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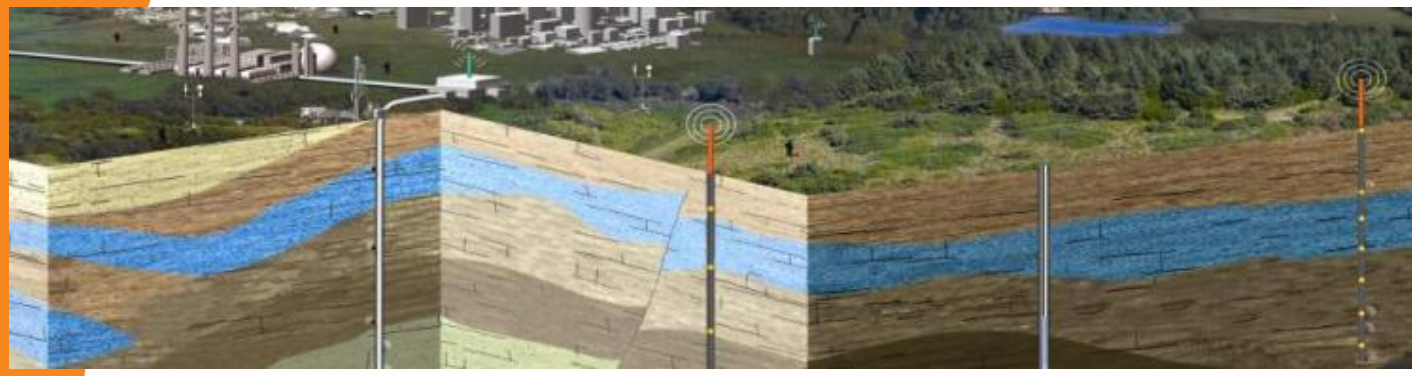

Deep Well Monitoring and Verification at the Illinois Basin – Decatur Project

Jim Kirksey

18 September 2012

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

MGSC

Other Contributors

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- University of Illinois, Geology Department
- Randy Locke and the MVA team
  Illinois State Geological Survey
- Ahsan Alvi and Eric Berlin
  Schlumberger Carbon Services

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MVA Goals for the Project

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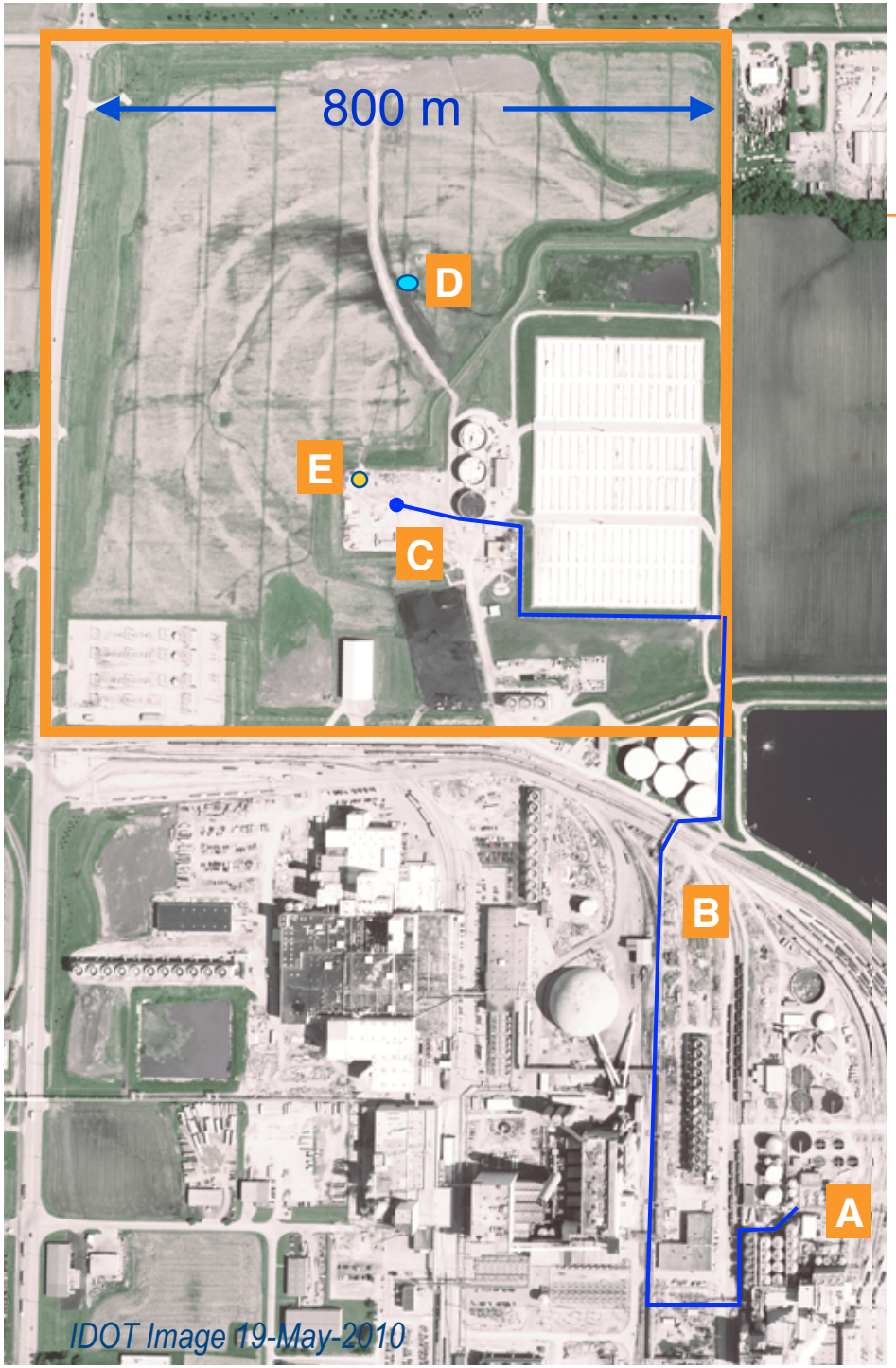
- Demonstrate that project activities are protective of human health and the environment both in the near surface and deep subsurface
  - brine and CO_2 are not significantly affecting areas outside of the intended reservoir
- Evaluate CO_2 interactions with formation solids and fluids.
- Provide validation of numerical reservoir models



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Illinois Basin – Decatur Project Site

A. Dehydration / Compression facility location
B. Pipeline route
C. Injection well
D. Verification / Monitoring well
E. Geophone well

IBDP Environmental Monitoring Framework

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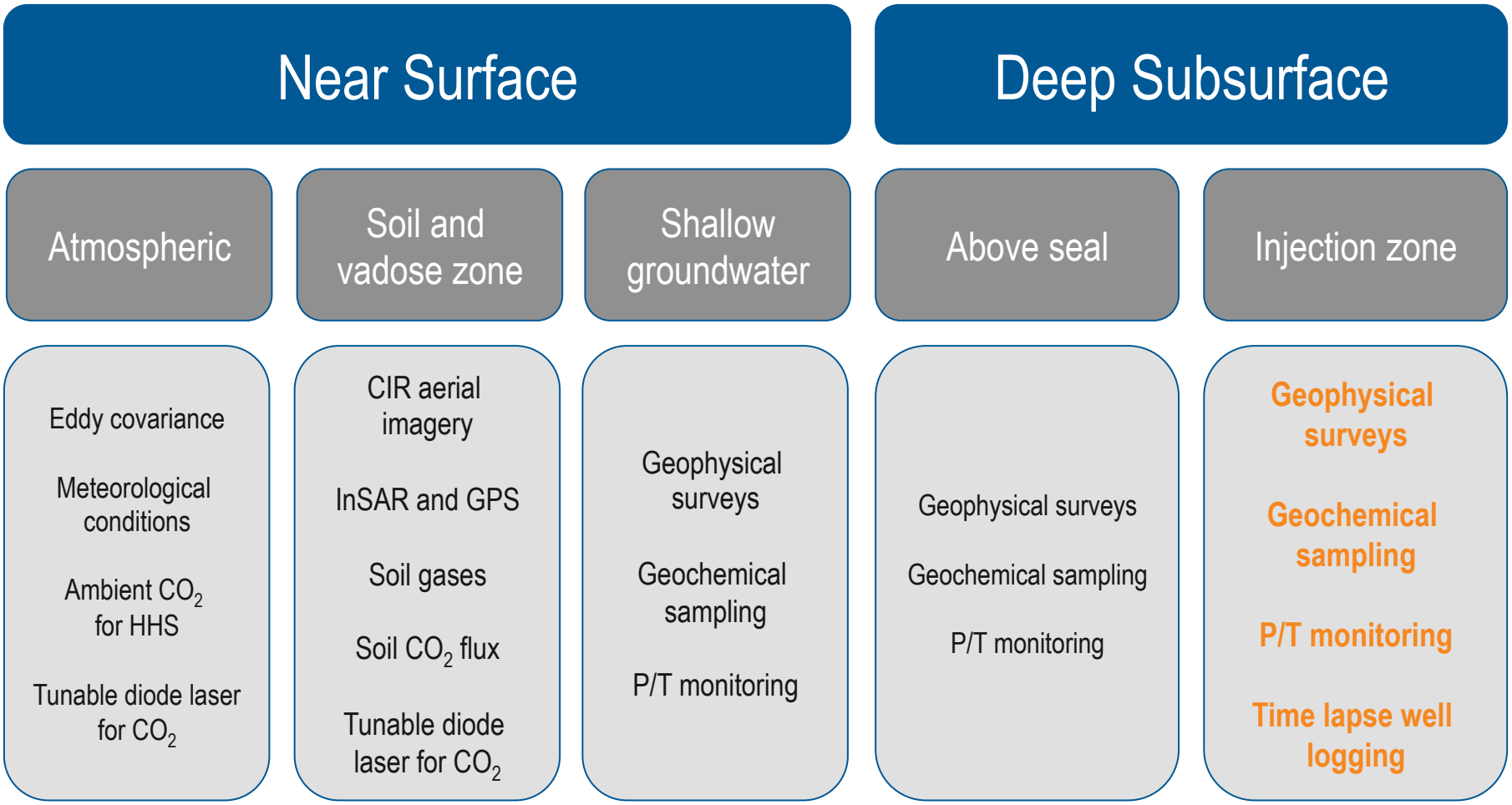

MVA Activities at IBDP

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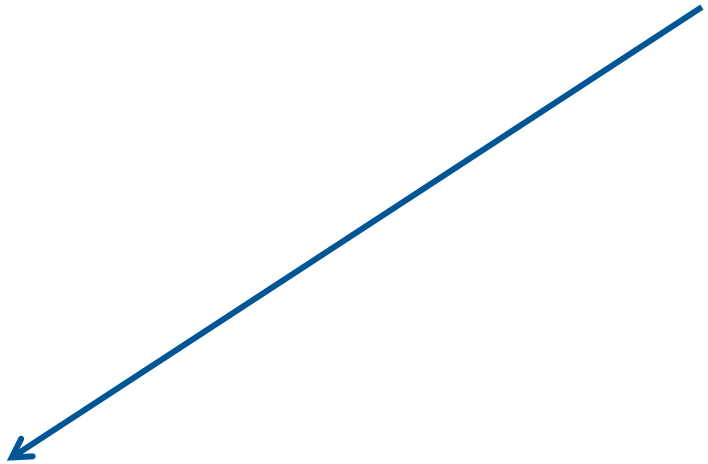
Near surface

- Soil/vadose zone
- Atmosphere
- Groundwater

Deep subsurface

- Mount Simon formation
- Above the caprock
- Well bore
- Micro-seismic



Deep Well MVA Activities

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- Pressure and Temperature
- Geophysical
- Geochemical
- Time lapse well logs

Pressure and Temperature Monitoring

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- Compression and pipeline
- Injection Wellhead
- Injection tubing and packer, quartz gauge at packer and DTS fiber optic through length of injection tubing
- Verification well head
- 9 zones in Mount Simon (in Verification well)
- 2 zones above caprock (in Verification well)
- Used for both reservoir monitoring and confirmation of wellbore integrity

Measurement of Temperature and Pressure

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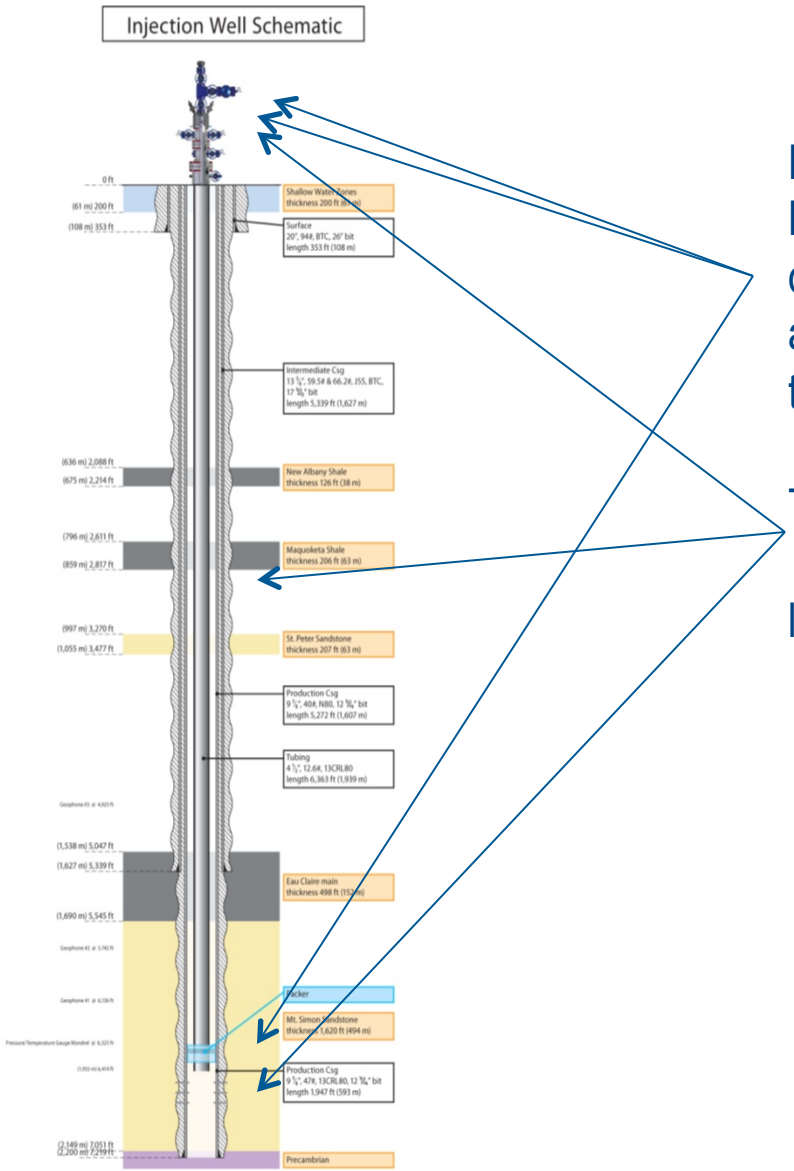
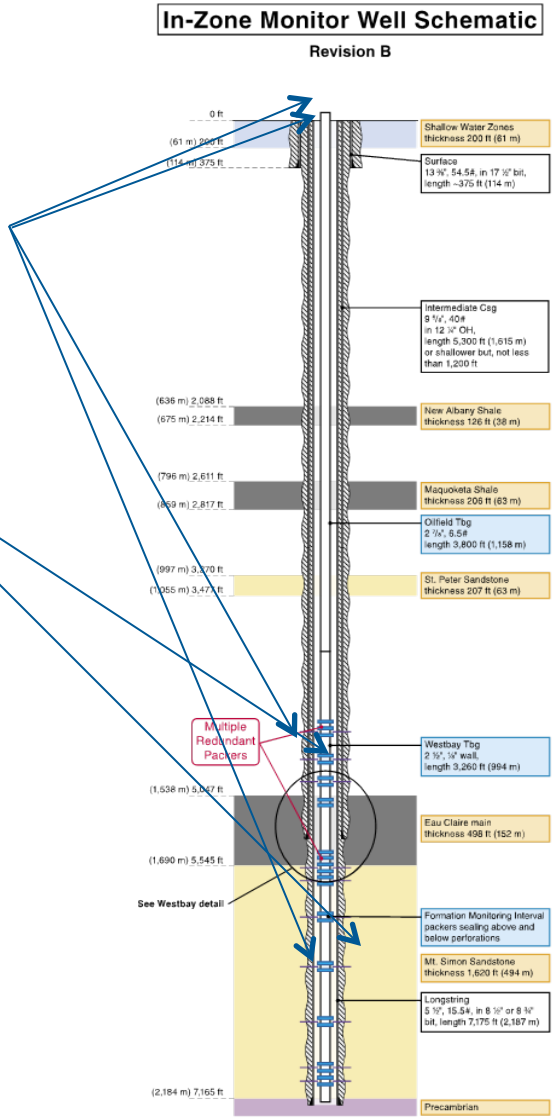


Pressure:
Down hole quartz, surface and annular transducers

Temperature:
At each gauge location



Temperature and Pressure Data

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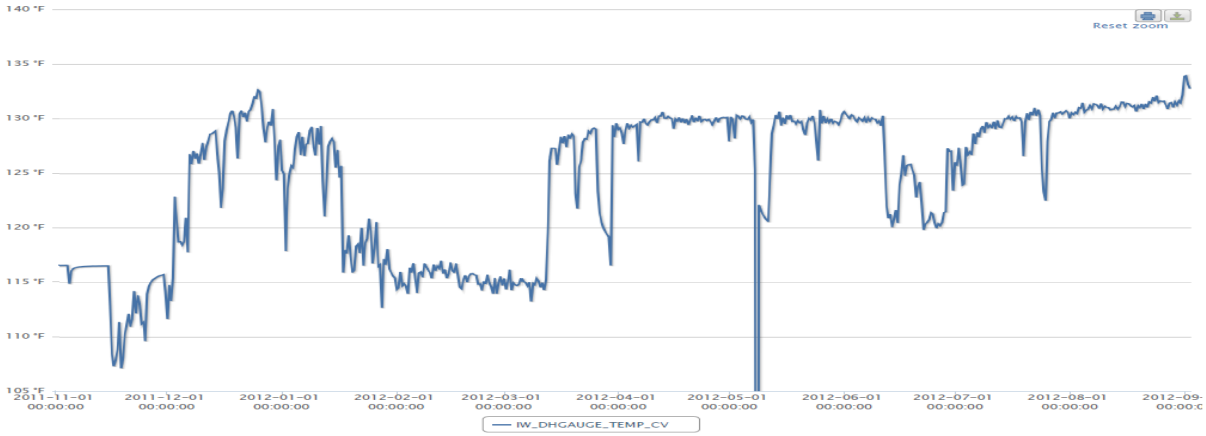
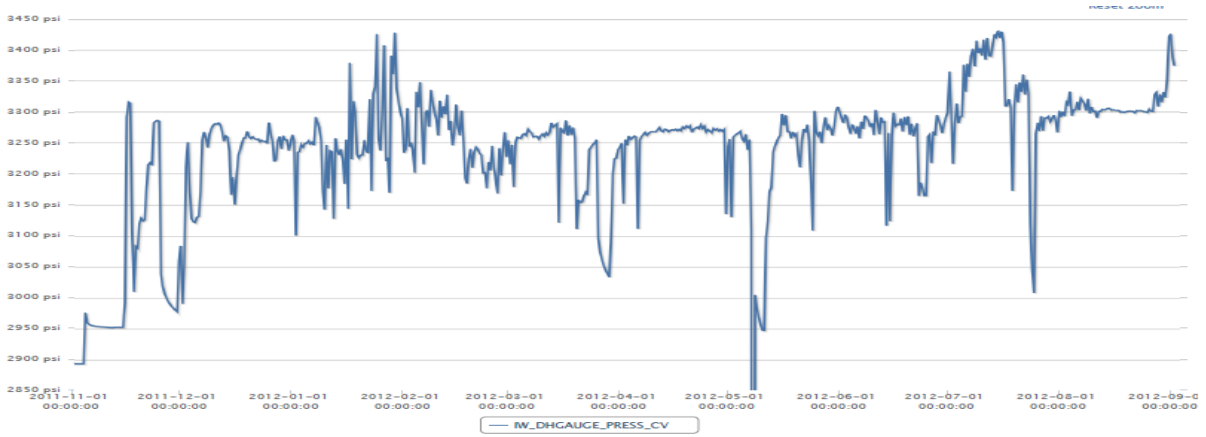
Down hole temperature at CCS #1



Down hole pressure at CCS#1



Data from DTS Fiber Optic Temperature Monitoring

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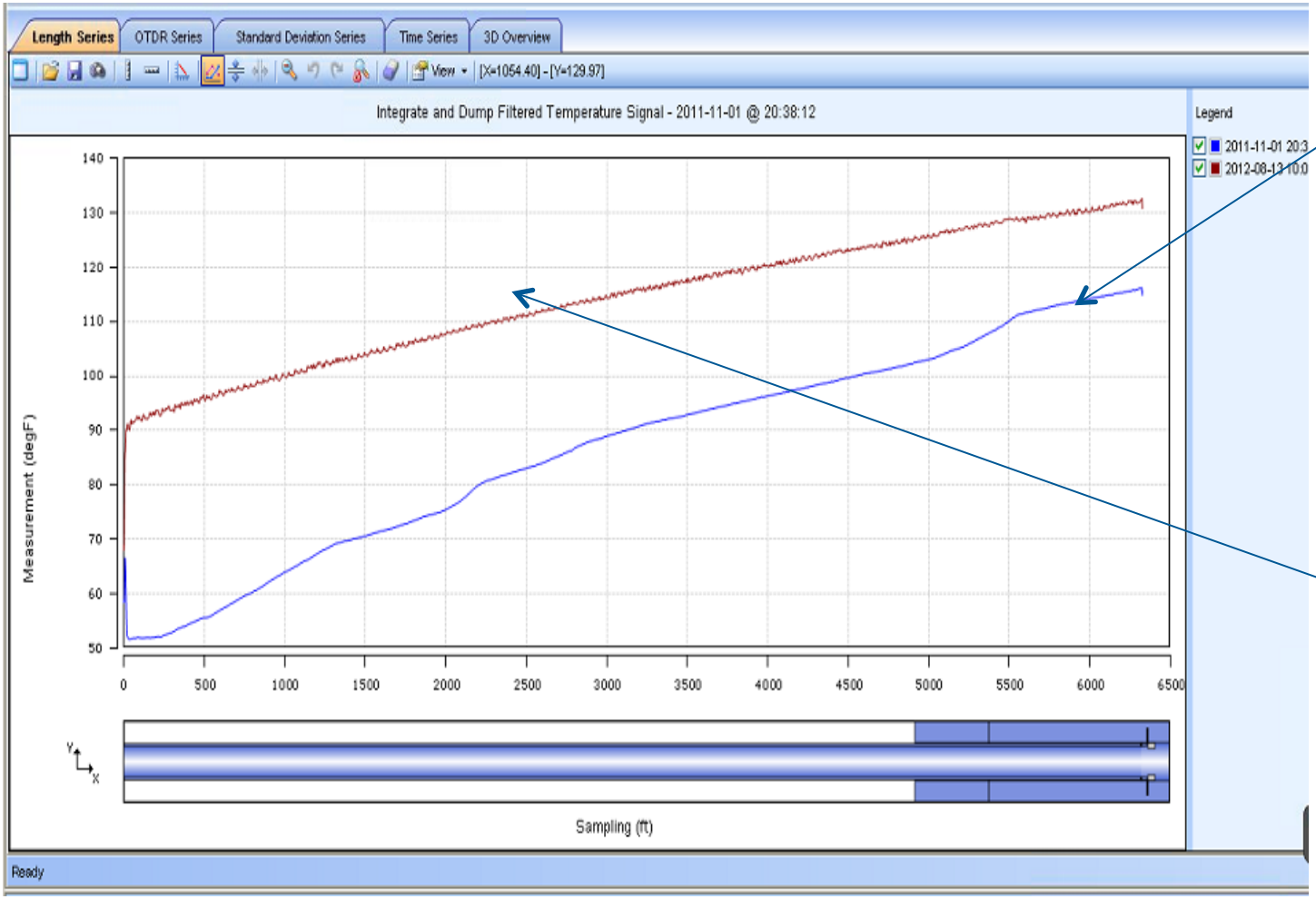

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Pressure Data From Verification Well #1

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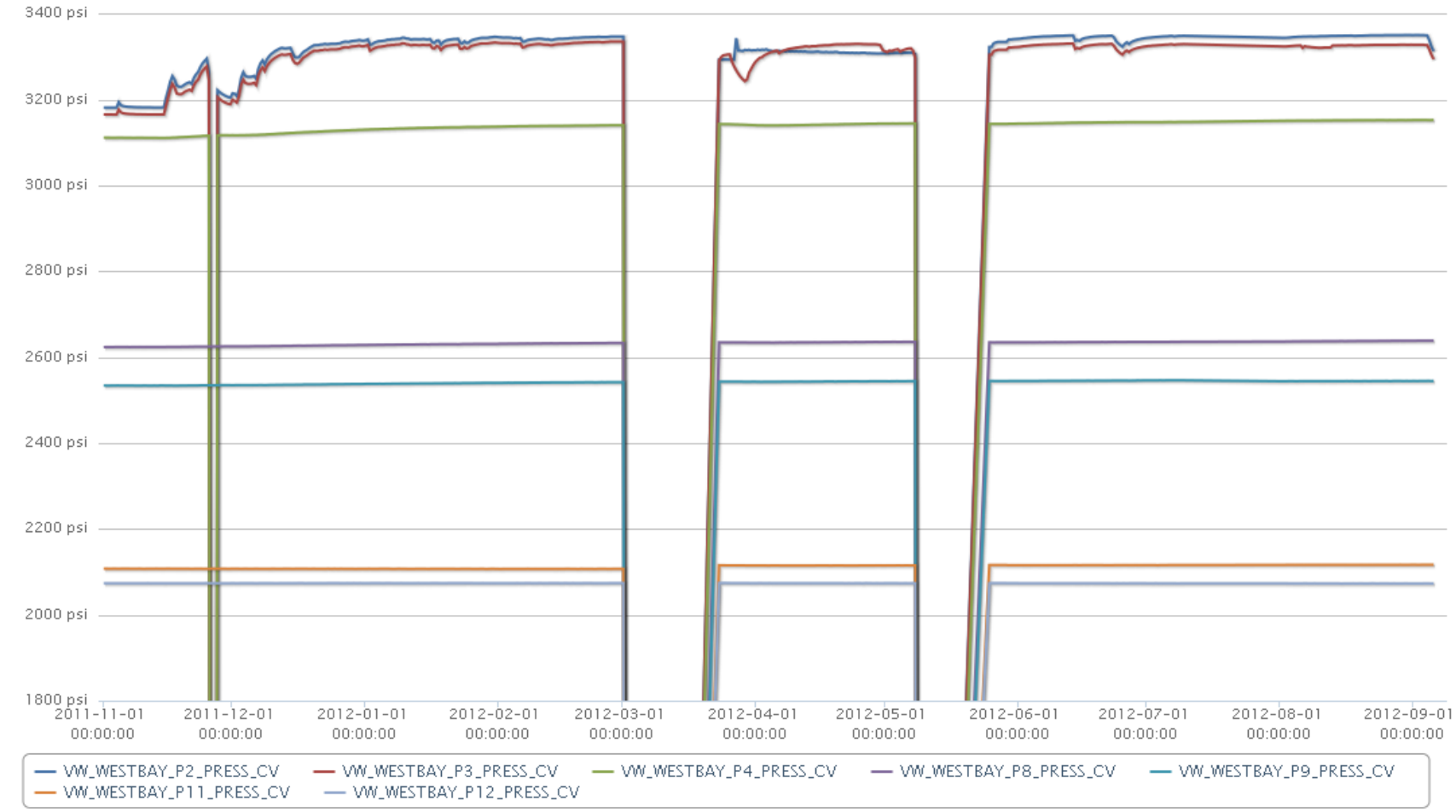
Down hole pressure data from Verification well #1



Geophysical Monitoring

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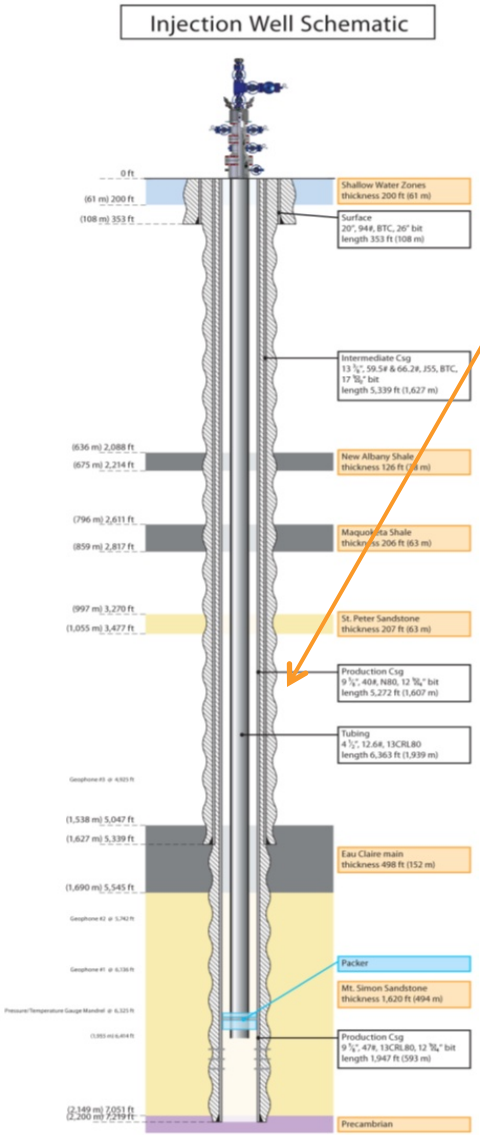


Injection Well:

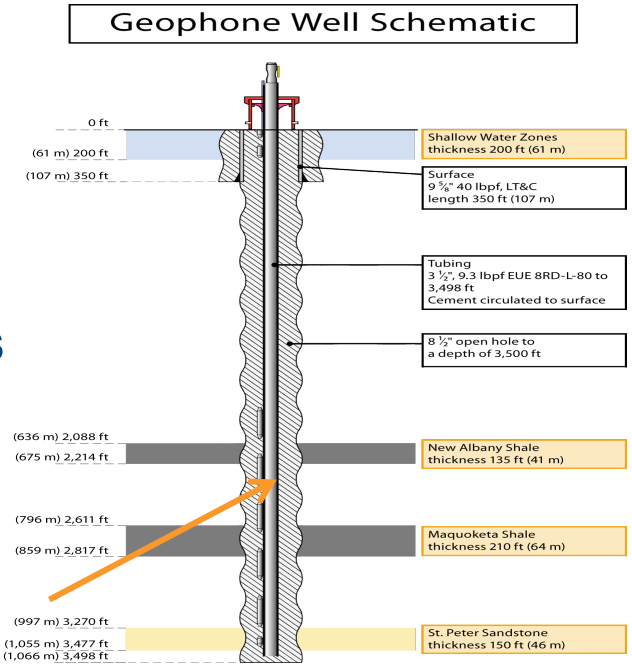
Micro-seismic Geophones (PS^3)

- 3-levels, 4-component packages
- Monitors near-wellbore seismicity

Geophone Well:

Multi-level Geophone Array

- 31-levels, 3-component packages
- 4D Vertical Seismic Profile surveys
- Cemented in place
- Additional passive seismic data



Geophysical Monitoring

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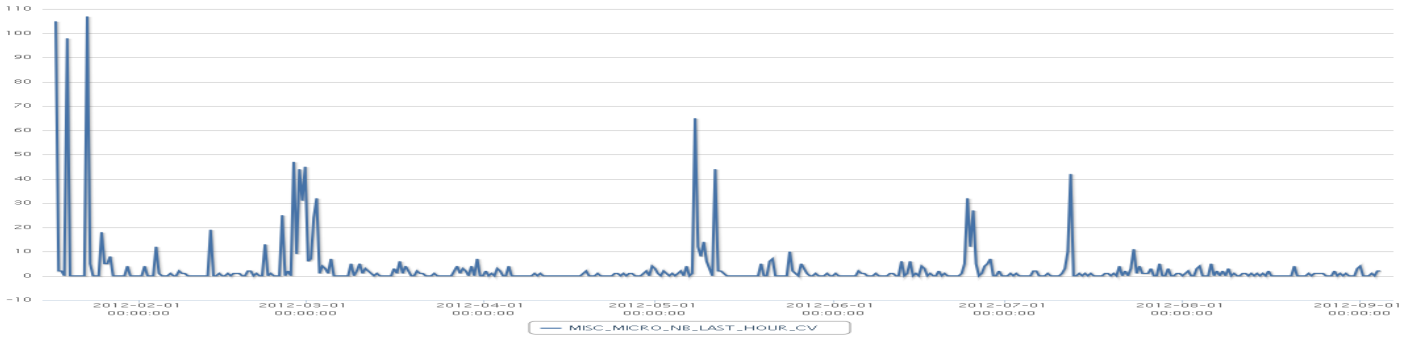
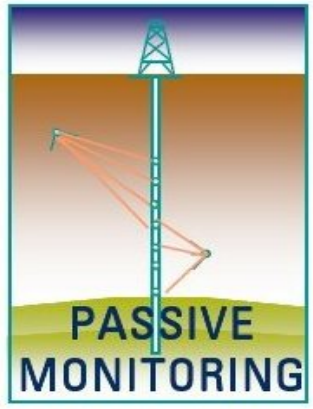
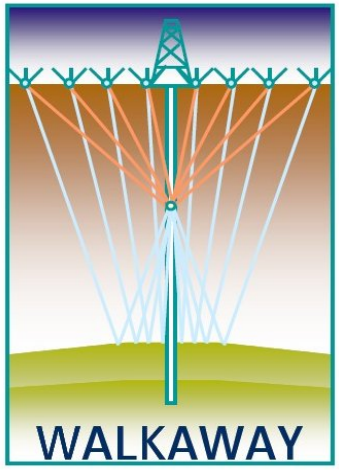
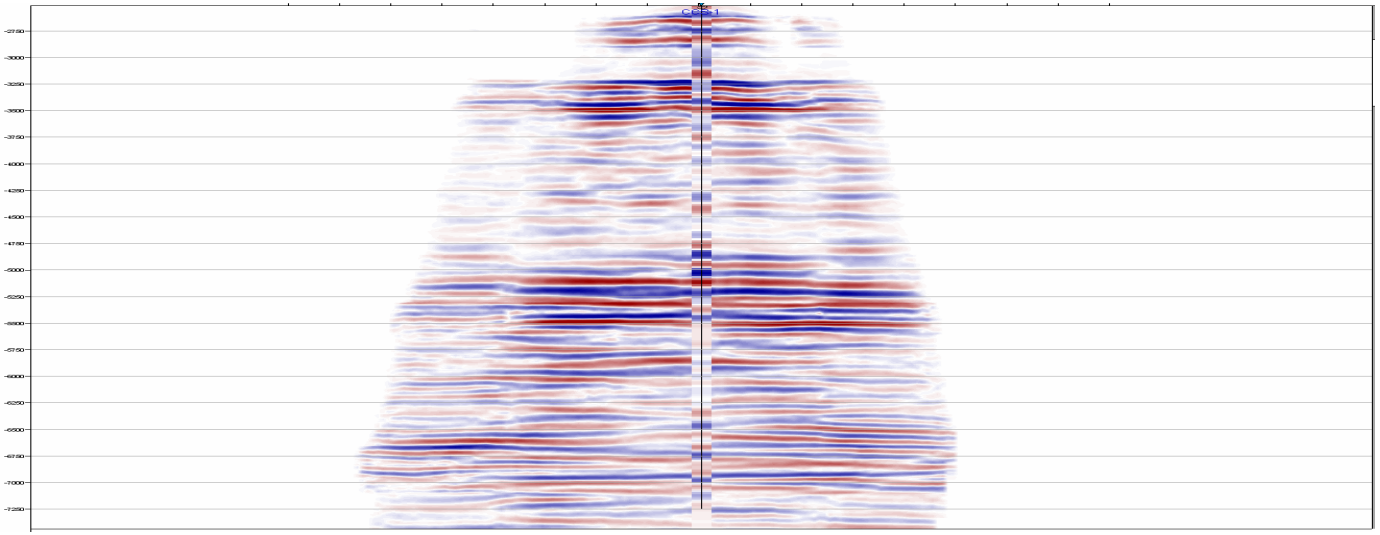
Passive counts from the CCS#1 Well:



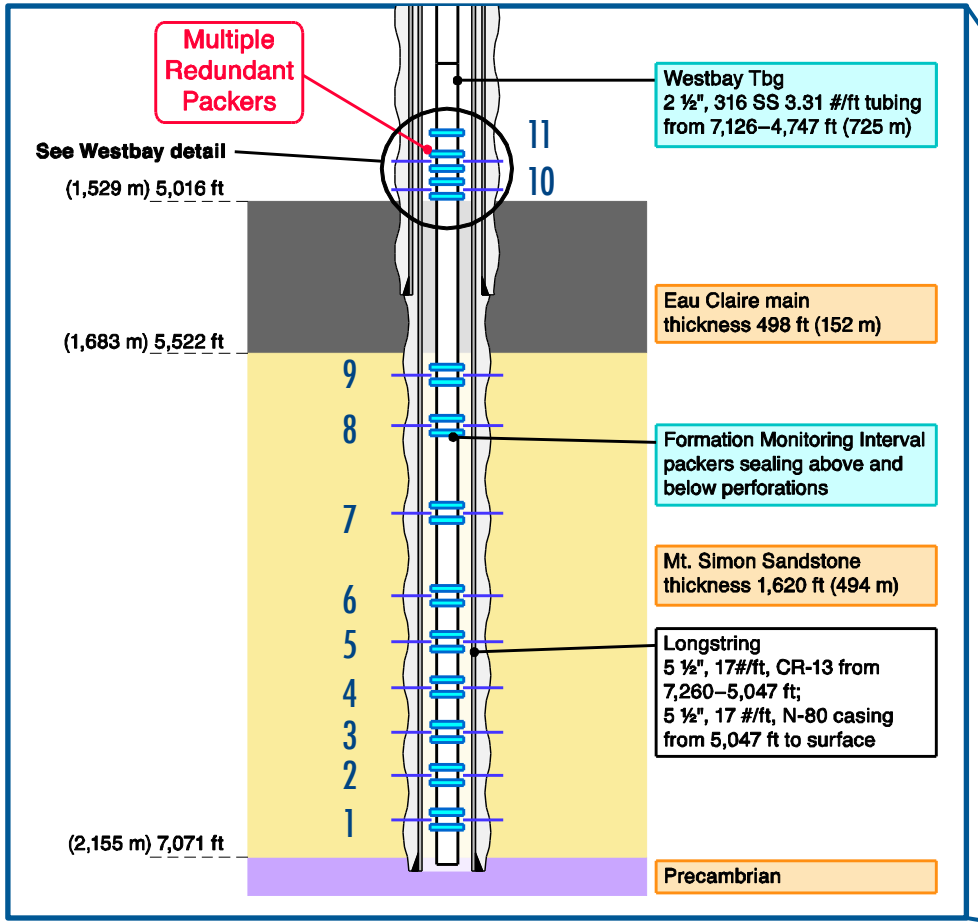


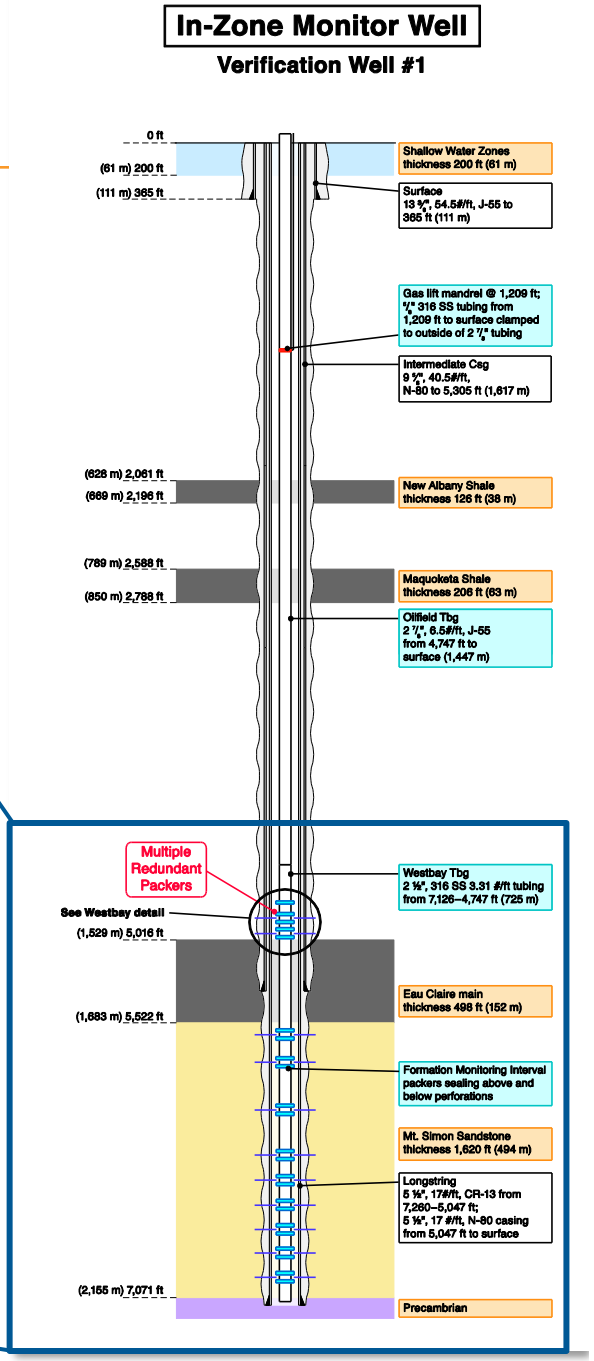
Seismic data obtained from VSP's





Verification Well Schematic





Geochemical Monitoring Activies

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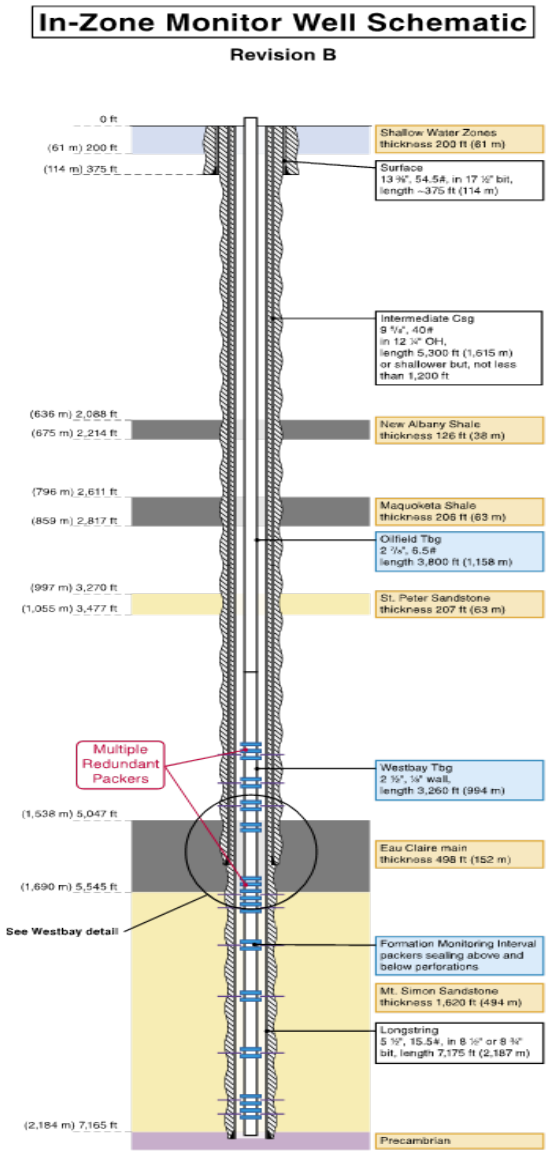
- Verification well Westbay* multilevel groundwater characterization and monitoring system designed to take in-situ samples
- Formation fluid sampled during initial completion by both swab and using Westbay system post installation
  - 2 sampling events prior to injection
  - 2 sampling events after injection commenced
  - 47 Westbay samples analyzed to date (28 prior to injection and 19 post injection)



IBDP Deep Fluid Sampling

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Outcomes

- Developed IBDP detailed sampling procedures for Westbay system
- Developed pre-injection data set to characterize deep brines
- Validated/adjusted geochemical modeling inputs

Lessons Learned

- Minimize non-native fluid movement into sampling zones from cross-zone flow, well circulation, and completion fluids
- Select field/lab tests and purge adequate volumes to ensure sample integrity

Results of time lapse logging in both the CCS#1 and VW#1

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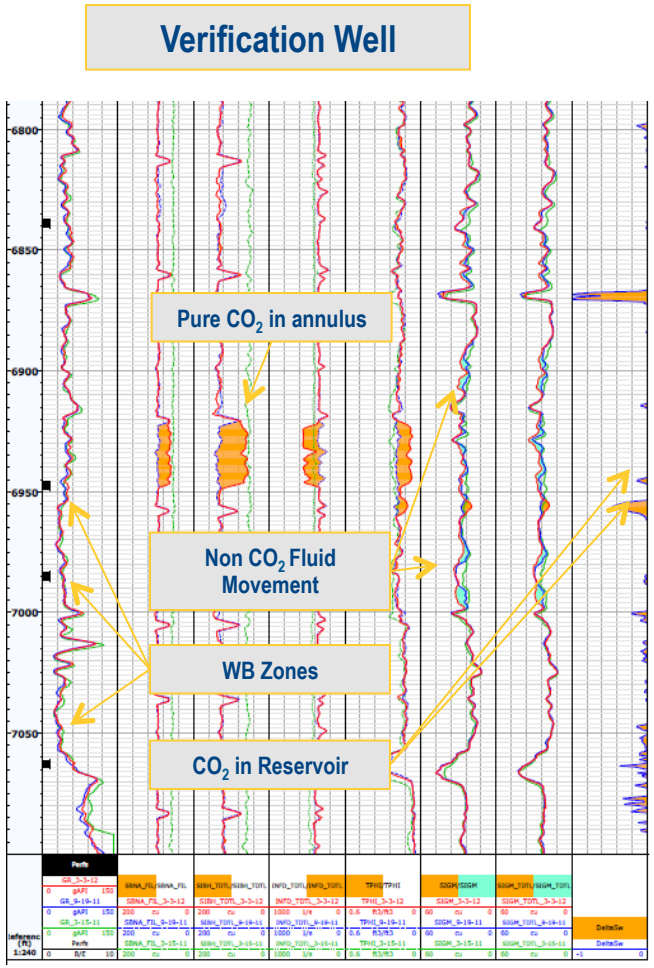

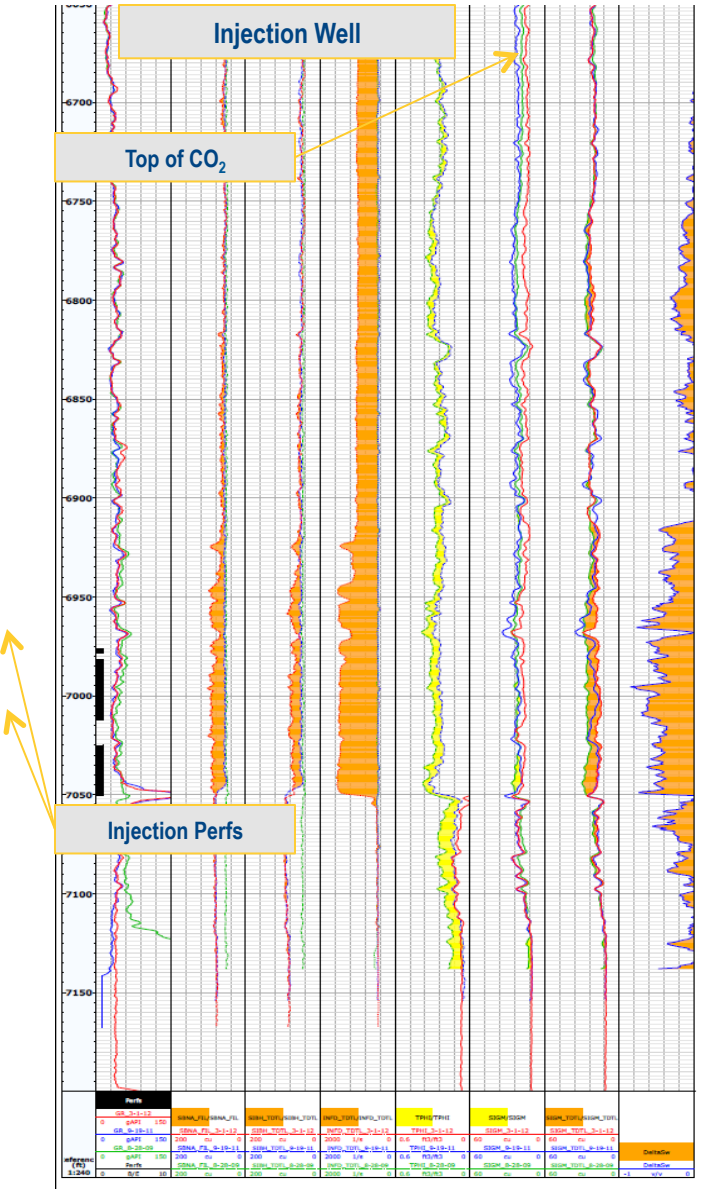

Results of time lapse logging in both the CCS#1 and VW#1

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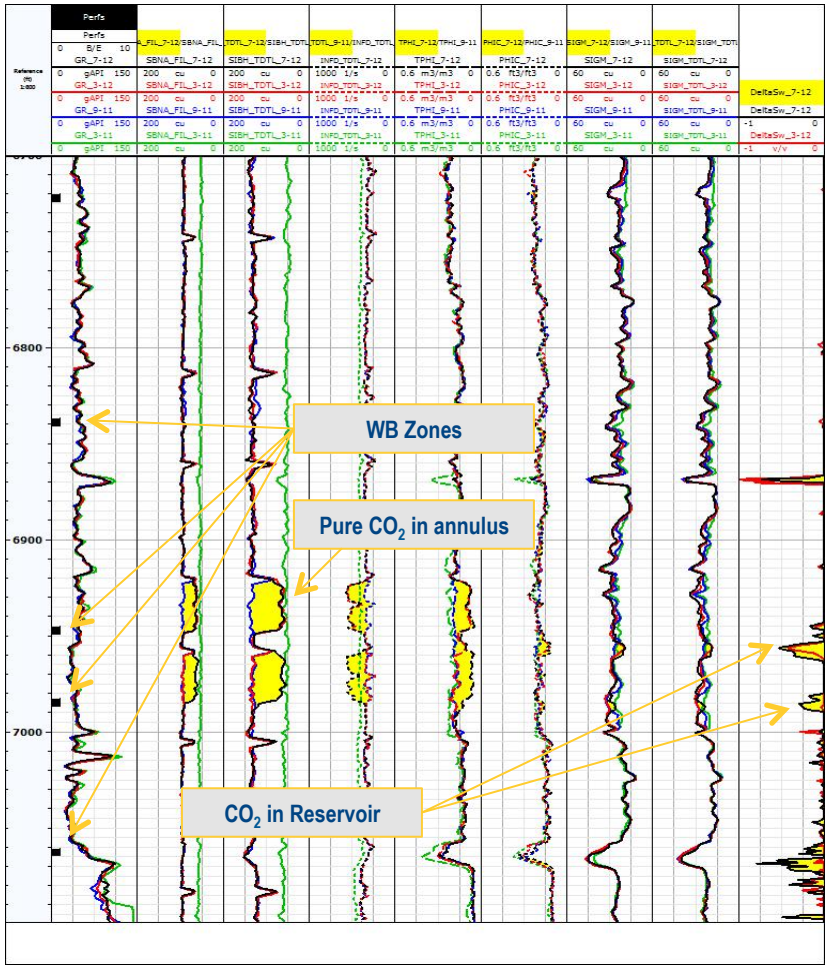
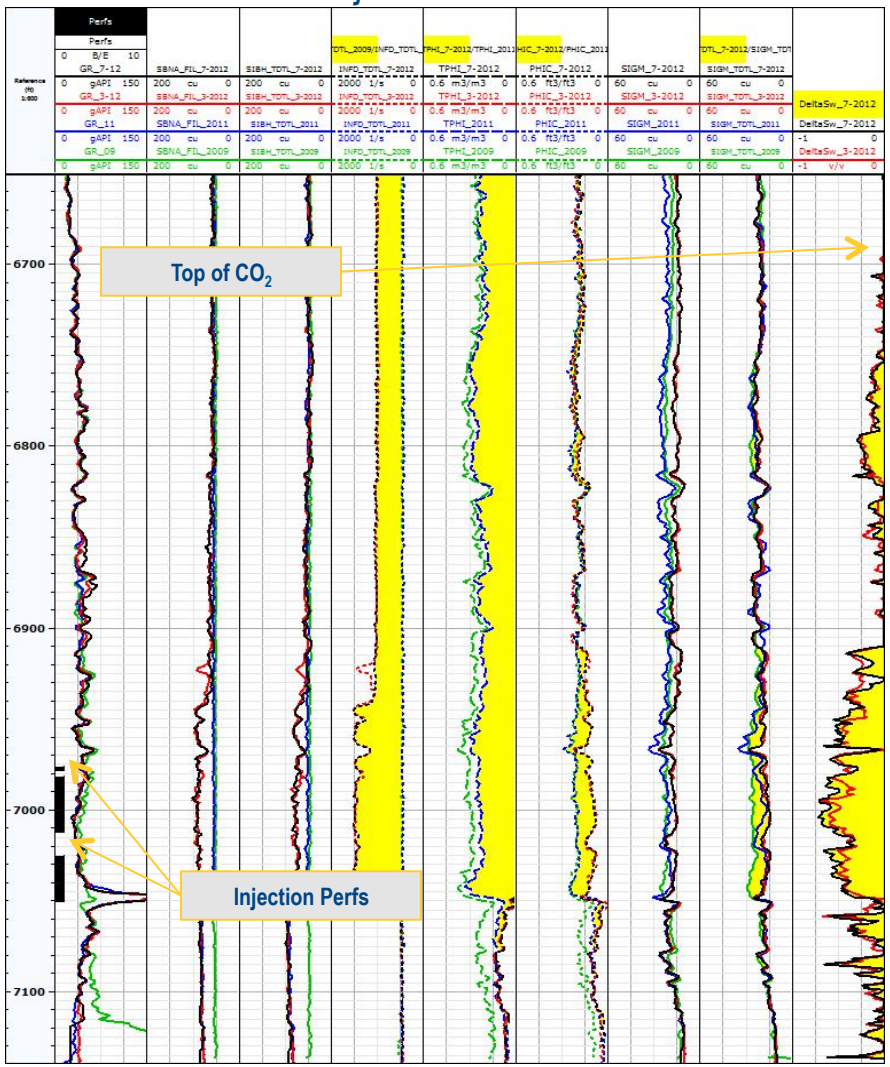
Verification Well



Injection Well



Logging done with RST* reservoir saturation tool

Monitoring via Well Logging Spinner Survey

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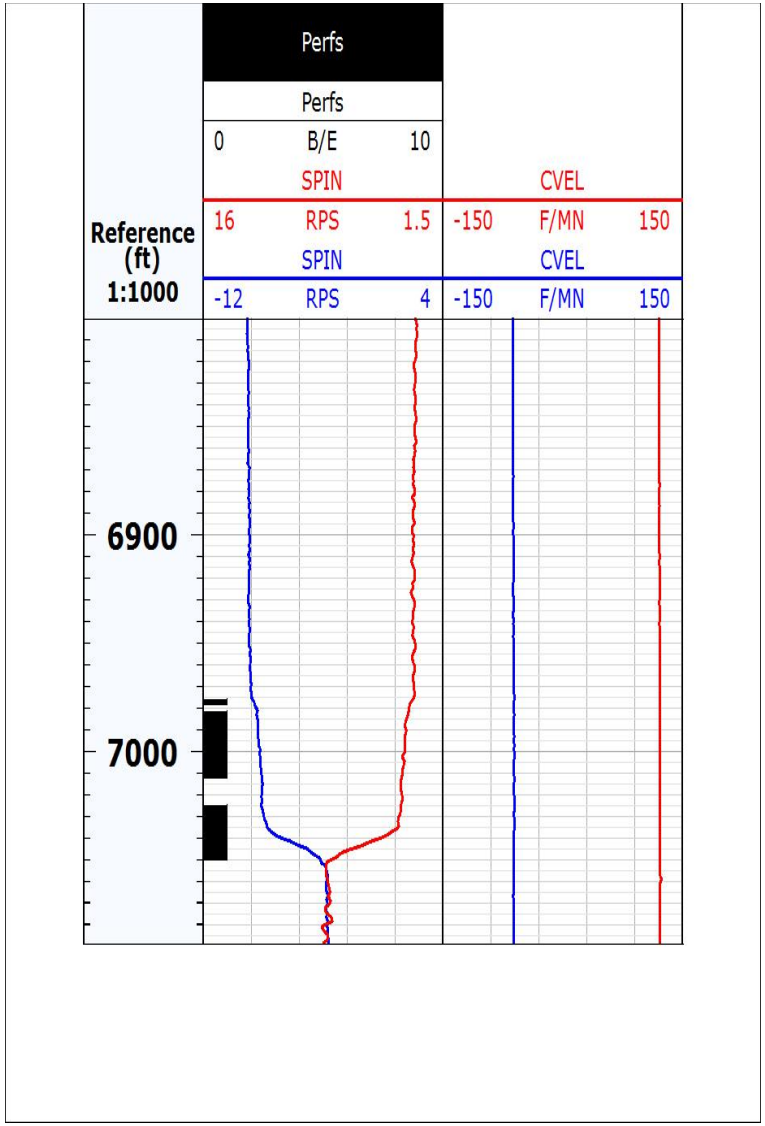
CCS#1 injection well:

Results of spinner survey run while injecting CO_2



Conclusions

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- The deep well MVA activities are meeting the Project MVA goals
- Information obtained is helping to gain new insights into plume movement in the reservoir
- Geochemical analysis will lead to better understanding of the interaction of the sequestered CO_2 and the reservoir
- Well bore integrity is constantly monitored ensuring protection of human health and environment
- Data gathered will be used throughout the life of the project