Properties with an emphasis on Wellington Field, April 23, Denver, RMAG & PTTC Symposium titled, "Making Money with Science", April 23, Denver, Colorado.

W. Lynn Watney, John Youle, Dennis Hedke, Paul Gerlach, Raymond Sorenson, Martin Dubois, Larry Nicholson, Thomas Hansen, David Koger, and Ralph Baker, 2013, Sedimentologic and Stratigraphic Effects of Episodic Structural Activity During the Phanerozoic in the Hugoton Embayment, Kansas USA: AAPG Annual Meeting, Oral presentation, Pittsburgh, PA, May 21

W. Lynn Watney, Jason Rush, Martin Dubois, Robinson Barker, Tiraz Birdie, Ken Cooper, Saugata Datta, John Doveton, Mina Fazelalavi, David Fowle, Paul Gerlach, Thomas Hansen, Dennis Hedke, Yevhen Holubnyak, Breanna Huff, K. David Newell, Larry Nicholson, Jennifer Roberts, Aimee Scheffer, Ayrat Sirazhiev, Raymond Sorenson, Georgios Tsoflias, Eugene Williams, Dana Wreath, John Youle, 2013, Evaluating Carbon Storage in Morrowan and Mississippian oil fields and Underlying Lower Ordovician Arbuckle Saline Aquifer in Southern Kansas: AAPG Annual Meeting, Poster, Pittsburgh, PA, May 20.

DOE Site visit and project review, June 3-5, 2013, Regional CO₂ Storage, Wellington and Cutter field calibration sites, SW Kansas CO₂-EOR Initiative, and Small Scale CO₂ Test Injection at Wellington, Wichita, KS.

Watney, L., Rush, J., Raney J., and Brian Dressel, DOE Project Manager, 2013, Presentation to the 2013 KGS Annual Kansas Field Conference. Participants included Kansas legislators and state officials, morning of Tuesday, June 4th, Meet bus at site of Wellington KGS #1-32. Brought core and posters in addition to describing DOE-CO₂ project and answering questions pertaining economics, safety, and policy.

The 2013 KGS Annual Field Conference was carried out by Shane A. Lyle, Catherine S. Evans, Rex C. Buchanan, and Robert S. Sawin and was focused on "South-Central Kansas Oil Exploration, Water Allocation, and Range Management". This project is operated by the Kansas Geological Survey and funded, in part, by the Kansas Water Office, the Kansas Department of Transportation, and the Kansas Department of Wildlife, Parks and Tourism. The Wellington Field was Stop #1 on the trip that traversed south-central Kansas (Figure 37). Members of the DOE-CO₂ team met the bus at the site of Berexco Wellington KGS #1-32 in Wellington Field.

GEOCHEMICAL AND MINERALOGICAL CHARACTERIZATION OF THE ARBUCKLE AQUIFER: STUDYING MINERAL REACTIONS AND ITS IMPLICATIONS FOR CO₂ SEQUESTRATION

BARKER, Robinson¹, WATNEY, W. Lynn², SCHEFFER, Aimee³, FORD, Sophia¹, and DATTA, Saugata¹, (1) Department of Geology, Kansas State University, 108 Thompson Hall, Manhattan, KS 66506, rbarker@ksu.edu, (2) Kansas Geological Survey, Univ of Kansas, 1930 Constant Avenue, Lawrence, KS 66047, (3) Geology, University of Kansas, 1475 Jayhawk Blv. Room 120, Lawrence, KS 66045

GEOCHEMICAL AND MICROBIOLOGICAL INFLUENCES ON SEAL INTEGRITY DURING SC-CO₂ EXPOSURE, ARBUCKLE AQUIFER, SE KANSAS

JACKSON, Christa¹, SCHEFFER, Aimee², FOWLE, David³, WATNEY, W. Lynn⁴, STRAZISAR, Brian⁵, and ROBERTS, Jennifer A.³, (1) Geology, University of Kansas, 1475 Jayhawk Blvd, Room 120, Lawrence, KS 66045, christa.jackson@ku.edu, (2) Geology, University of Kansas, 1475 Jayhawk Blv. Room 120, Lawrence, KS 66045, (3) Geology, University of Kansas, Multidisciplinary Research Building, 2030 Becker Dr, Lawrence, KS 66047, (4) Kansas Geological Survey, Univ of Kansas, 1930 Constant Avenue, Lawrence, KS 66047, (5) Geomechanics and Flow Laboratory, National Energy Technology Laboratory, 626 Cochran Mill Road, PO Box 10940, Pittsburgh, PA 15236

GEOCHEMICAL, MICROBIOLOGICAL, AND PERMEABILITY CHARACTERISTICS INDICATING VERTICAL ZONATION OF THE ARBUCKLE SALINE AQUIFER, A POTENTIAL CO₂ STORAGE RESERVOIR

SCHEFFER, Aimee¹, STOTLER, Randy L.², WATNEY, W. Lynn³, FOWLE, David⁴, DOVETON, John H.⁵, RUSH, Jason⁶, NEWELL, K. David⁷, FAZELALAVI, Mina³, WHITTEMORE, Donald O.⁸, and ROBERTS, Jennifer A.⁴, (1) Geology, University of Kansas, 1475 Jayhawk Blv. Room 120, Lawrence, KS 66045, ascheffer@ku.edu, (2) Department of Geology, University of Kansas, Lawrence, KS 66045, (3) Kansas Geological Survey, Univ of Kansas, 1930 Constant Avenue, Lawrence, KS 66047, (4) Geology, University of Kansas, Multidisciplinary Research Building, 2030 Becker Dr, Lawrence, KS 66047, (5) Kansas Geological Survey, Univ of Kansas, 1930 Constant Avenue, Campus West, Lawrence, KS 66047, (6) Kansas Geological Survey, The University of Kansas, 1930 Constant Avenue, Lawrence, KS 66047, (7) Kansas Geological Survey, University of Kansas, 1930 Constant Avenue, Lawrence, KS 66047-3726, (8) Kansas Geological Survey, University of Kansas, 1930 Constant Ave, Lawrence, KS 66047

M.S. Theses

Ayrat Sirazhiev, 2012, Seismic Attribute Analysis of the Mississippian Chert at the Wellington Field, south-central Kansas: M.S. Thesis, Department of Geology, The University of Kansas.

Ohl, Derek Robert, 2012, Rock formation characterization for carbon dioxide geosequestration: 3D seismic amplitude and coherency anomalies, and seismic petrophysical facies classification, Wellington and Anson-Bates fields, Sumner County, Kansas, USA, M.S. Thesis, Department of Geology, Kansas State University, 77 p.

Randi Jo Lee, 2012, Integration of in situ and laboratory velocity measurements: analysis and calibration for rock formation characterization Isham, M.S. Thesis, Department of Geology, Kansas State University.

Presentations

Geofest 2012, October 26th 2012, held in Lawrence, KS at Kansas Geological Survey, focused on a review of the DOE funded CCUS research in a morning seminar and a core workshop in the afternoon to examine the entire 1600 ft long core from Wellington KGS #1-32. Attendees included members of the Kansas Geological Society, Kansas Geological Survey, Departments of Geology at Kansas University and Wichita State University