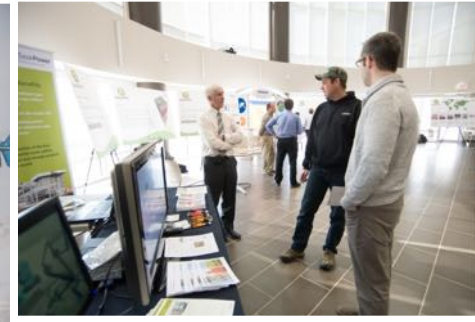




CO₂GeoNET

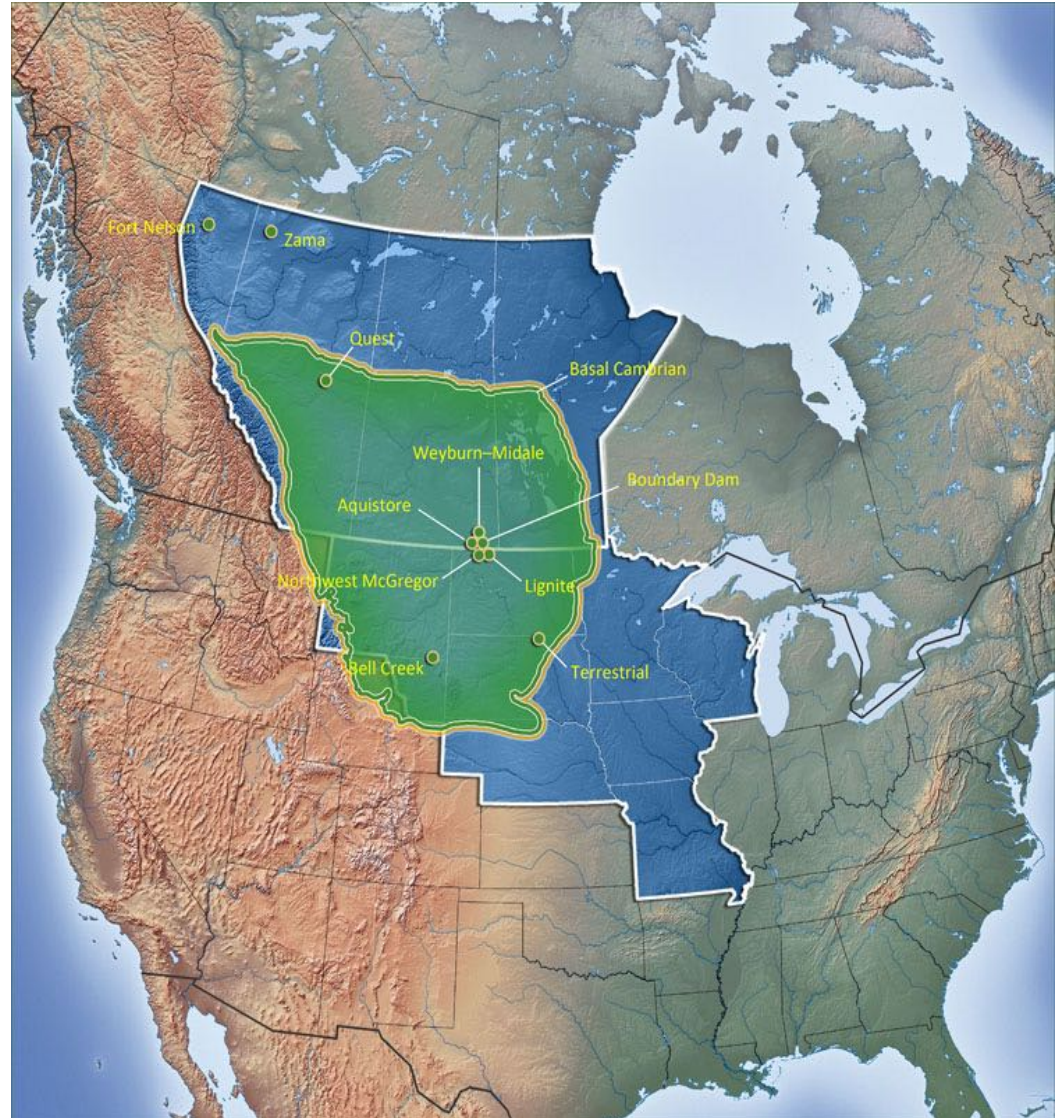


Kyle Worth, P.Eng, PMP
Senior Project Manager
Petroleum Technology Research Centre





- Non-Profit Research & Development Company
- Collaborative partnership with Industry, Government and Research Organizations
- Extensive network of researchers worldwide
- Research associated with CO₂ management
 - IEAGHG Weyburn –Midale CO₂ Monitoring & Storage Project
 - SaskCO₂USER
 - Aquistore



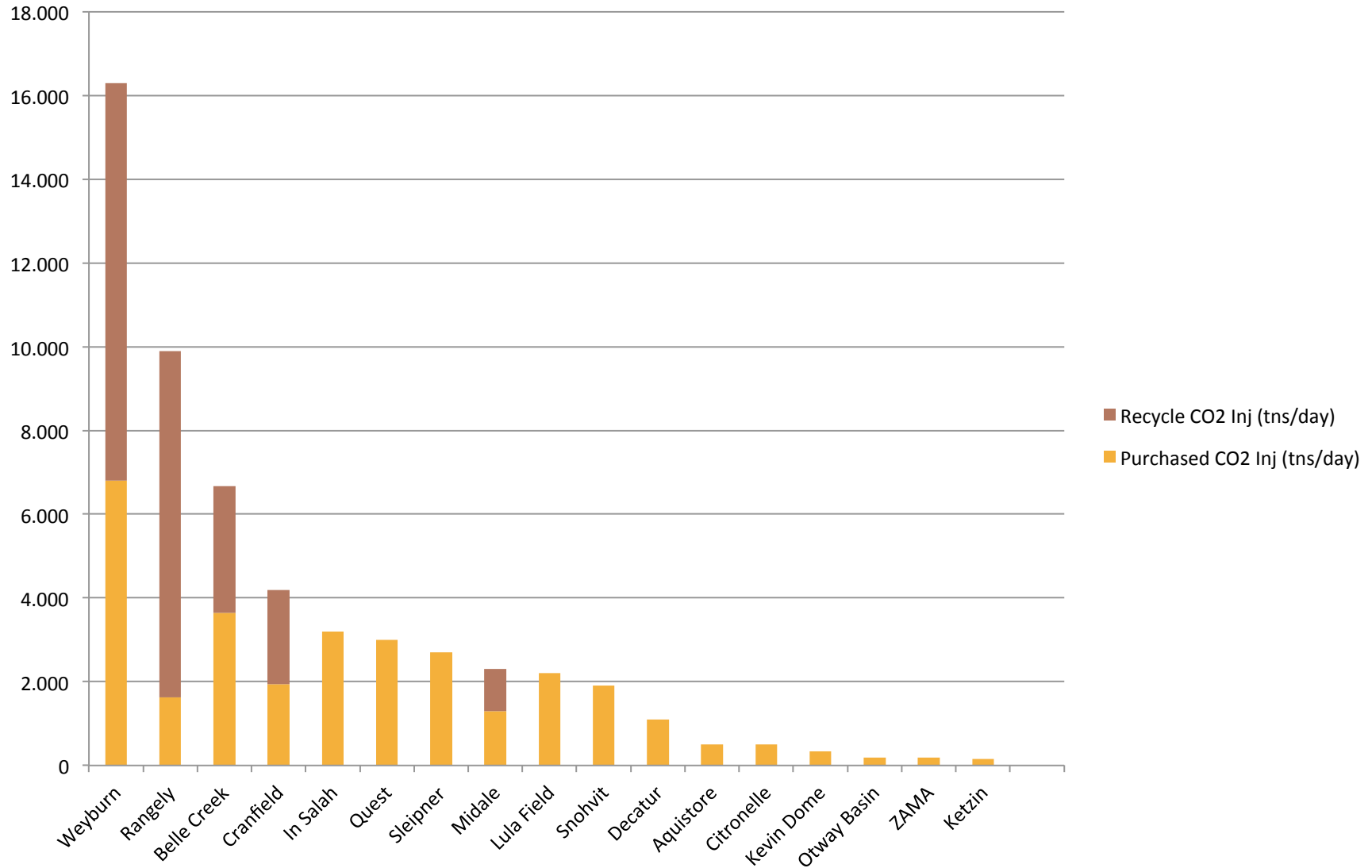
WEYBURN (CO₂-EOR) AQUISTORE (CO₂ STORAGE)



- Integrated CO₂-EOR and CO₂ Storage CCUS Project
- Practical application of observations, new data, and evidence is key
- Moving beyond pilot demonstration to commercially operating scale
 - Risk Assessment
 - Uncertainties
 - MMV



15 YEARS OPERATIONAL EXPERIENCE



AQUISTORE: DEEP SALINE CO₂ STORAGE PROJECT



- Injection began April 16, 2015
- \$45M, government & industry
- Commercial phase
- MMV risk based from Weyburn Best Practices



65,000
CUMULATIVE TONNES
OF CO₂ STORED

0
INDUCED SEISMIC
EVENTS

2100
MAX INJECTION RATE
TONNES/DAY

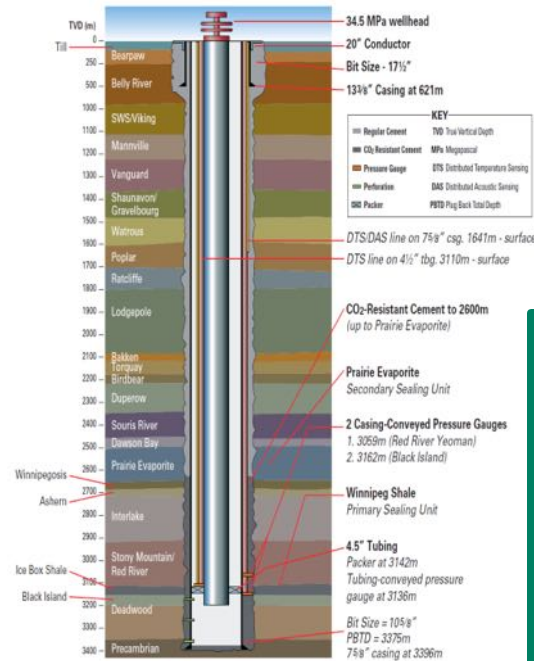
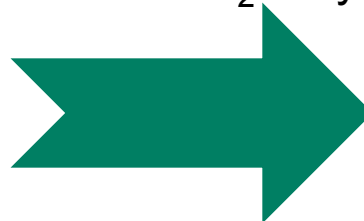
30
MONITORING
TECHNOLOGIES DEPLOYED

CO₂-EOR WELLS VS CCS WELLS



Weyburn Field:

- 282 Injector Wells
- 140 tonnes CO₂ /day



Aquistore Injector Well:

- One well
- (400 – 2000+) tonnes CO₂/day









Designed for: (1) project/plume monitoring; (2) public assurance; (3) technology innovation

Surface-based:

- Regional 3D seismic survey
 - Geological characterization
 - Baseline & time-lapse
- Permanent seismic array
 - Time-lapse imaging
- Electrical/electromagnetic
- Gravity

PLUME

- Passive seismic (broadband & short period array)
- InSAR
- GPS
- Tiltmeters

DEFORMATION

- Groundwater & soil gas monitoring
- Carbon isotope profile

LEAKAGE

Down-hole

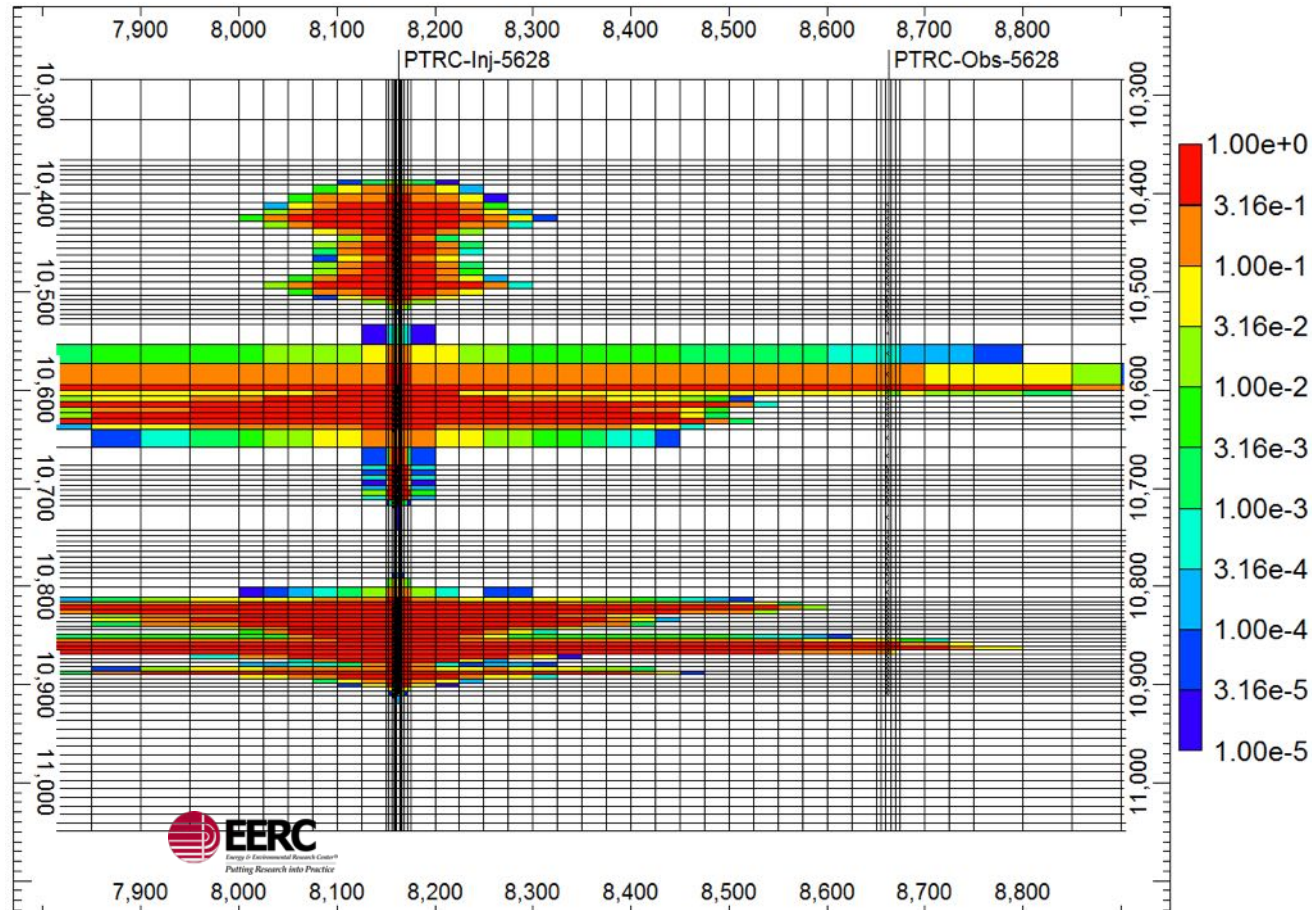
- Cross-well seismic & VSP
- Cross-well & surface-to-downhole electrical monitoring
- Real-time P & T
- Passive seismic
- Fluid sampling
- Time-lapse logging
- Distributed Acoustic/ Temperature Sensors (DAS/ DTS)
- Heater cable
- Gravity

IN SITU

AQUISTORE: RESERVOIR SIMULATIONS



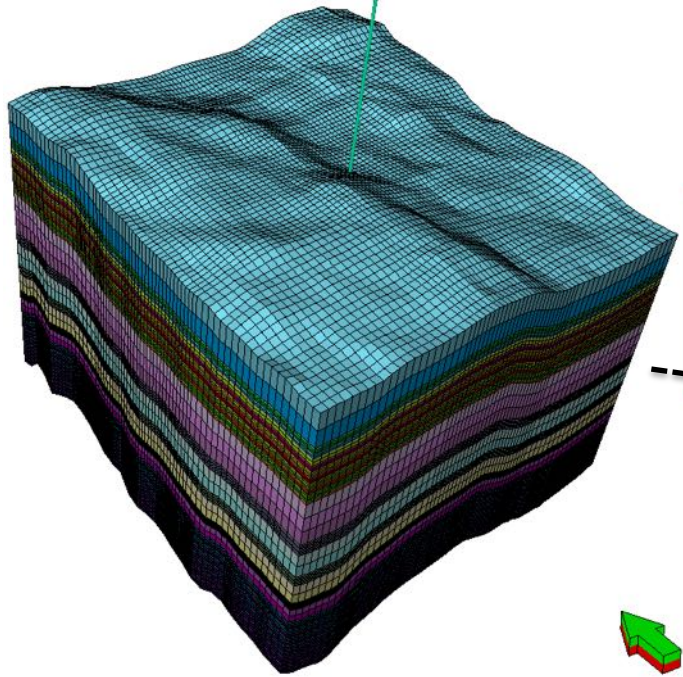
Gas Saturation 2015-08-31 I layer: 45



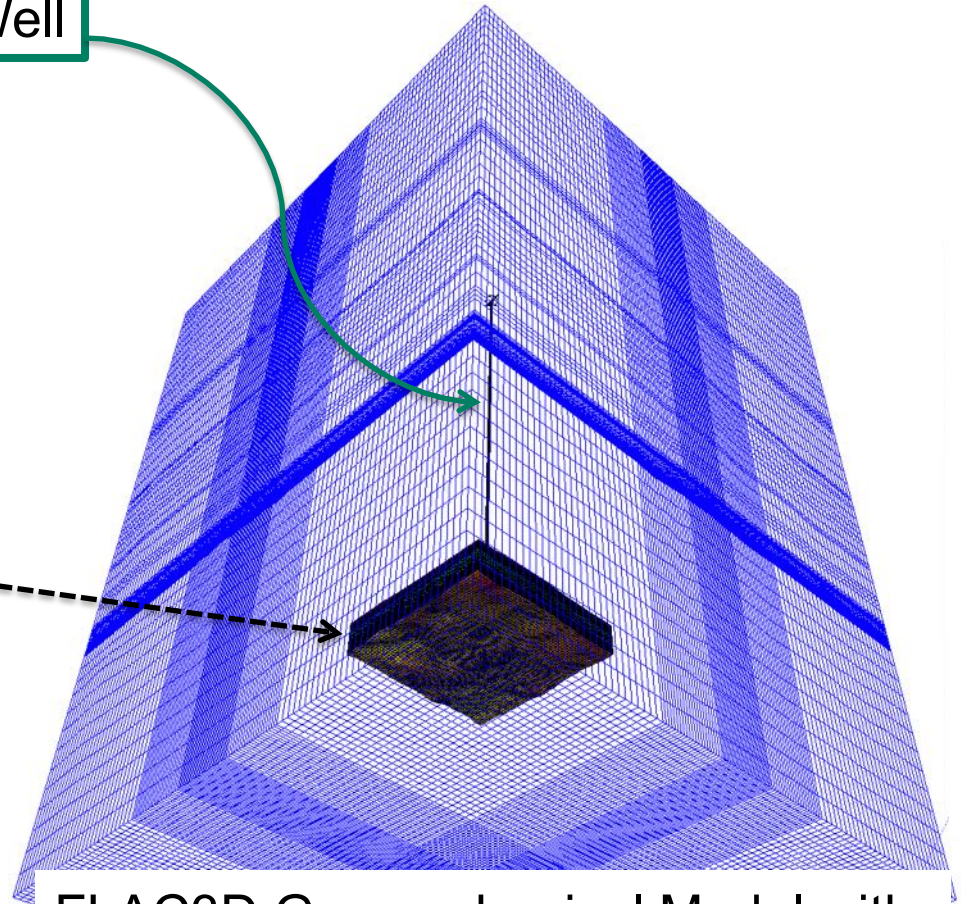
AQUISTORE: NON-ISOTHERMAL RESERVOIR GEOMECHANICAL SIMULATIONS



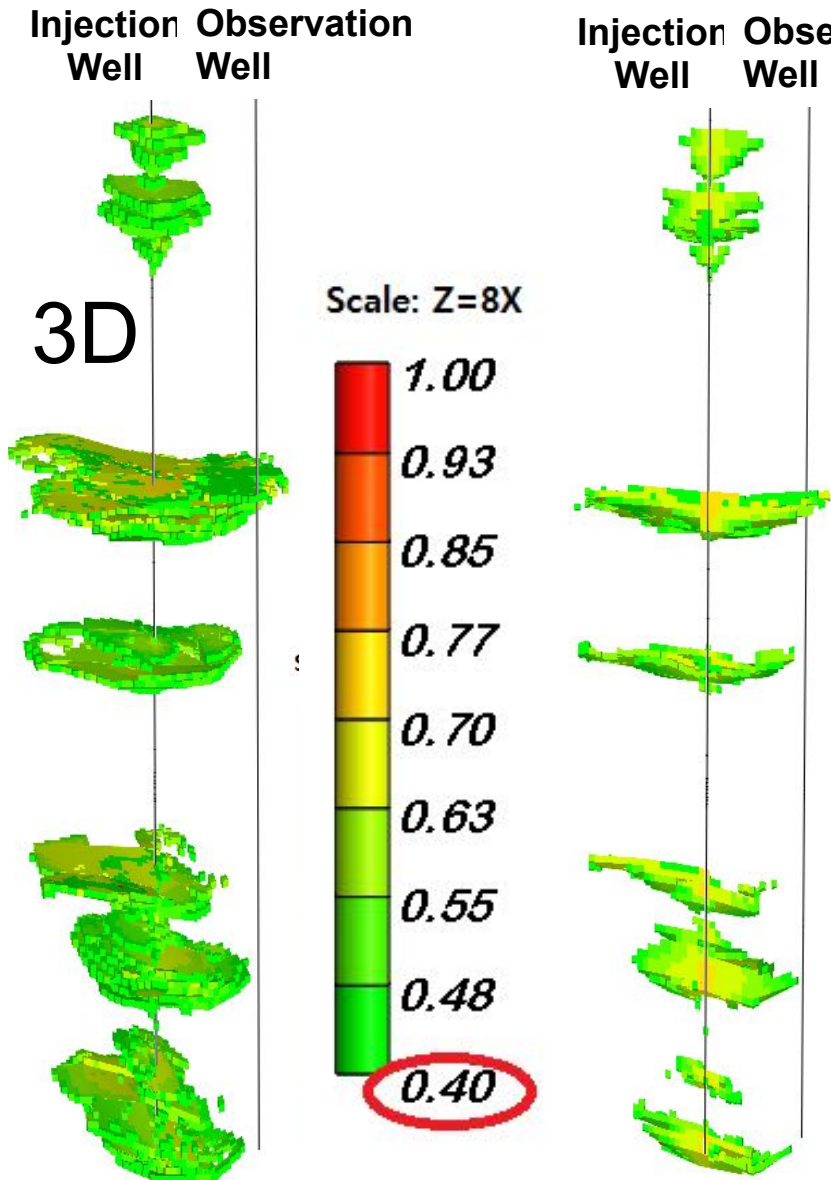
CO₂ Injection and Observation Well



GEM Simulation Model



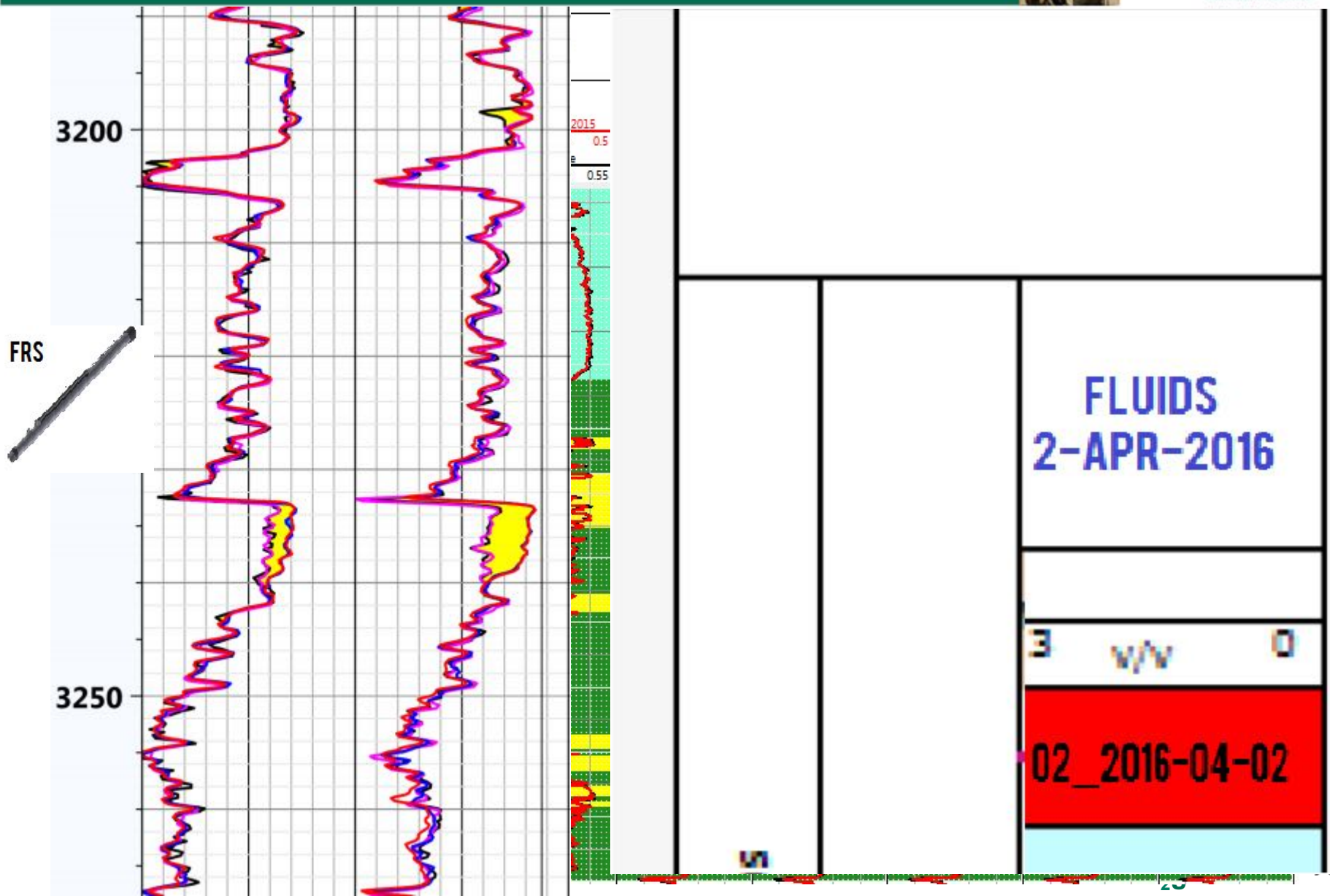
FLAC3D Geomechanical Model with
embedded GEM Model



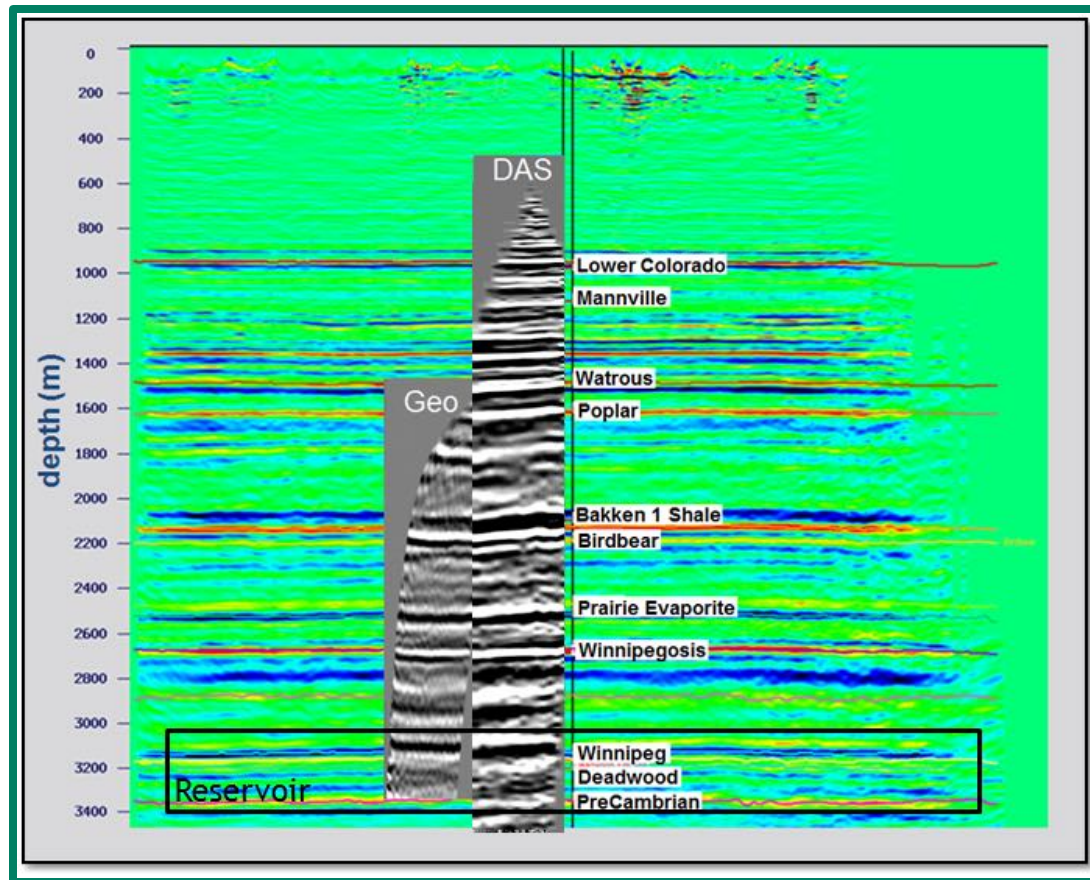
2D Slice through Inj and Obs Wells

CO₂ Saturation
Distributions after 7
months after CO₂ injection
with 138 tonnes/day
injection rate for P₉₀ case

AQUISTORE: REPEAT PULSED NEUTRON LOGGING



2016 3D SURFACE SEISMIC/VSP/DAS Benchmark Program

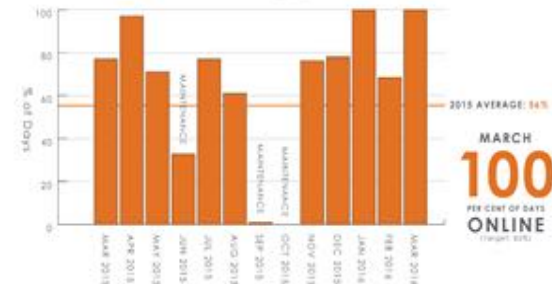


2016: MOVING FORWARD



- Variable injection
 - Thermal
 - Geomechanical
- Well Integrity
 - Casing, Cement
- Quantification
 - Modeled vs observed
 - Validate tools
- Induced Seismicity

TIME ONLINE

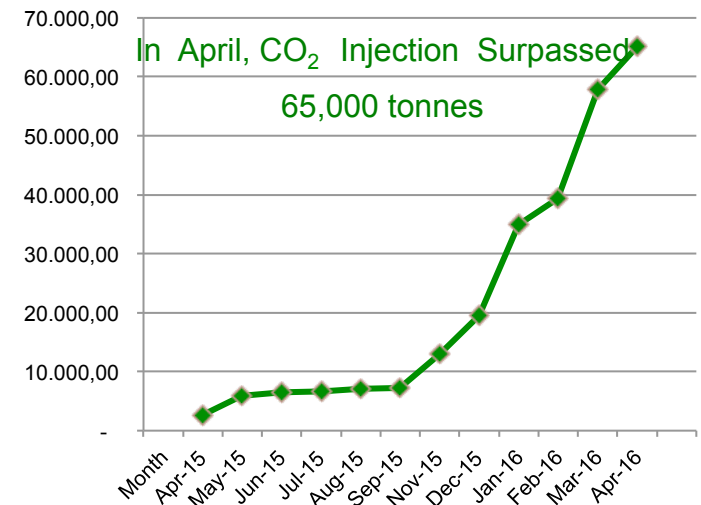


757,000 TONNES

captured since operational start-up

2014: 115,000 t 2015: 625,000 t 2016: 317,000 t

Cumulative CO₂ Injection



THANKS TO OUR SPONSORS & IN-KIND COLLABORATORS

