

# CO<sub>2</sub> Sequestration Illinois Basin Coal

## MGSC Update

presented by  
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Midwest Geological  
Sequestration Consortium  
[www.sequestration.org](http://www.sequestration.org)



# Acknowledgements

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- The **MGSC** is a collaboration led by the geological surveys of Illinois, Indiana, and Kentucky



# CO<sub>2</sub> Injection into One Coal

Purpose: To determine the CO<sub>2</sub> injection and storage capability, and the ECBM recovery potential of Illinois Basin coal

- Drill injection and multi-monitor well project, obtaining coal cores for extensive analyses
- Simulation of CO<sub>2</sub> injection with COMET
- Water Injection PT Tests
- 40 to 80 Day CO<sub>2</sub> Test- Injection of up to 700 tons of CO<sub>2</sub> with 60 day soak

# Coal and Coal Gas Properties to be Measured Prior to CO<sub>2</sub> Injection

- Gas Content
- Coal Gas Composition
- Coal Gas Isotopic Composition
- Adsorption Isotherms- CH<sub>4</sub>, N<sub>2</sub>, and CO<sub>2</sub>
- Thermal Maturity and Maceral Composition
- Moisture
- Permeability
- Fracture Gradient

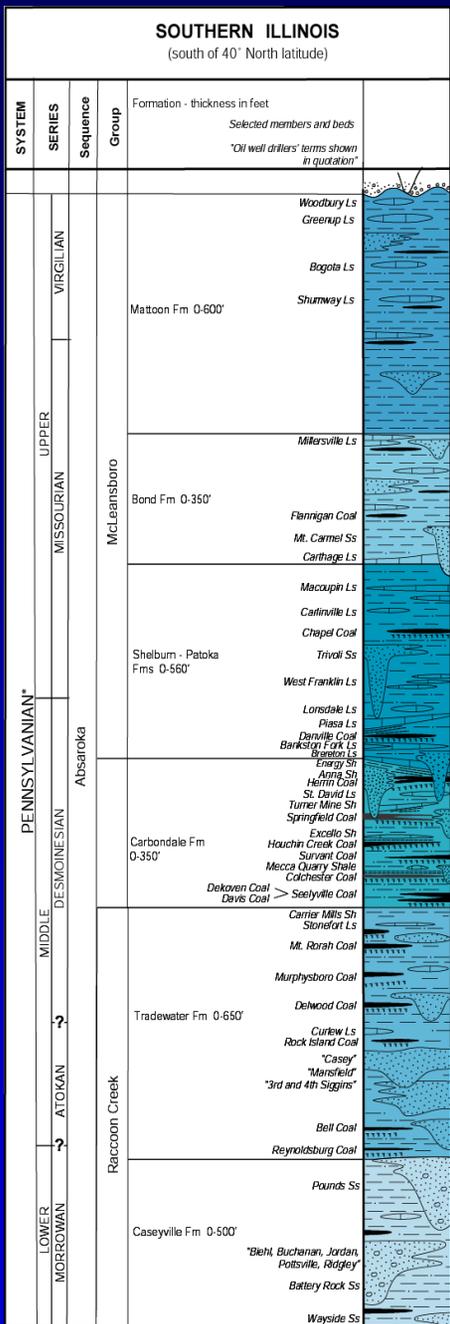
# CO<sub>2</sub> Logistics

- Liquid CO<sub>2</sub> brought to site by semi- 20 tons/load
- Downloaded to 50 ton capacity temporary storage unit
- Skid mounted CO<sub>2</sub> pump, heater and delivery system- convert to gas phase
- Gas phase injected down well

# MMV

(monitor, mitigation and validation)

- Prior to, during and after injection, ISGS will monitor for any CO<sub>2</sub> leaks.
- Soil gas and shallow groundwater monitoring holes.
- Monitor on-site temporary storage tank and well delivery equipment for leaks to atmosphere.
- High resolution multi-spectral air photos before and after injection to look for vegetative stress.

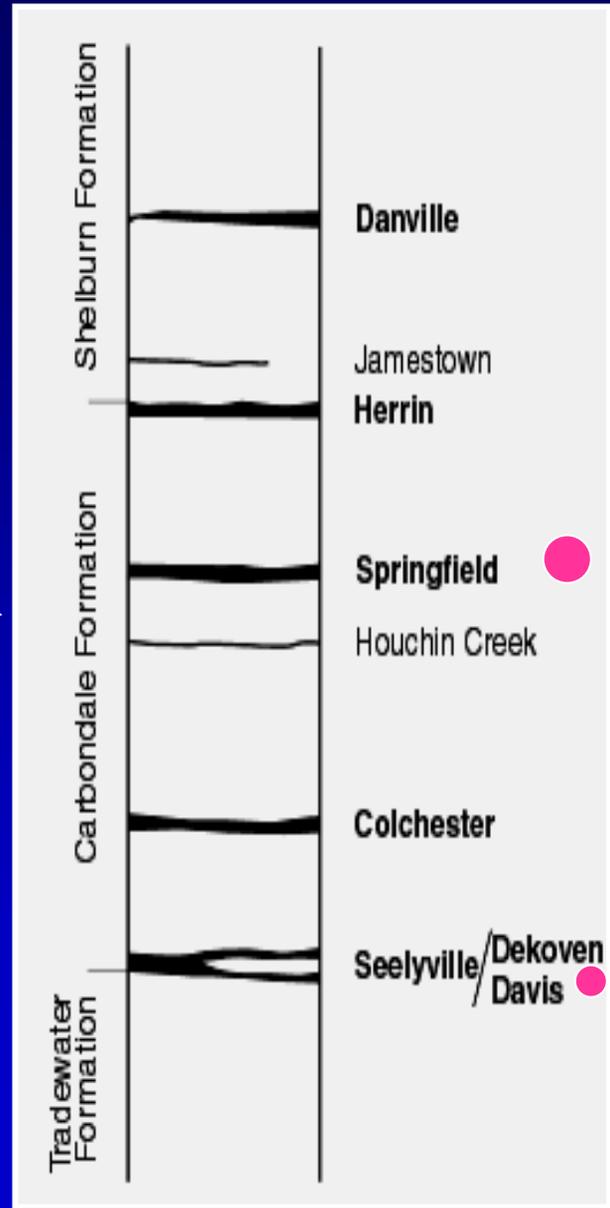


# Illinois Pennsylvanian Rocks

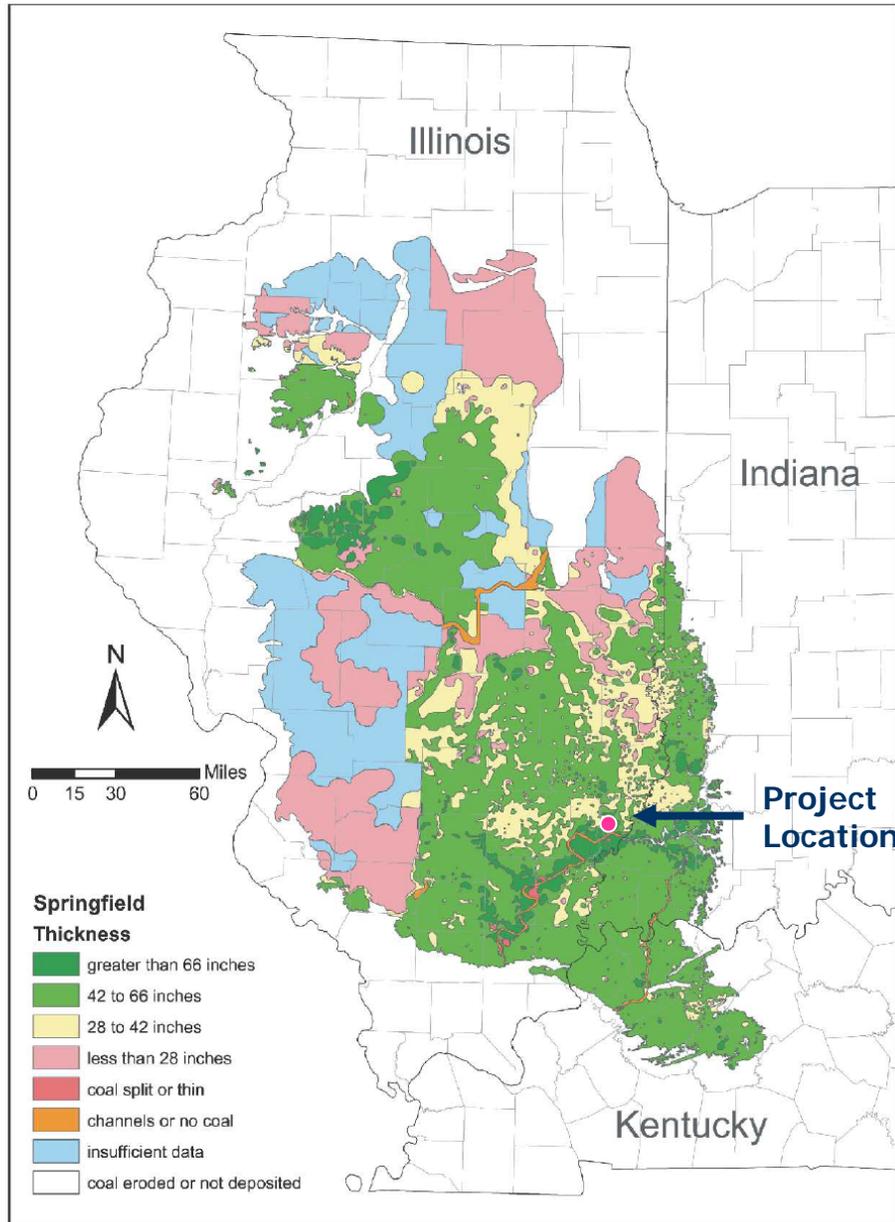
Shale Seals Throughout

Major Coal Gas/CO<sub>2</sub> Injection Targets

Principal Coal Gas Targets



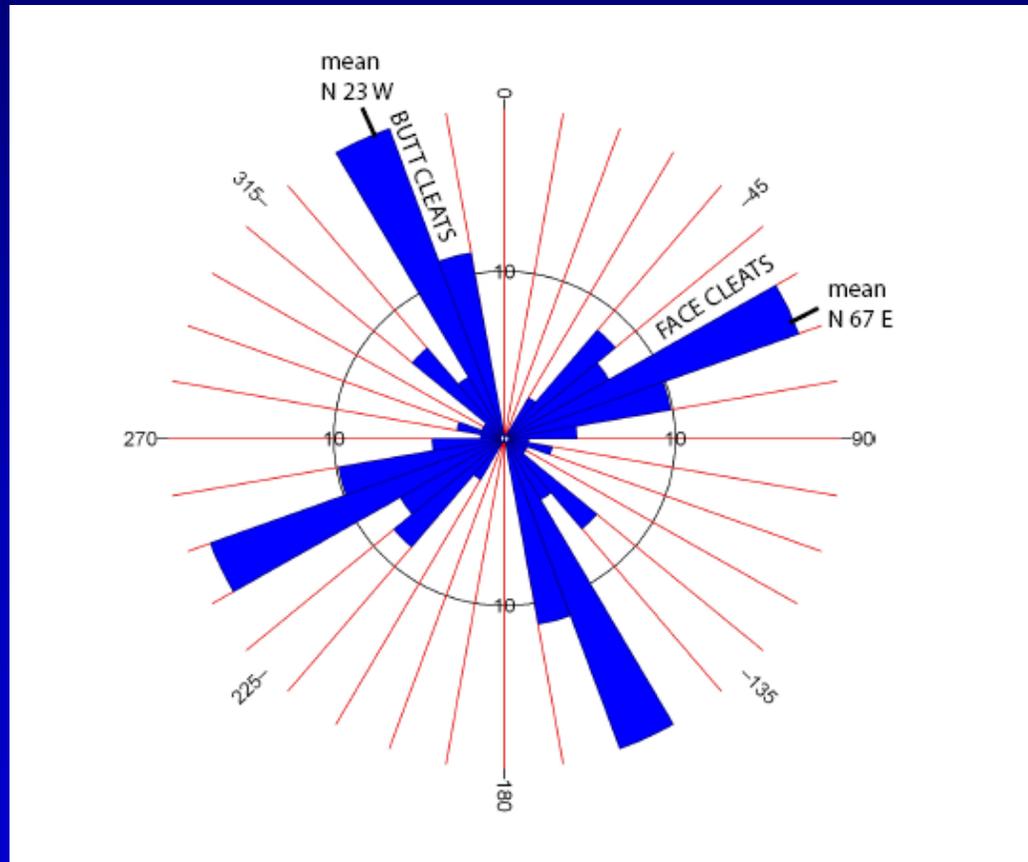
## Thickness of the Springfield Coal



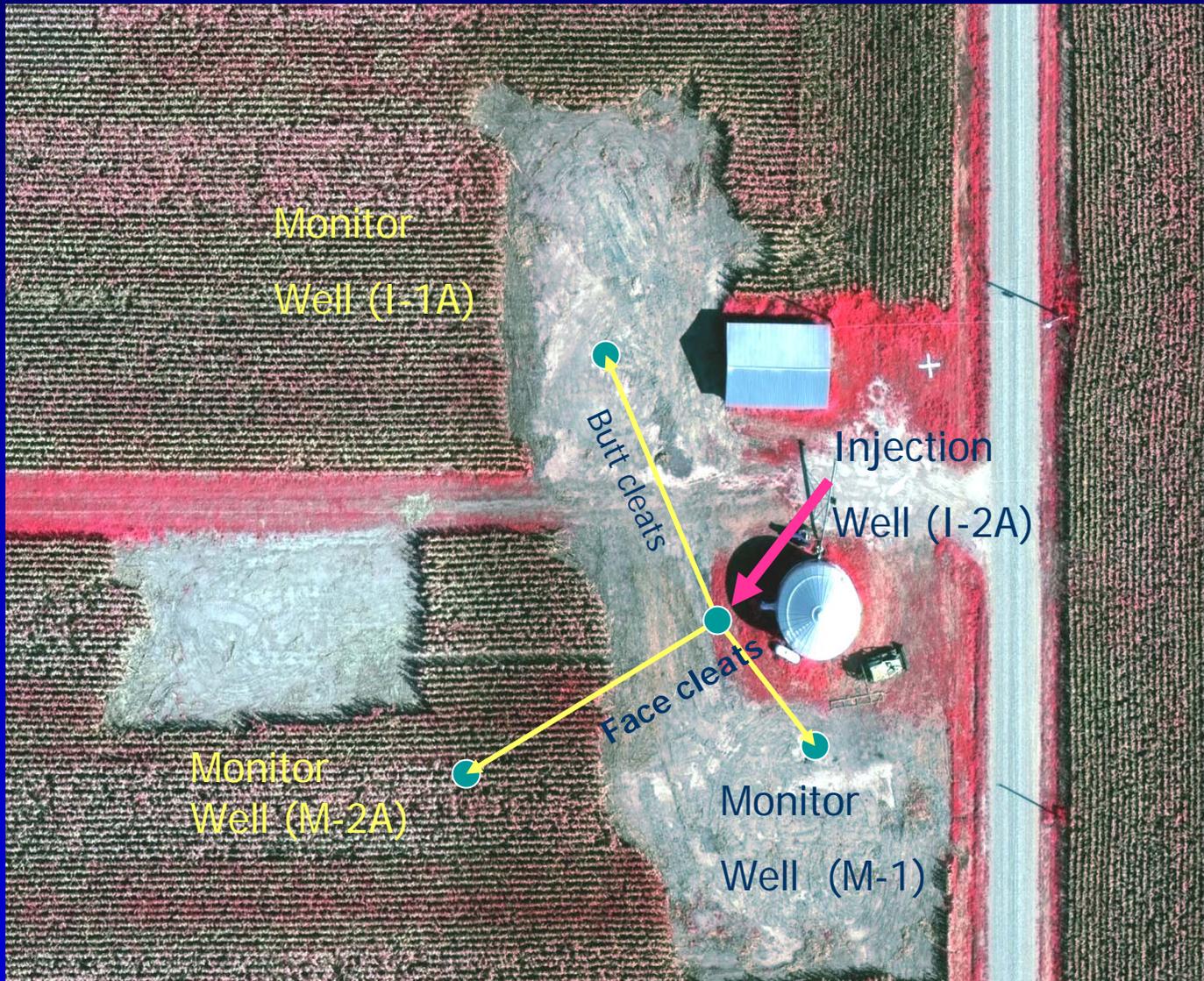
**7ft thick  
Springfield  
Coal**

5 miles east of Albion,  
IL in Wabash County

# Springfield Coal Cleat Orientations at Wabash Mine, 6 miles SE



# CO<sub>2</sub> Injection into Coal Tanquary Farm Site Western Wabash County, Illinois



# Tanquary Farm Injection Site



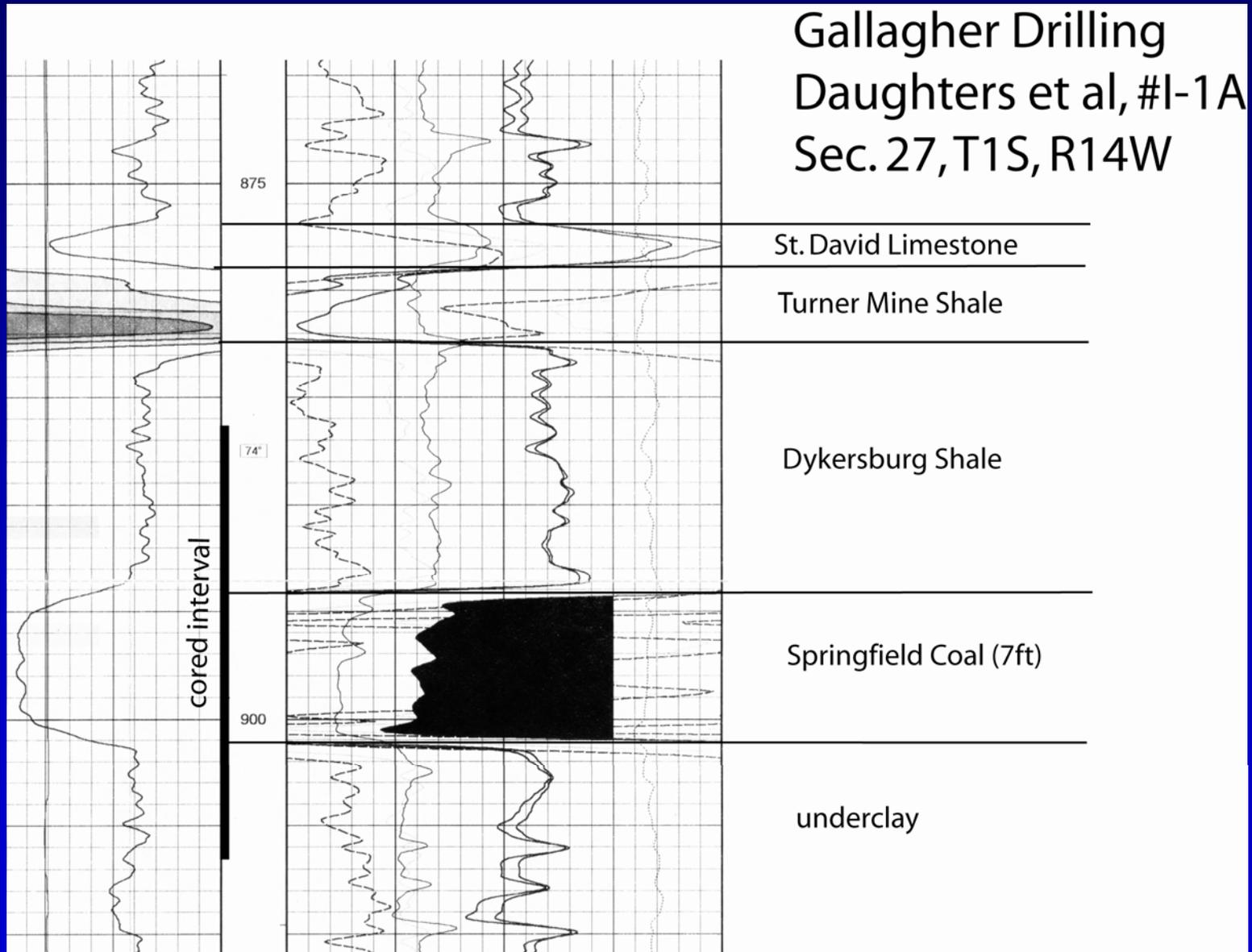
# Coal Formation Tops from GR-Den-Neutron Log

Gallagher Drilling, L.P. Daughters et al #I-1A

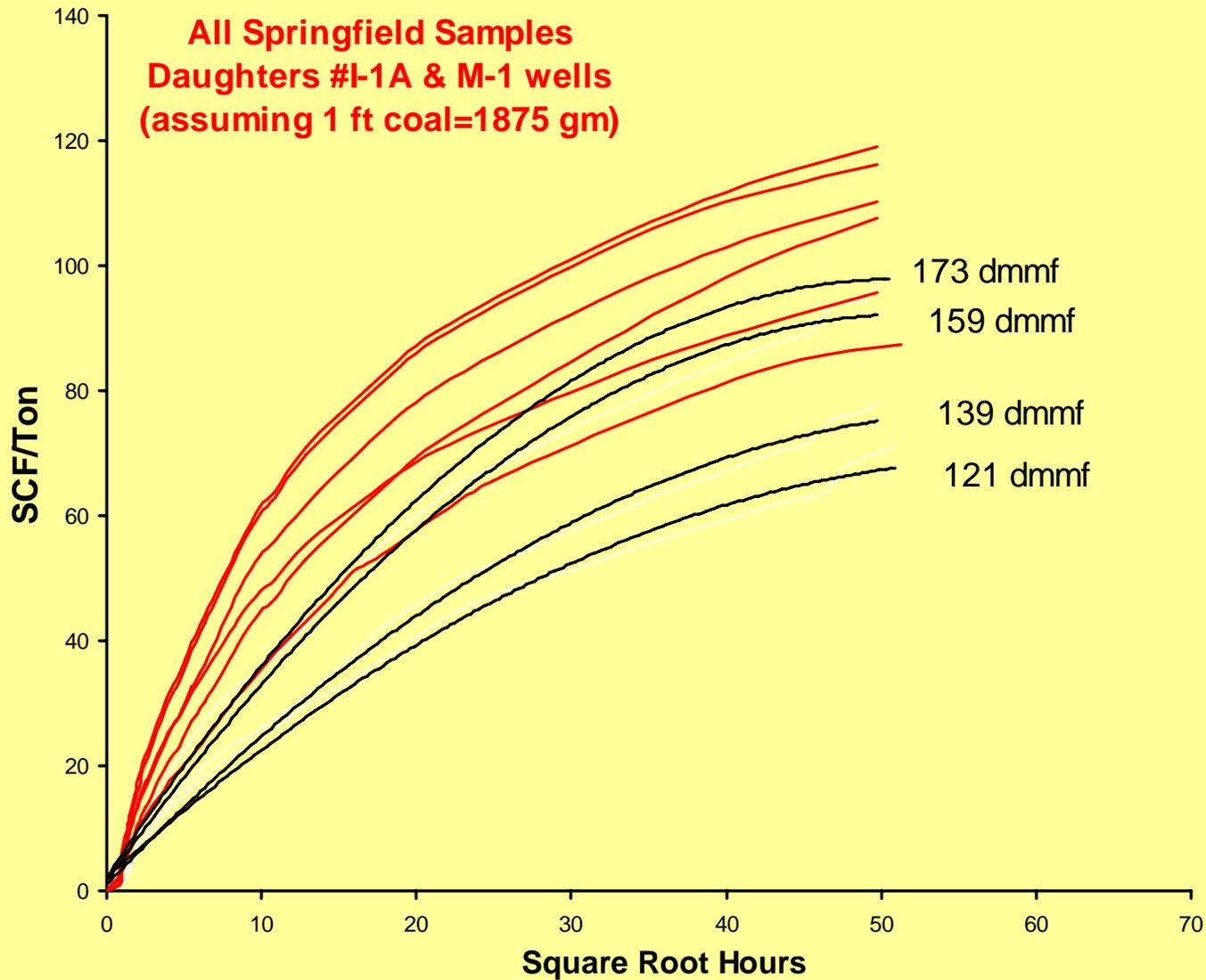
NW Sec 27, T1S, R14W, Wabash Co. IL

<b>Coal</b>	<b>Top</b>	<b>Base</b>	<b>Net Coal</b>	<b>Canister Samples</b>
Danville	759	762.6	3.6	3
Herrin	787.5	792.6	5.1	4
Briar Hill	856.5	858.6	2.1	0
Springfield	894.2	901.2	7	5
Houchin Creek	999	1001.8	2.8	2
Survant	1008.6	1010	1.4	0
Colchester	1069	1070	1	0
Seeleyville	1142.5	1148.7	6.2	4
	<b>Net Coal</b>		<b>29.2</b>	<b>18</b>

# Springfield Coal, Principal Target



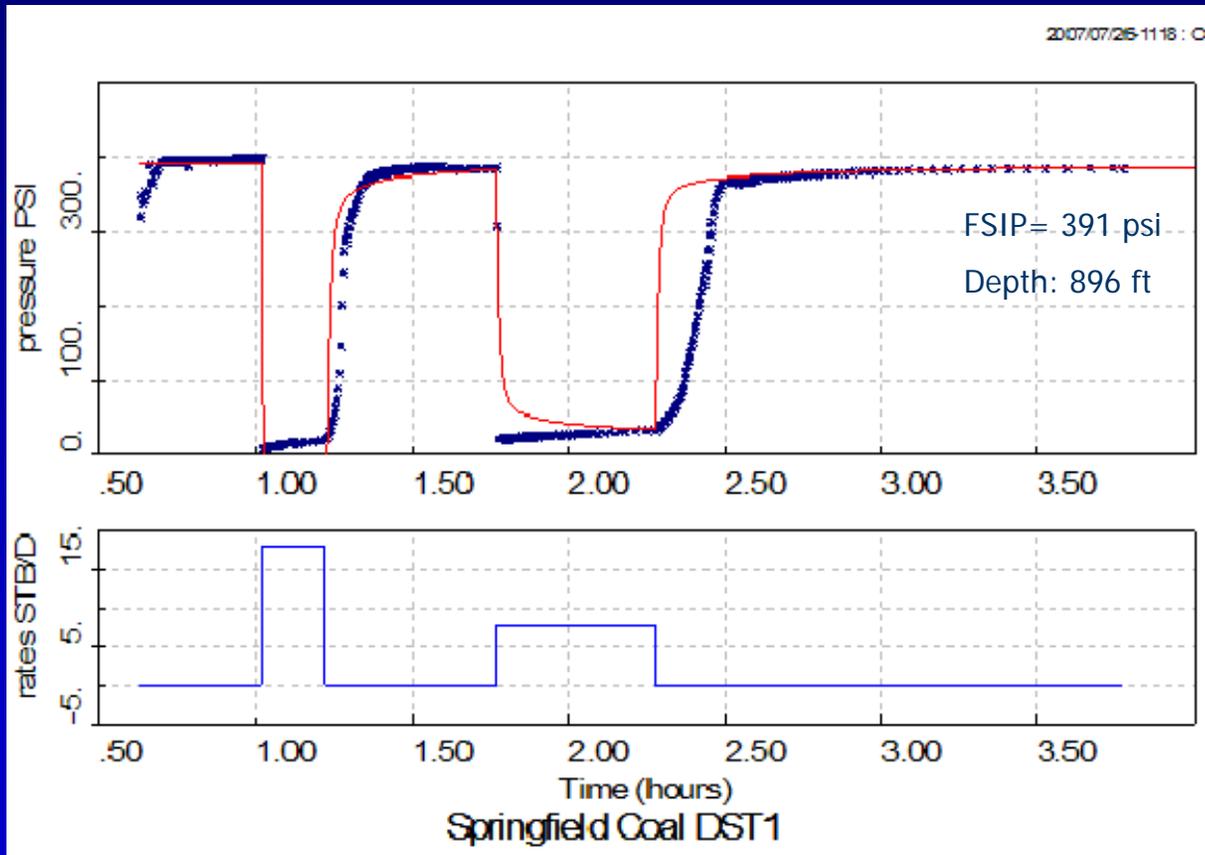
# CBM Desorption Projection Curves



# Normalized Air-Free Desorbed Gas Composition (vol %)

<b>Well</b>	<b>Interval</b>	<b>Depth</b>	<b>H<sub>2</sub></b>	<b>N<sub>2</sub></b>	<b>CO<sub>2</sub></b>	<b>CH<sub>4</sub></b>	<b>C<sub>2+</sub></b>
I-1A	Springfield Coal	895.5		8.89	2.62	88.43	0.07
I-1A	Springfield Coal	896.5		2.73	1.59	95.63	0.04
I-1A	Springfield Coal	897.5		4.70	1.57	93.69	0.04
I-1A	Springfield Coal	898.5	0.07	6.90	1.42	91.57	0.04
I-1A	Springfield Coal	901.5		7.09	1.39	91.49	0.03
M-1	Springfield Coal	900.5		2.72	1.69	95.56	0.03

# Springfield Coal DST in I-1A Well



Perm: 6.8 md

Skin: 9.1

Coal Pressure  
= Hydrostatic

# Pulse and Injection/Fall-off Tests

- Tests run in and between the initial two wells
- Step-rate injection tests indicated that the coal frac pressure was 900 psi. Frac gradient ~ 1.0 psi/ft
- Injection/Fall-off tests indicated permeability of <10 md, similar to DST derived perm.
- Pressure communication between wells was demonstrated by pulse tests
- Conclude from COMET modeling that we have to reduce well spacing to 100 feet to ensure significant gas saturation detectable in monitor wells.
- Anticipate CO<sub>2</sub> injection rate of up to 20 tons/day

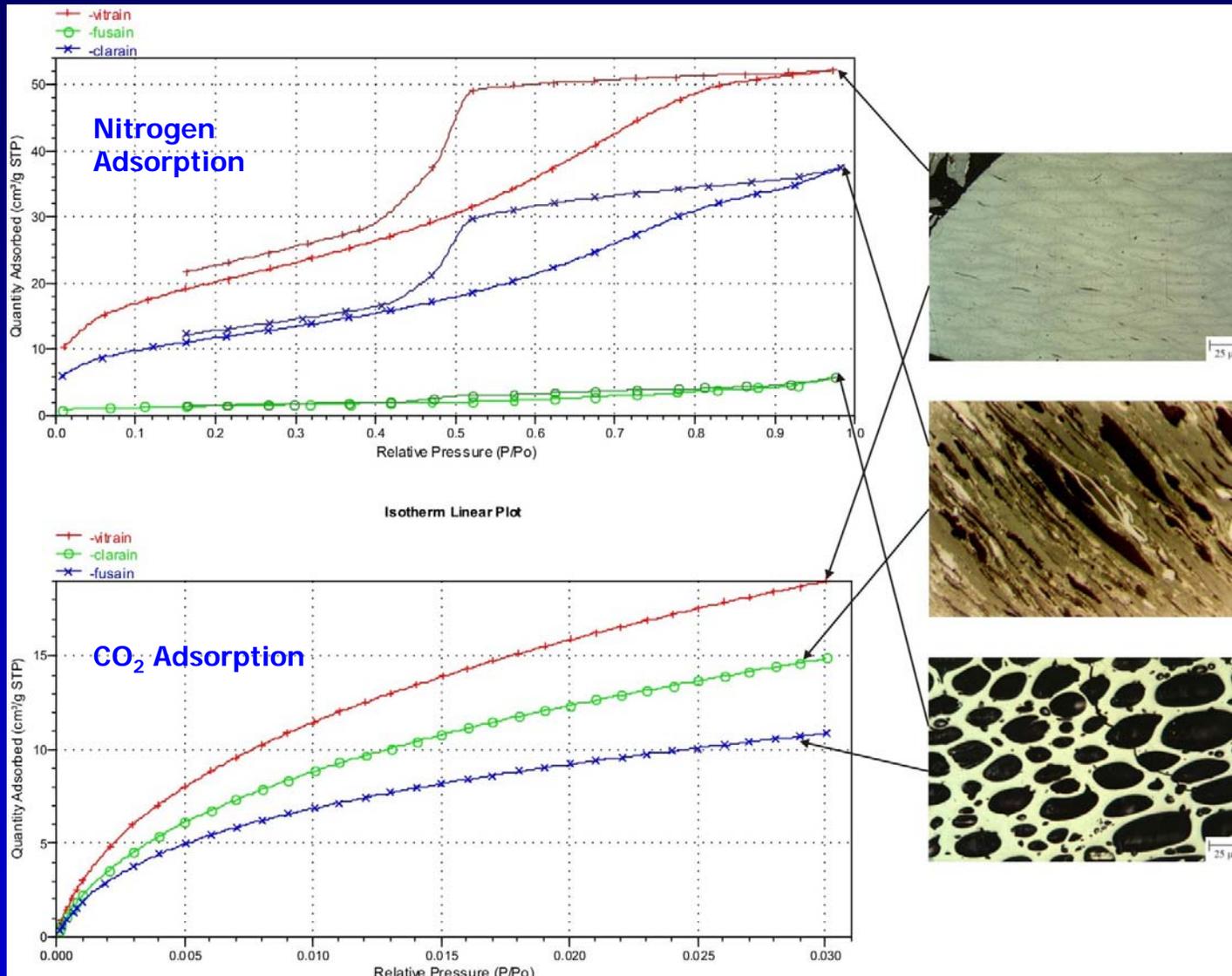
# Present Project Status

- Two wells drilled, cored, DST, logged and cased
- Core to IGS, SIU and ISGS for lab analyses
- PTA and pulse tests completed in October to better measure permeability. These results and our COMET modeling guided us to locate the final wells to better ensure that we will see CO<sub>2</sub> at our monitor wells within the injection period of 40-80 days.
- Drilling final coal wells anticipated in December or January
- Install MMV soil gas and groundwater monitor wells to collect background data once all the coal wells drilled
- CO<sub>2</sub> injection scheduled for May 2008

Laboratory research at SIU and IGS is being conducted to assist in the field demonstration project. The main emphasis of the research is on:

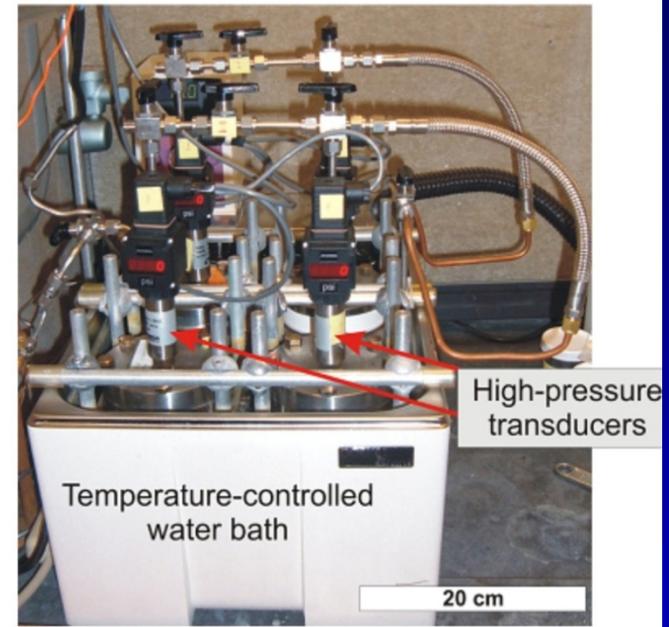
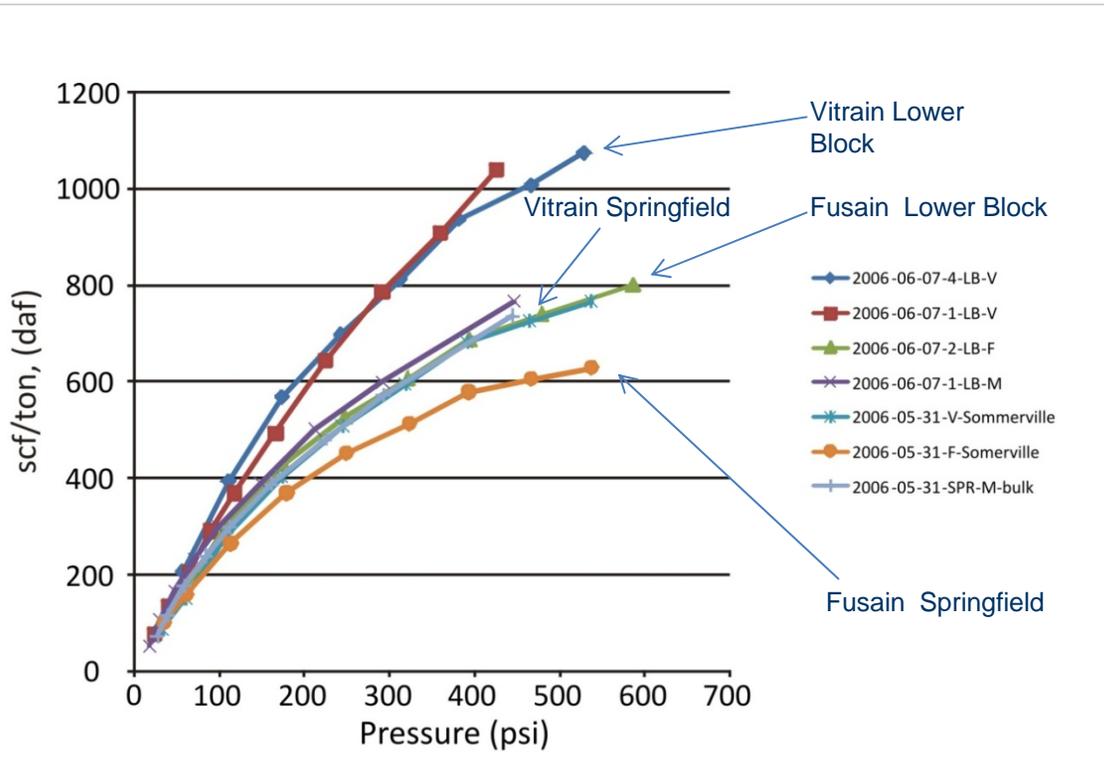
- 1) Understanding changes in mesopore and micropore characteristics (surface area, volumes, and size distribution) as a result of CO<sub>2</sub> adsorption (IGS).**
- 2) Investigating the influence of maceral composition on the CO<sub>2</sub>-adsorption derived changes in the coal (IGS)**
- 3) Determining the extent of swelling of the coal as a result of CO<sub>2</sub> adsorption or shrinkage of the coal with CH<sub>4</sub> desorption (SIU)**
- 4) Determining the CH<sub>4</sub>, N<sub>2</sub>, and CO<sub>2</sub> adsorption isotherms of the Springfield and Seeleyville coals (SIU)**

# Coal lithotypes vary with regard to gas adsorption



**At low pressure** conditions (up to 700mmHg) vitrain adsorbs the most nitrogen and CO<sub>2</sub> and fusain the least nitrogen and CO<sub>2</sub>

# Carbon dioxide adsorption capacity



Volumetric high pressure absorption apparatus

**At high pressure** conditions (up to 600 psi) vitrain adsorbs the most CO<sub>2</sub> and fusain adsorbs the least CO<sub>2</sub>. Moreover, the adsorption of a single lithotype varies between the coals. For example, for all lithotypes of the Lower Block it is much higher than for the Springfield.

Thus, composition of Illinois Basin coal strongly influences CO<sub>2</sub> adsorption capacity and, consequently, will influence adsorption of CO<sub>2</sub> into the coal beds

# Summary



- Two wells in place
- Core analyses in progress
- Well testing completed
- Drill remaining two wells
- Install MMV
- Inject CO<sub>2</sub>
- Monitor



Midwest Geological  
Sequestration Consortium  
[www.sequestration.org](http://www.sequestration.org)