CMC
Containment &
Monitoring Institute

# CaMI CCS FIELD RESEARCH STATION
# ALBERTA, CANADA

## 10TH $CO_2$GEONET OPEN FORUM
## 11TH – 12TH MAY 2015

**DON LAWTON (CaMI)**
**RICHARD ADAMSON (CMC)**
**KIRK OSADETZ (CaMI)**
**AMIN SAEEDFAR (CaMI)**

# CMC RESEARCH INSTITUTES AND CaMI

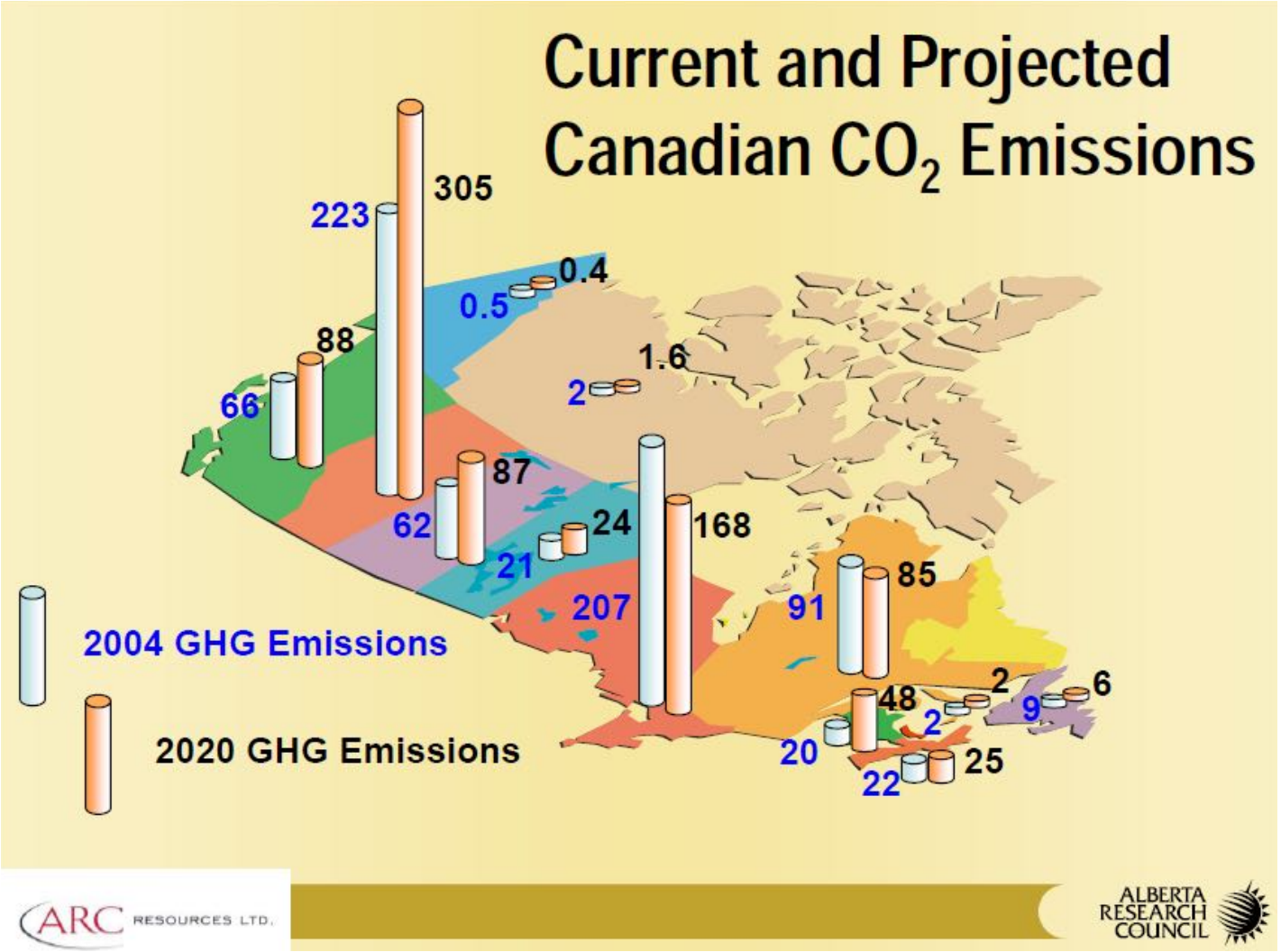
***CMC Research Institutes, Inc. is federally incorporated independent not-for-profit corporation dedicated to accelerating innovation associated with addressing the challenge of industrial greenhouse gas emissions.***

***The Containment and Monitoring Institute (CMC.CaMI) is the first of a series of challenge-focused research institutes developed as operating divisions of CMC.***

***CMC is hosted by the University of Calgary.***

***CaMI is an affiliate of the University of Calgary, which is actively involved in the Field Research Station at Newell County.***

# CANADA'S $CO_2$ EMISSIONS




ARC RESOURCES LTD.

ALBERTA RESEARCH COUNCIL

# GOVERNMENT OF ALBERTA CCS RFA

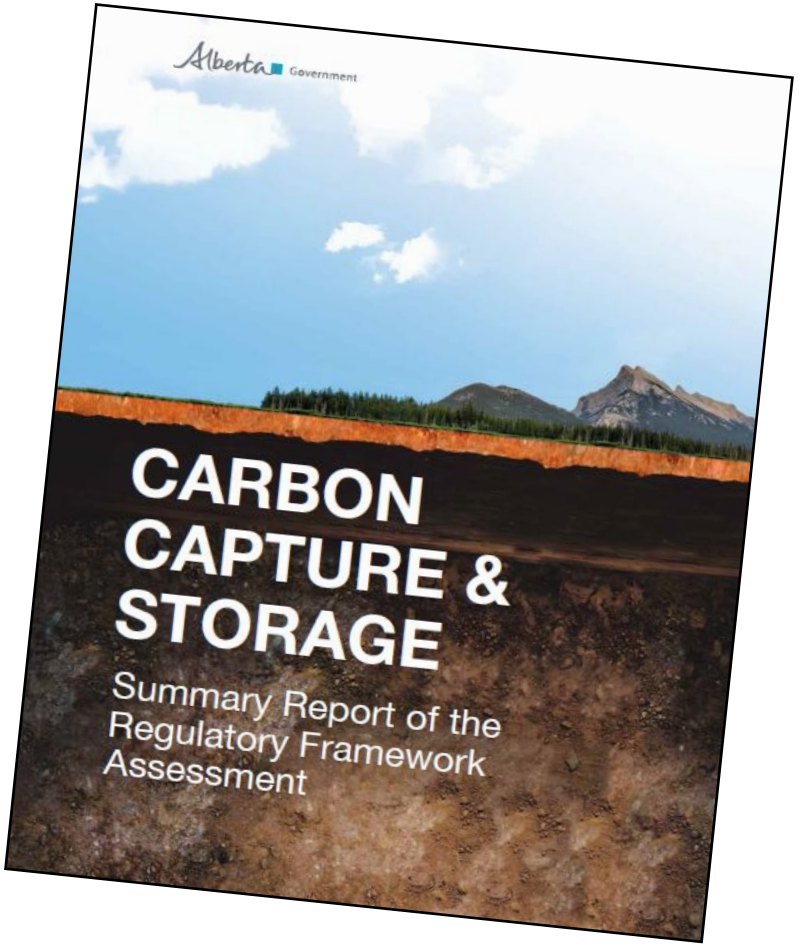
**Government**

**of Alberta**

**Regulatory**

**Framework Assessment**

**(August 2013)**



# RFA RECOMMENDATION

## RISK ASSESSMENT, MONITORING, & TECHNICAL REQUIREMENTS

***"Require MMV and closure plans to be based on a project-specific risk assessment, and include the use of best available technologies to monitor the atmosphere, surface, ground and surface water, and subsurface."***

# RFA CLOSURE MMV

## RECOMMENDATIONS FOR CLOSURE REQUIREMENTS

*"a) Sequestered $CO_2$ and affected fluids are conforming to the objectives and regulatory requirements as described in the project application and approvals.*

*c) Sequestered $CO_2$ and affected fluids are contained in the sequestration complex.*

*d) Sequestered $CO_2$ is behaving in a predictable manner.*

*e) Sequestered $CO_2$ is expected to continue to behave in a predictable manner and is trending towards stability"*

# MONITORING CHALLENGES

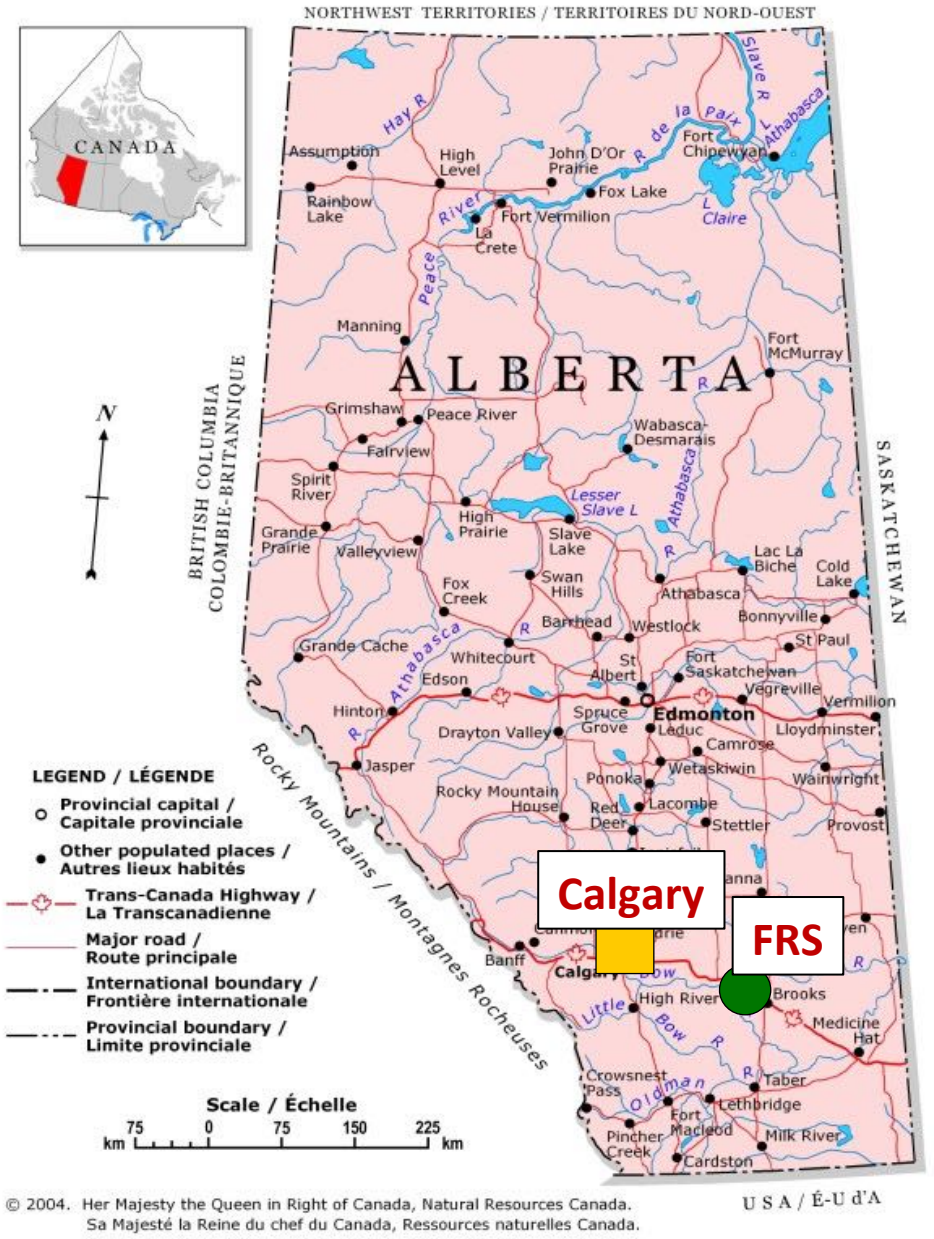
## VERIFICATION OF CONFORMANCE AND CONTAINMENT

- ***Thin storage formations (saturation-thickness)***
- ***Cap rock integrity***
- ***Thief zones, resolution from monitoring methods***
- ***High rock matrix K and μ values***
- ***Pressure vs $CO_2$ saturation***
- ***Pressure interference with existing hydrocarbon pools***
- ***Pressure interference between adjacent CCS projects***
- ***Brine/$CO_2$ migration through old wells***
- ***Out of zone $CO_2$ migration to another storage formation (pore space encroachment)***

# CaMI FIELD RESEARCH STATION (FRS)

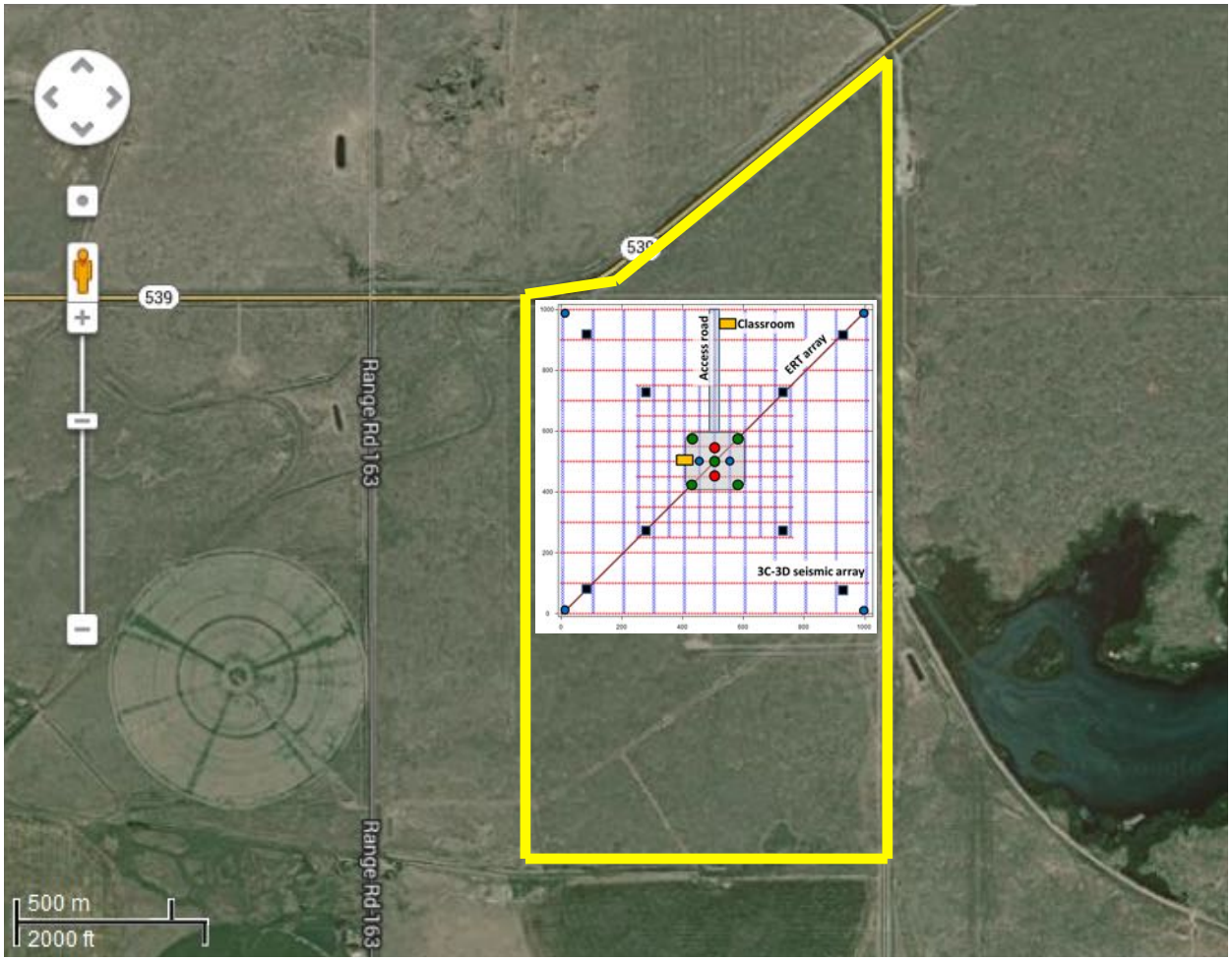
- *Undertake controlled $CO_2$ release at 300 m & 500 m depth; ~1000 t/yr.*
- *Determine $CO_2$ detection thresholds*
- *Develop improved monitoring technologies.*
- *Monitor gas migration at shallow to intermediate depths.*
- *University & industry field training & research, integrating engineering and geoscience*
- *Provide quantitative monitoring knowledge to the regulator (AER)*
- *Accelerate public outreach & education.*
- *Provide on-site fuel cell for $CO_2$ source and natural gas utilization; energy storage; energy efficiency*

# LOCATION OF THE FRS

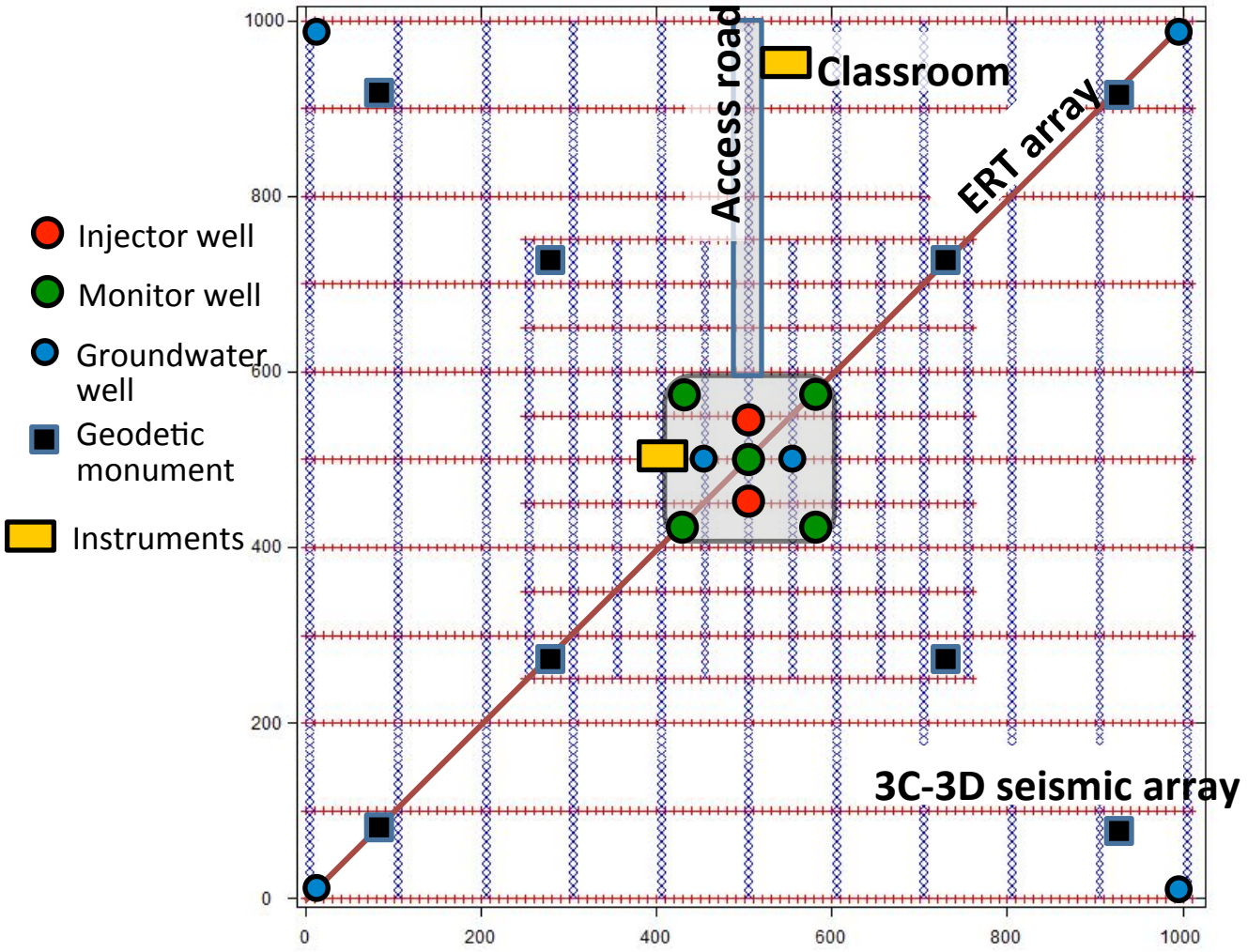


# FRS SITE – COURTESY OF CENOVUS

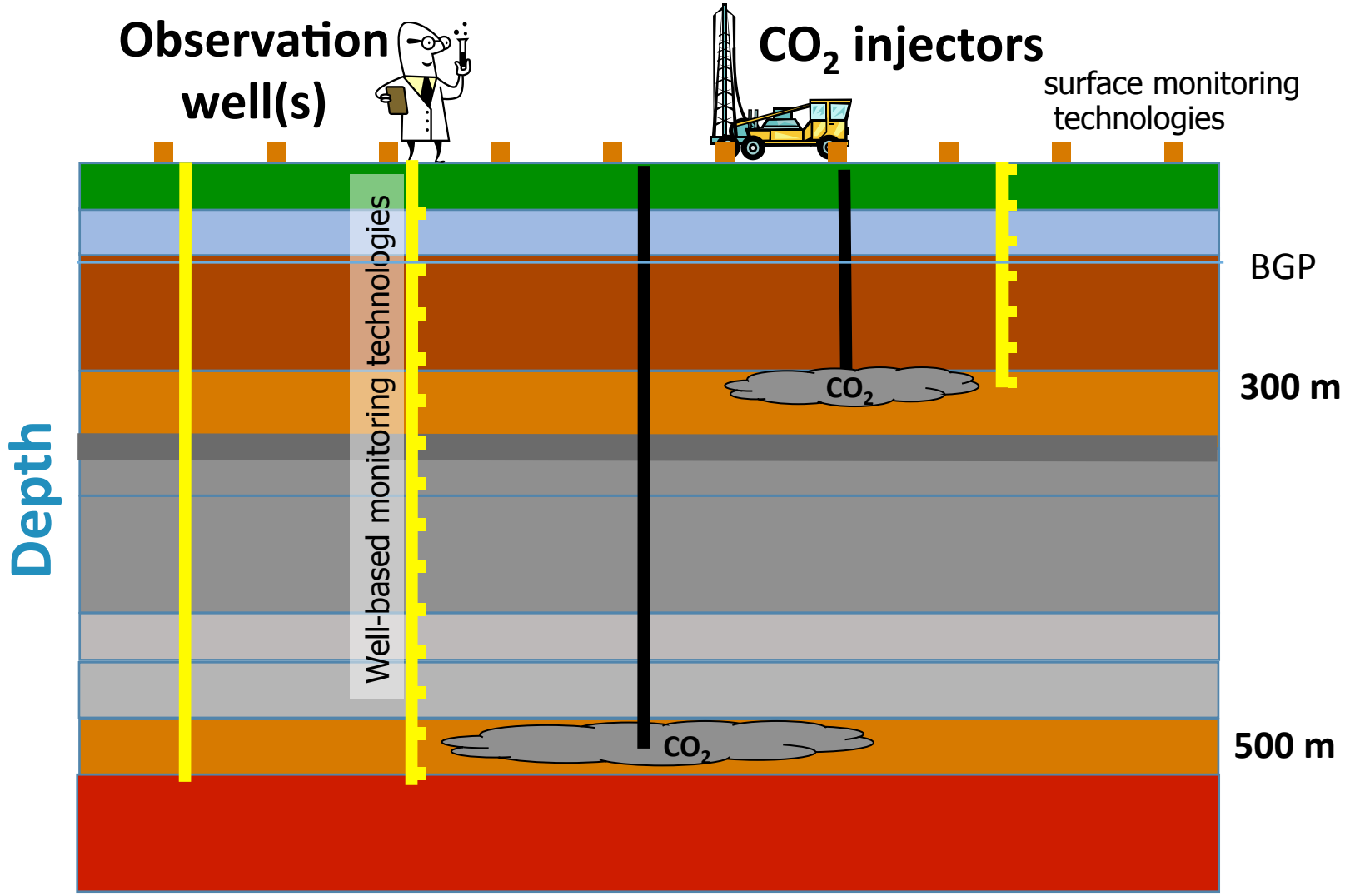
# CAMI | UOFC | FRS



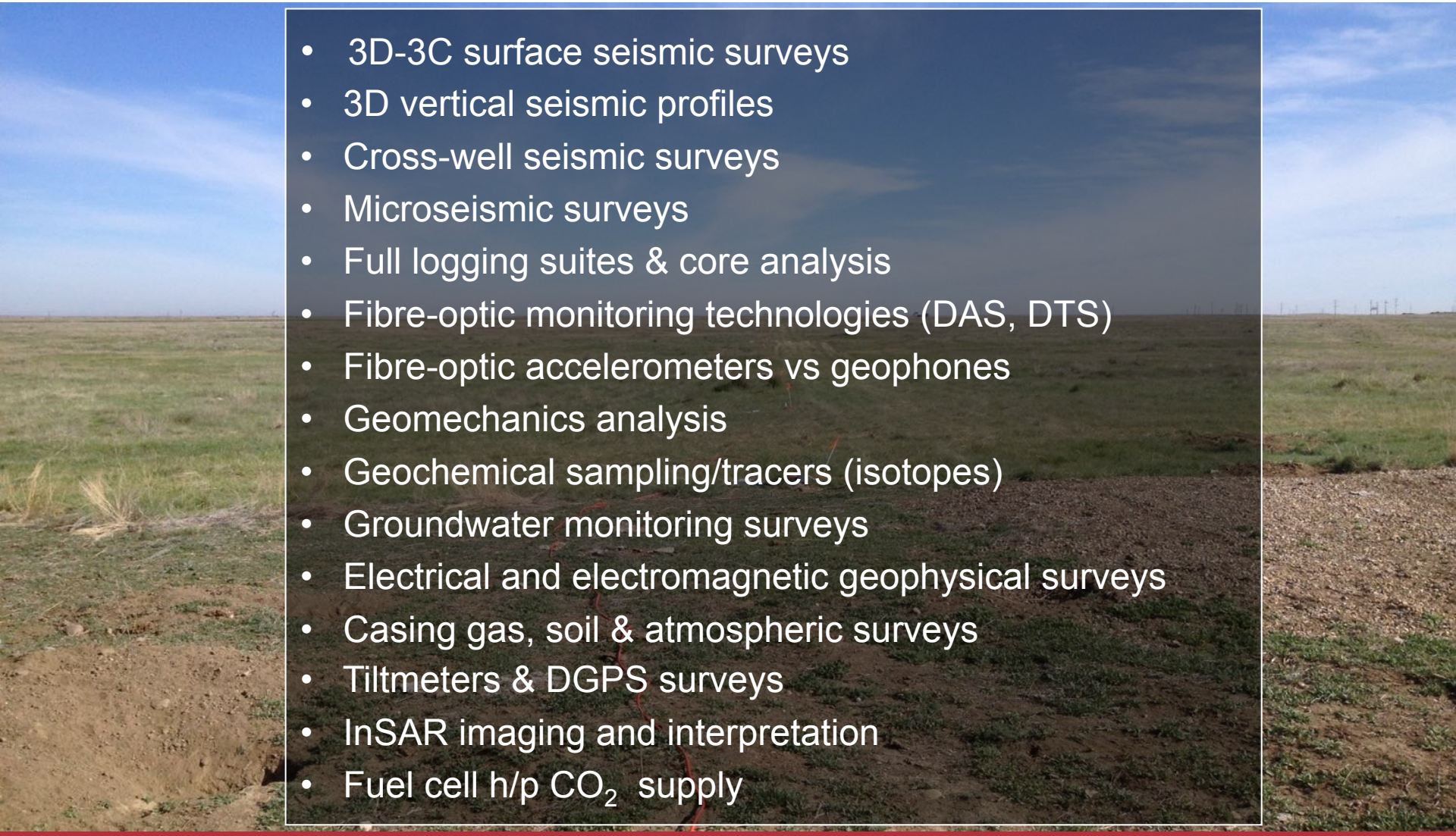
# FRS MONITORING LAYOUT



# FRS SCHEMATIC



# FRS monitoring technologies



- 3D-3C surface seismic surveys
- 3D vertical seismic profiles
- Cross-well seismic surveys
- Microseismic surveys
- Full logging suites & core analysis
- Fibre-optic monitoring technologies (DAS, DTS)
- Fibre-optic accelerometers vs geophones
- Geomechanics analysis
- Geochemical sampling/tracers (isotopes)
- Groundwater monitoring surveys
- Electrical and electromagnetic geophysical surveys
- Casing gas, soil & atmospheric surveys
- Tiltmeters & DGPS surveys
- InSAR imaging and interpretation
- Fuel cell h/p $CO_2$ supply

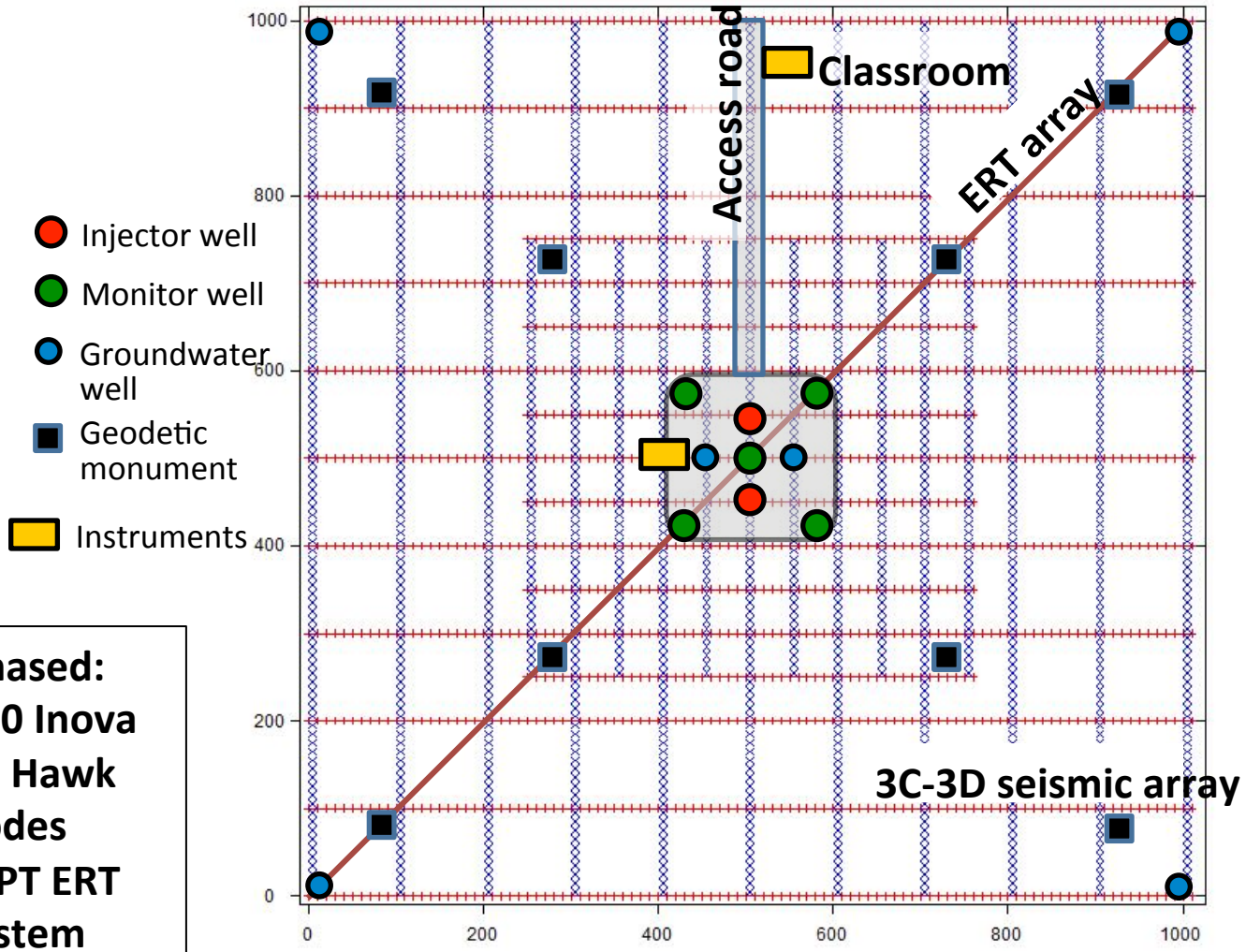
# PUBLIC ENGAGEMENT AND OUTREACH

## March 13 & May 8, 2014: County of Newell

- *Manager – Planning and Development*
- *Director of Information Technology*
- *Manager of Fire and Emergency Services*
- *Chief Administrative Officer*
- *Director of Corporate Services*
- *Director of Agricultural Services*

The latest in greenhouse gas containment technology: Don Lawton, PhD, PGeoph is proposing a carbon capture containment and monitoring research station near Scandia that will attract international attention when up and running in early 2015. Lawton, centre, made a pitch for County of Newell support last week with part of his team, Ruth Klinkhammer, right, and Kirk Osadetz, left. Mickey Dumont | Chronicle photo

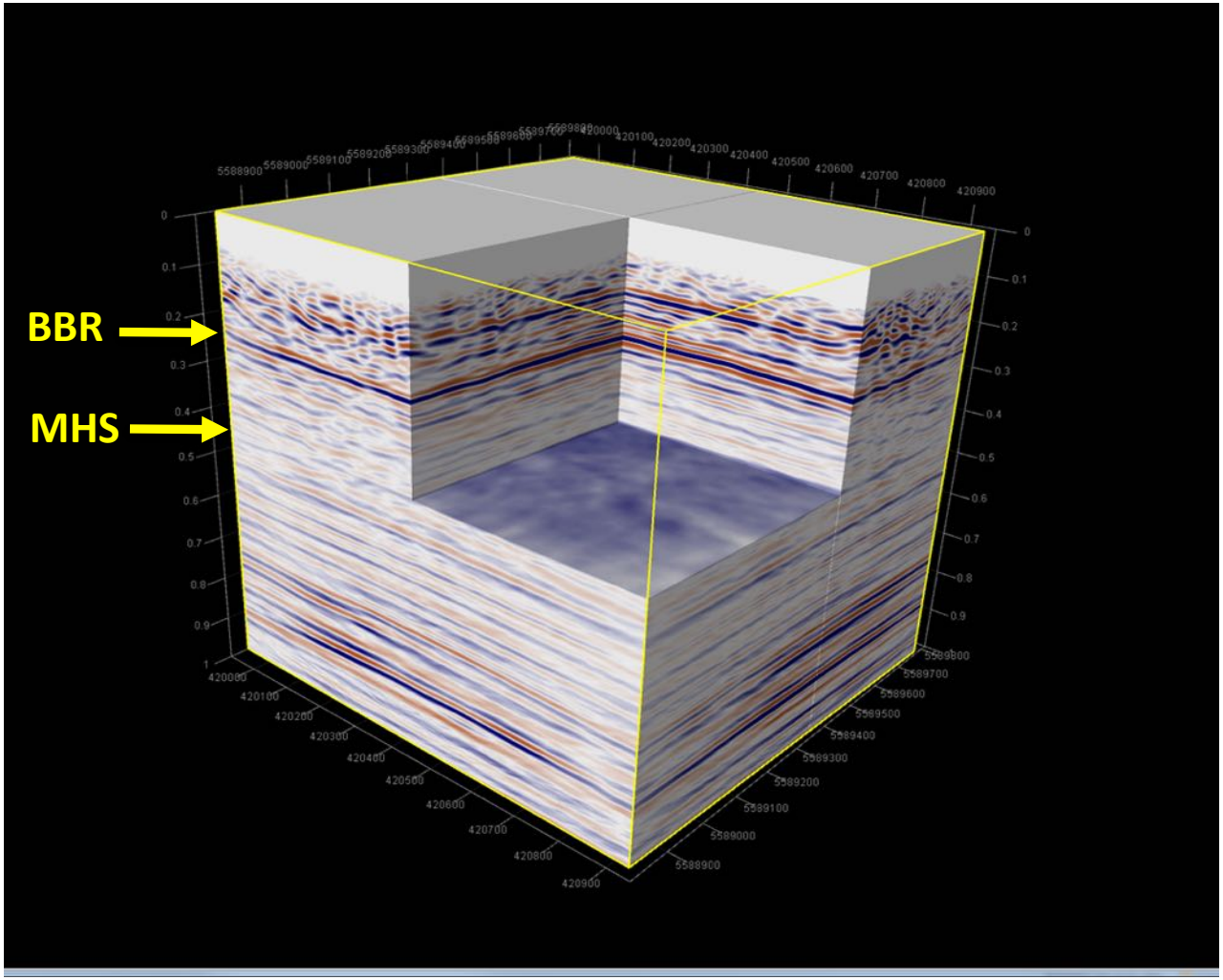
# FRS MONITORING LAYOUT



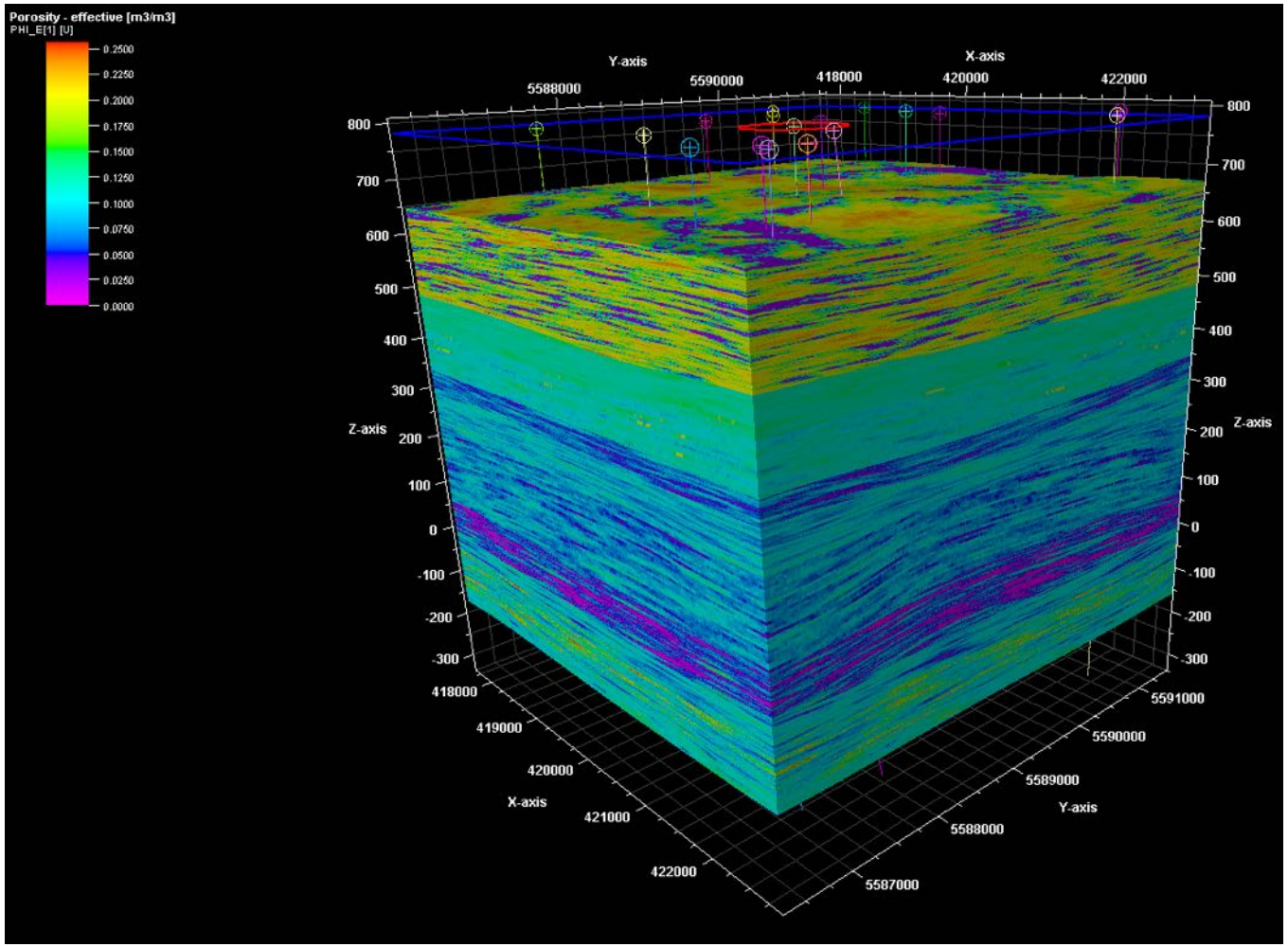

**Purchased:**

- **500 Inova 3C Hawk nodes**
- **MPT ERT system**

# FRS SEISMIC VOLUME

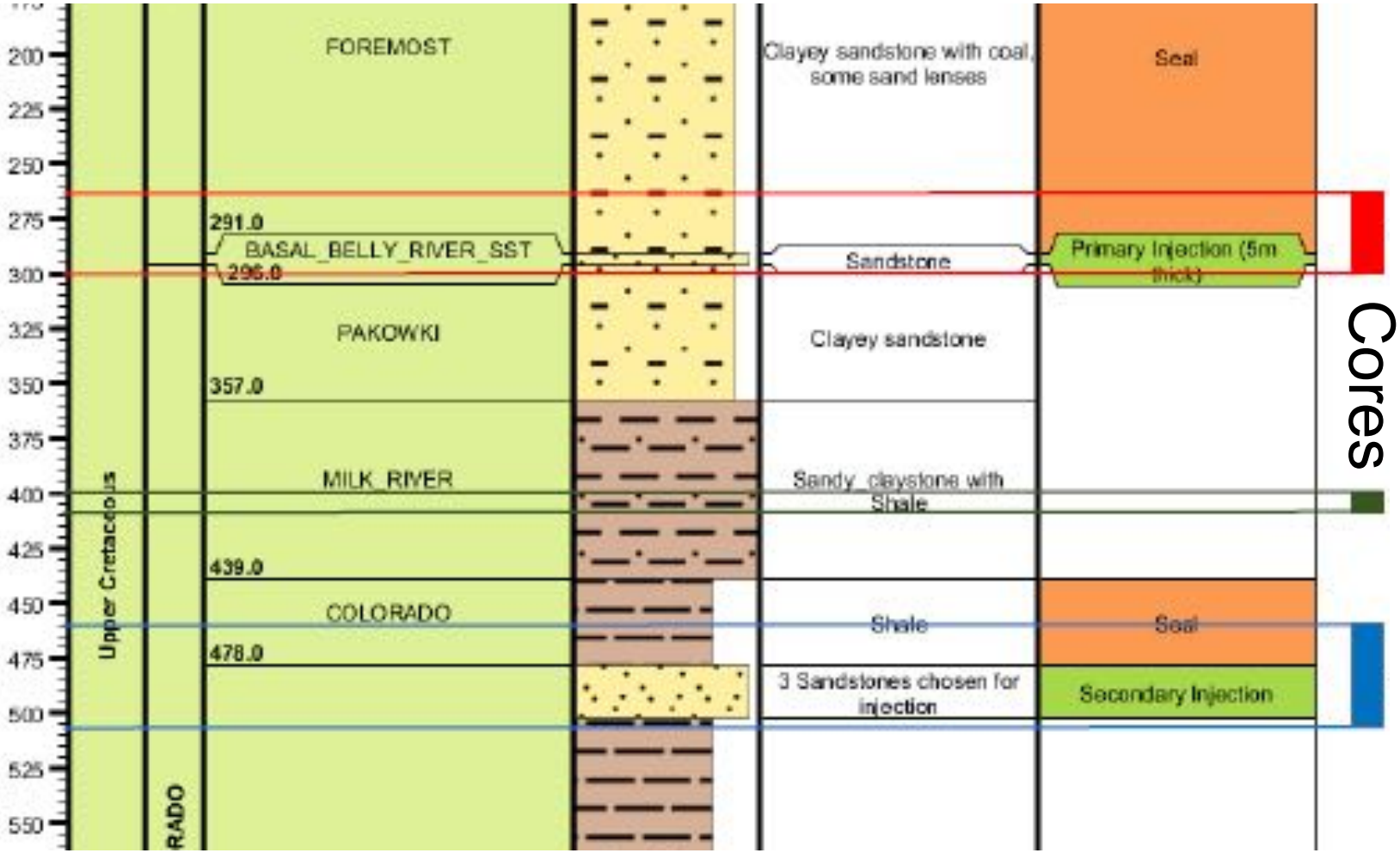


# FRS GEOSTATIC MODEL



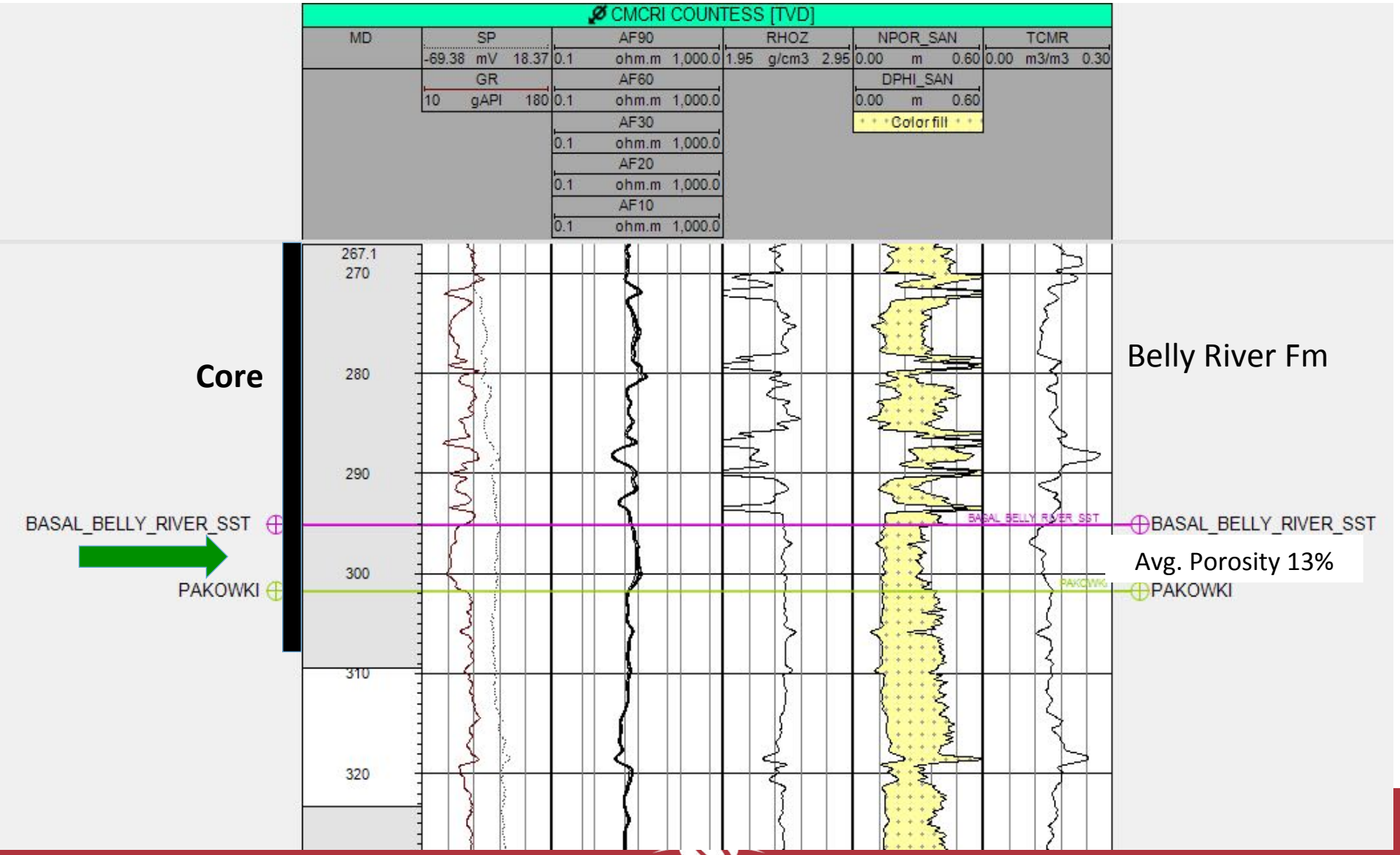
# FRS #1 WELL (FEB 2015)

# FRS #1 SAMPLING




Mud-gas sampling every 5 m

# BASAL BELLY RIVER FM (300m)



# BASAL BELLY RIVER FM (300m)

## Cap rock


## Reservoir

# MOBILE GEOCHEM LABORATORY

- *Sondes for field measurements (pH, EC, T, DO, Eh)*
- *Soil gas flux chambers and soil gas collection probes*
- *Gas chromatographs for hydrocarbon and soil gas analyses*
- *Ion chromatograph (Dionex) for anion and cation concentration analyses on water samples*
- *Titrators for alkalinity and $H_2S$ in water samples*
- *Portable $H_2S$ gas analyzer*
- *Carbon isotope laser analyzer for methane*
- *Carbon and oxygen isotope laser*

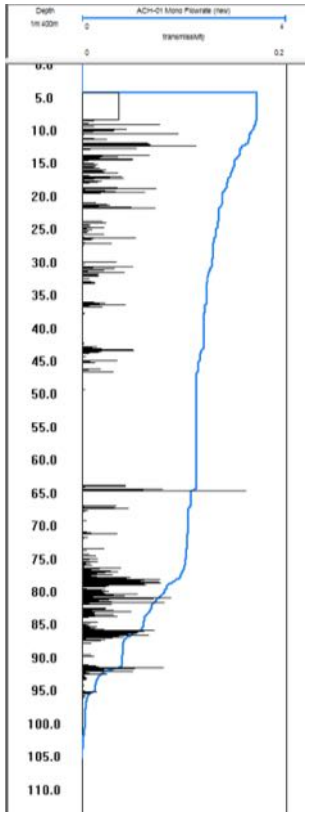
# NEAR-SURFACE CHARACTERIZATION

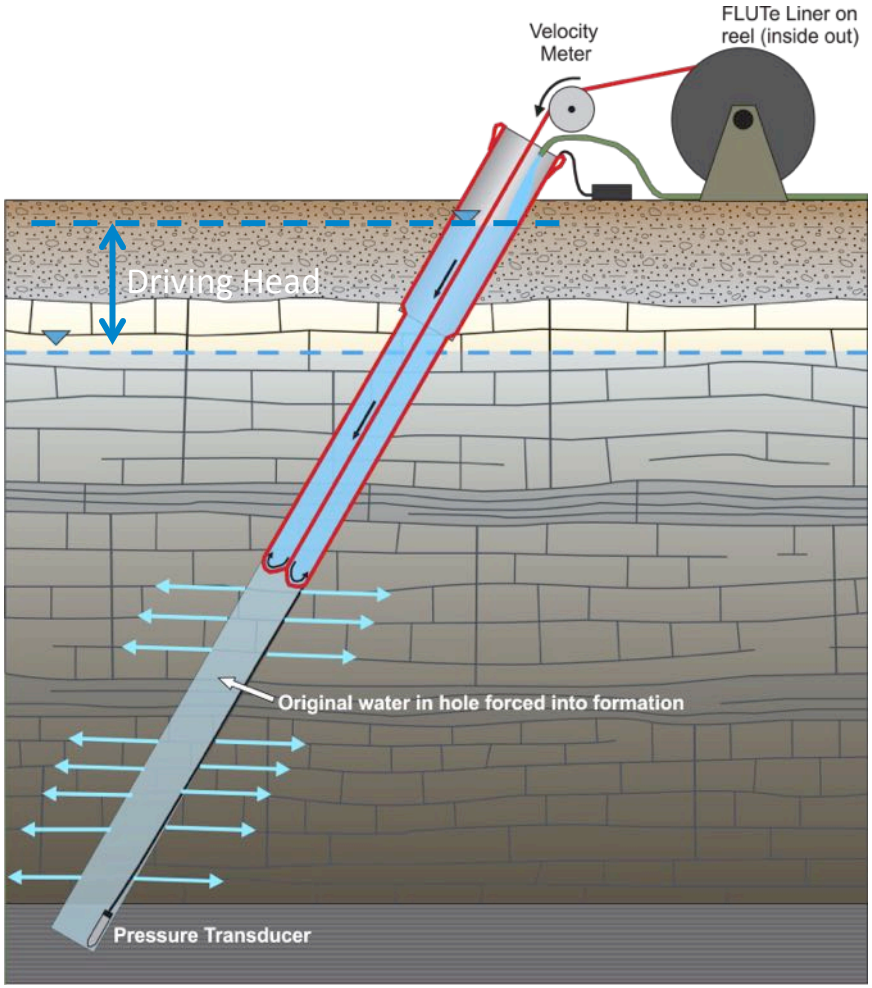
## PROPOSED G360 CONTRIBUTION, UNIVERSITY OF GUELPH (DR. JOHN CHERRY, DR. BETH PARKER, DR. AARON CAHILL)

- ***Characterize geology to 300 m depth in high detail using Discrete Fracture Network (DFN) Methodology.***
- ***Using results from characterization design a highly accurate and relevant multi-level Westbay groundwater sampling system.***
- ***Use data from characterization and custom built Westbay to observe and understand impacts of injected $CO_2$***

# FLUTE TRANSMISSIVITY PROFILING

**Provides depth-discrete transmissivity distribution**




Aaron Cahill

# 2015 SCHEDULE

| | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|
| PS processing | | | | | | | | | |
| Seismic interp. | | | | | | | | | |
| Log analysis | | | | | | | | | |
| Core logging | | | | | | | | | |
| Core analysis | | | | | | | | | |
| Reservoir model | | | | | | | | | |
| Simulation | | | | | | | | | |
| Injection appl. | | | | | | | | | |
| FRS 1 injector | | | | | | | | | |
| Monitor 1 well | | | | | | | | | |
| Water wells (4) | | | | | | | | | |
| Baseline work | | | | | | | | | |
| Monitor 2 well | | | | | | | | | |
| FRS #2 | | | | | | | | | |

# RESOURCING AND COLLABORATIONS

- *$4.40 M CMC (capital & operating)*
- *$4.92 M from Western Economic Diversification (Federal - capital)*
- *Implementation through Schlumberger Carbon Services*
- *NRCan*
- *AITF*
- *US Department of Energy*
- *UK Carbon Capture and Storage Research Centre*
- *Scottish Carbon Capture and Storage*
- *South Korea*
- *Industry subscriptions (programs)*

# SUMMARY

- *There is a need to better characterize containment risks for injection or production of fluids into/from reservoirs*
- *FRS is a unique benchmarking and evaluation program for monitoring subsurface fluids*
- *FRS is unique internationally*
- *FRS is being developed by CaMI in collaboration with the University of Calgary for training and education*
- *Technologies transferable to other monitoring challenges (EOR, HF, AGD, CSS, SAGD)*
- *Evaluation of shallow $CO_2$ storage potential for oil sands*

# CONTACTS

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