

# Integrated geological and seismic site characterization at Priddis, Alberta

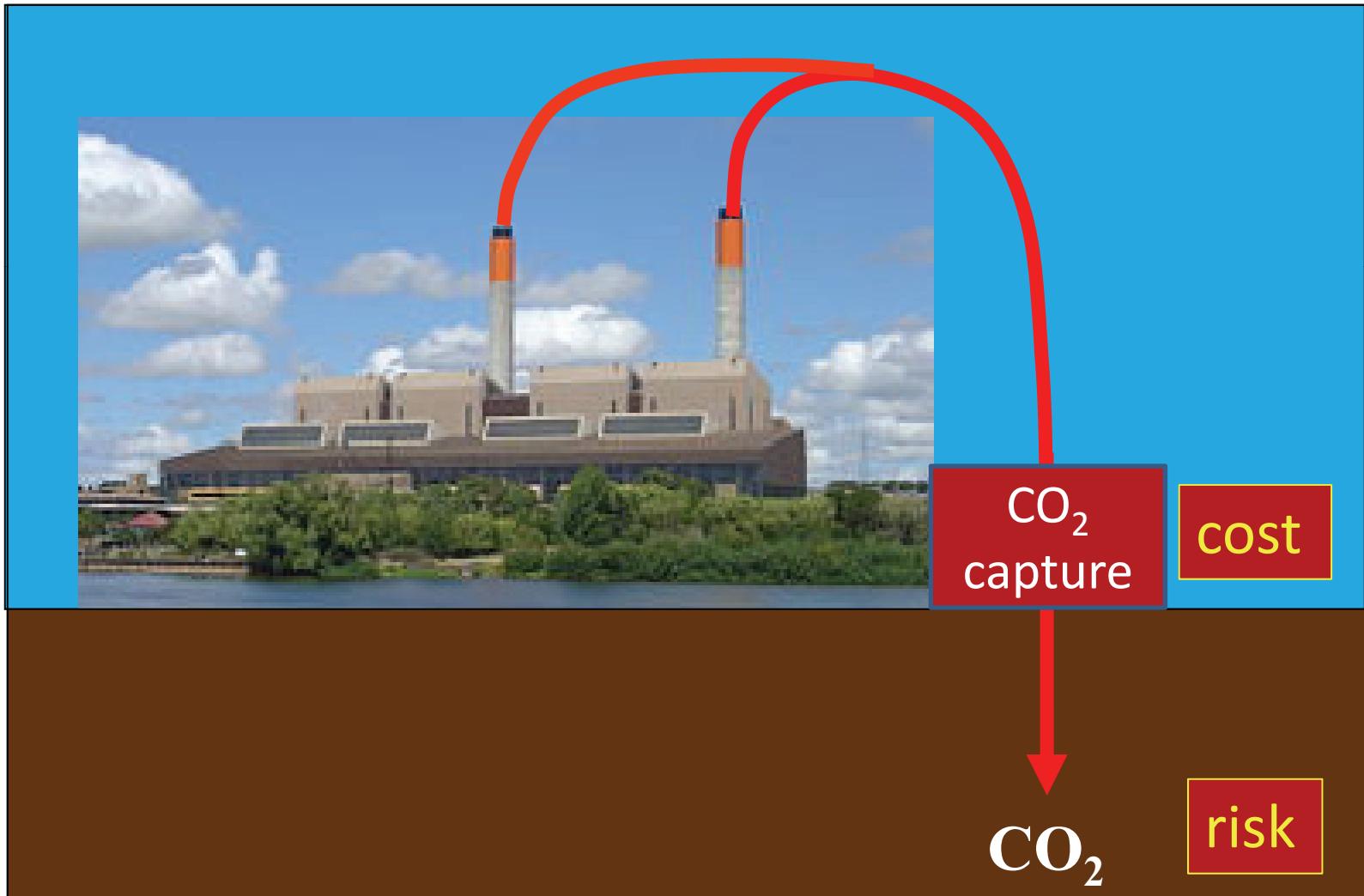
Don Lawton & Helen Isaac



# Geoscience Field Research Station

- A field site for development and testing of geophysical and other monitoring technologies.
- Assess monitoring methods for CO<sub>2</sub> detection threshold at shallow to intermediate depths for carbon capture and storage (CCS) risk assessment.
- Training in monitoring for students and industry.
- Information to regulators for CCS conformance metrics

# Carbon Capture and Storage (CCS)



# CCS regulations & policy



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## Bulletin 2010-22

June 29, 2010

### ERCB Processes Related to Carbon Capture and Storage (CCS) Projects

THE LEGISLATIVE ASSEMBLY OF ALBERTA

## BILL 24

CARBON CAPTURE  
STORAGE  
REGIMENT ACT, 2010

Passed in Alberta Legislature December 1, 2010

THE MINISTER OF ENERGY

# CCS Act

## **Bill 24: Rights to inject captured carbon dioxide for sequestration**

### **Section 116**

**(3)** A lessee of an agreement under this section shall in accordance with the regulations

- (a) submit a monitoring, measurement and verification plan for approval;
- (b) comply with the monitoring, measurement and verification plan that has been approved;
- (c) provide reports with respect to the lessee's compliance with the monitoring, measurement and verification plan;
- (d) fulfil the work requirements with respect to the location of the agreement.

# CCS regulations

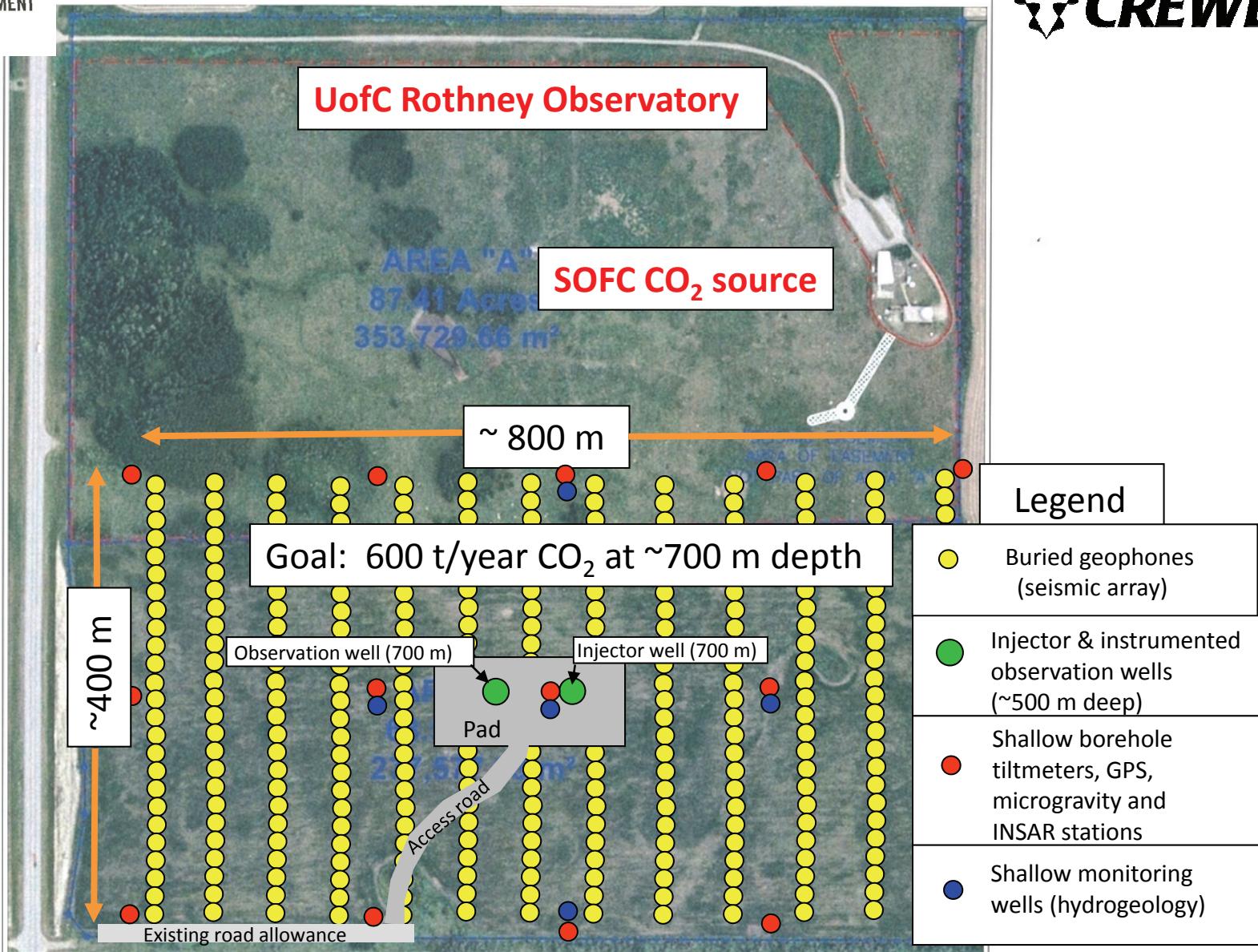
**ERCB Bulletin 2010-22 June 29, 2010**

## **ERCB processes related to Carbon Capture and Storage (CCS) Projects**

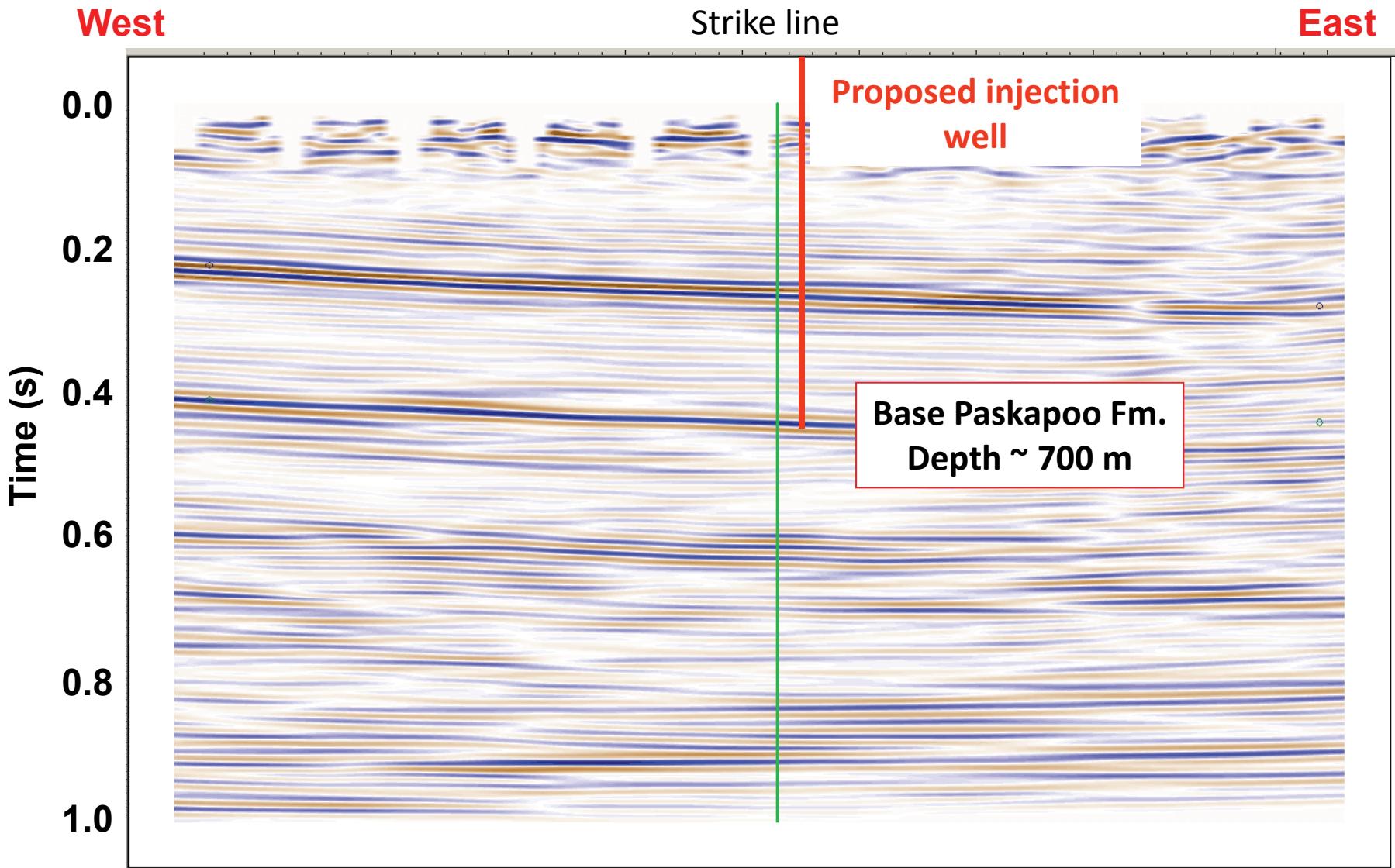
### **4 Monitoring, Reporting, and Safety**

- The *Pipeline Regulation (AR 84/2009)* describes requirements for pipeline monitoring and reporting.
- *Directive 007: Volumetric and Infrastructure Requirements* and *Directive 017: Measurement Requirements for Upstream Oil and Gas* describe general requirements and procedures for measurement.
- The *Directive 065* application process provides the mechanism for proposing methods of monitoring and reporting injected CO<sub>2</sub> volumes, pressures, composition, and other pertinent data (in addition to standard volumetric reporting via the Petroleum Registry of Alberta).
- *Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry* sets out procedures and protocols that the ERCB expects operators to have in place and be able to demonstrate before commencing CCS operations.
- The majority of project-specific operating conditions, monitoring, and reporting requirements will be set out in the scheme approval documents.

# UofC/CMC Priddis GFRS



# 3D seismic PP volume, May 2010 (CREWES)



# 2010 geophysics field school

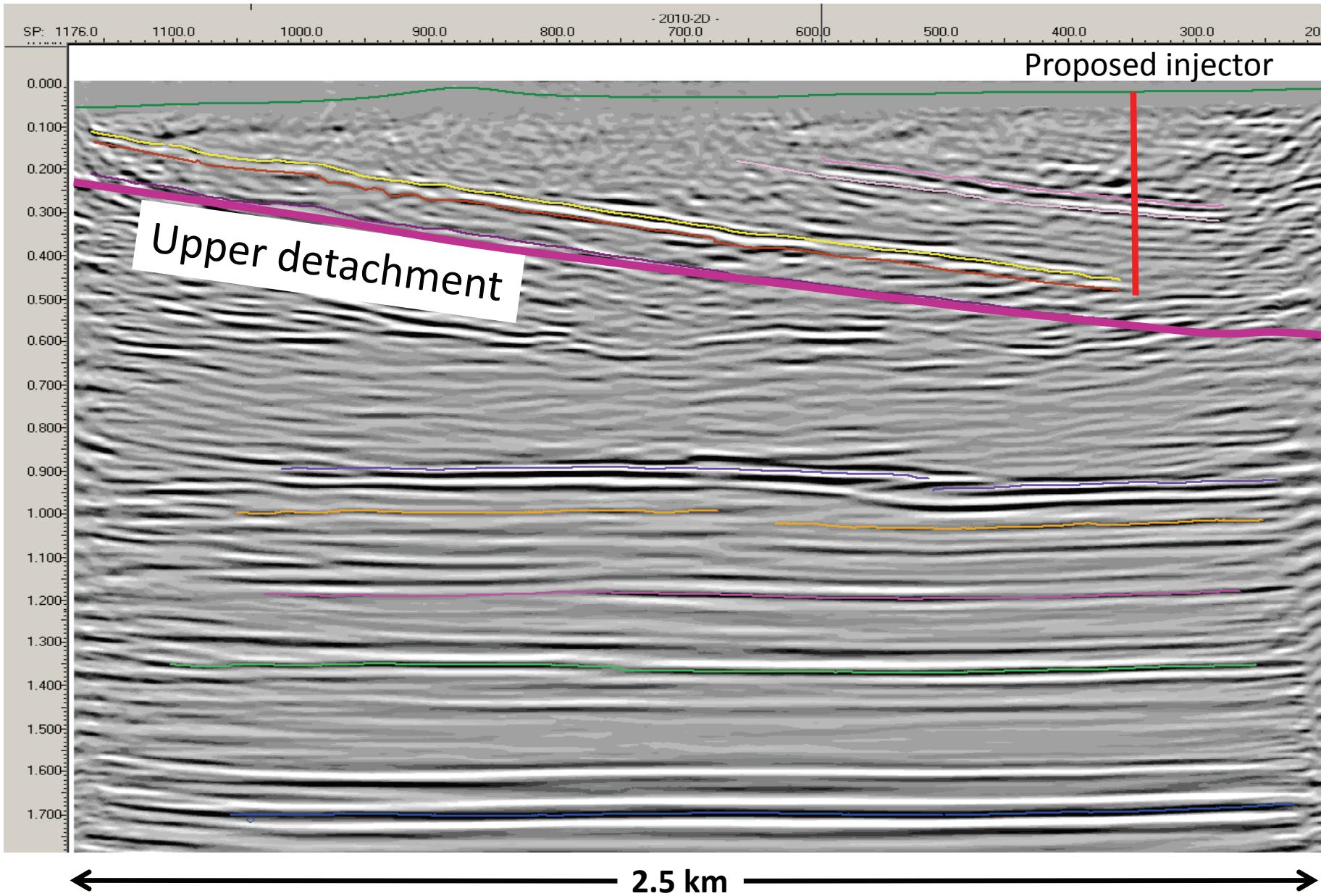




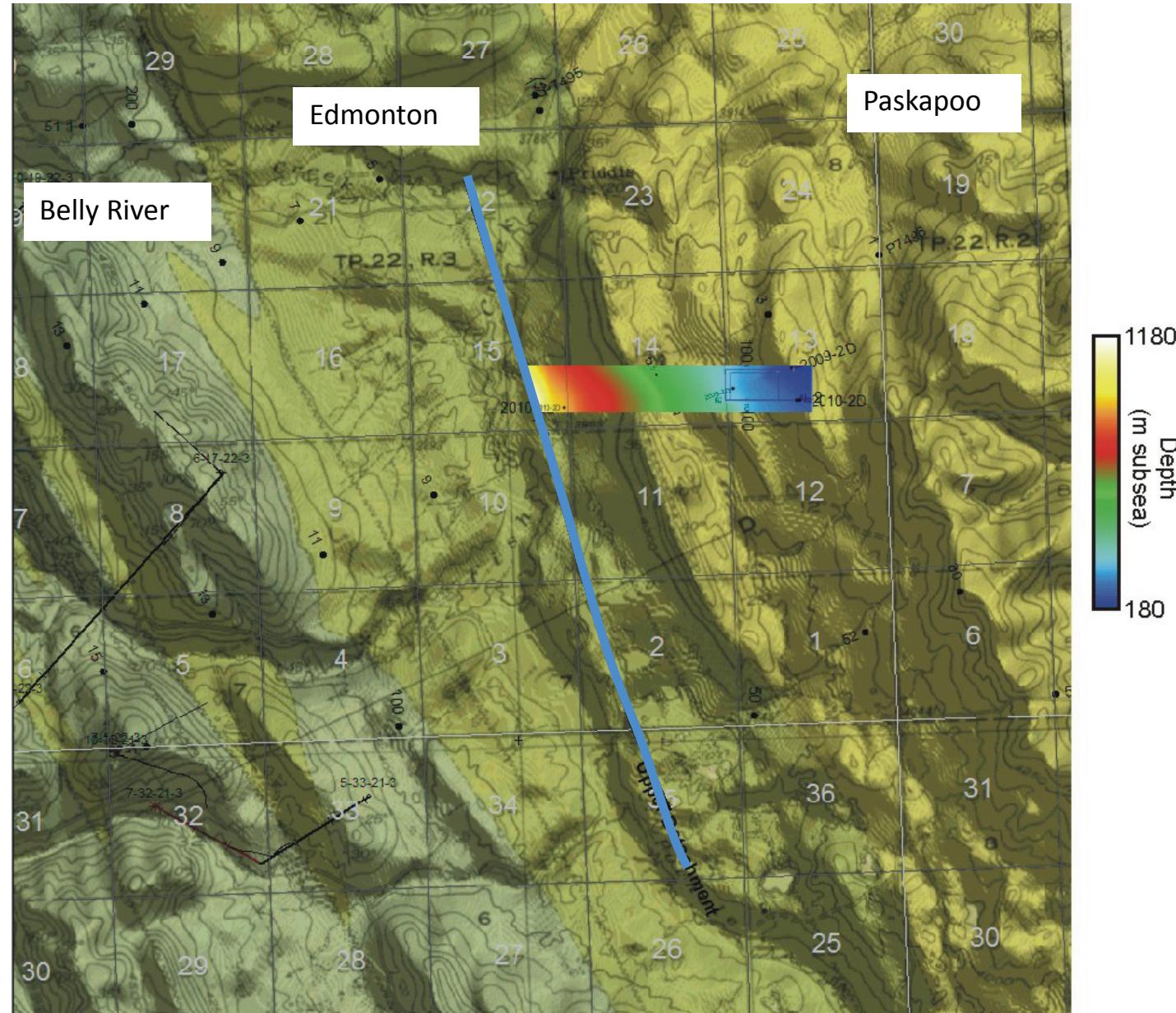




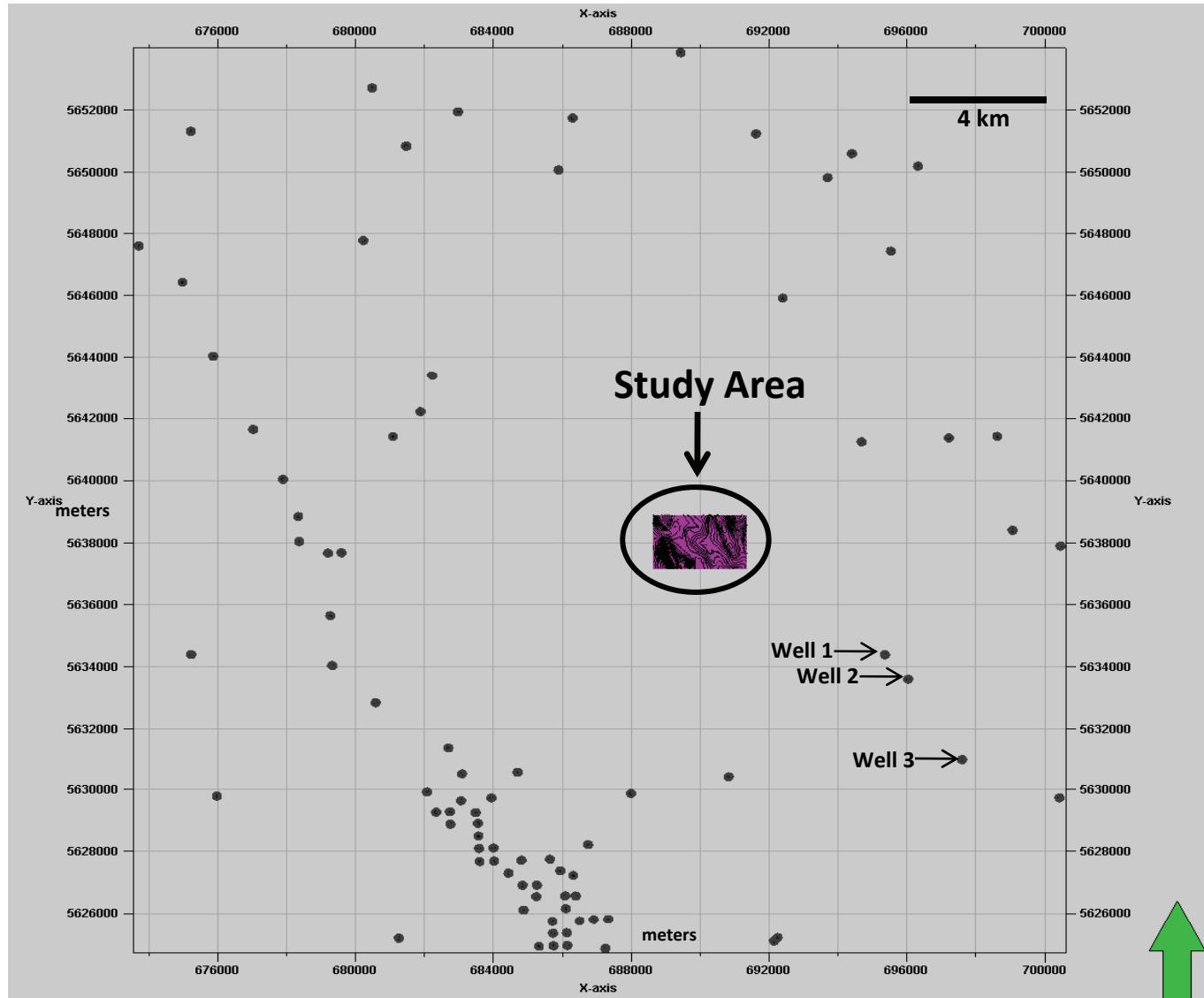
# New 2D seismic line, August 2010



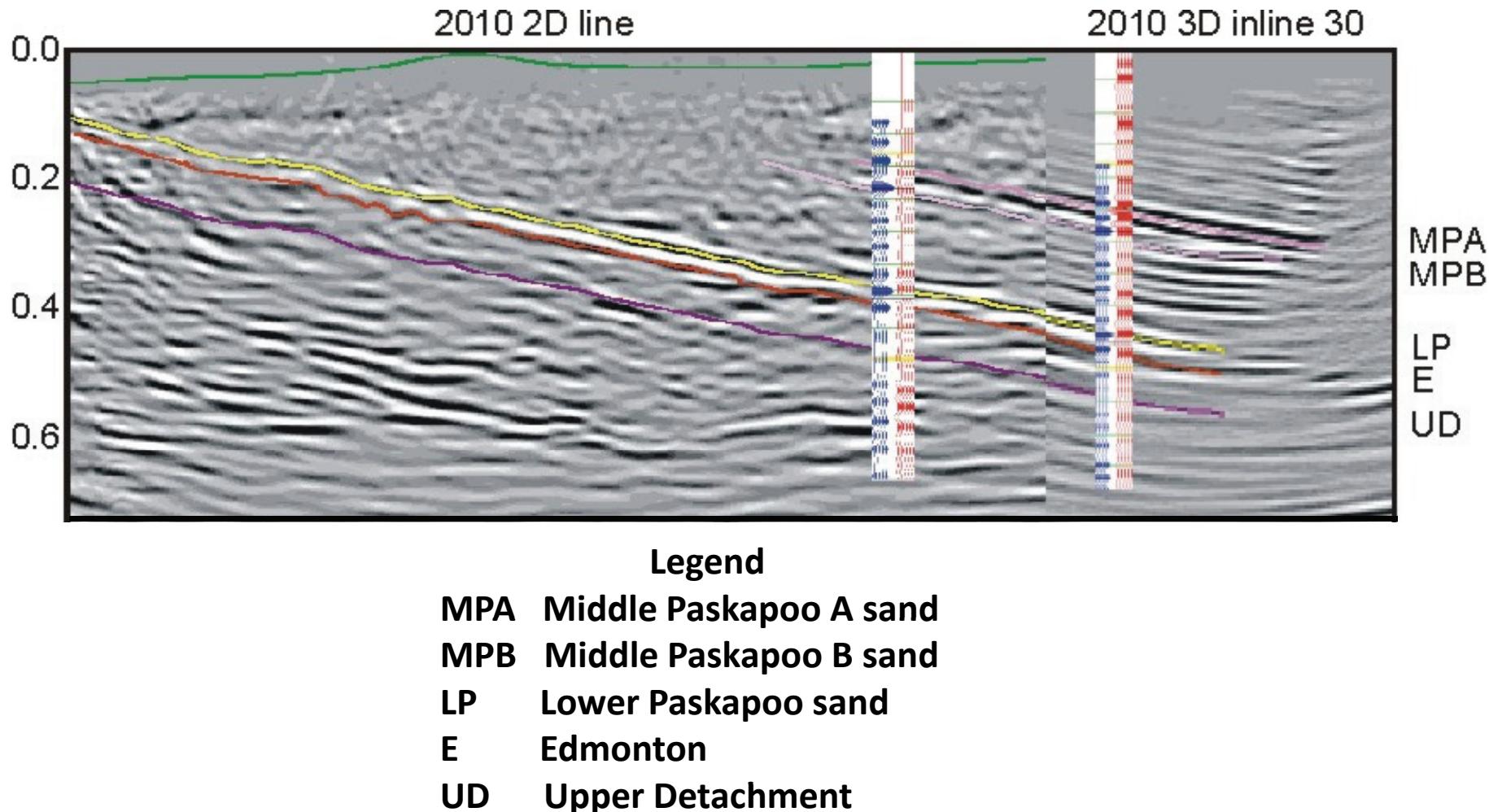
# Upper detachment – field & seismic mapping



# Well projections

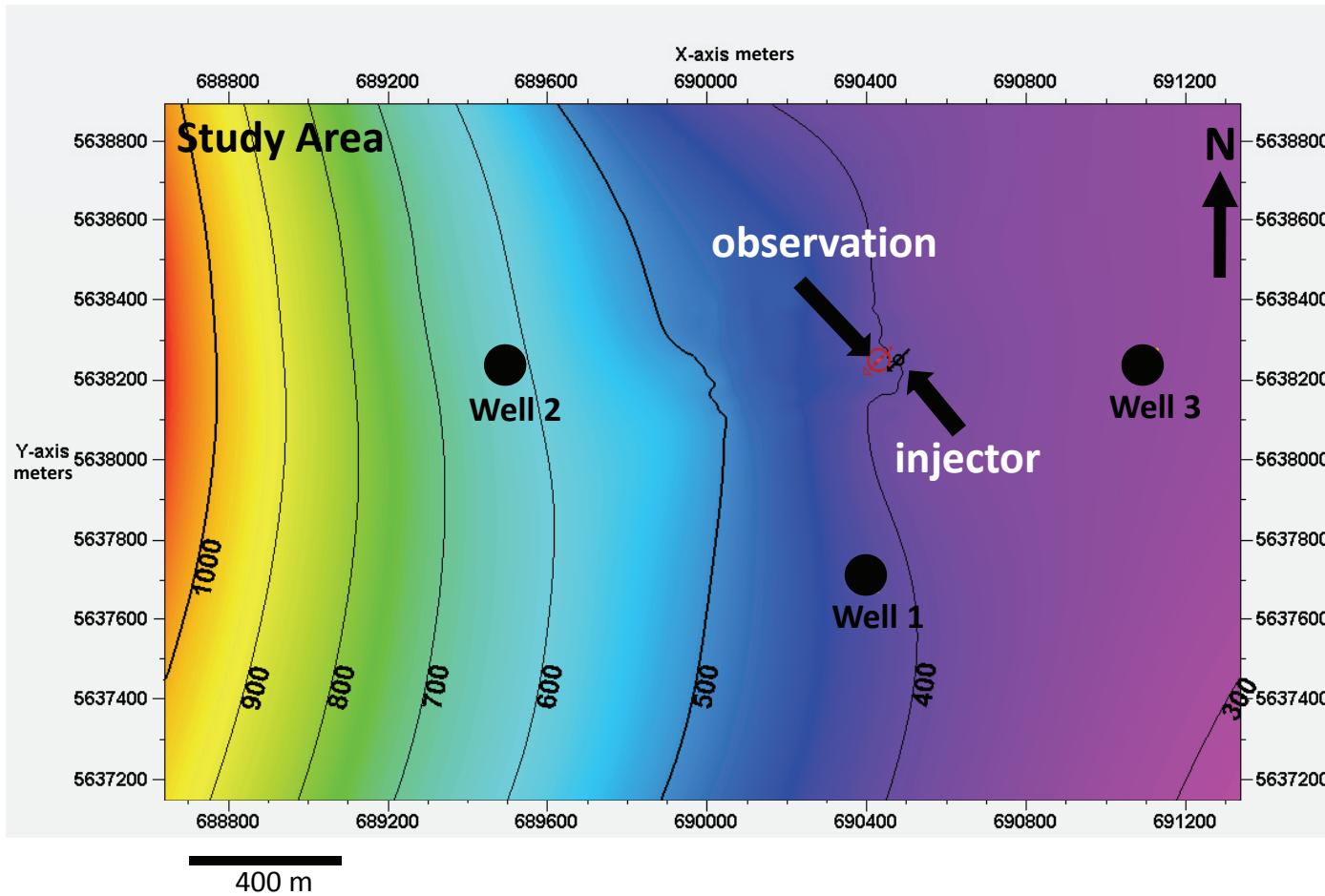


# Seismic data – synthetic ties

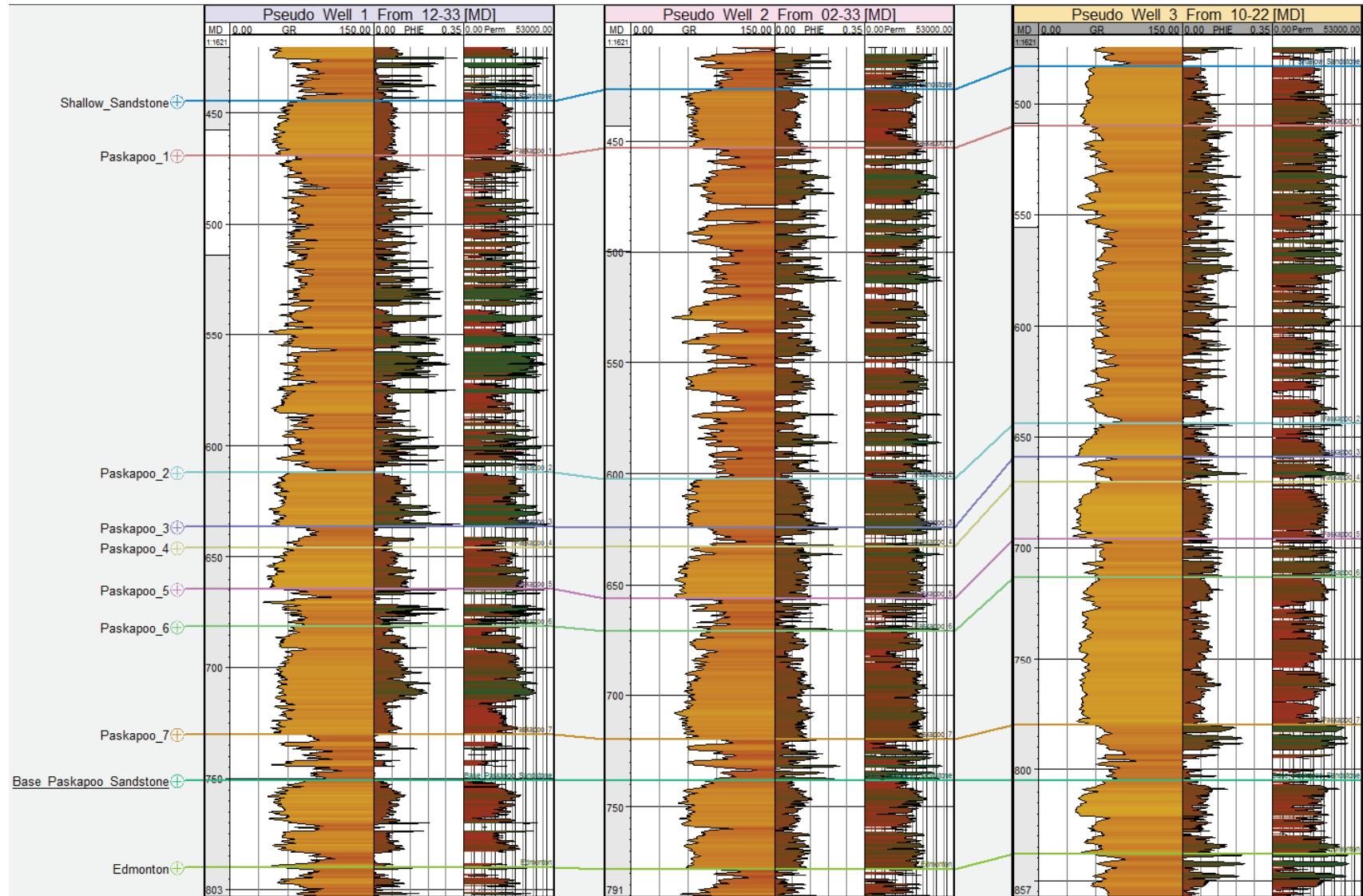


# Pseudo wells

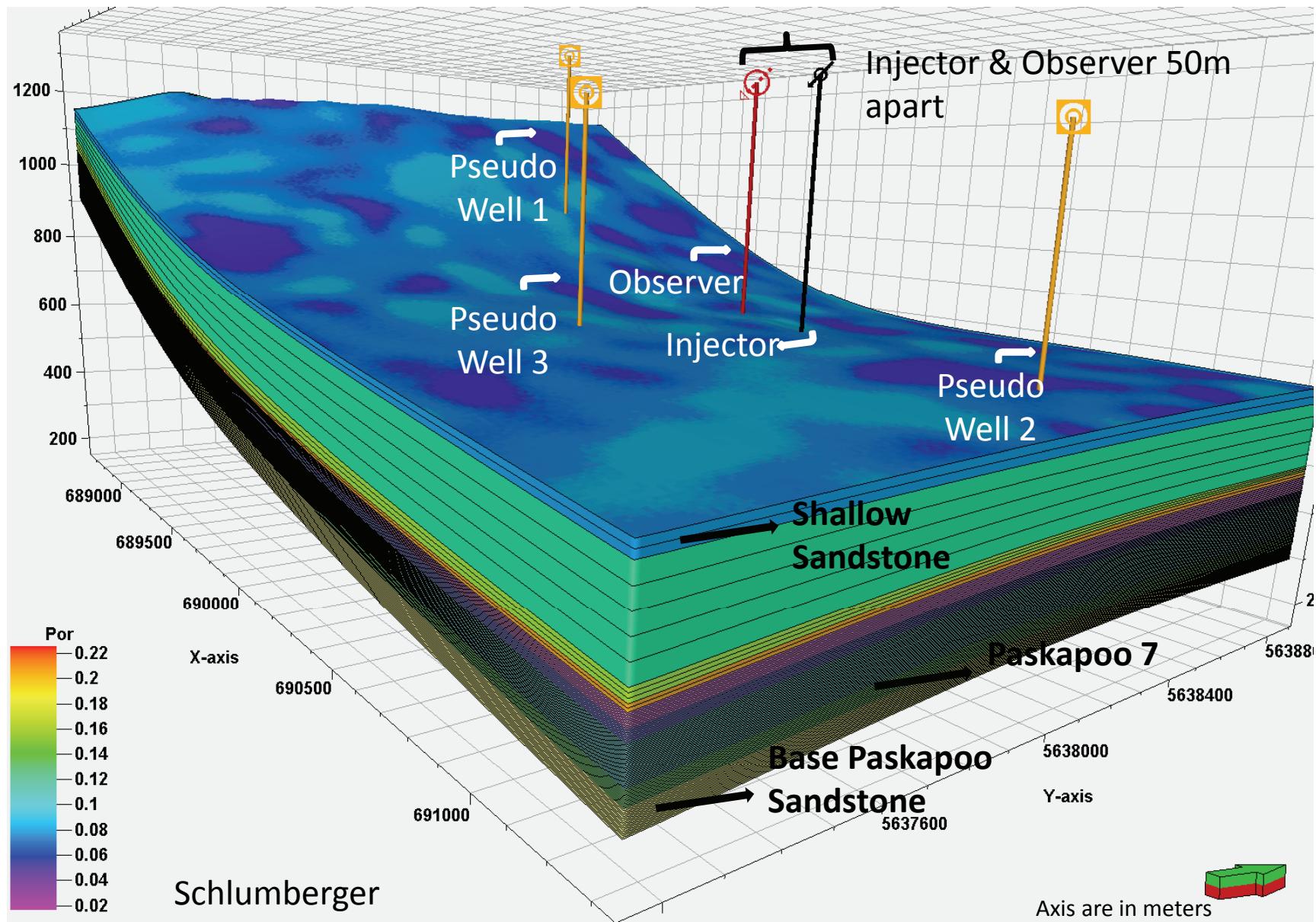
Create pseudo wells from nearby wells with logs into study area and adjust KB elevations to match surfaces extrapolated from seismic data



# Pseudo-wells

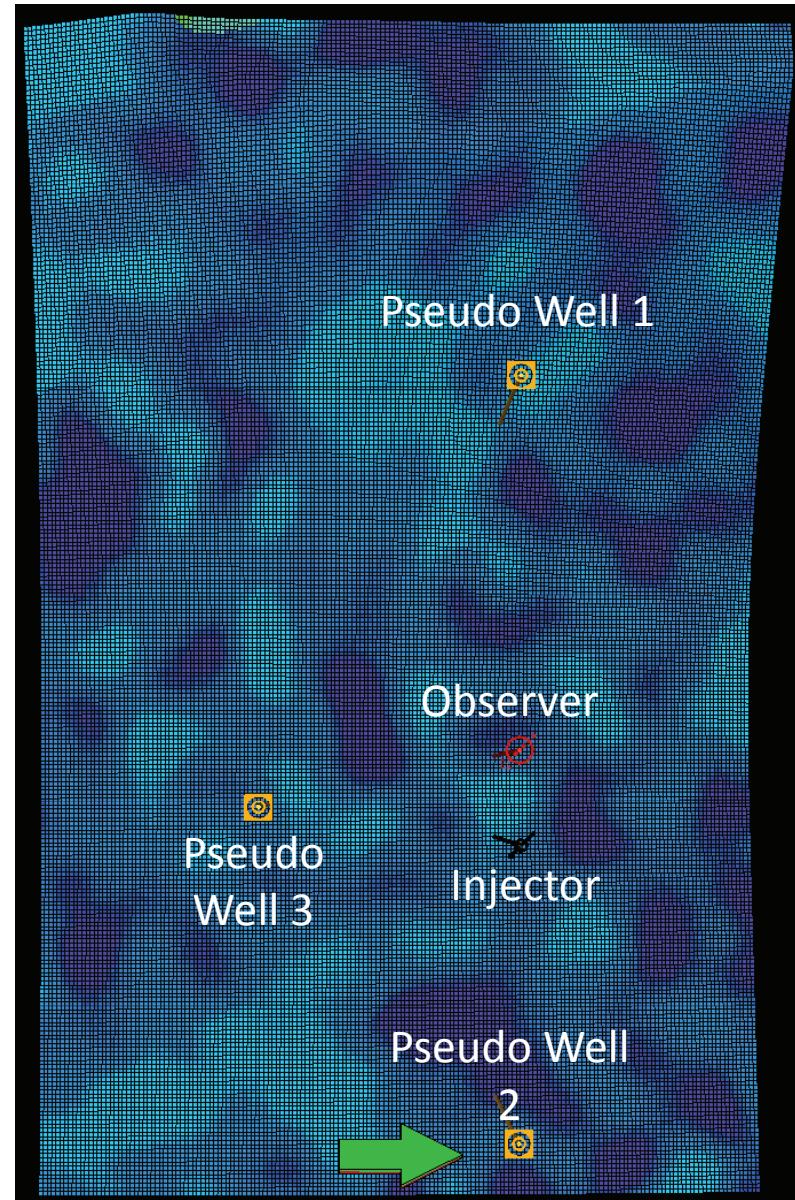


# Geologic model

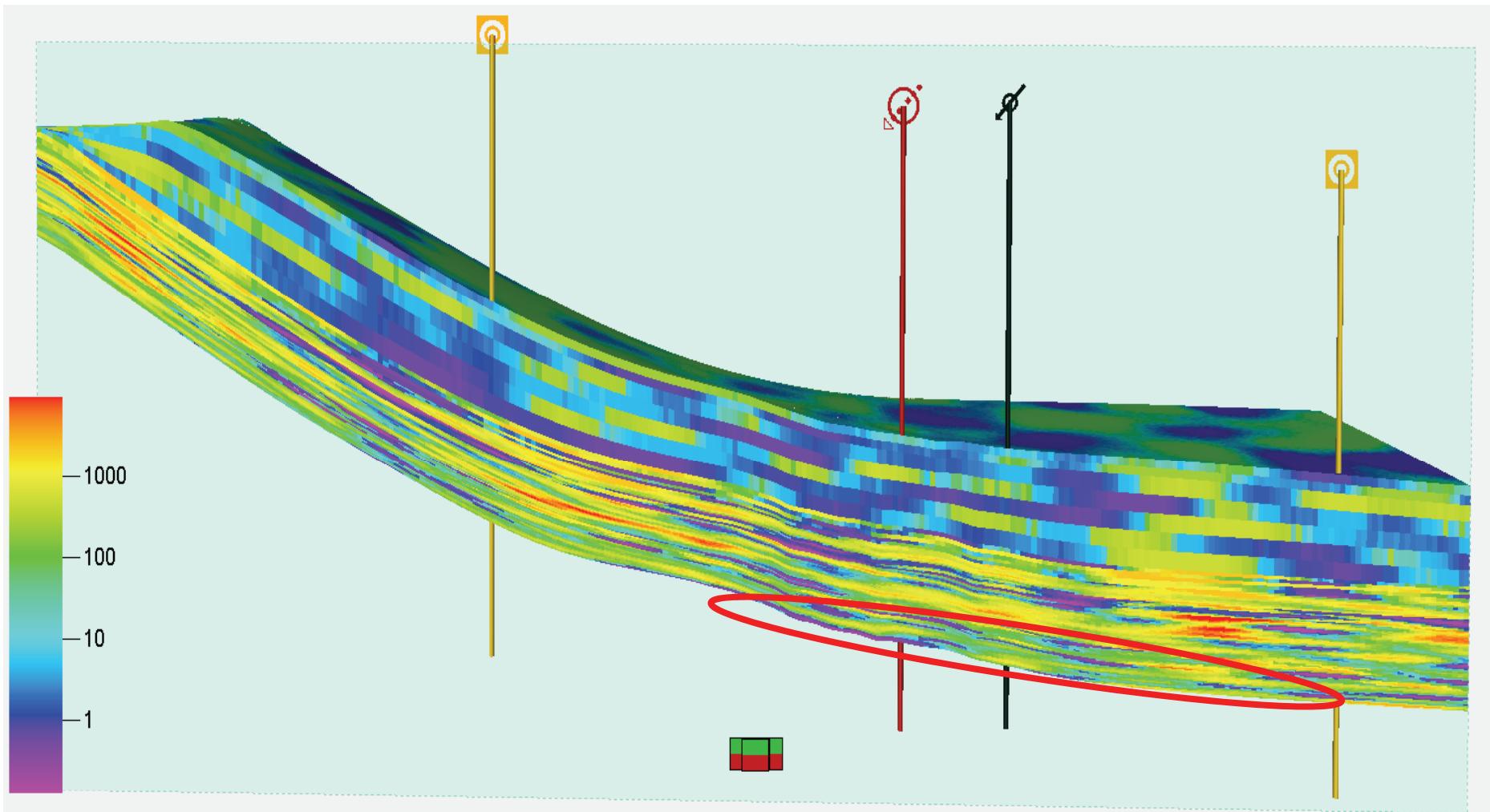


# Geologic model

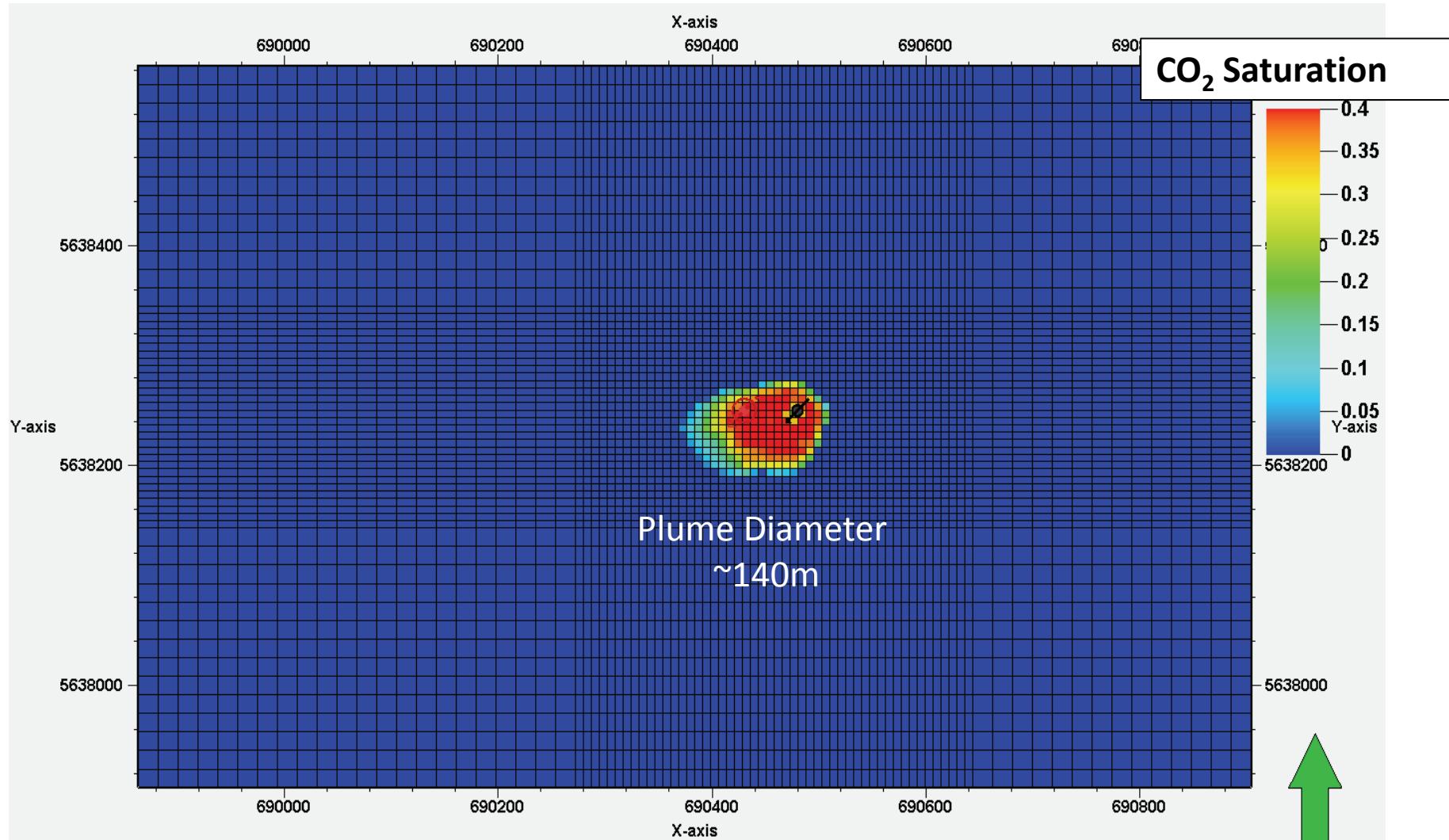
- 2.7×1.7 km study area represented by 269×174 grids
- 10m×10m grids in horizontal directions
- 90 layers used to represent ~341m thick formation
- Thickness of layers change between 1.2m (Injection Zone) and 30m (Overburden)



# Permeability distribution: mean 170 mD

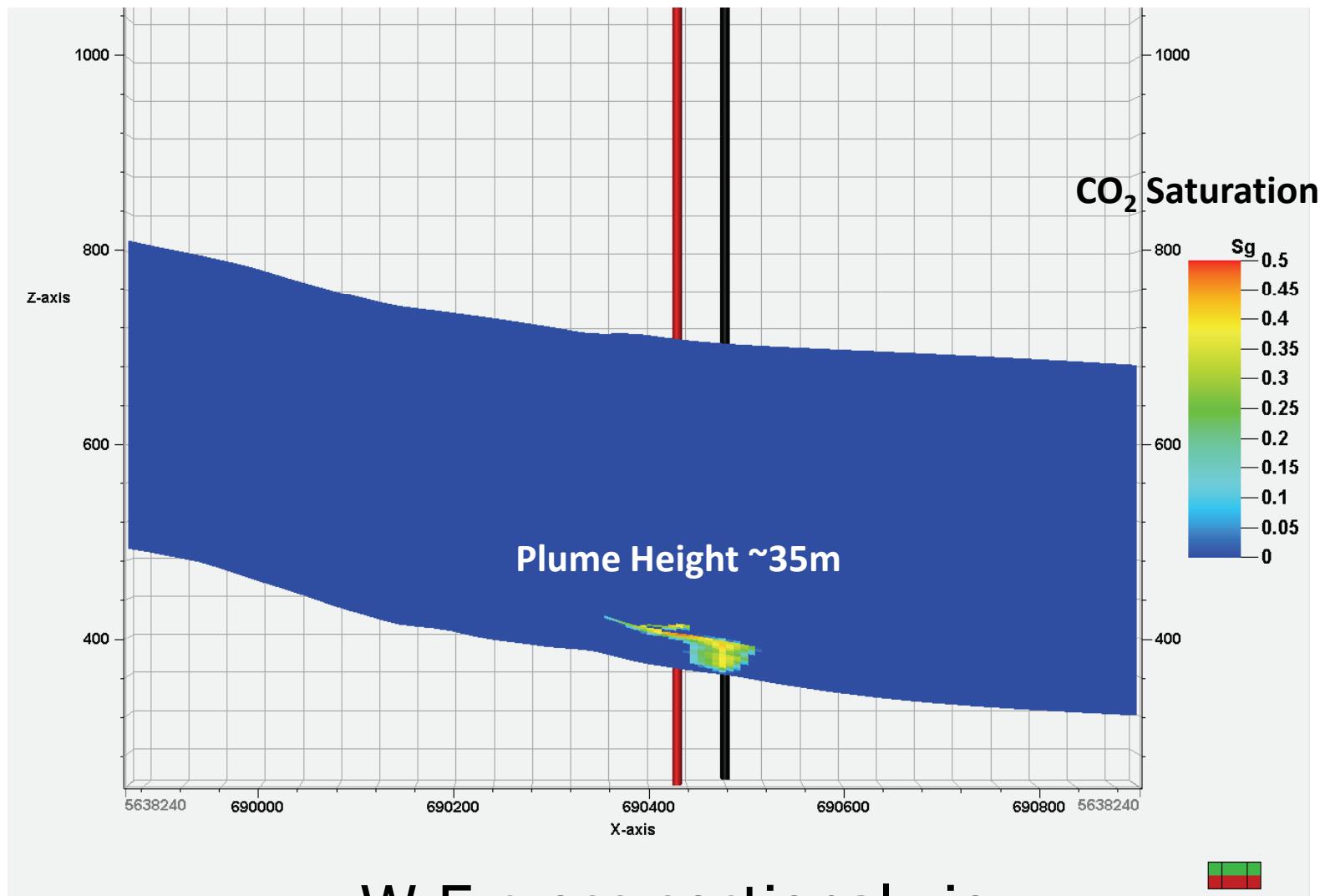


# Five annual CO<sub>2</sub> injections of 600 tonnes, end of injection; pessimistic reservoir quality

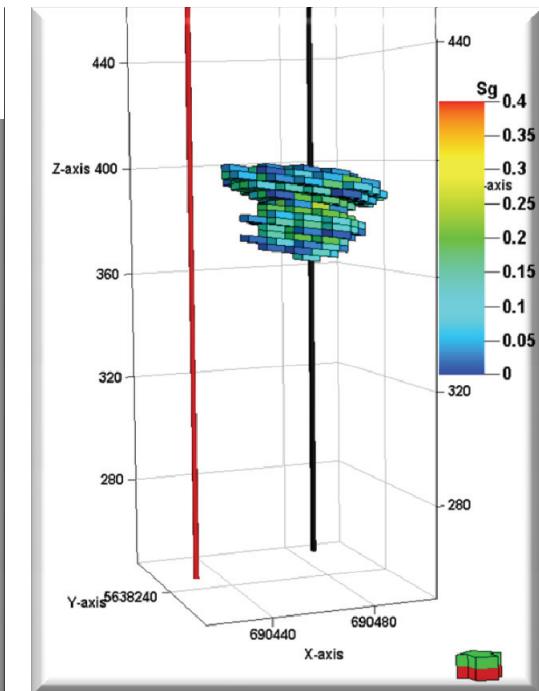
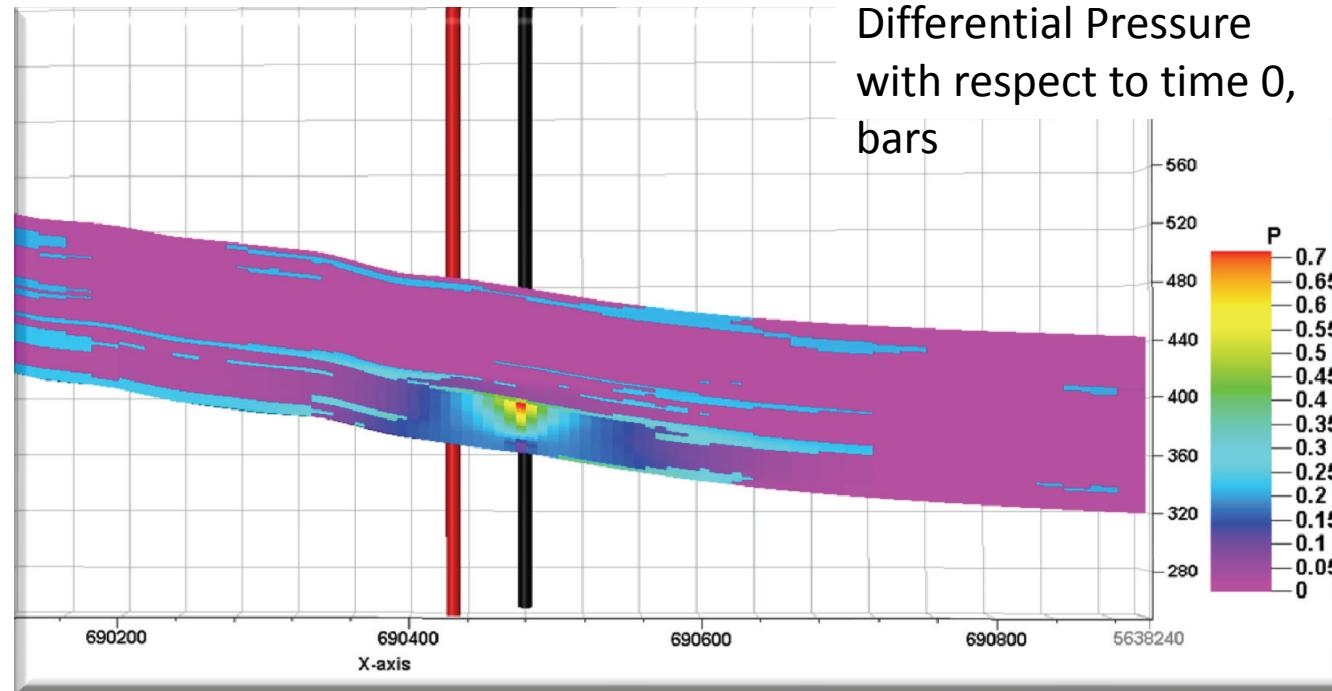


Map view

# Five annual CO<sub>2</sub> injections of 600 tonnes, end of injection; pessimistic reservoir quality

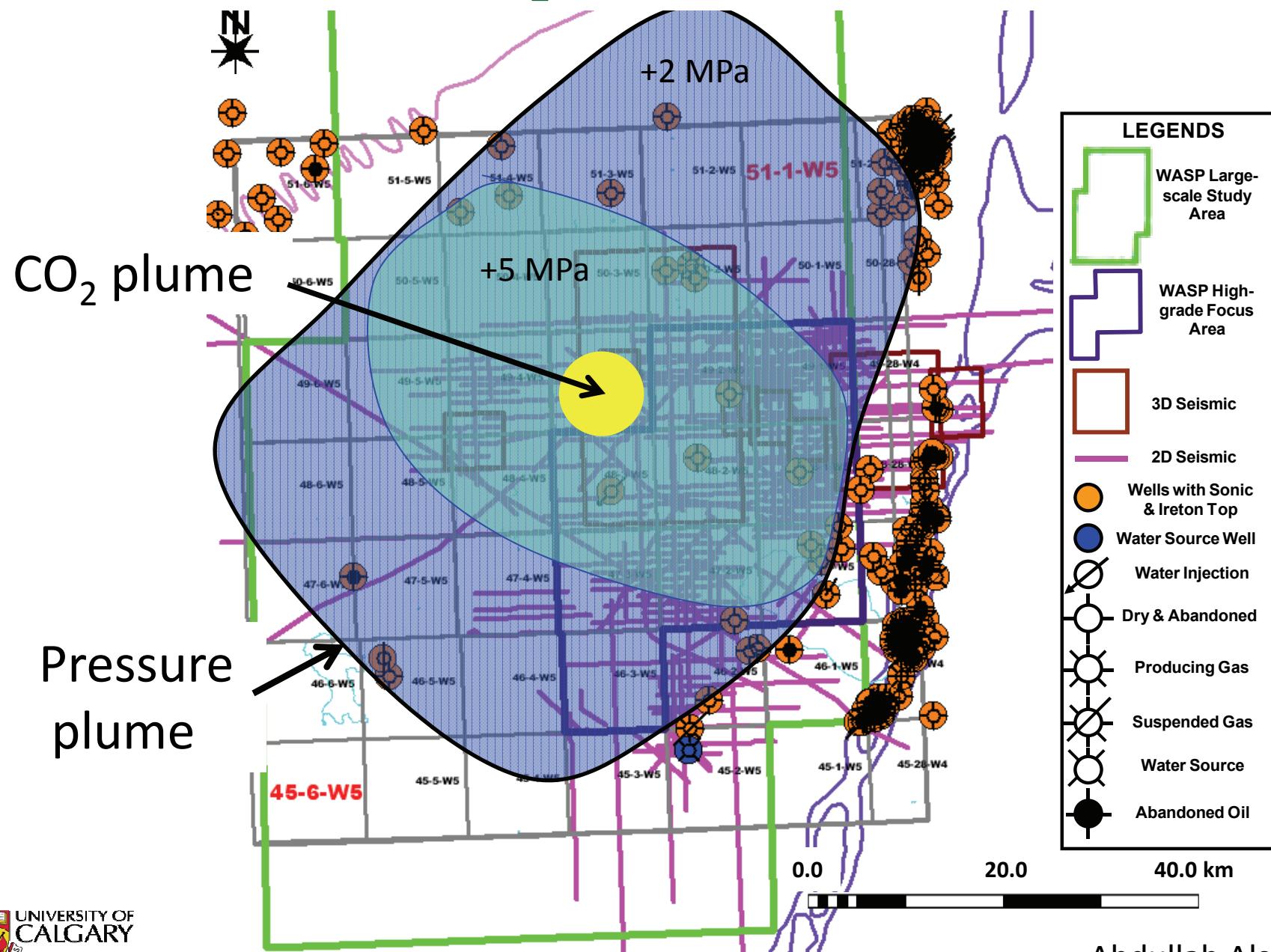


# Five annual CO<sub>2</sub> injections of 600 tonnes, pressure at end of injection pessimistic reservoir quality



3D Plume at the end of Injection

# WASP: 50 years of CO<sub>2</sub> injection (Nisku) at 1 Mt/year



# Risks to be mitigated through monitoring

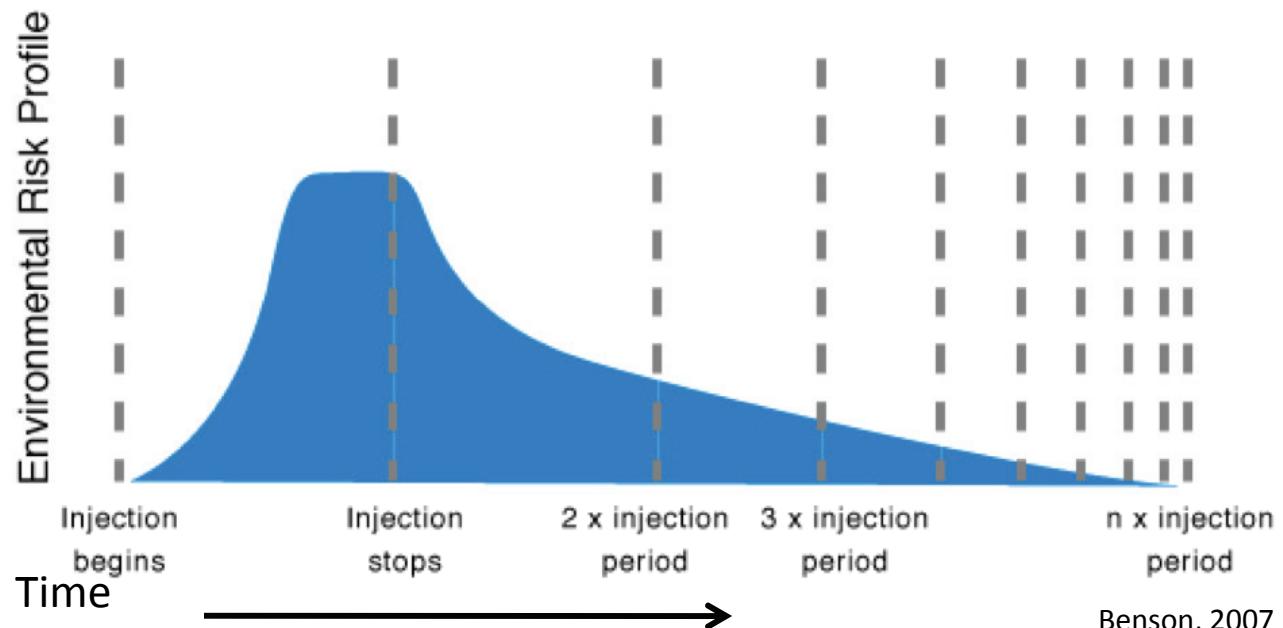
- Pressure interference with existing hydrocarbon pools
- Pressure interference between adjacent CCS projects
- Brine migration through old wells
- Out of zone CO<sub>2</sub> migration to another storage formation (pore space)
- CO<sub>2</sub> migration to shallow aquifers through wells or natural pathways (faults, fractures)

# USDOE National Risk Assessment Partnership

-  [Lawrence Berkeley National Laboratory](#)
-  [Lawrence Livermore National Laboratory](#)
-  [Los Alamos National Laboratory](#)
-  [National Energy Technology Laboratory](#)
-  [Pacific Northwest National Laboratory](#)

## **NRAP's MISSION**

*To provide the scientific underpinning for risk assessment with respect to the long-term storage of CO<sub>2</sub>, including assessment of residual risk associated with a site post-closure.*



# Timelines/Conclusions

- Full project proposal to ERCB by Dec 31, 2010
- Approvals by March 31, 2011
- Test well drilled July, 2011
- Test well evaluation August, 2011
- Go/no go decision for injection
- Injection permit, September, 2011
- Observation well(s) drilled Fall 2011
- MMV installation, Fall 2011
- CO<sub>2</sub> injection to start, 2012
- .... I retire sometime after that

# Acknowledgements

- CREWES sponsors
- CREWES staff and students
- 2010 Geophysics Field School students
- ISEEE, University of Calgary
- Carbon Management Canada
- ARAM Rentals
- Schlumberger Carbon Services
- NSERC, AERI