Modeling CO_2 Sequestration in Saline Aquifer and Depleted Oil Reservoir to Evaluate Regional CO_2 Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas Project Number (DE-FE0002056)

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Lawrence, KS 66047

*speaker

U.S. Department of Energy

National Energy Technology Laboratory

Carbon Storage R&D Project Review Meeting

Developing the Technologies and Infrastructure for CCS

August 12-14, 2014

5:35 Tues

Brighton

Presentation Outline

1. Benefits to the Program
2. Project Overview
3. Technical Status
4. Accomplishments to Date
5. Summary

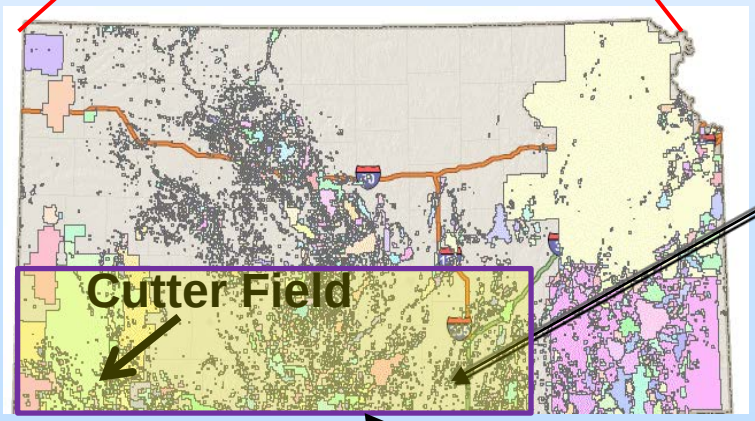
1. Benefits to the Program

- **Goal–**
  - **Predict geologic CO_2 storage capacity within ±30%**
- **Project benefits --**
  - Quantify CO_2 storage at five Kansas fields through compositional reservoir simulations addressing storage efficiency and optimized use of CO_2 for EOR
  - Simulate commercial scale (>30 MM tonnes) storage at 10 regional sites analogous to Wellington & Cutter fields
  - Refine CO_2 storage capacity of the Arbuckle saline aquifer in southern Kansas (25,000 mi^2) through use of large-scale compositional simulation (currently 9-75 billion tonnes, 200 yrs. KS emissions)
  - Utilize extensive digital (LAS) log database, 3D seismic, gravity-magnetics, and remote sensing to evaluate site suitability, risk, and storage efficiency
  - Allow user to query and analyze information via *Interactive Project Mapper, NATCARB, and suite of Java applications*

Project Overview: Goals and Objectives

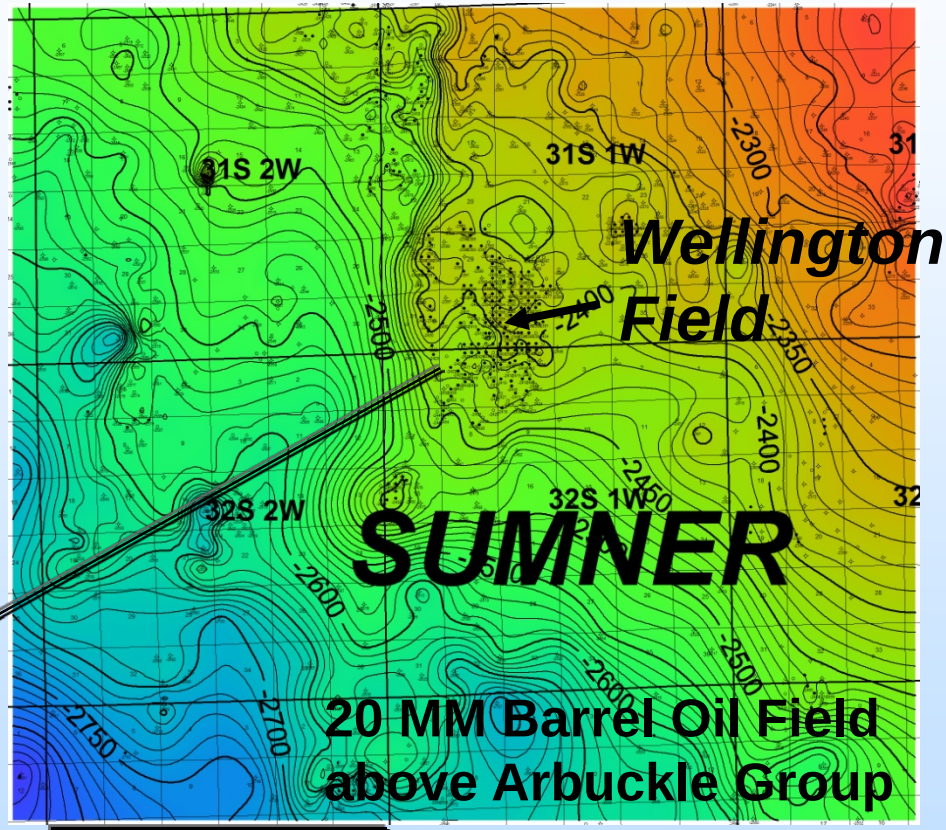
- **Model CO_2 storage at Wellington & Cutter fields and three additional fields in southwestern Kansas**
  - ***Success*** –
  - *a) Drilled 3 basement tests, 2@ 5200 ft TD at Wellington Fld & 1@7700 ft (Cutter Fld)*
  - *b) Cored 2552 ft of Arbuckle and caprock in Wellington and Cutter fields*
  - *c) Collected 22 mi^2 of multicomponent 3D seismic*
  - *d) Sampled and tested brines from 35 DST, perf and swab operations in three basement tests*
  - *e) Built static (Petrel) and dynamic models (CMG) with CO_2 storage and EOR outcomes*
- **Static and dynamic modeling of the Lower Ordovician Arbuckle Group in southern Kansas (25,000 mi^2)** *(Predict CO_2 storage within ±30 percent)*
  - ***Success*** –
  - *a) Mapped the aquifer's hydrostratigraphic units/flow units and confining strata;*
  - *b) Establish distinctive geochemical signatures of brines in hydrostratigraphic units through extensive fluid sampling and analysis;*
  - *c) Simulated commercial scale CO_2 injection at 10 sites;*
  - *d) Regional storage capacity accomplished using composition simulation, flow units, and their key properties (Φ, kv, kh, Pc) realized from core, test, and petrophysical data obtained from Wellington and Cutter field calibration boreholes.*

Regional and site studies to evaluate carbon storage in Kansas



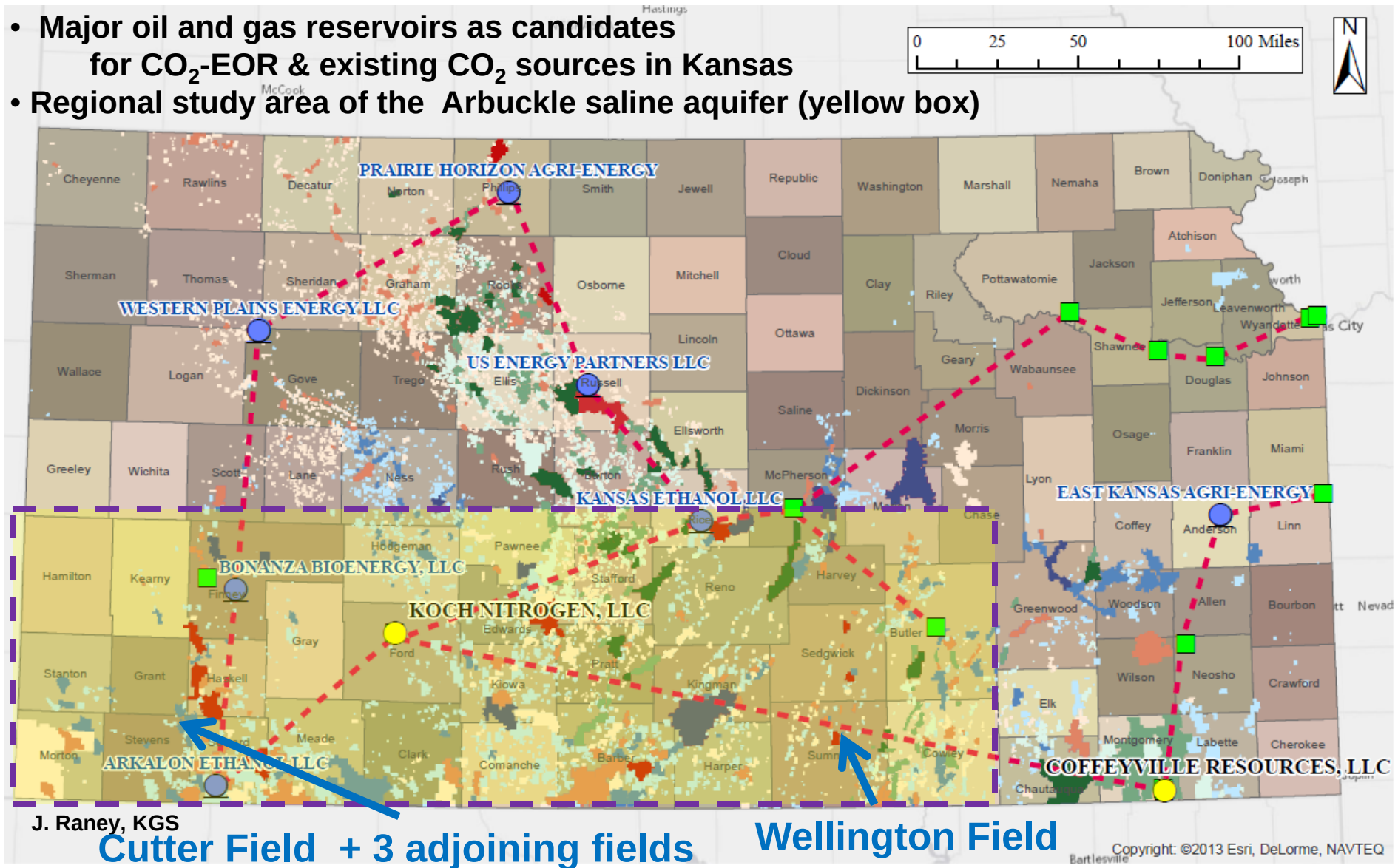
Regional study area (25k mi^2, 65k km^2) estimate carbon storage

Top Mississippian Structure, 10 ft C.I.



KU KANSAS GEOLOGICAL SURVEY
The University of Kansas

- **Major oil and gas reservoirs as candidates for CO_2-EOR & existing CO_2 sources in Kansas**
- **Regional study area of the Arbuckle saline aquifer (yellow box)**



J. Raney, KGS

Cutter Field + 3 adjoining fields

Wellington Field (small scale field test)

Source: USGS, Kansas Geological Survey, DASC

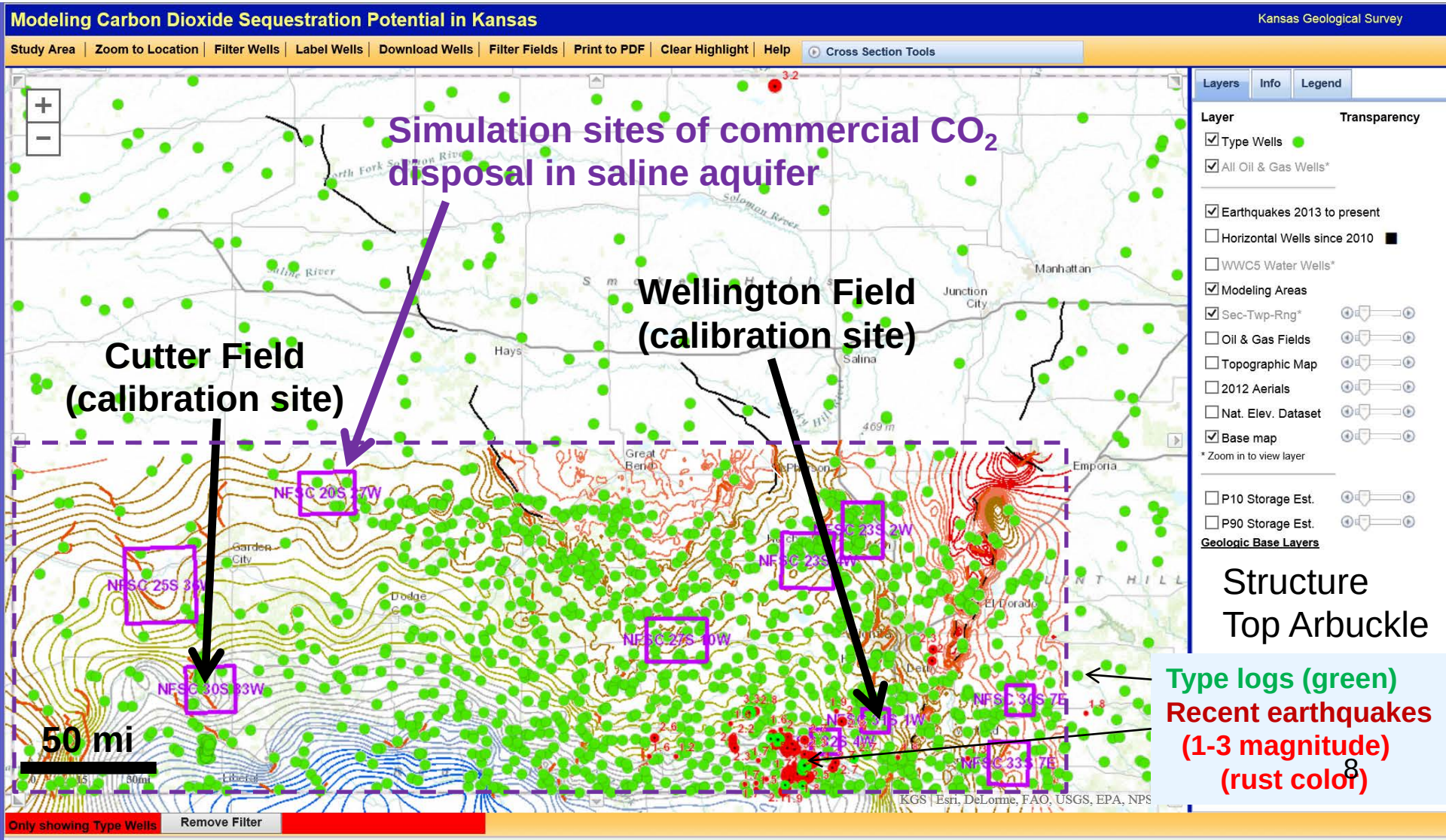
Cumulative Oil Produced (2013)

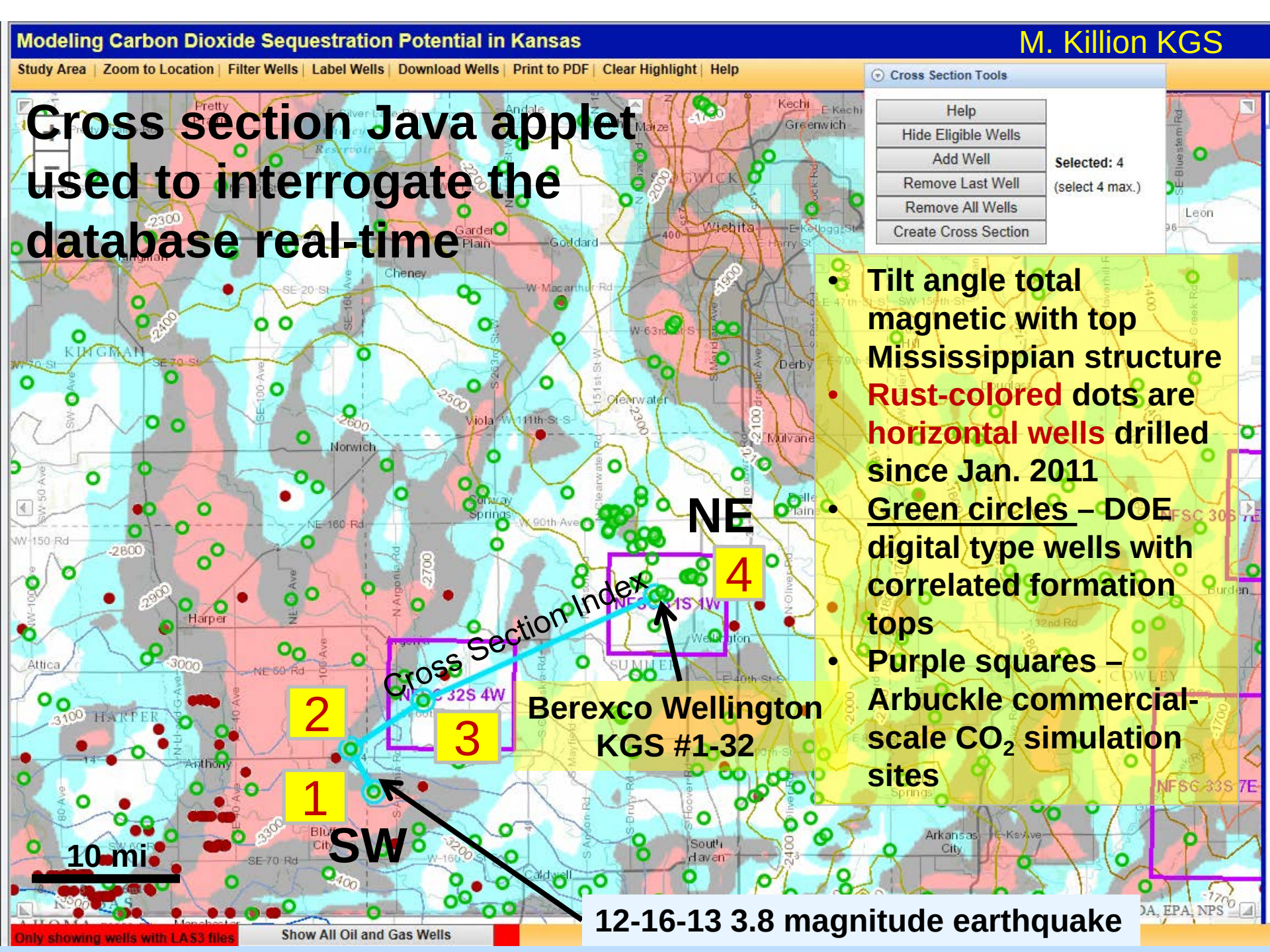
Arbuckle Fields	Lansing-KC Fields	Mississippian Fields
0 - 1,000,000 bbls	0 - 1,000,000 bbls	0 - 1,000,000 bbls
1,000,000 - 10,000,000	1,000,000 - 10,000,000	1,000,000 - 10,000,000
10,000,000 - 100,000,000	10,000,000 - 100,000,000	10,000,000 - 100,000,000

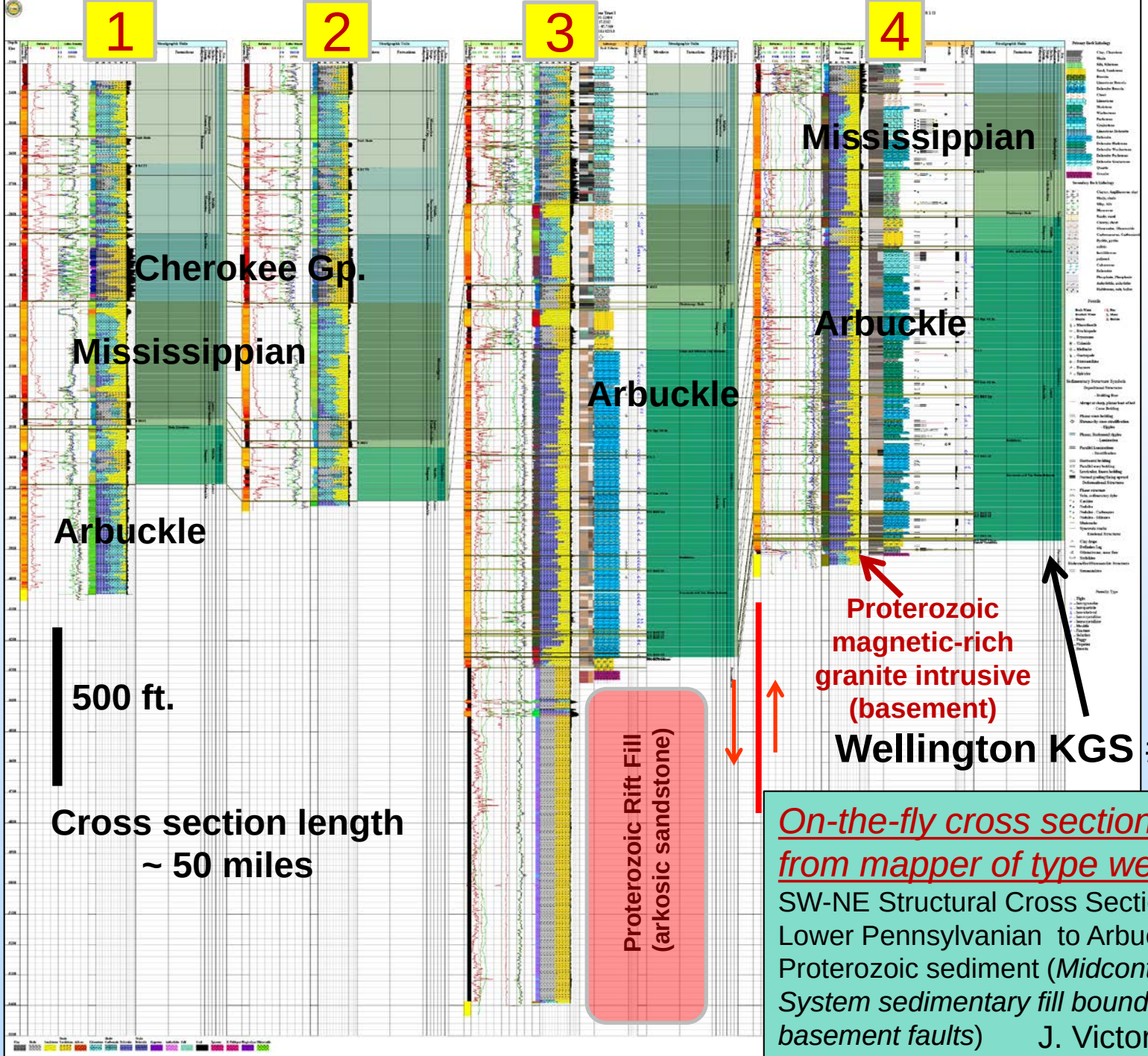
- Ammonia Plant
- Ethanol Plant
- 500,000+ tonnes CO2 emmitted in 2011
- Potential CO2 Pipeline Network

Kansas Interactive CO_2 Mapper

access to key maps, static seismic volumes, modeling results, well data, gravity/magnetics, remotely sensed surface lineaments, faults, and earthquakes (data exchange with NATCARB)



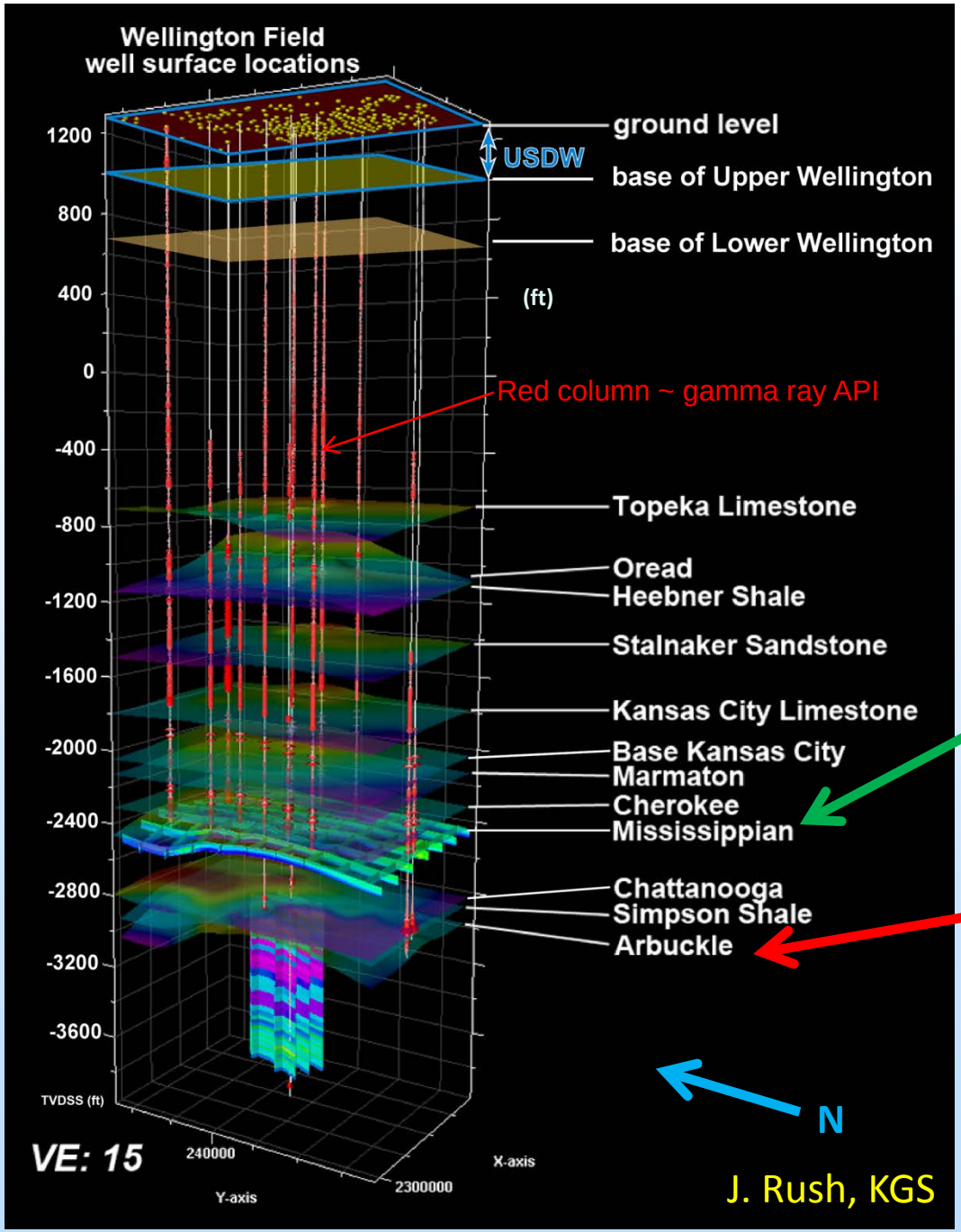

Modeling Carbon Dioxide Sequestration Potential in Kansas
M. Killion KGS
Study Area | Zoom to Location | Filter Wells | Label Wells | Download Wells | Print to PDF | Clear Highlight | Help
Cross Section Tools
Help
Hide Eligible Wells
Add Well
Remove Last Well
Remove All Wells
Create Cross Section
Selected: 4
(select 4 max.)
Cross section Java applet used to interrogate the database real-time
Tilt angle total magnetic with top Mississippian structure
Rust-colored dots are horizontal wells drilled since Jan. 2011
Green circles – DOE digital type wells with correlated formation tops
Purple squares – Arbuckle commercial-scale CO2 simulation sites
NE
SW
Cross Section Index
1
2
3
4
Berexco Wellington KGS #1-32
12-16-13 3.8 magnitude earthquake
10 mi
Only showing wells with LAS3 files
Show All Oil and Gas Wells



On-the-fly cross section tool from mapper of type wells

SW-NE Structural Cross Section
Lower Pennsylvanian to Arbuckle and Proterozoic sediment (*Midcontinent Rift System sedimentary fill bounded by basement faults*)

J. Victorine, KGS

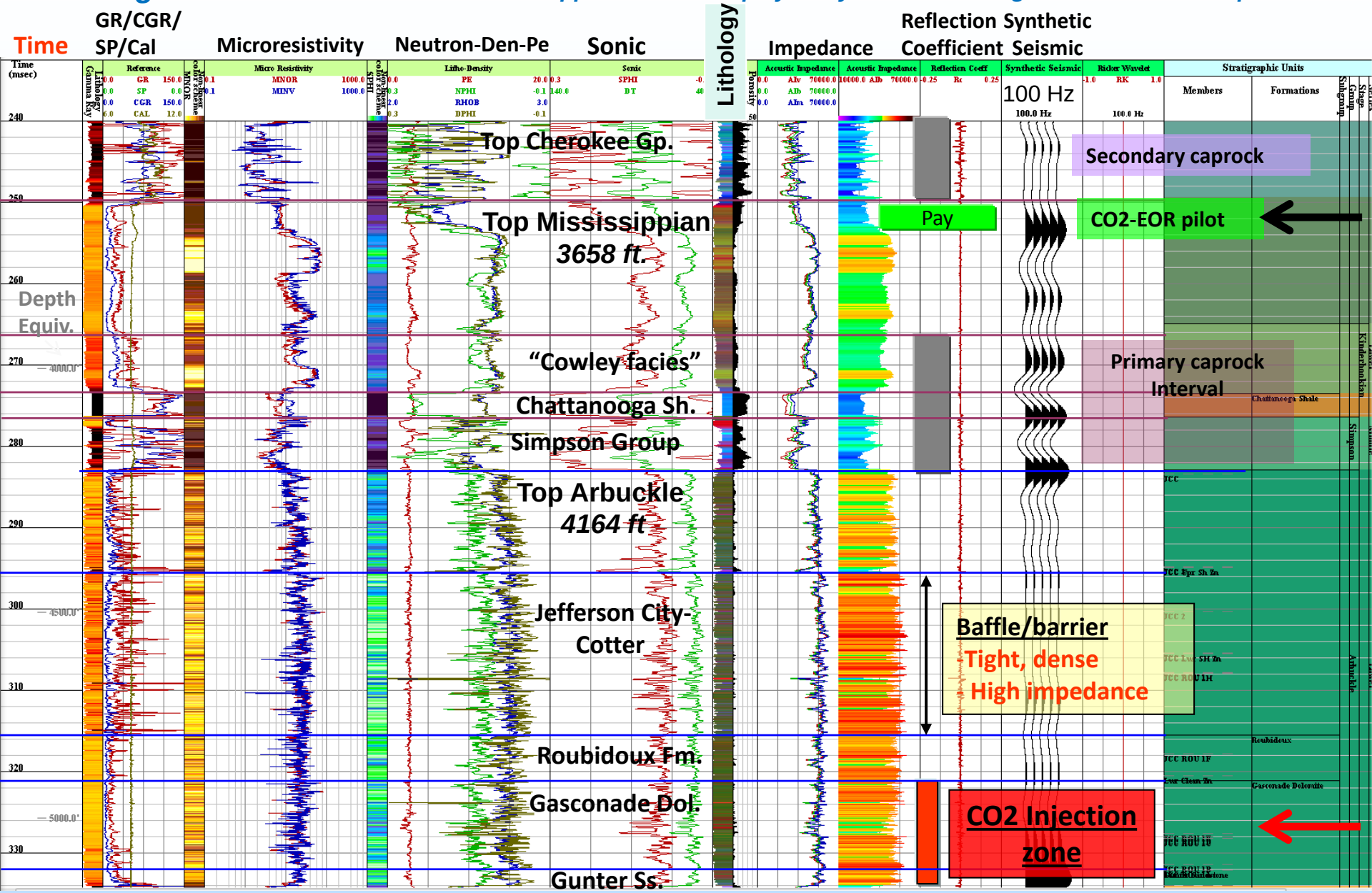


Wellington Field Sumner County Kansas

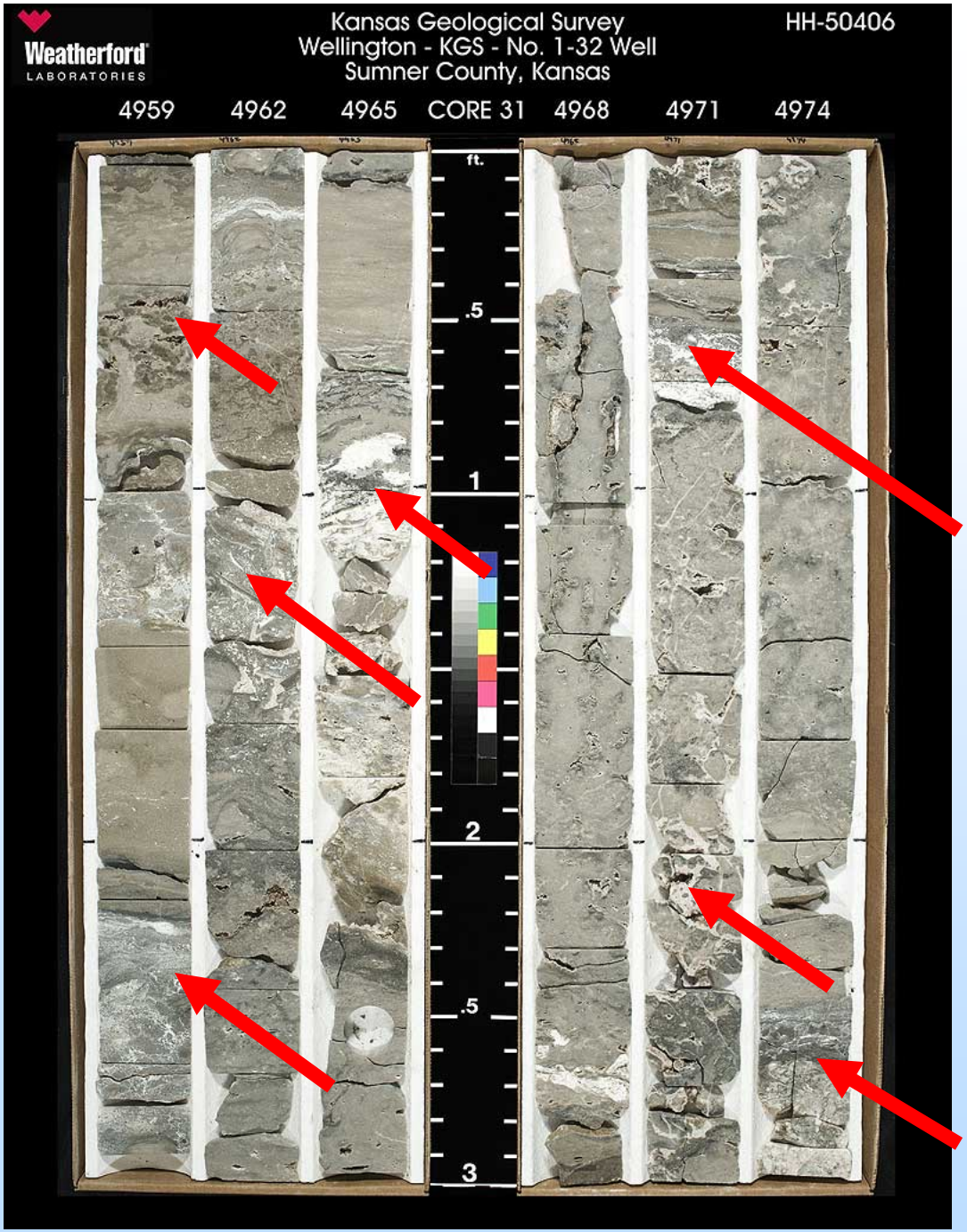
- Eastern calibration site
- upcoming small scale injections in the Mississippian oil reservoir (first) and deeper Arbuckle saline aquifer

CO_2 Injection Zones in Arbuckle and Mississippian

Wellington Field KGS #1-28 --- Java applet used to display → Synthetic seismogram and seismic impedance



Proterozoic granite – bottom of core = *5174 ft (1600 m)* **Java App: http://www.kgs.ku.edu/software/S**

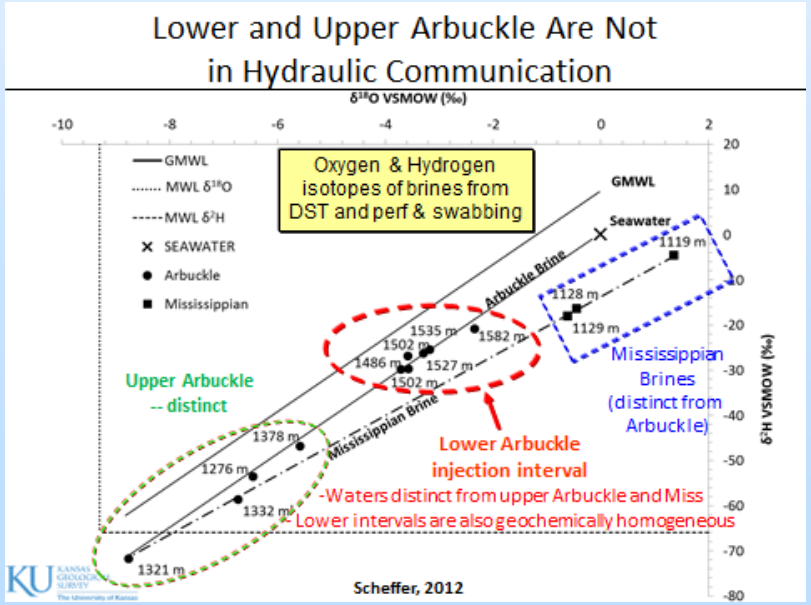


Planned CO_2 injection zone in lower Arbuckle

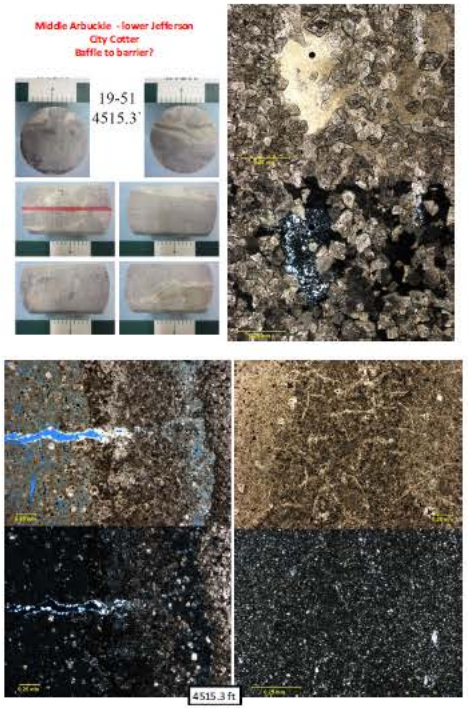
Thin, shallowing-upward peritidal cycles, topped with autoclastic/crackle breccias, silicified in places

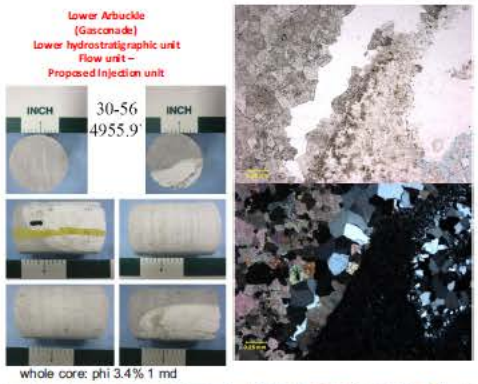
Aquiclude/baffle in the middle of the Arbuckle

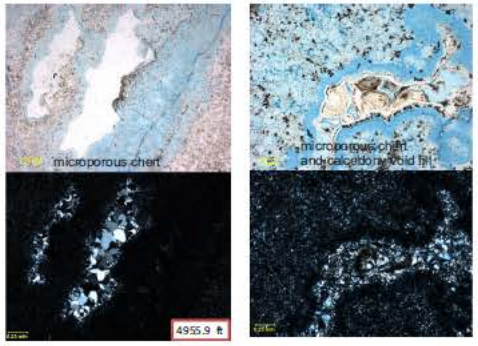
argillaceous dolomite & shale

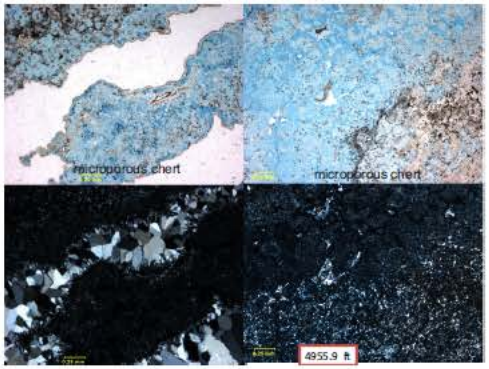


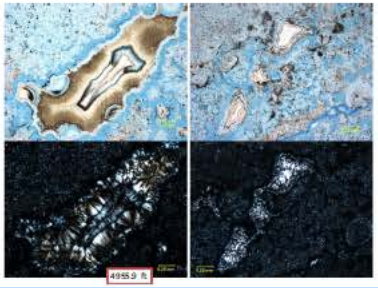
Thin Sections – Baffle Zone (Mid Arb.)





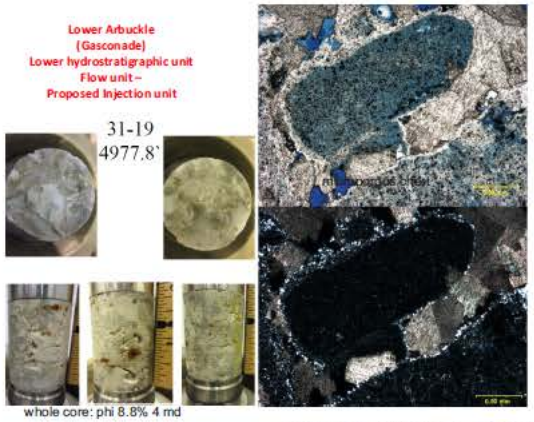


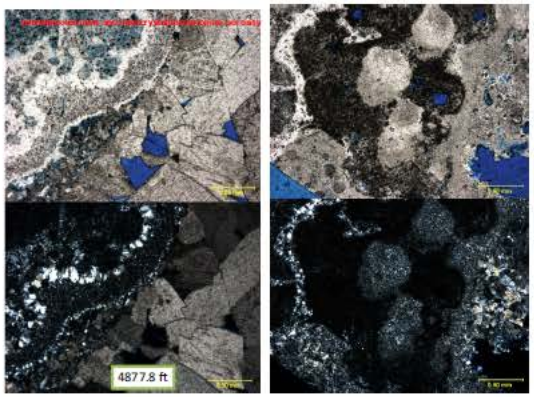


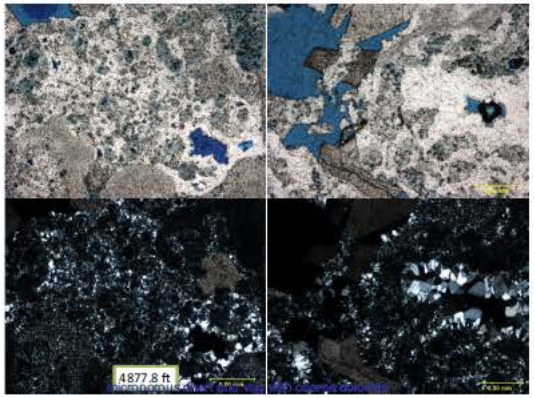


Considerable variation in pore types available to react with the CO_2

Lower Arbuckle Injection Zone







Pairs of photomicrographs
Plane light and crossed nichols

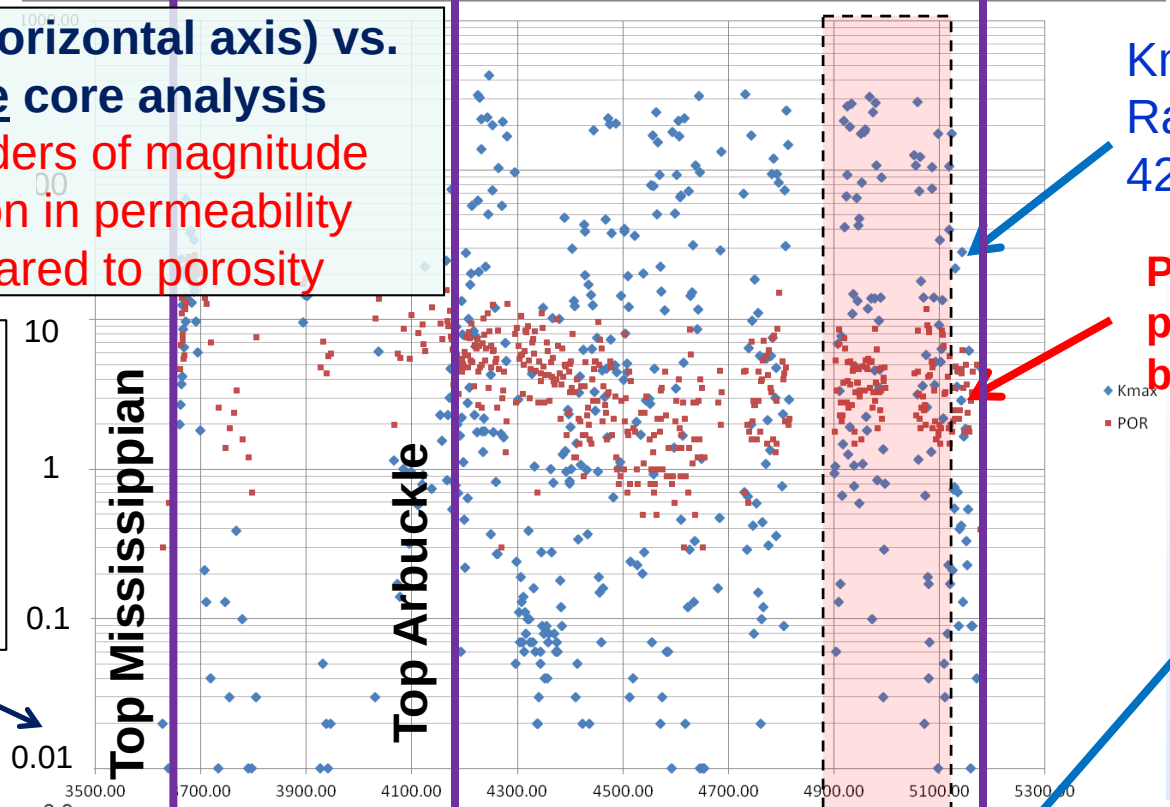
R. Barker, S. Datta, KSU

Depth (horizontal axis) vs. <u>whole</u> core analysis
- 4.5 orders of magnitude variation in permeability compared to porosity

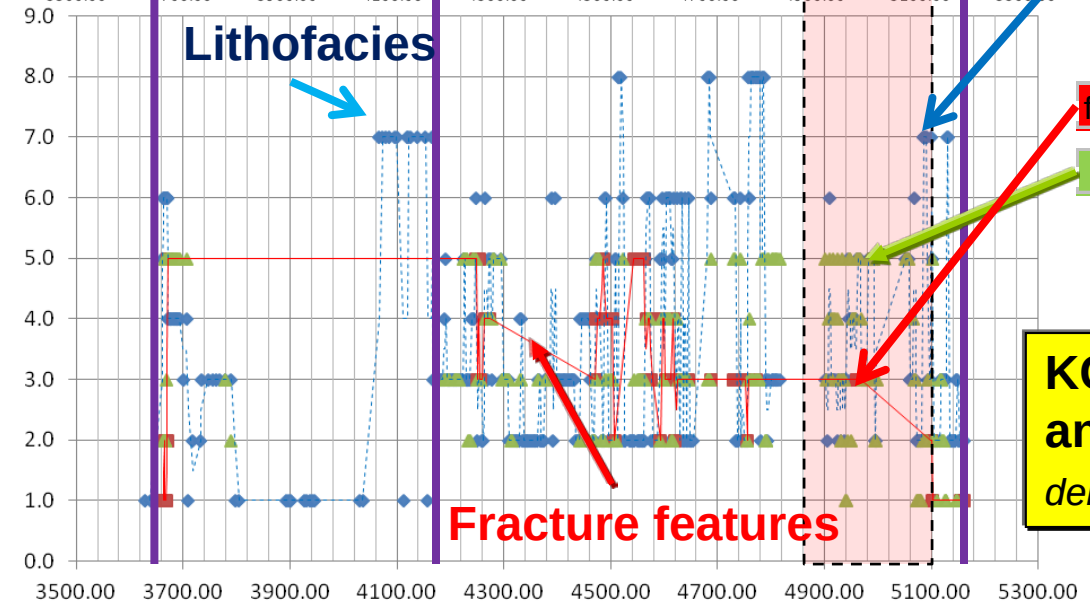
Kmax
Ranges from 0.01 to 425 md (whole core)

Porosity – predominately between 1-10%

Minimum k reported as <0.01 md, but accuracy of measurement down to 0.005 md (Weatherford)



<u>Lithofacies</u> --
Shale = 1
Mudstone = 2
Packstone= 3
Grainstone = 4
Incipient breccia = 5
Breccia =6
Sandstone = 7
Microbialite = 8



fractures (1-5, highest; 0, none)

Vugs (small to large, 1-5)

Lithofacies
Fractures
Vugs

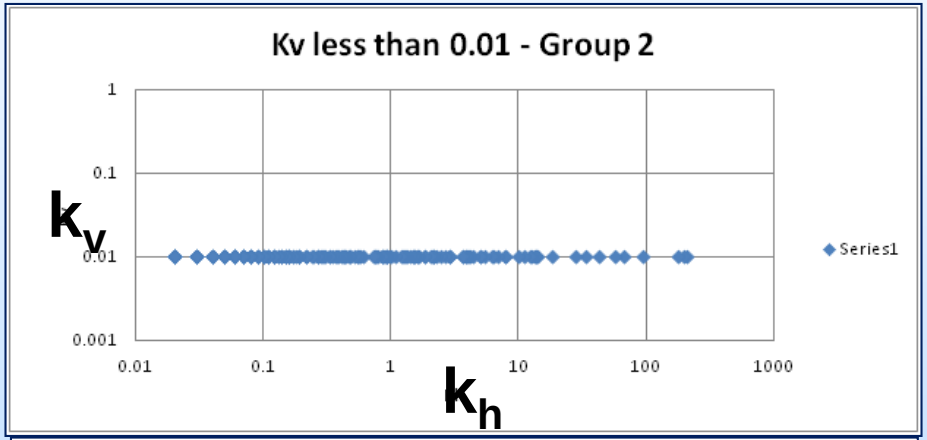
KGS #1-32 whole core analysis *compared to core derived lithofacies* ***N = 480***

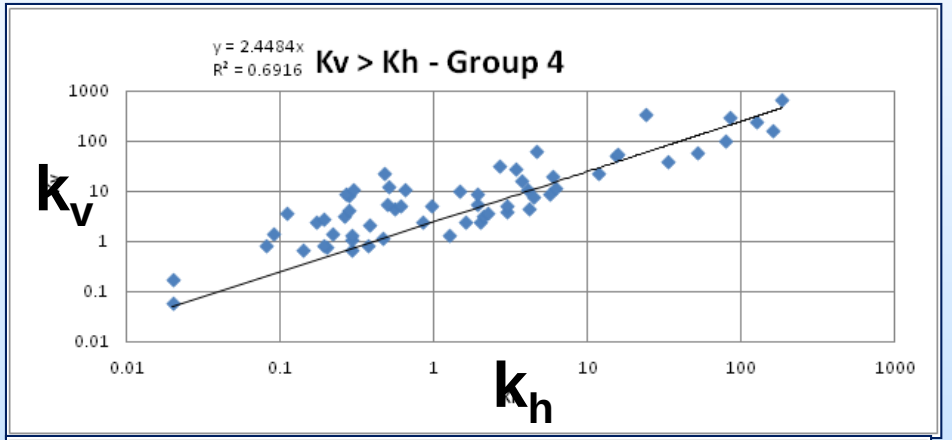
Correlations Between K_v and K_h Obtained From Whole Core Analysis & Five *Petrofacies* Groups

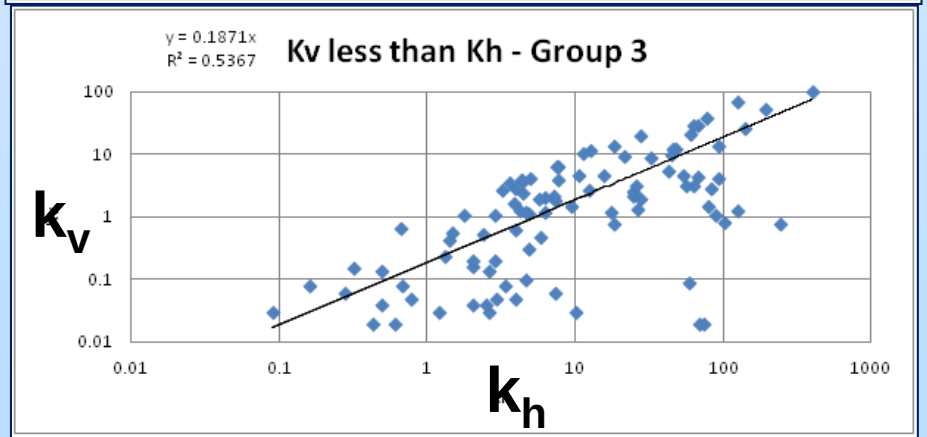
(K_v necessary to model crossflow between flow units)

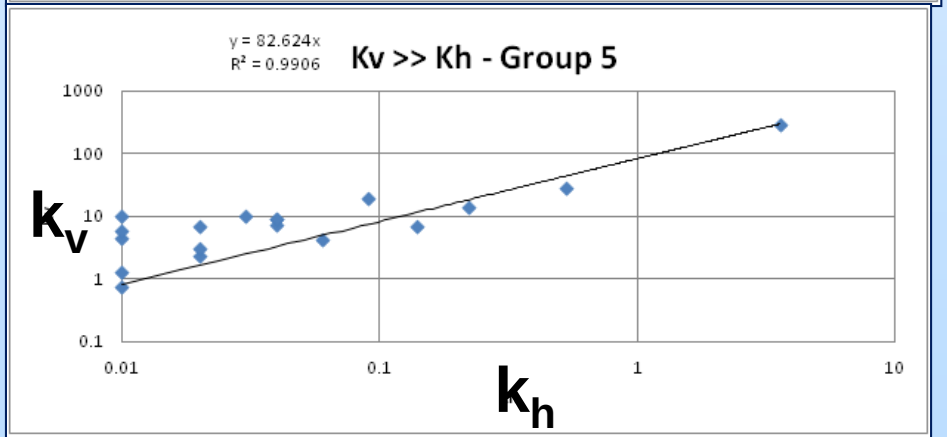
Group 1
There are 15 whole core samples in this group; both vertical and horizontal permeability are less 0.01 mD.

Mina Fazelalavi, KGS



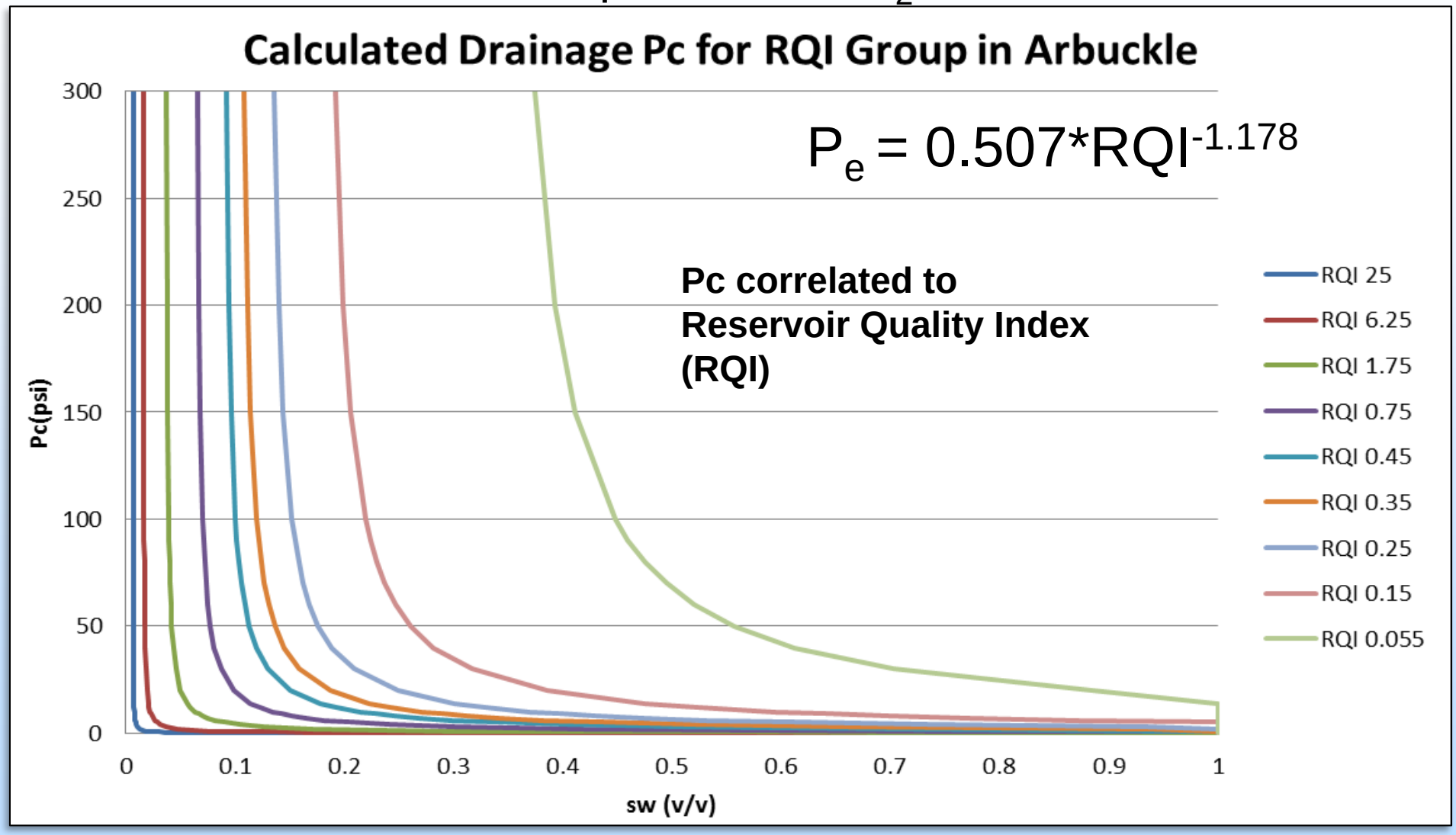






Range of Pore Types in Arbuckle Group

-- expressed by variations in capillary pressure profiles with supercritical CO_2



M. Fazelalavi, KGS

“TRIPLE COMBO” PERMEABILITY -- REALIZATIONS FROM MODERN LOGS OF TYPE WELLS USING NEURAL NETWORK

RHOmaa and Umaa were not found to contribute significantly to permeability prediction, although they suggest that chertier dolomites tend to be more permeable than dolomites. However, gamma-ray, porosity, resistivity were useful as predictors, and so the model input requirements are from a basic triple combo well log suite common in Type Well Database:

1. **GR (Gamma-ray, API units)**
2. **PHIt (volumetric porosity%)**
3. **PHIr (connected porosity estimated from resistivity log %)**

PHIDensity = (2.71 - RHOB[]) / (2.71 - 1)

Rwa = (((PHID[]+PHIN[])/2)^2)*(ResDeep[]/1)

PHIr = (Rwa[]/ResDeep[])^.5

Doveton, KGS

Comparison of k_h permeability in validation well (Wellington KGS #1-28) using neural network with different numbers of nodes in the hidden layer

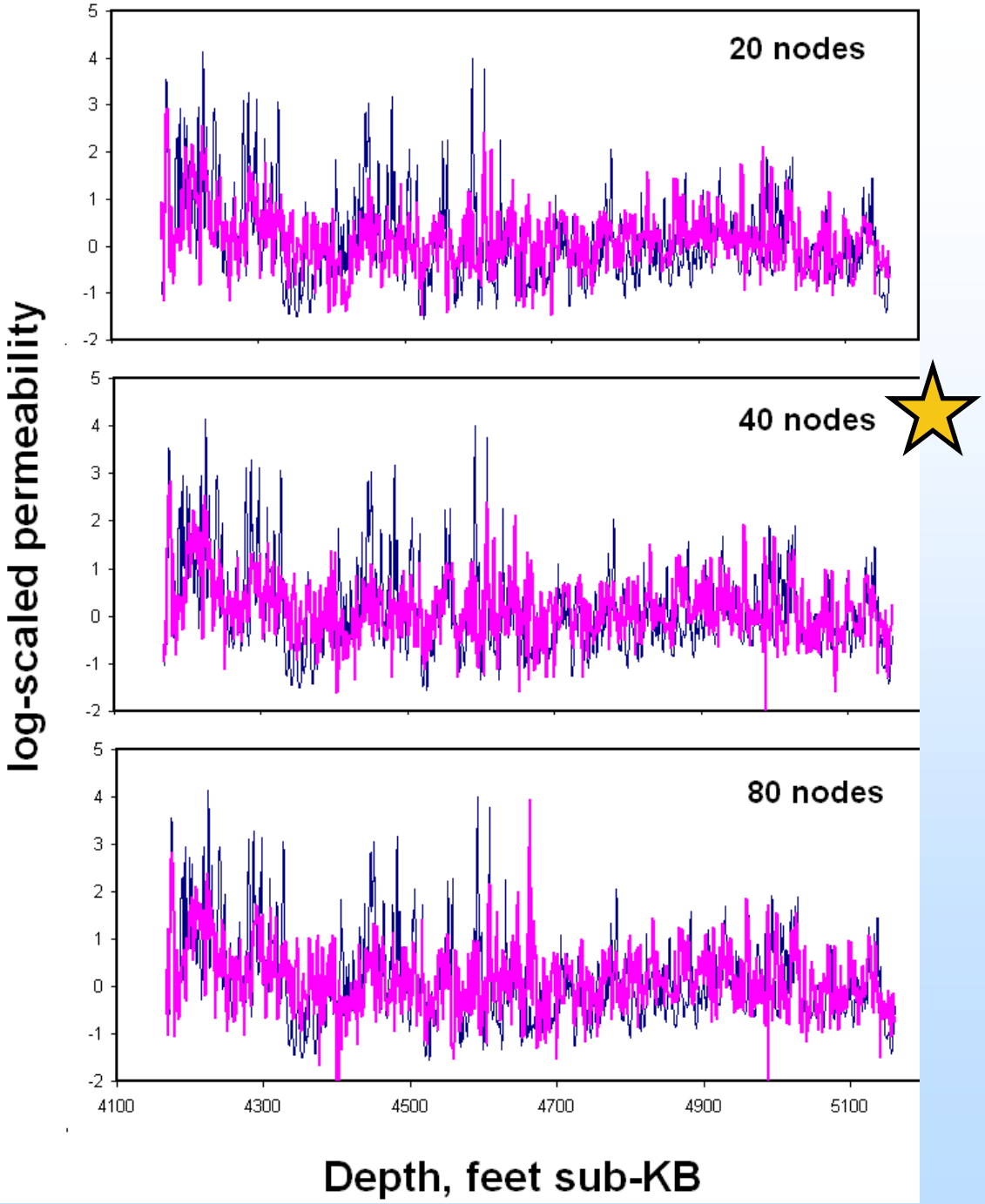
core-log calibrated (with Swir & Φ_e from NMR)

$$k = 1014\left[\frac{a}{S_{wir}\phi_e} + b\right]^2 \frac{\phi_e^3}{(1-\phi_e)^2}$$

predicted

Swir = irreducible water saturation

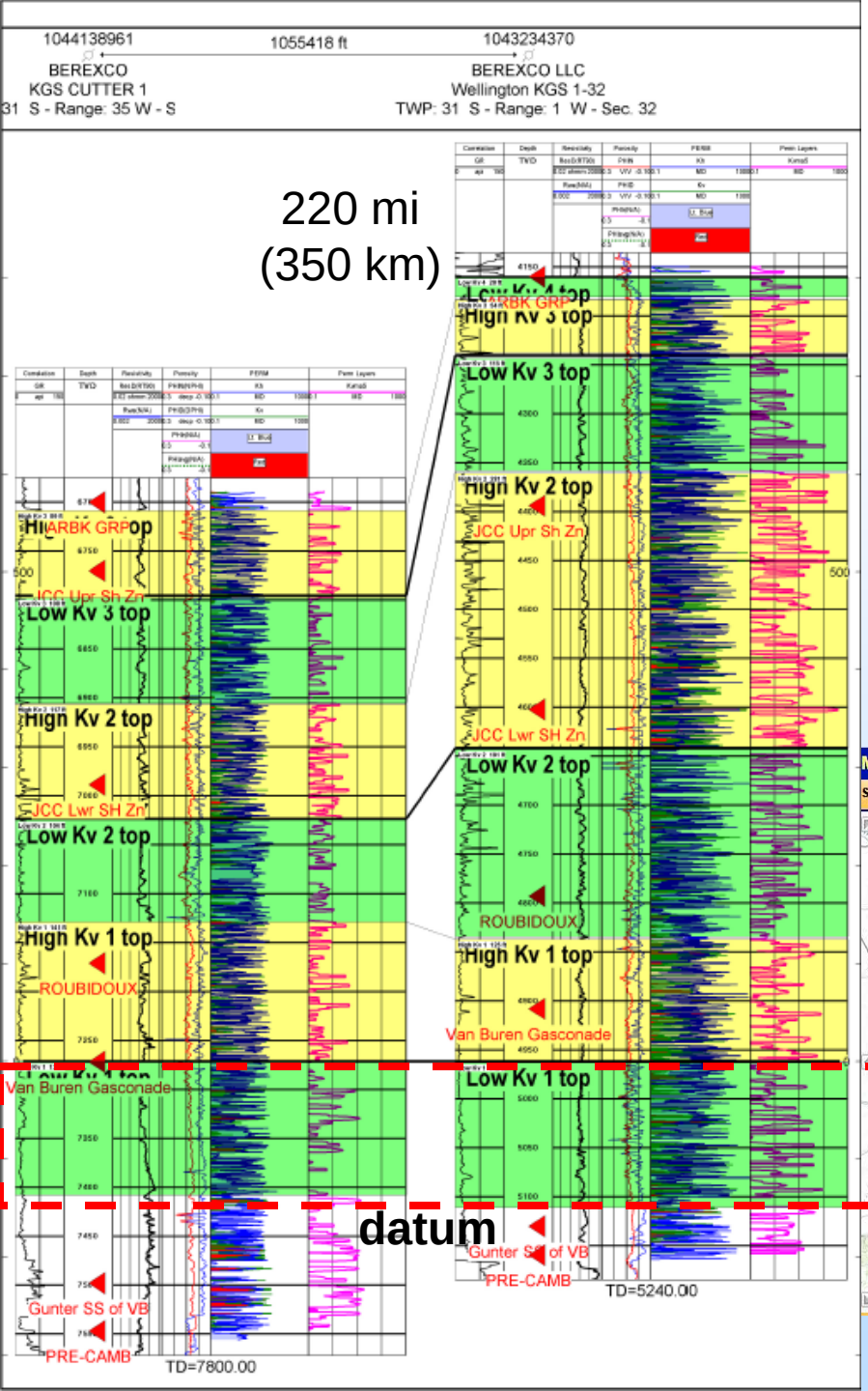
Φe = effective porosity via NMR

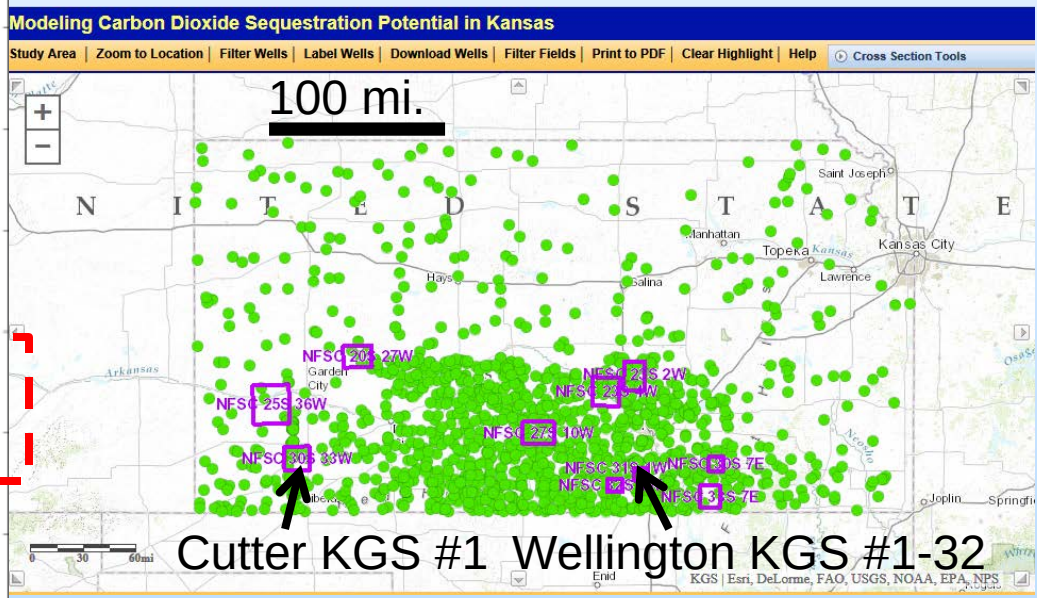


Doveton, KGS

Flow units & computed Kh & Kv in Arbuckle Group extended to Digital Type Wells (•)

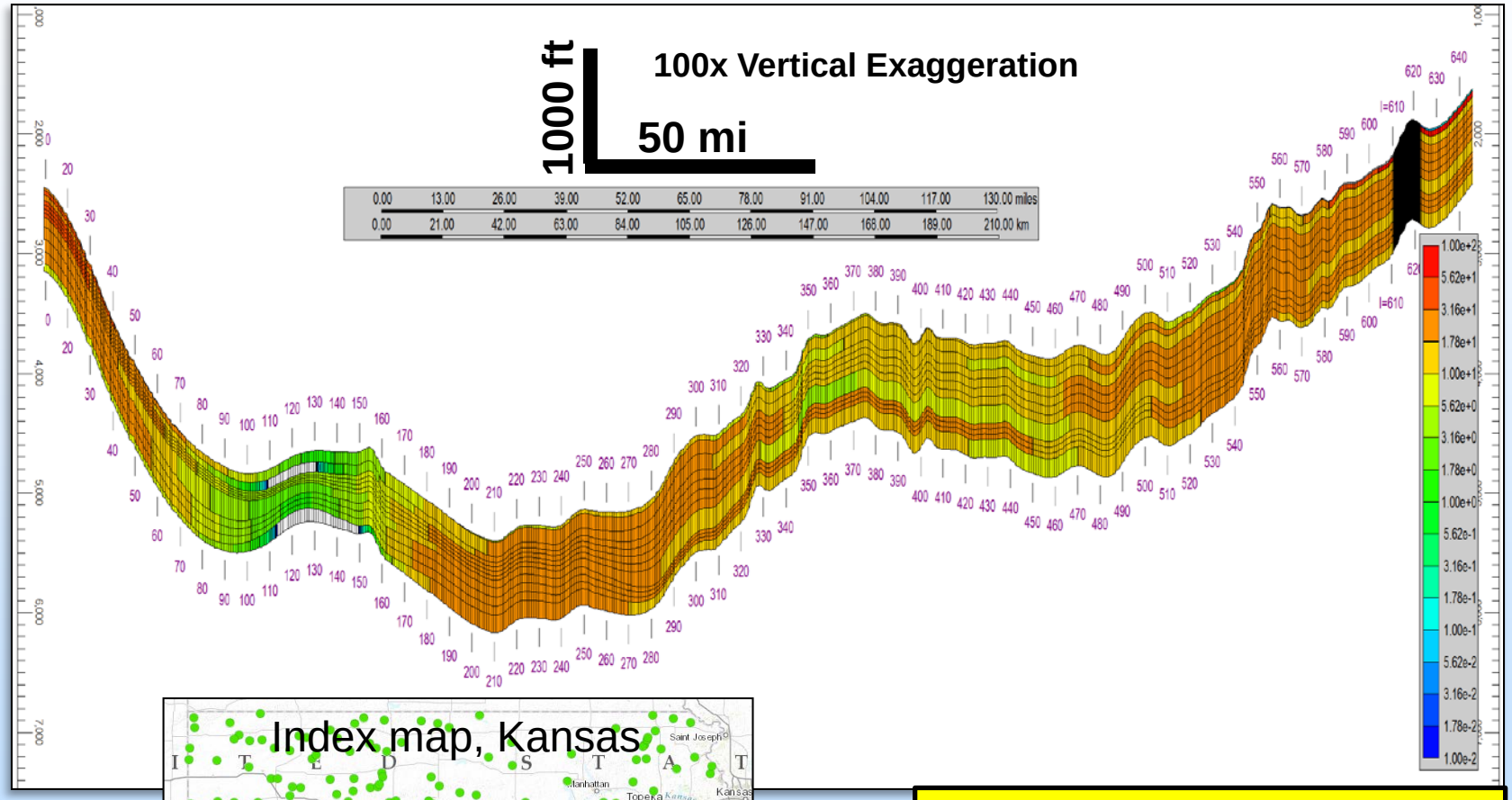
- Correlation of flow units
- cross section illustrating wells in Cutter and Wellington Fields (350 km)

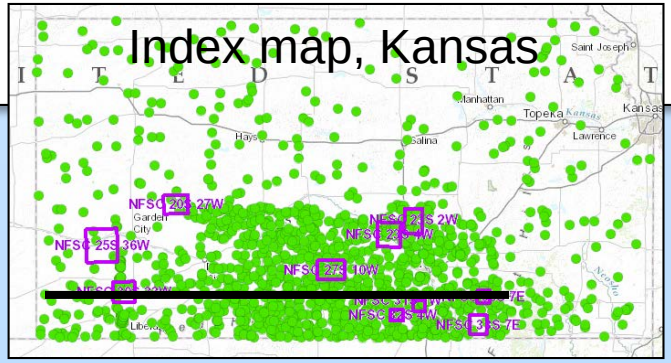




Gerlach, Williams, Fazelalavi, Doveton, KS CO_2

Structural cross section showing regional Arbuckle flow units, southern Kansas





Horizontal Permeability, md

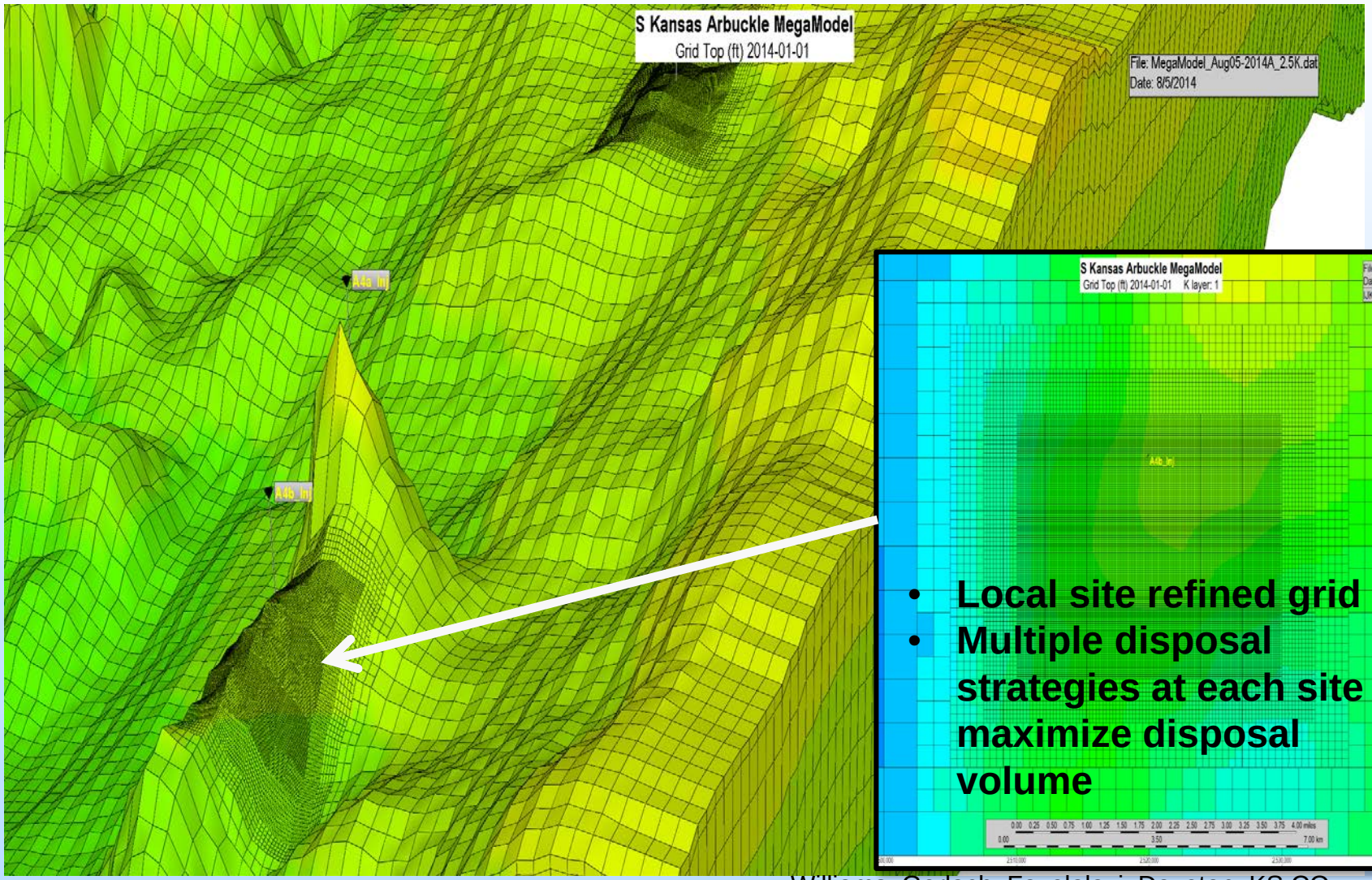
Williams, Gerlach, Fazelalavi, Doveton, KS CO_2

Utilization of refined models from 10 sites

local grid refinement, Site 4b, SE Kansas

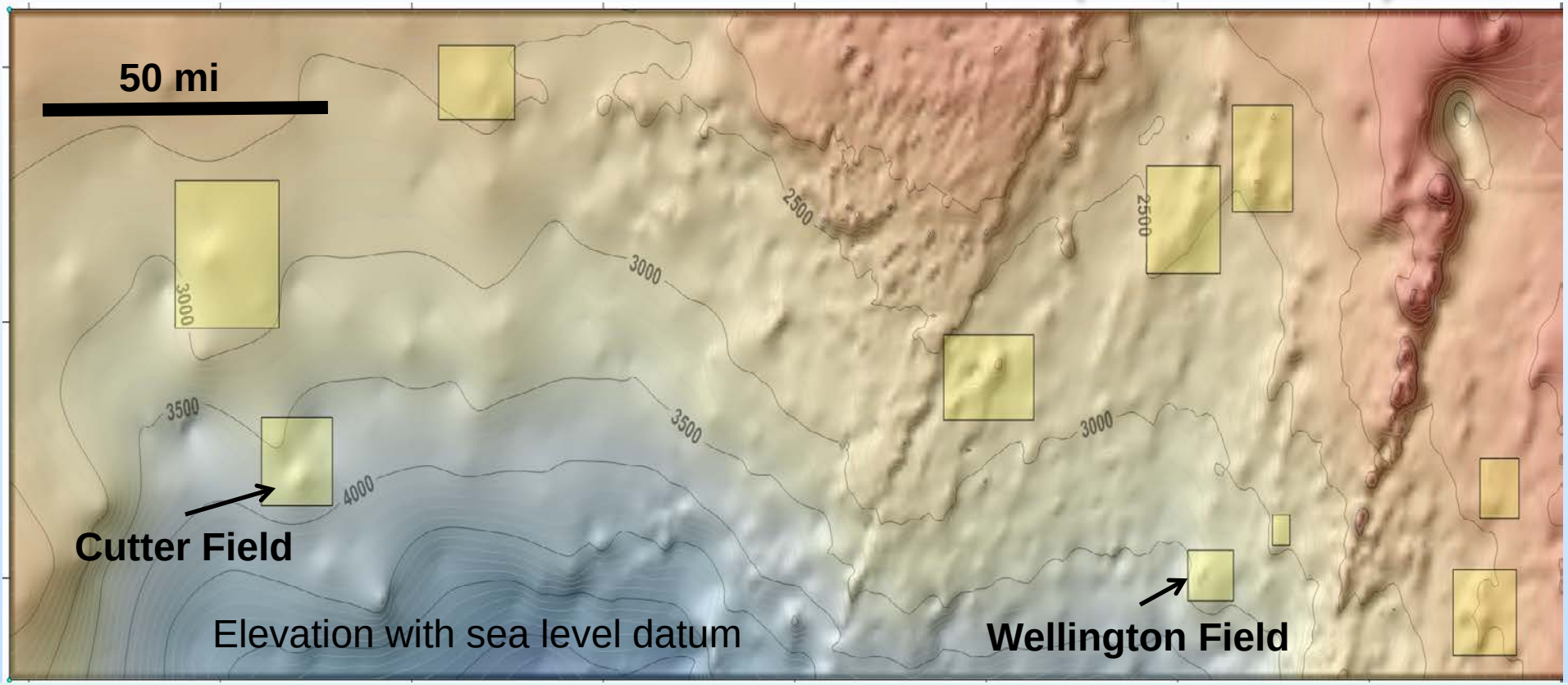
-- each of 10 sites analogous to Wellington and Cutter fields

-- structure with overlying oil field for infrastructure CO_2



MegaModel (simulation) and 10 regional sites for commercial-scale simulation

2nd generation CO_2 Storage Capacity Estimate of the Arbuckle in Southern Kansas (25,000 mi²)



- 10 local modeling sites (***yellow boxes***) including Cutter and Wellington fields
- Simulation of entire 25,000 mi² based calibration of key variables at Wellington and Cutter fields (flow units, Φ, kv, kh, Pc to sCO2,solubility and geochemistry)
- ***Predict CO_2 storage within ±30 percent***

Williams, Gerlach, Fazelalavi, Doveton, KS CO_2

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 -- COMPLETED
- KGS Milestone 2.4: Evaluate CO_2 Sequestration Potential of Arbuckle Group Saline Aquifer - Wellington field -- COMPLETED
- KGS Milestone 3.1: CO_2 sequestration & EOR potential - Wellington field – 98%
- KGS Milestone 3.2: Characterize leakage pathways - Risk assessment area -- COMPLETED
- KGS Milestone 3.3: Risk assessment related to CO_2-EOR and CO_2-sequestration -- COMPLETED
- KGS Milestone 3.4: Regional CO_2 Sequestration Potential - 33 Counties – 99%

Summary

- **Key findings**
  1. Final estimates of CO_2 P10 & P90 storage in the Arbuckle aquifer nearly completed using dynamic modeling at 10 regional sites and MegaModel spanning southern Kansas.
  2. Use of a petroleum reservoir approach to assessing regional storage should improve the estimation of geologic CO_2 storage capacity to within ±30%
  3. Testing and evaluations performed at calibration sites provided robust input for the regional models.
  4. Calibration was accomplished with multiple, independent methods that addressed the reservoirs at all scales.
  5. Approaches used by petroleum industry permitted extending key reservoir properties → vertical and horizontal permeability→ rational flow units → closely conforming with regional stratigraphic correlations.
  6. Our concept --- Studies of CO_2 storage focused on oil fields introduces commercial deployment in Kansas that will lead to additional carbon storage Kansas' thick underlying Arbuckle saline aquifer.

- **Future Plans**
  - Complete the final report.

Appendix

ORGANIZATIONAL STRUCTURE

Modeling CO_2 Sequestration in Saline Aquifer and Depleted Oil Reservoir to Evaluate Regional CO_2 Sequestration Potential of Ozark Plateau Aquifer System, South-Central Kansas

DOE project -- 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

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

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

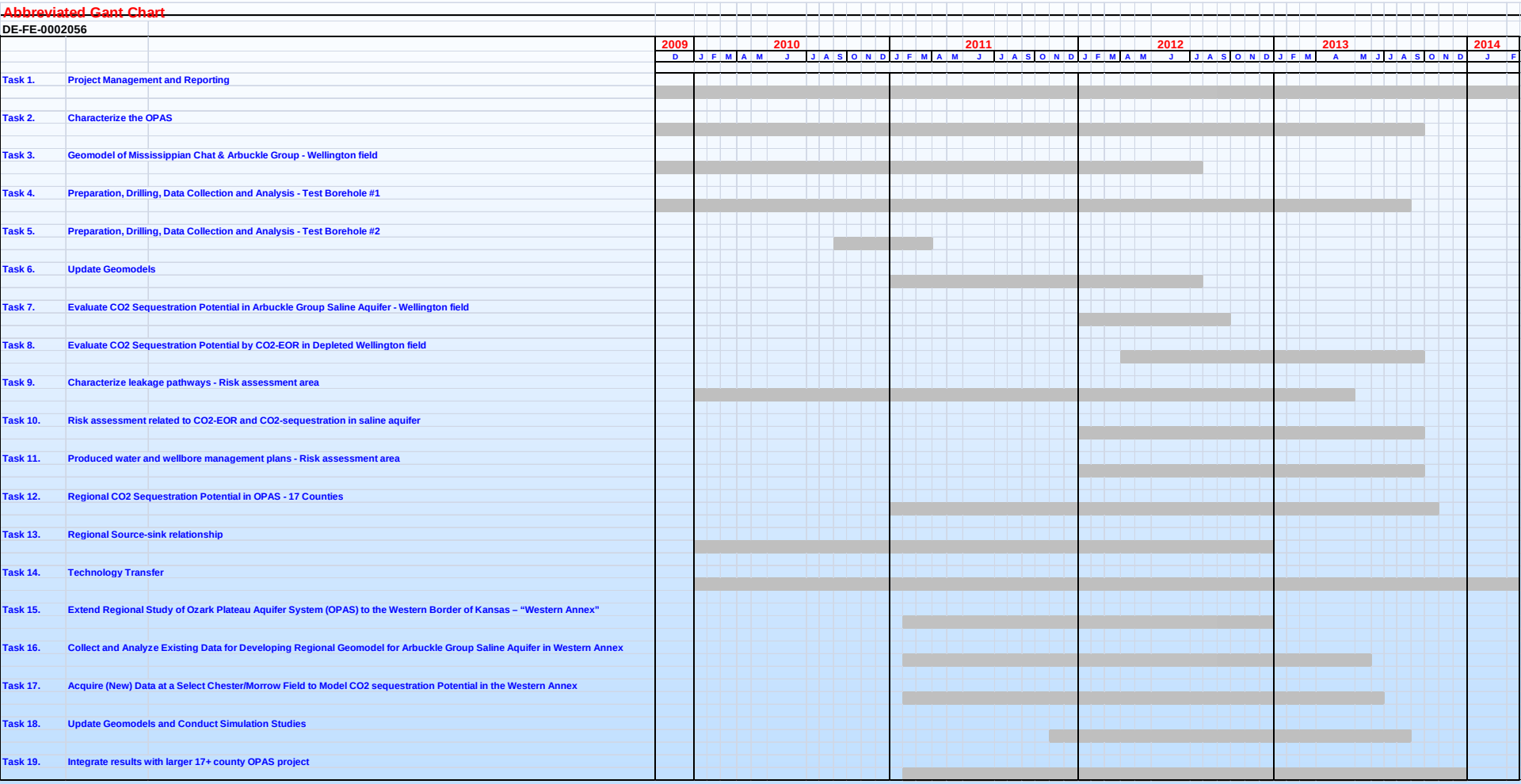
Bittersweet Energy, Inc., *Wichita, KS*

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

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 acquistion, interpret & design
Susan E. Nissen, *McLouth, KS* -- Geophysical Consultant, volumetic curvature
Lockhart Geophysical, *Denver, CO* -- acquis & 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

Gantt Chart


Abbreviated Gant Chart
DE-FE-0002056
2009
2010
2011
2012
2013
2014
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J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F
Task 1. Project Management and Reporting
Task 2. Characterize the OPAS
Task 3. Geomodel of Mississippian Chat & Arbuckle Group - Wellington field
Task 4. Preparation, Drilling, Data Collection and Analysis - Test Borehole #1
Task 5. Preparation, Drilling, Data Collection and Analysis - Test Borehole #2
Task 6. Update Geomodels
Task 7. Evaluate CO2 Sequestration Potential in Arbuckle Group Saline Aquifer - Wellington field
Task 8. Evaluate CO2 Sequestration Potential by CO2-EOR in Depleted Wellington field
Task 9. Characterize leakage pathways - Risk assessment area
Task 10. Risk assessment related to CO2-EOR and CO2-sequestration in saline aquifer
Task 11. Produced water and wellbore management plans - Risk assessment area
Task 12. Regional CO2 Sequestration Potential in OPAS - 17 Counties
Task 13. Regional Source-sink relationship
Task 14. Technology Transfer
Task 15. Extend Regional Study of Ozark Plateau Aquifer System (OPAS) to the Western Border of Kansas – "Western Annex"
Task 16. Collect and Analyze Existing Data for Developing Regional Geomodel for Arbuckle Group Saline Aquifer in Western Annex
Task 17. Acquire (New) Data at a Select Chester/Morrow Field to Model CO2 sequestration Potential in the Western Annex
Task 18. Update Geomodels and Conduct Simulation Studies
Task 19. Integrate results with larger 17+ county OPAS project

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 Cochrans 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