PTRC's Research into Carbon Storage

The IEAGHG Weyburn-Midale CO_2 Monitoring and Storage Project

and

Aquistore

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Presented at CAGS
April 18, 2011

Outline
概述

PTRC

石油技术研究中心

- Projects （项目）

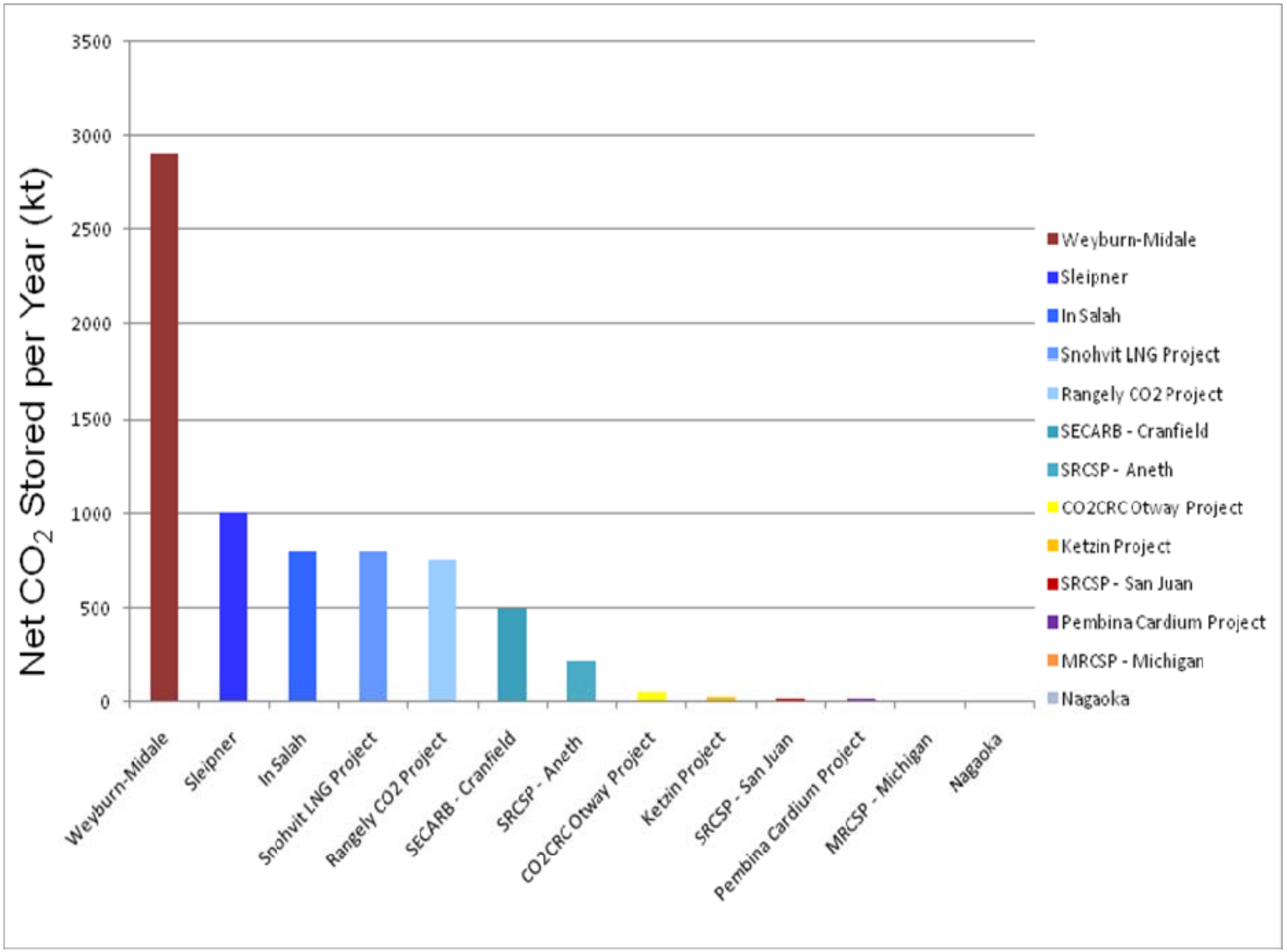
Carbon Management

碳管理

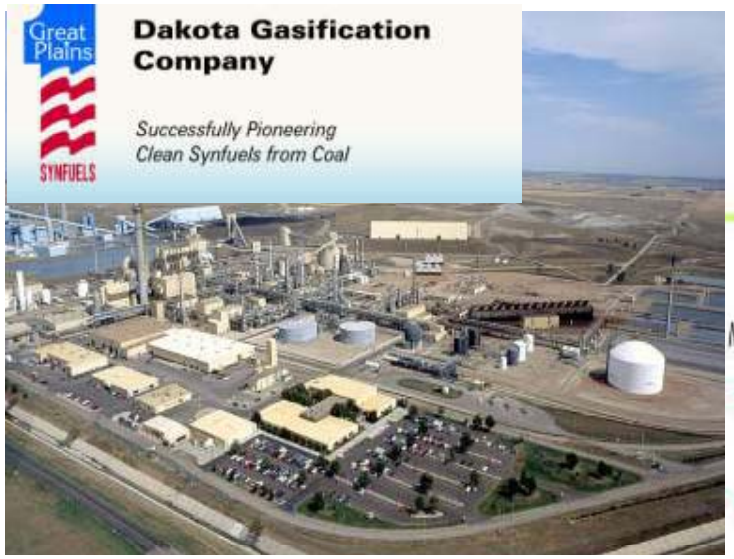
- Weyburn-Midale （Weyburn-Midale项目）
- Aquistore （Aquistore项目）

IEAGHG Programme Large CCS Projects

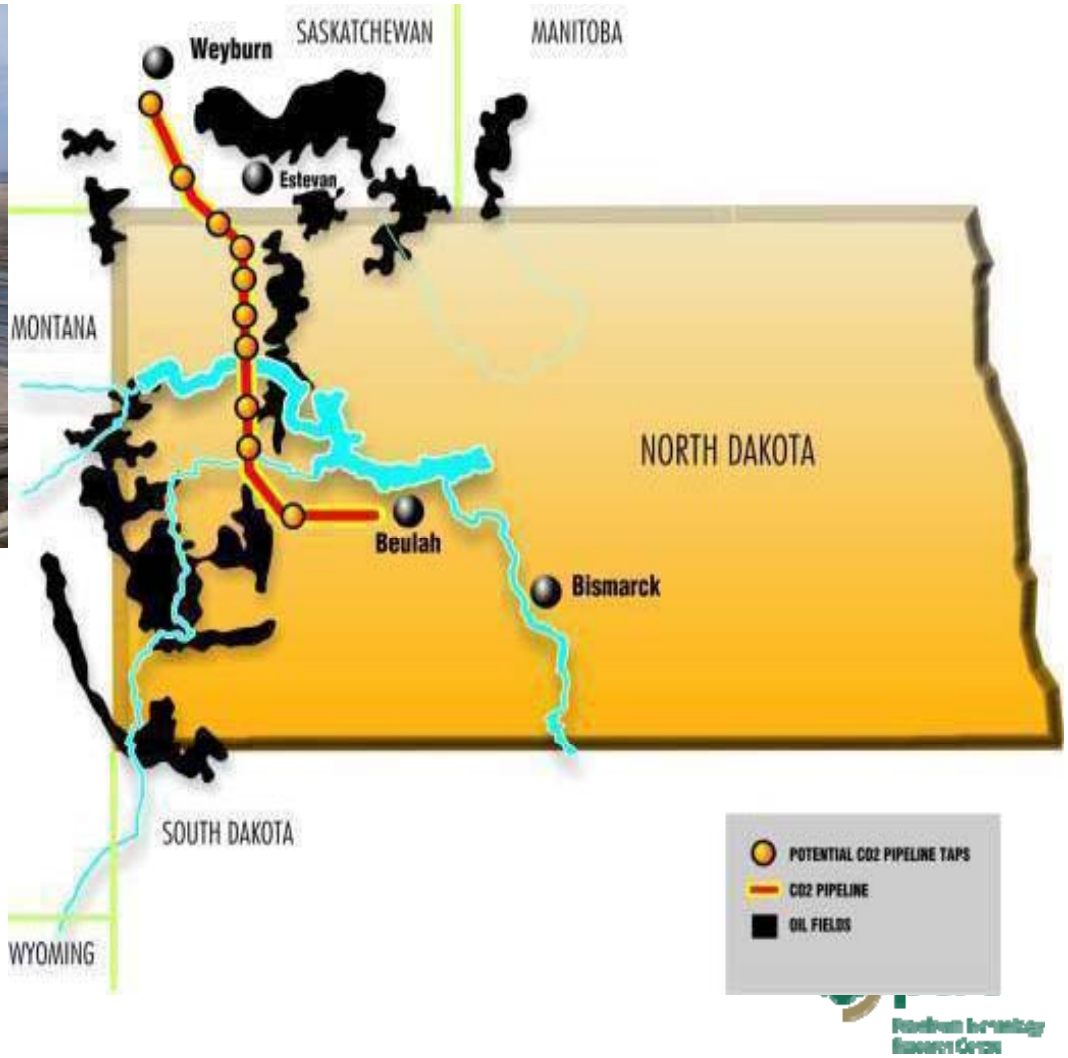
国际能源署GHG中心所规划的大型二氧化碳捕获及储存项目



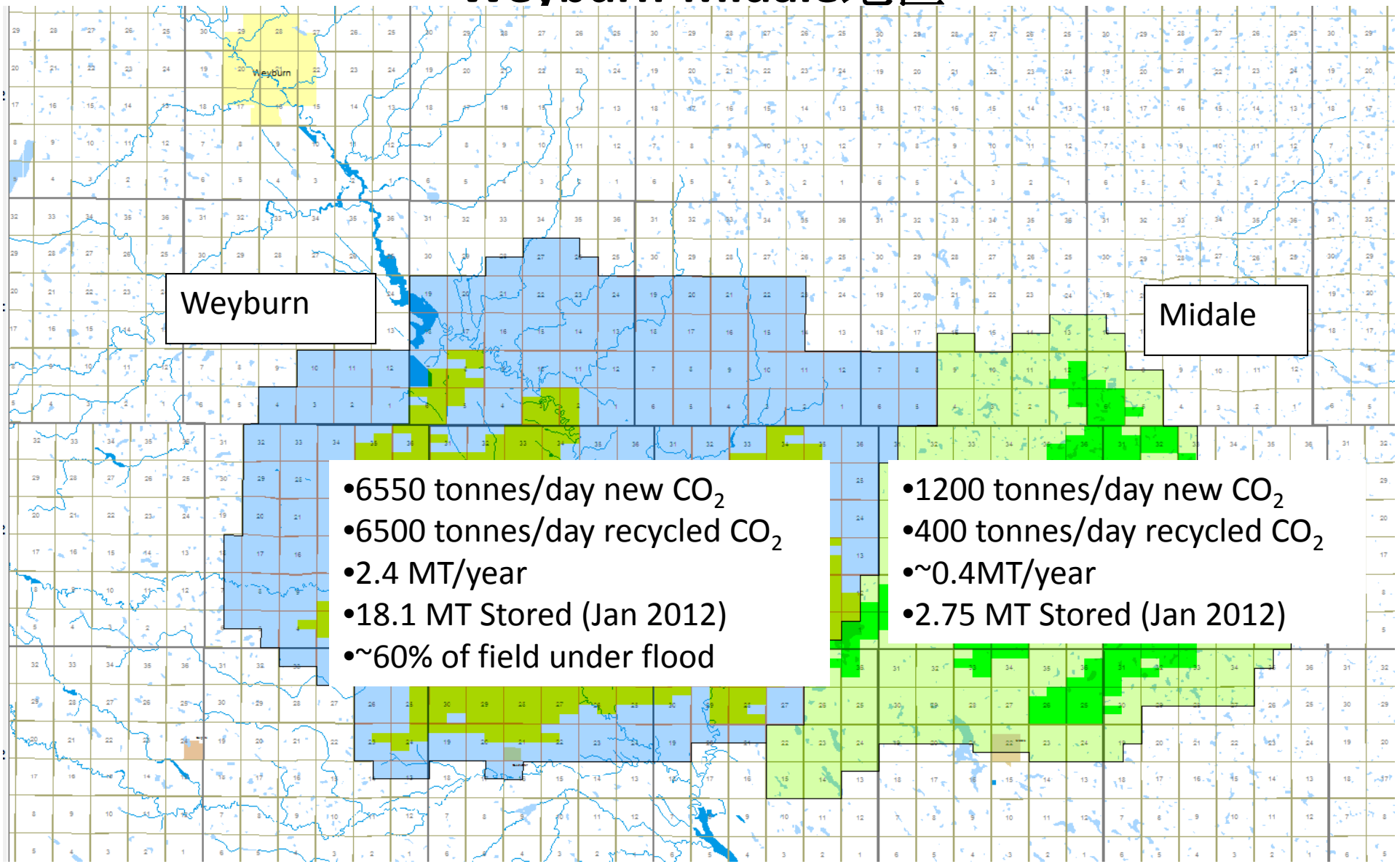
CO_2 Source: Great Plains Synfuel Plant
二氧化碳来源:大平原合成材料厂



- 250 mmscfd CO_2 by-product of coal (lignite) gasification
  - *approx. 8000 tonnes/day suitable for EOR*
- CO_2 purity 95% (less than 2% H_2S)
- 320 km pipeline (14 in & 12 in) built & operated by Great Plains



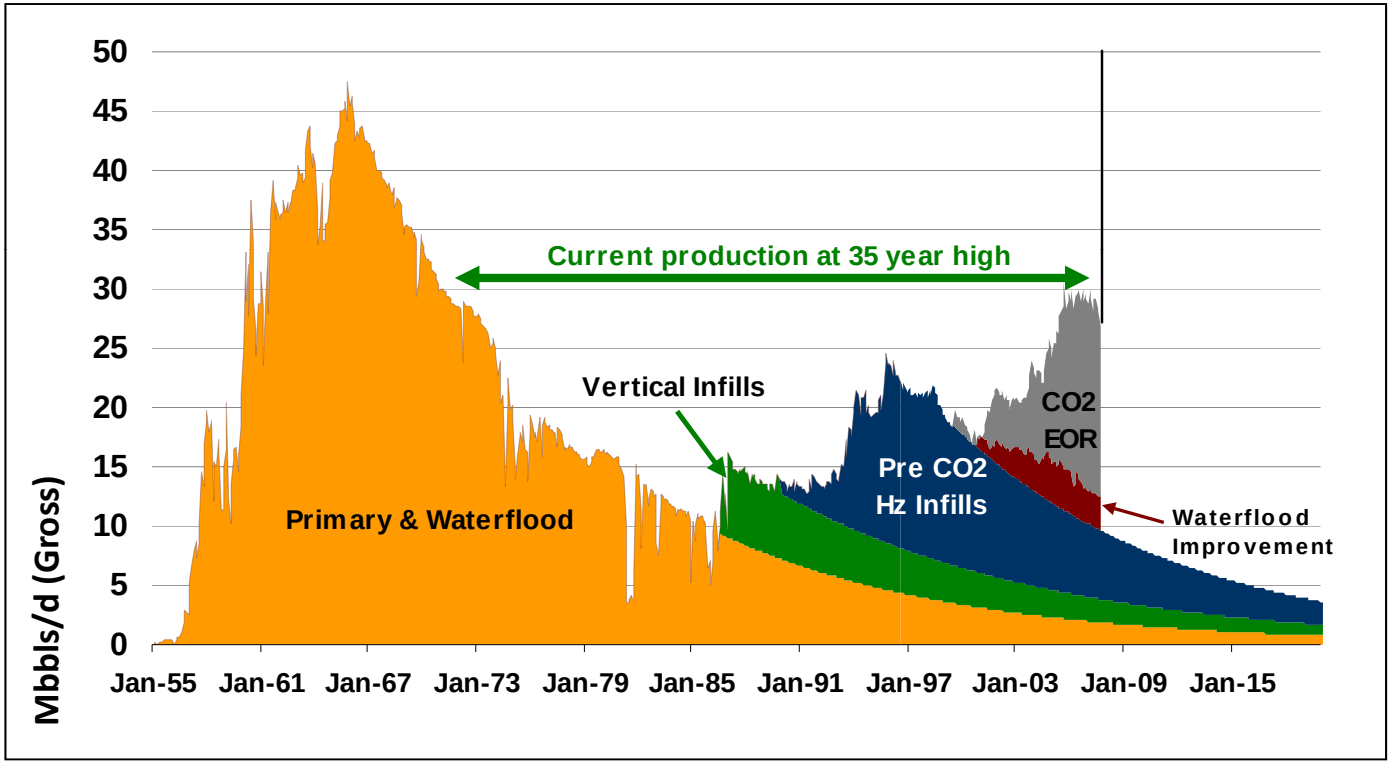
Weyburn-Midale Area
Weyburn-Midale地区



Total Oil Production at Weyburn

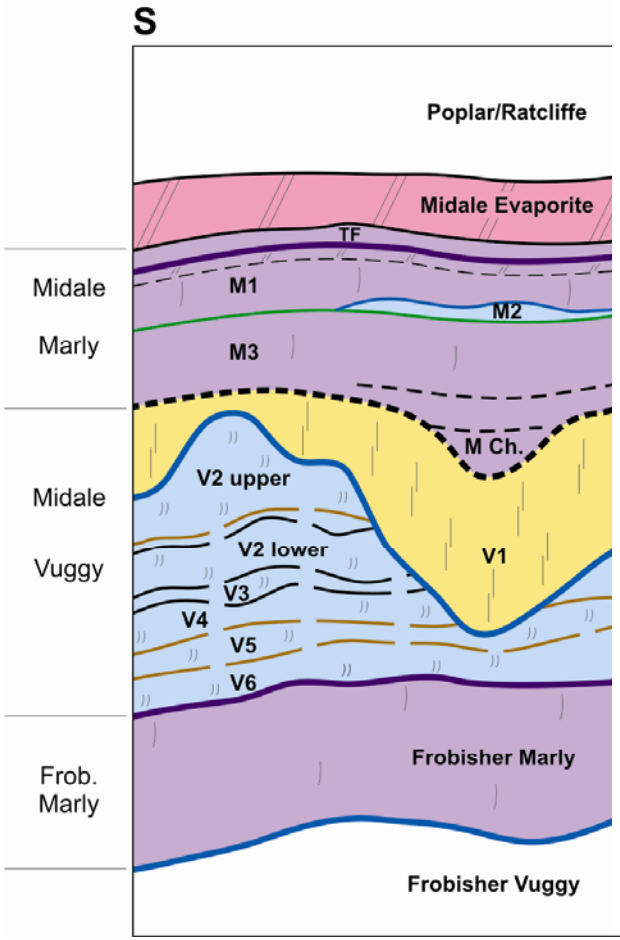
Weyburn地区石油生产的总况

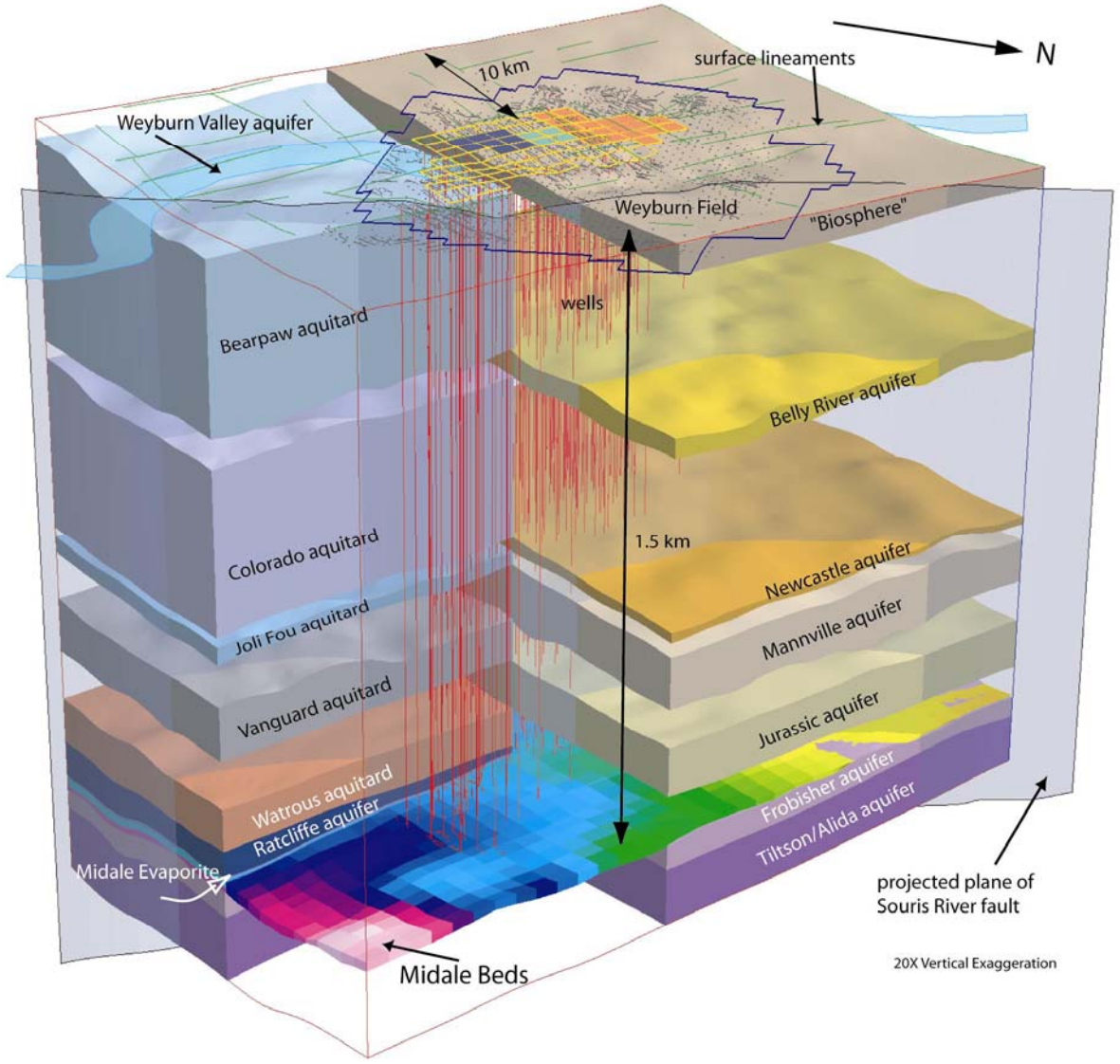
- Around 30,000 bbl/day: a 35-year high
- 20,000 bbl/d are due to the CO_2 flood



CO_2 stored equivalent to removing more than 8 million cars off the road for a year

Geological Integrity
地质完整性





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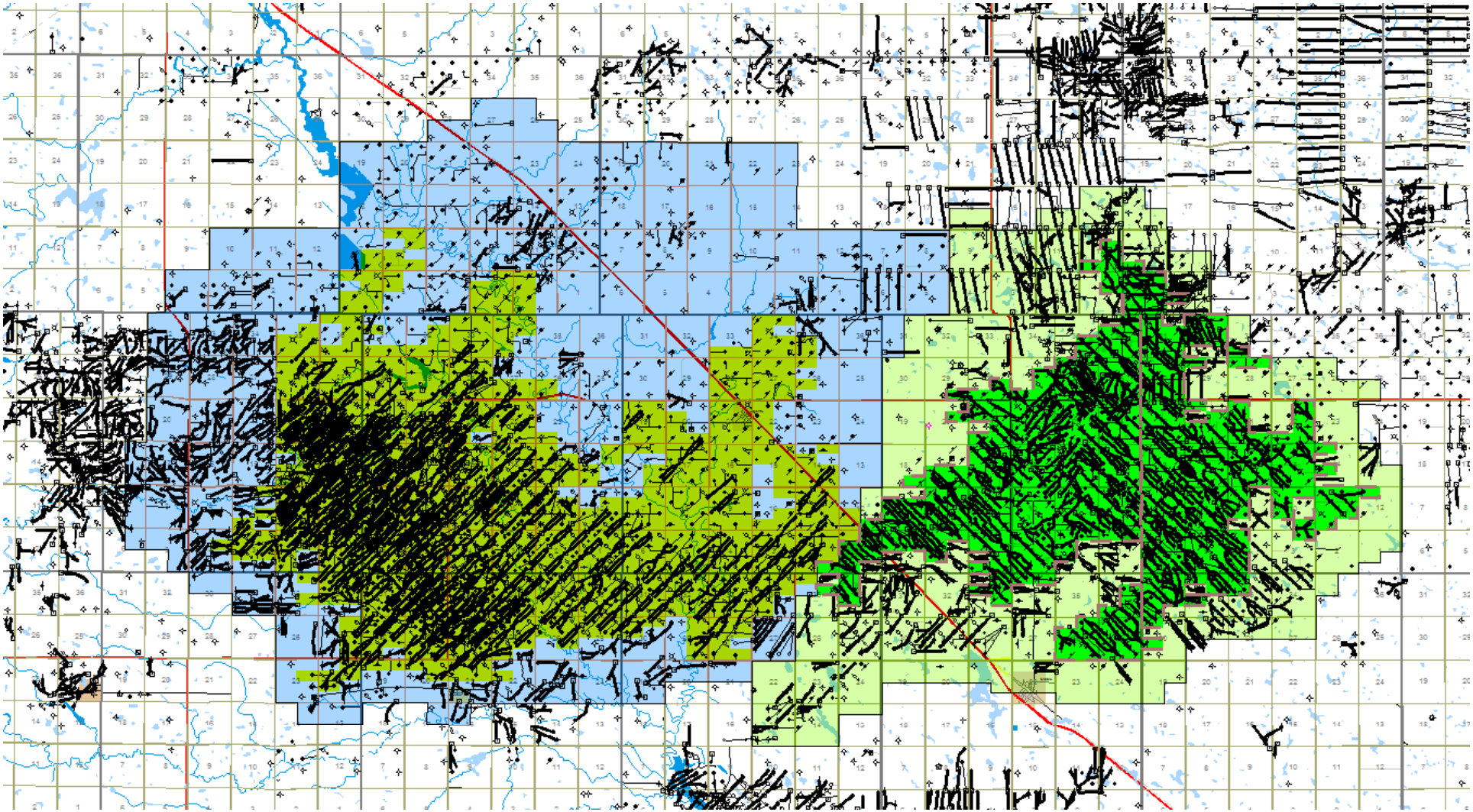
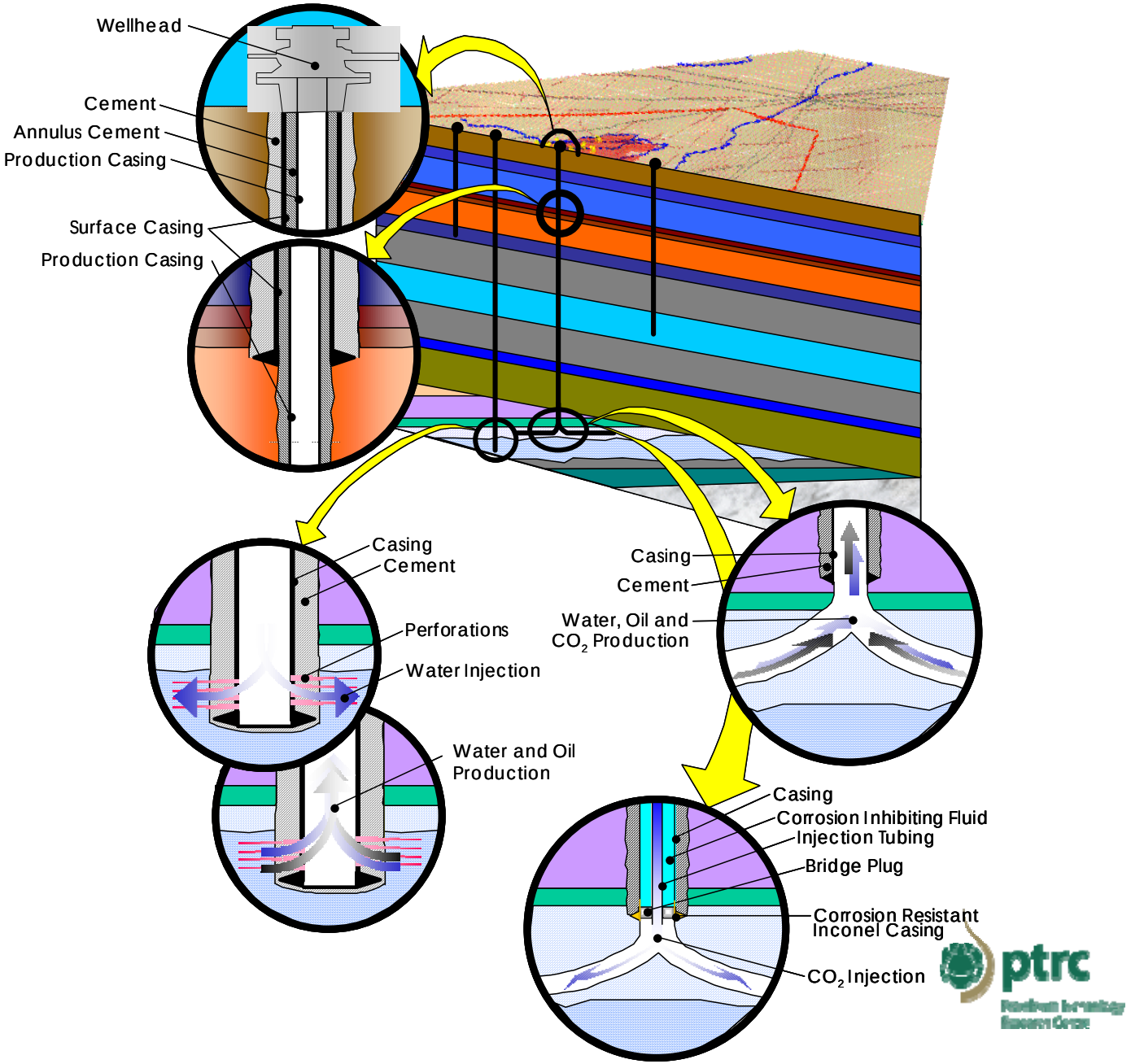
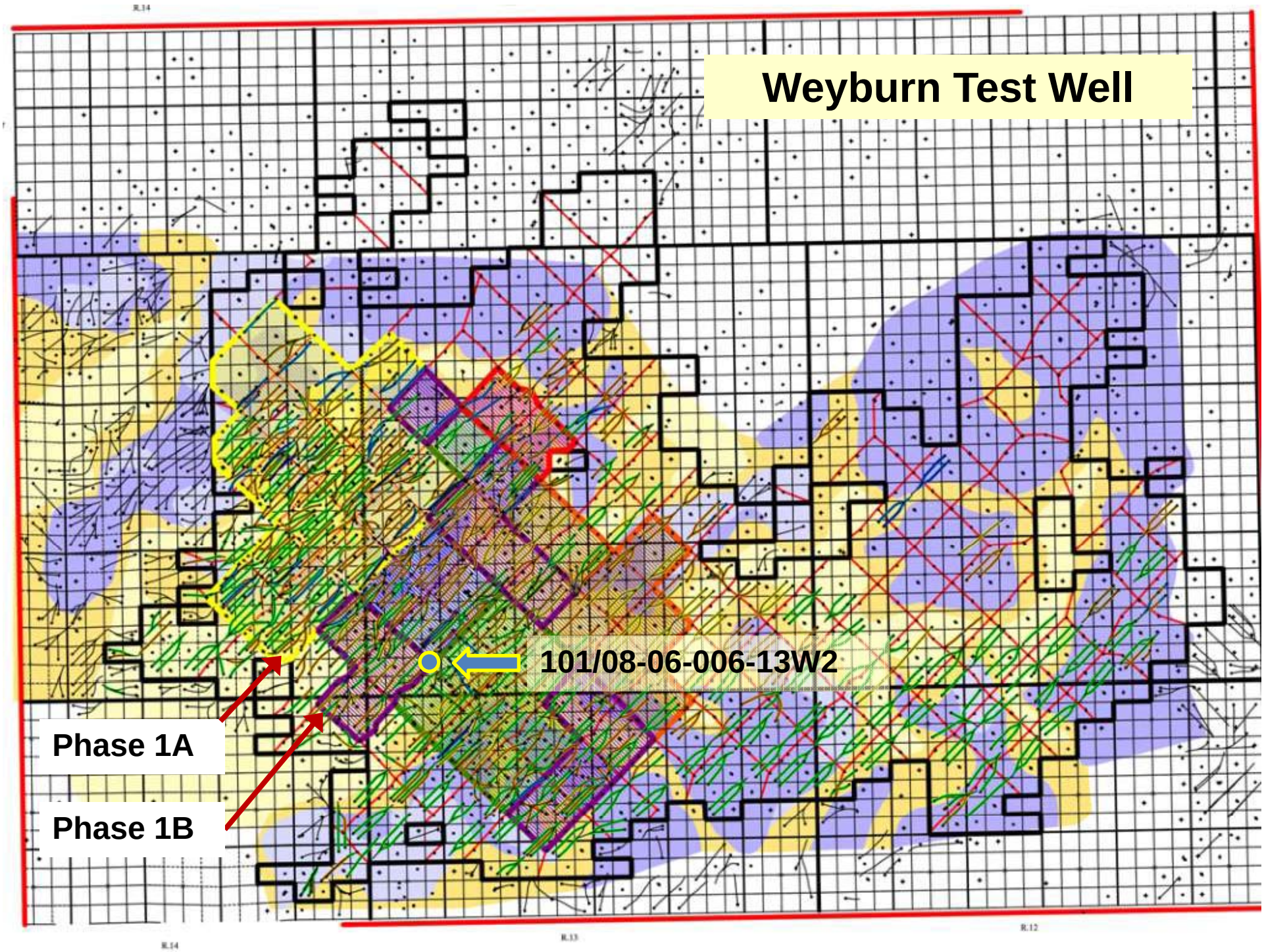
Why Wellbore Integrity?



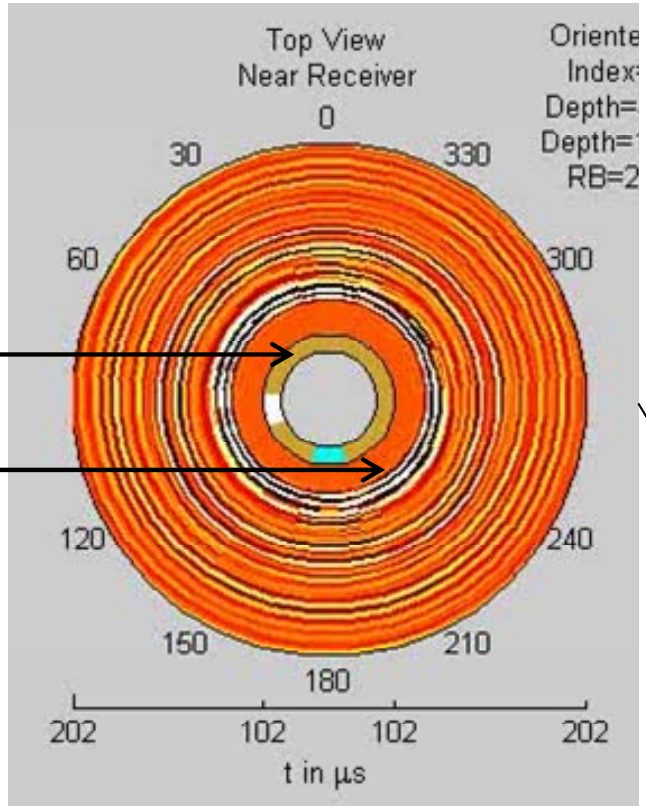
Wellbore Database

- **Well categories**



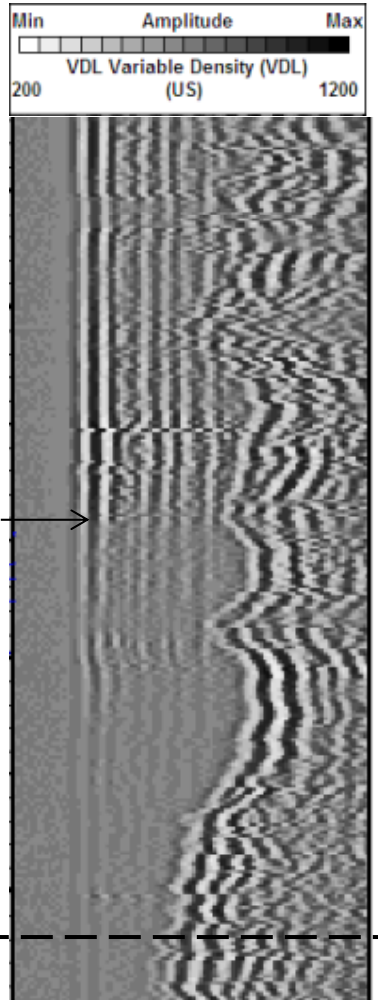

Weyburn Test Well
101/08-06-006-13W2
Phase 1A
Phase 1B
R.14
R.13
R.12

Logs: Cement is Present



Casing

Cement / Formation Interface (3rd interface)



Cement top

Modified coring tool:
→ Direct confirmation

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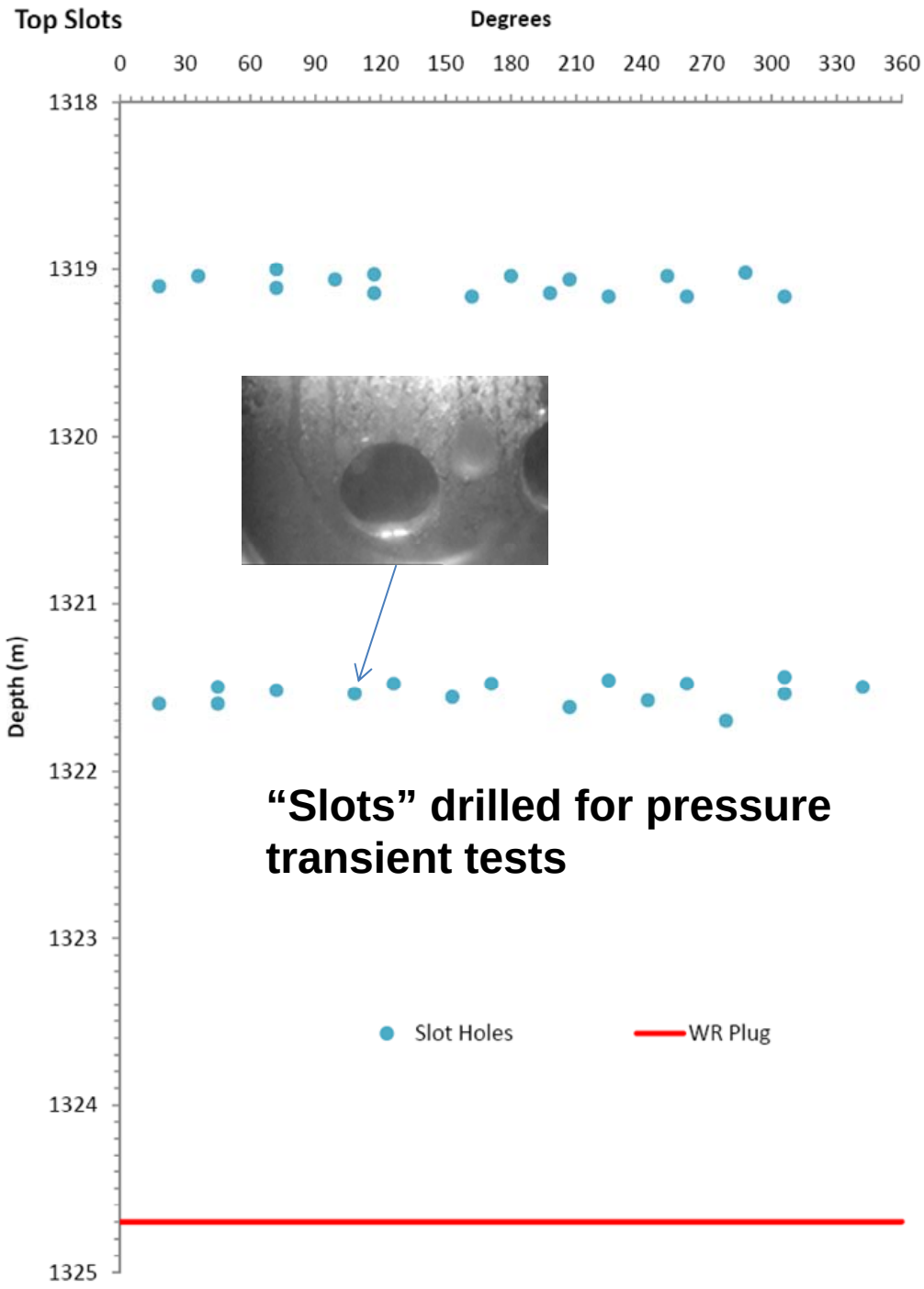


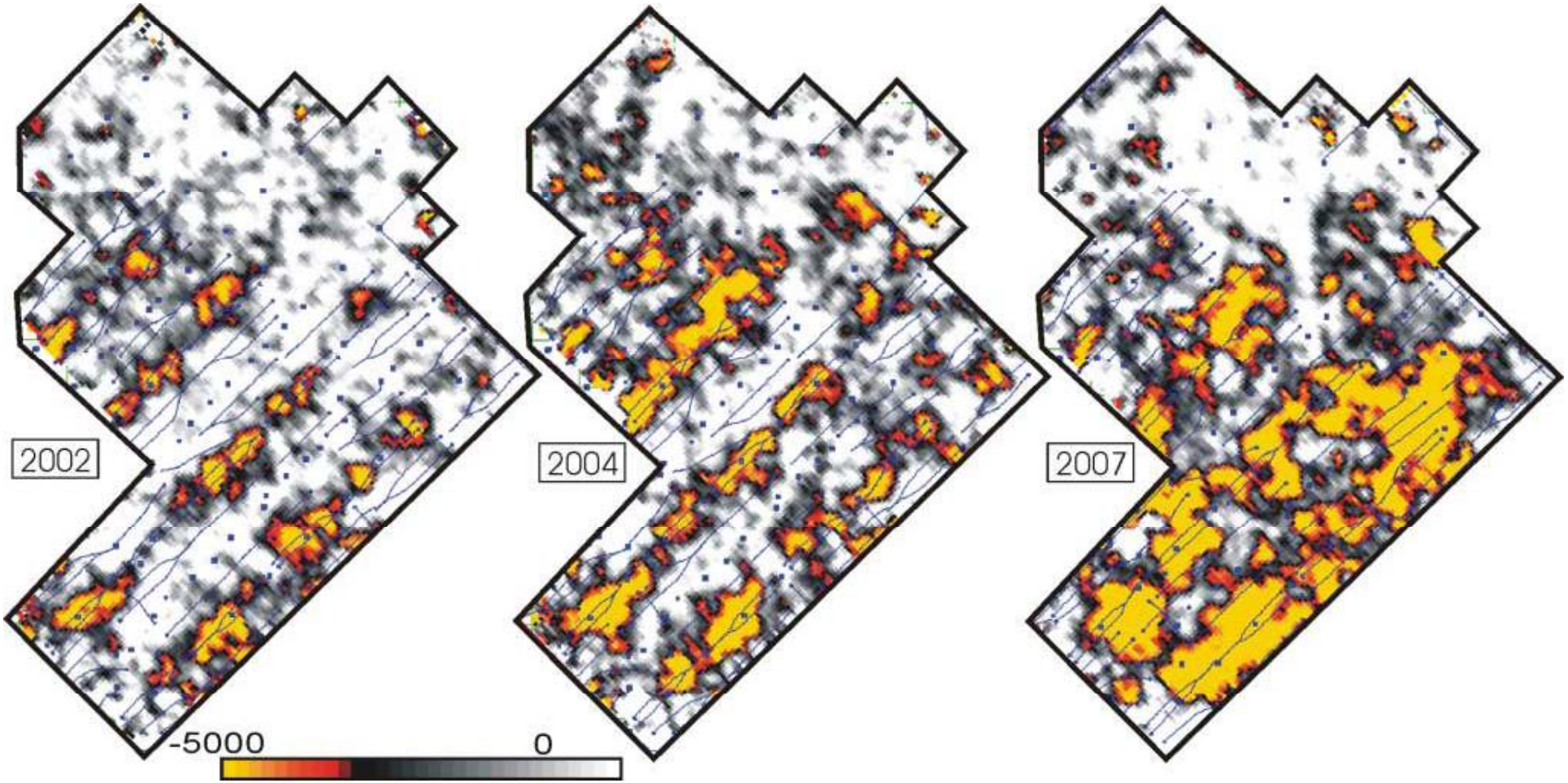
“Slots” drilled for pressure transient tests

Marly Amplitude Differences

2.8 MT CO_2

3.7 MT CO_2

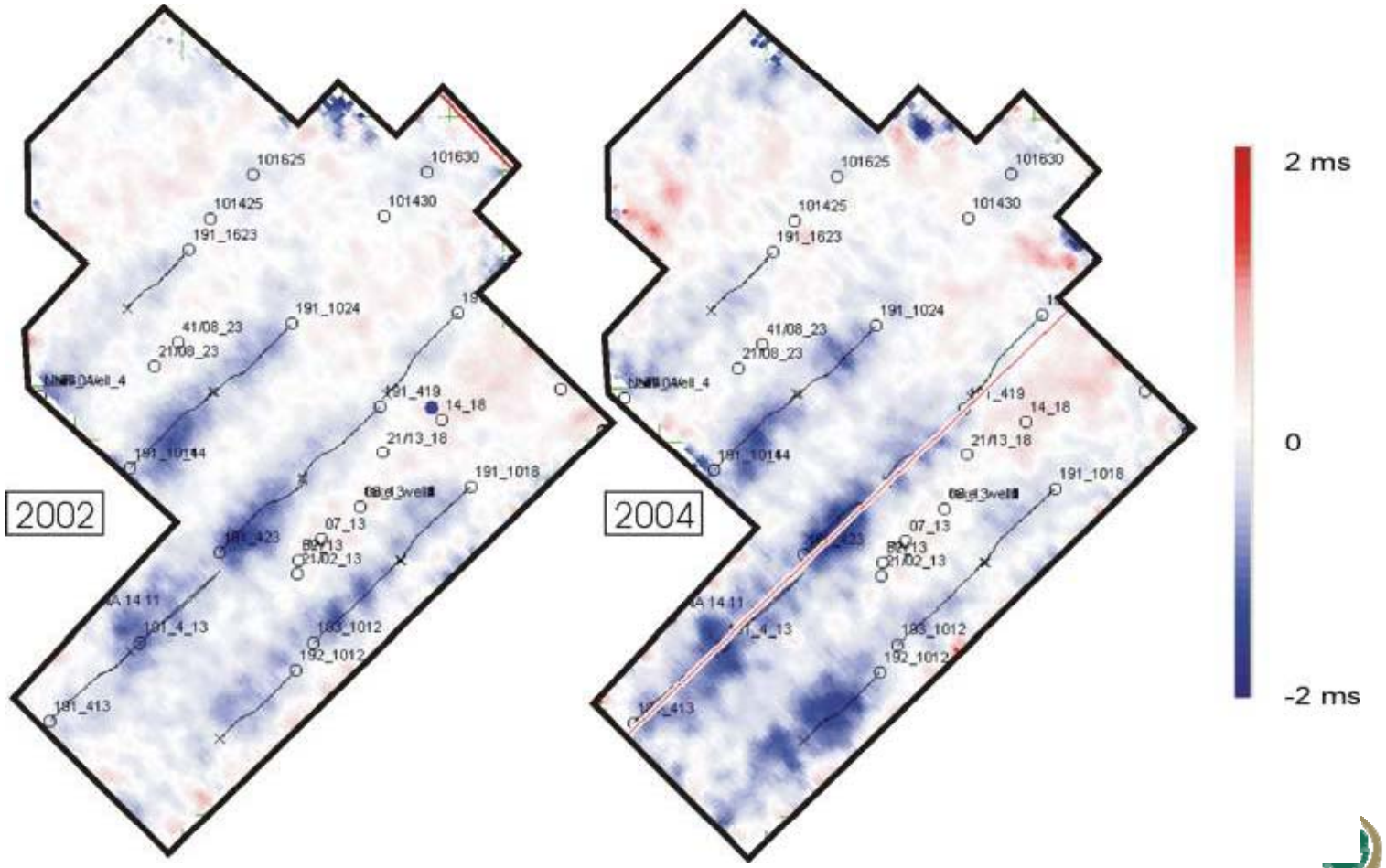
7.4 MT CO_2



Bakken Traveltime Differences

2.8 MT CO_2

3.7 MT CO_2



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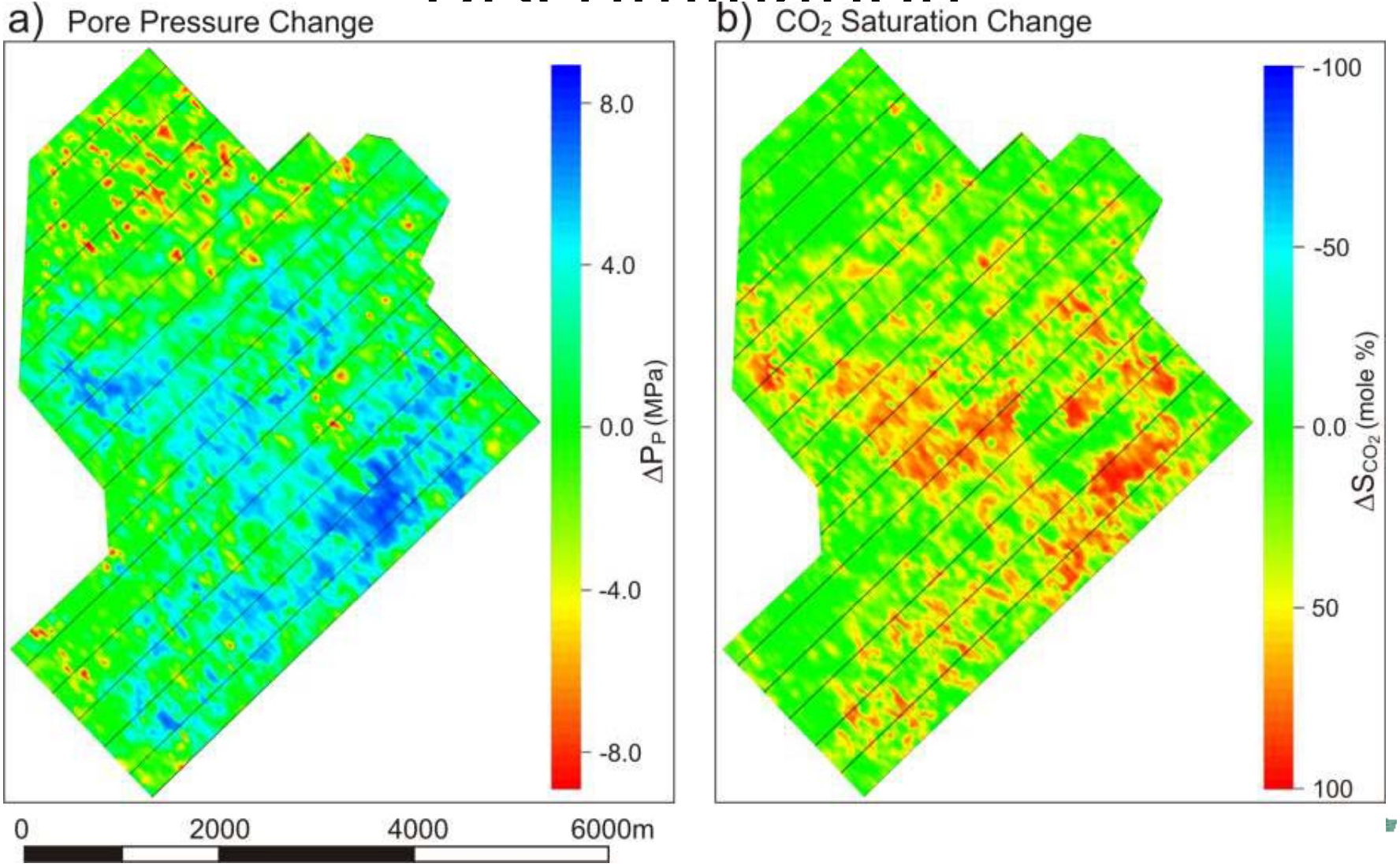
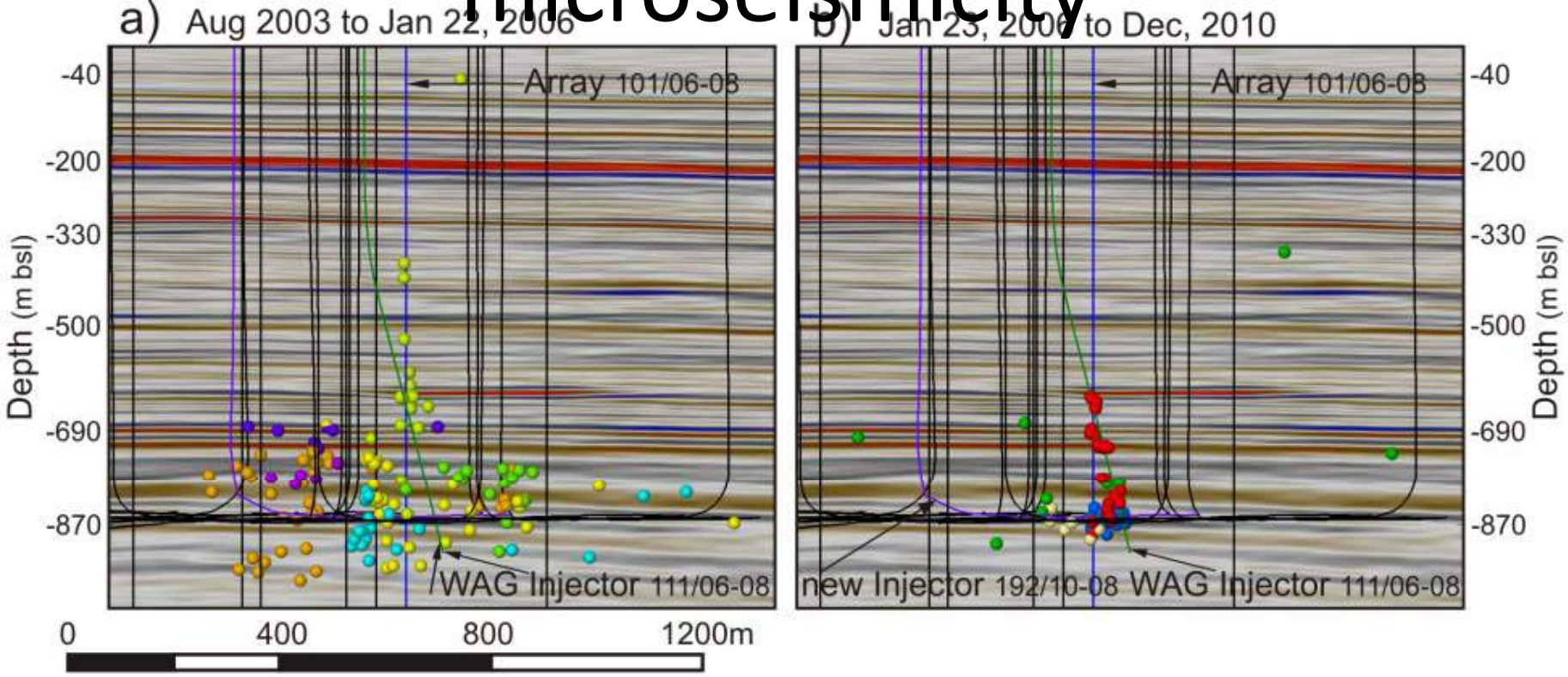
Pressure vs. Saturation Discrimination



Injection/Production related microseismicity

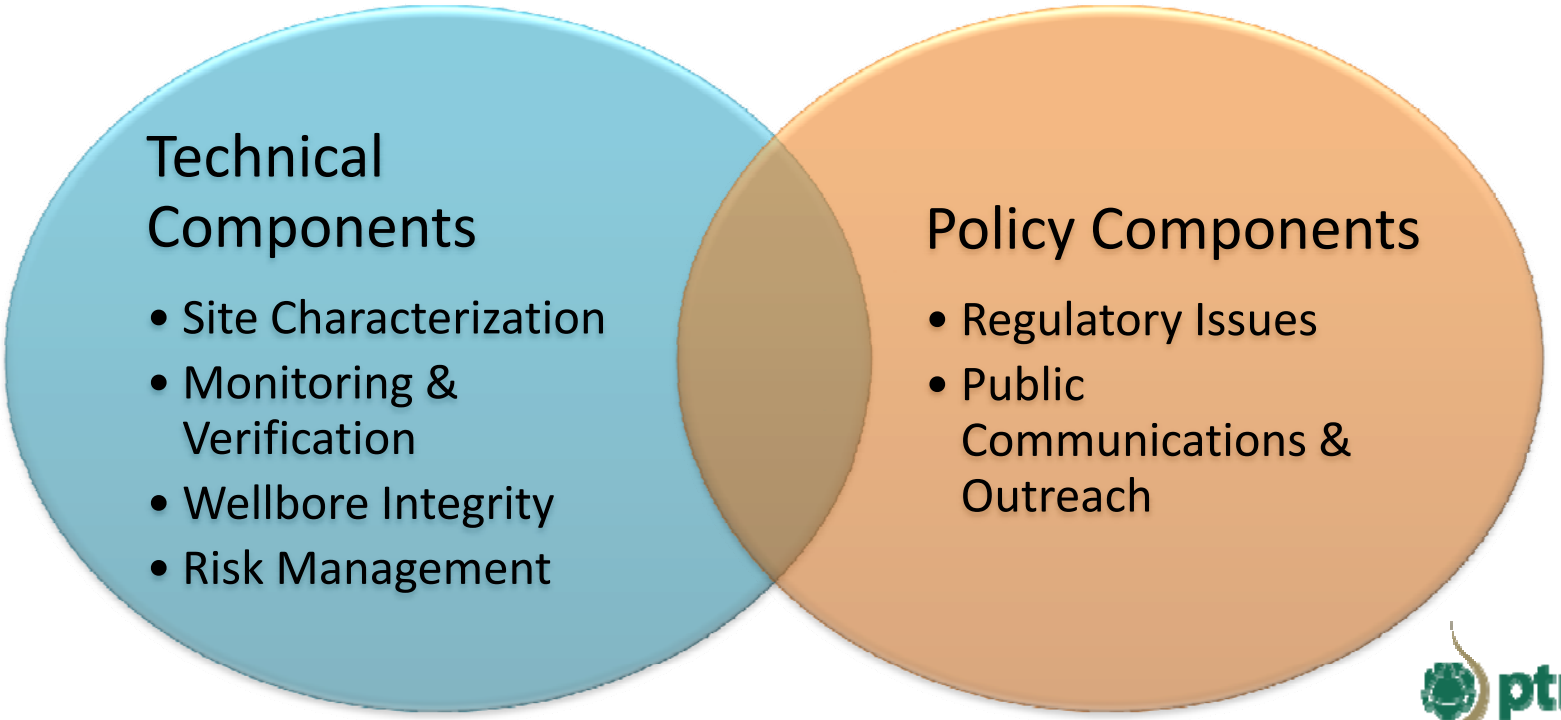


Weyburn-Midale Phase Two Objectives
Weyburn-Midale项目后期的主要目标

Best Practice Manual

Transition of CO_2-EOR Operations to CO_2-storage

Pre-injection, Operations, Post-injection, Closure



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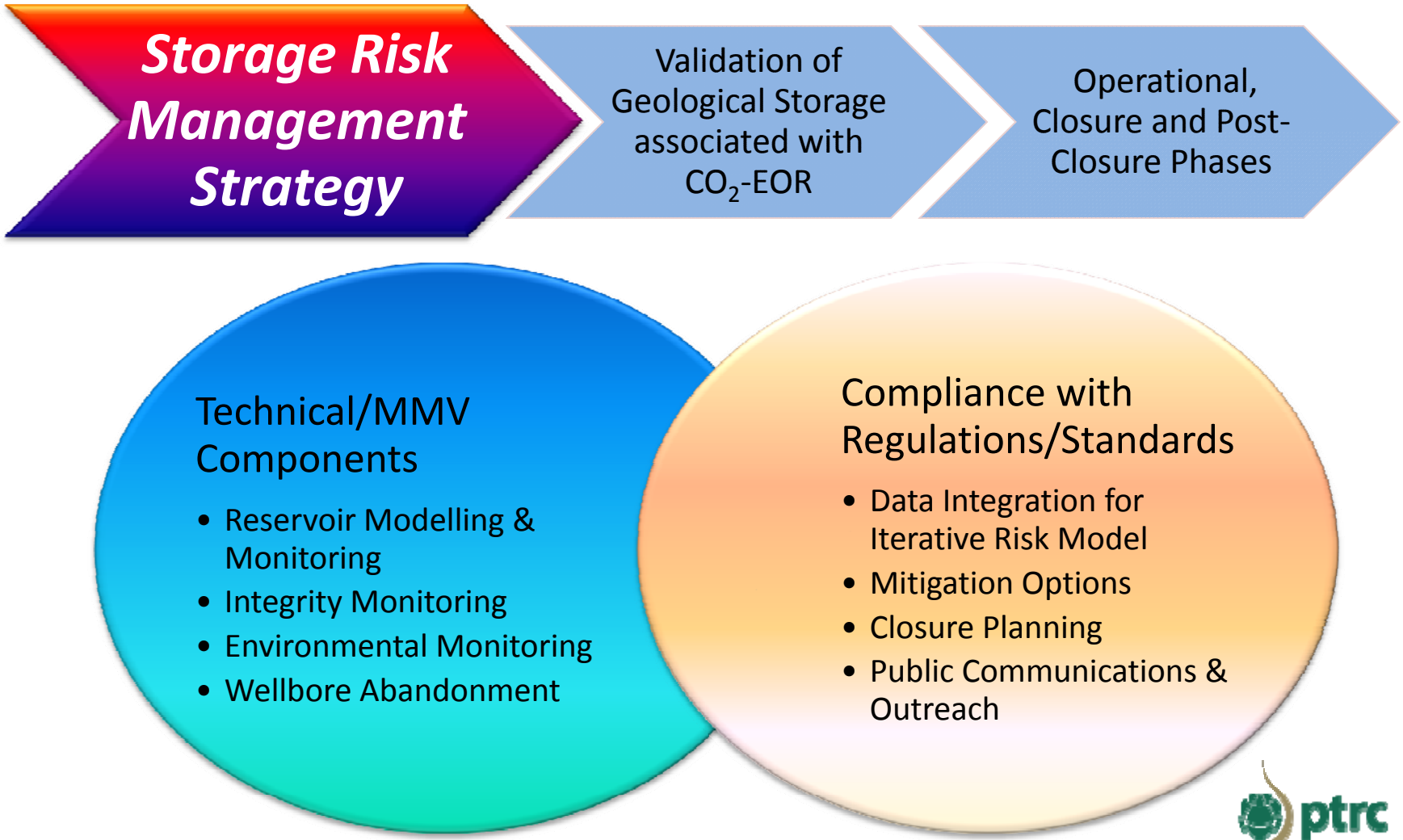
Weyburn-Midale Next Phase Objectives



Aquistore Project

- CO_2 storage research monitoring project
- Designed to inject 2000 tonnes CO_2/day
- $22.3M in sponsorship secured
- Buffer protection and long-term storage option for SaskPower's Boundary Dam Carbon Capture Project

Project Objectives:

- Demonstrate CO_2 storage in deep saline formation is a safe, workable solution to reduce greenhouse gas (GHG) emissions
- Develop best methods & technologies to monitor GHG
- Involve research institutions, policy makers, industry, and public

Phase 1: Demonstration & Evaluation

- site selection, permits, agreements, community engagement
- risk assessment, seismic surveys, monitoring programs
- evaluation/injection well
- observation/monitoring well
- test injection trucked in CO_2

Phase 2: Commercial & Monitoring

- On going monitoring and observation
- On going community engagement
- Pipeline tie-in CO_2 from Boundary Dam Power Station

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Project Location: Williston Basin

Project Location

Ground level view towards Boundary Dam Power Station

Well location remains largely free of water during the 1:500 year flood in Saskatchewan 2011

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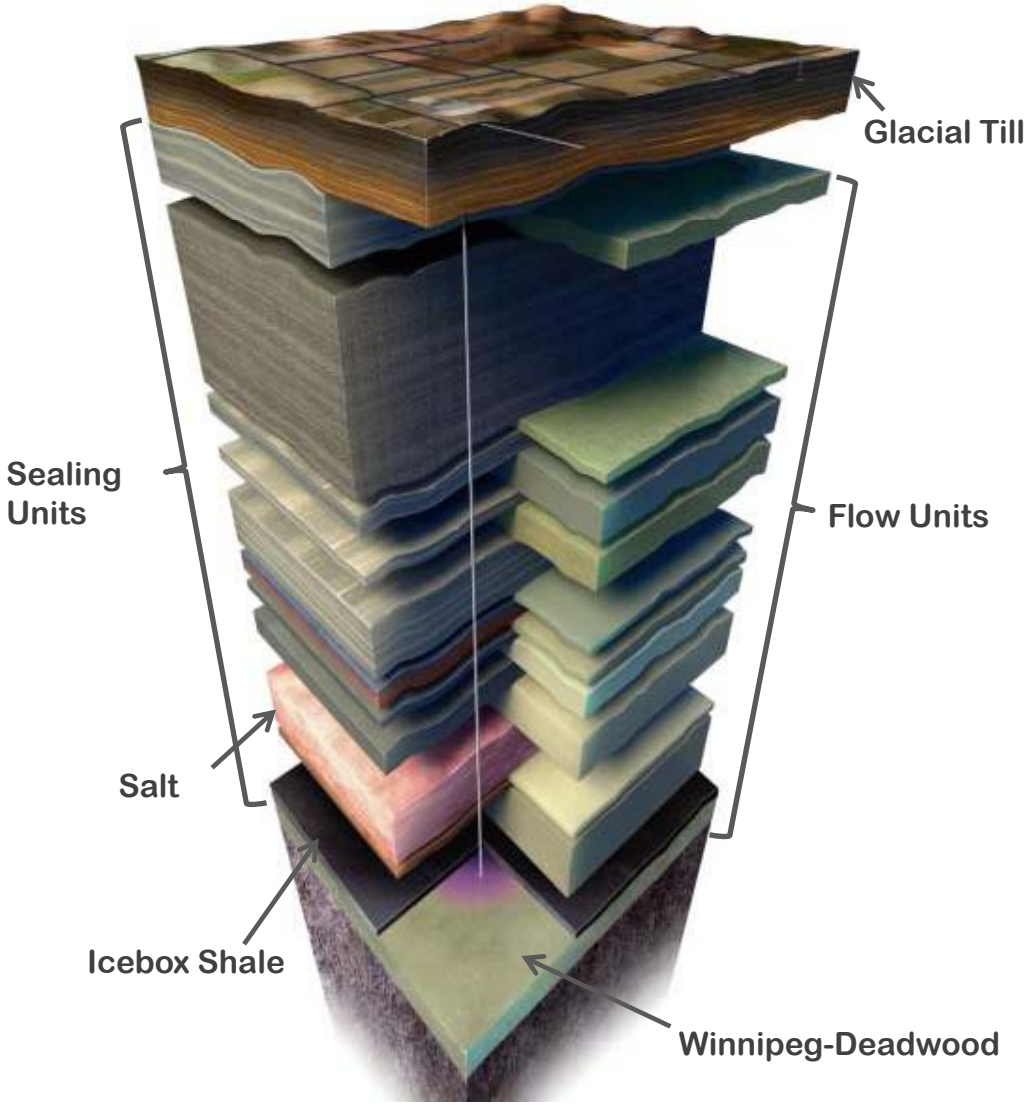
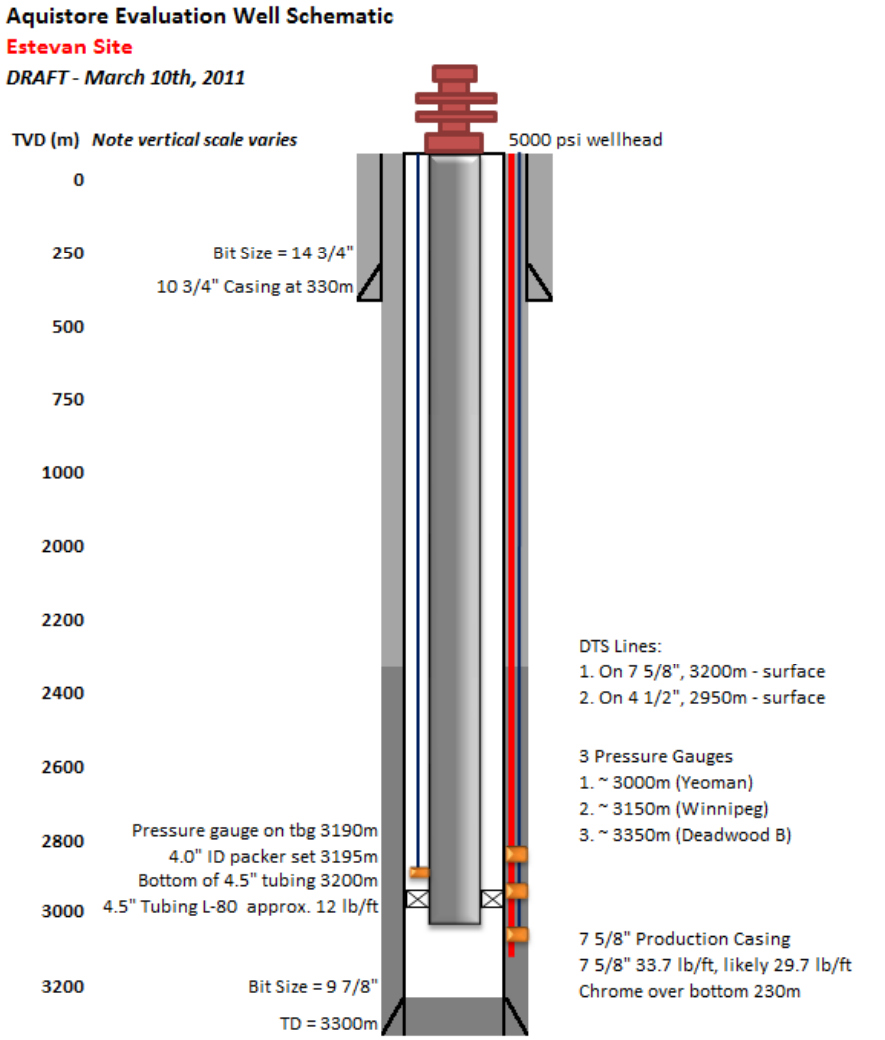
Subsurface Model



Well Design

- Well depth 3300m to reach Deadwood in Estevan area
- Surface 10-3/4” casing to ~330m
- Production 7-5/8” casing to ~3300m
- 7-5/8” production casing for operability with 4.5” tubing
- Achieves evaluation and potential injection objectives
- Coring, DST, Logging program



Measurement Monitoring & Verification Program

Designed for: (1) project/plume monitoring; (2) public assurance; (3) research objectives

Key Elements:

- Baseline 3D seismic survey
  - Time-lapse seismic surveys
  - Permanent seismic array
- Real-time pressure & temperature monitoring
- Passive seismic
- Downhole fluid sampling
- Time-lapse logging & VSP's
- Groundwater & Soil gas monitoring
- Downhole cross-well electrical monitoring
- Surface-to-downhole electrical monitoring
- Surface controlled-source electromagnetic monitoring
- Surface gravity
- Permanent tiltmetres
- Cross-well seismic

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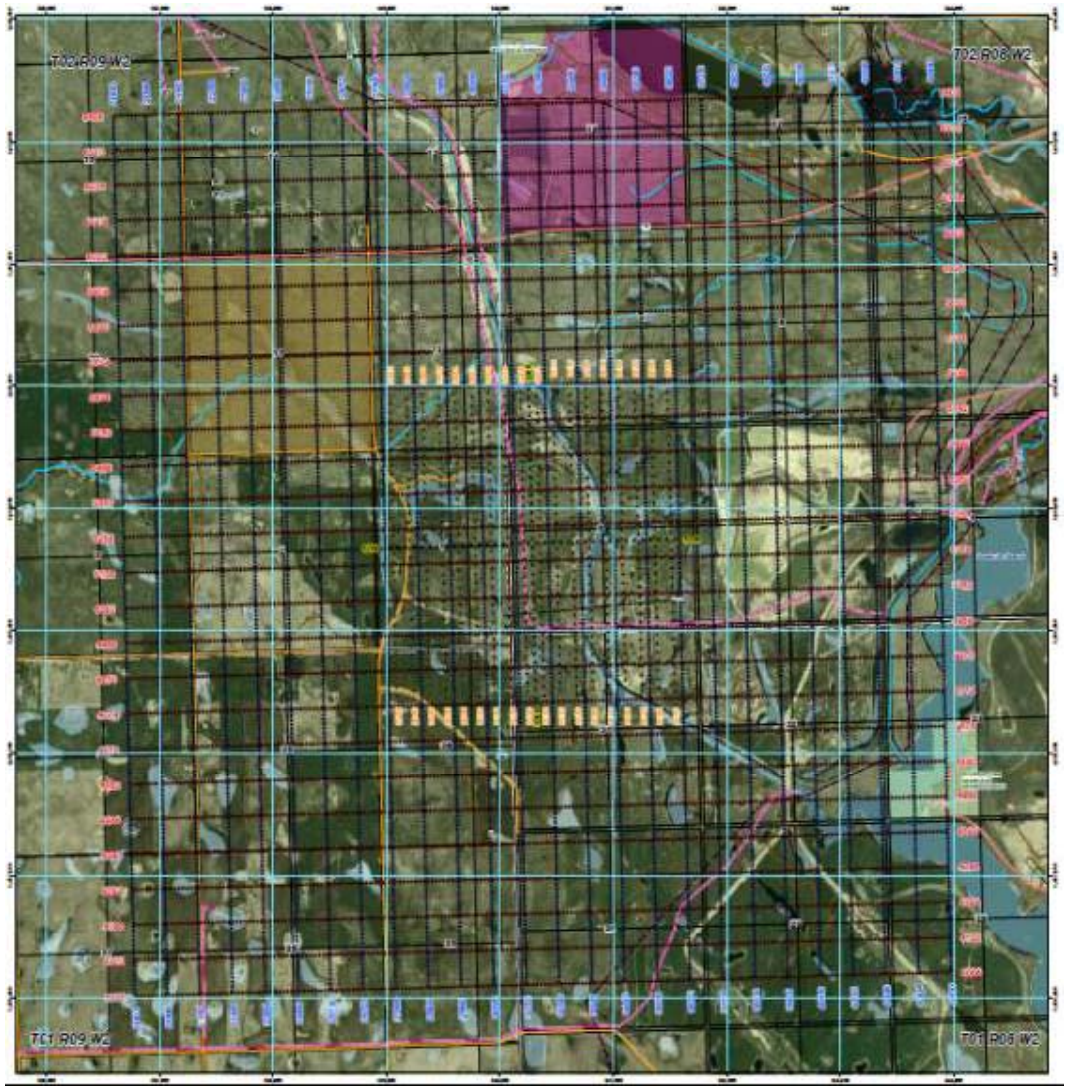
Seismic Program

3D Baseline Surface Seismic Survey

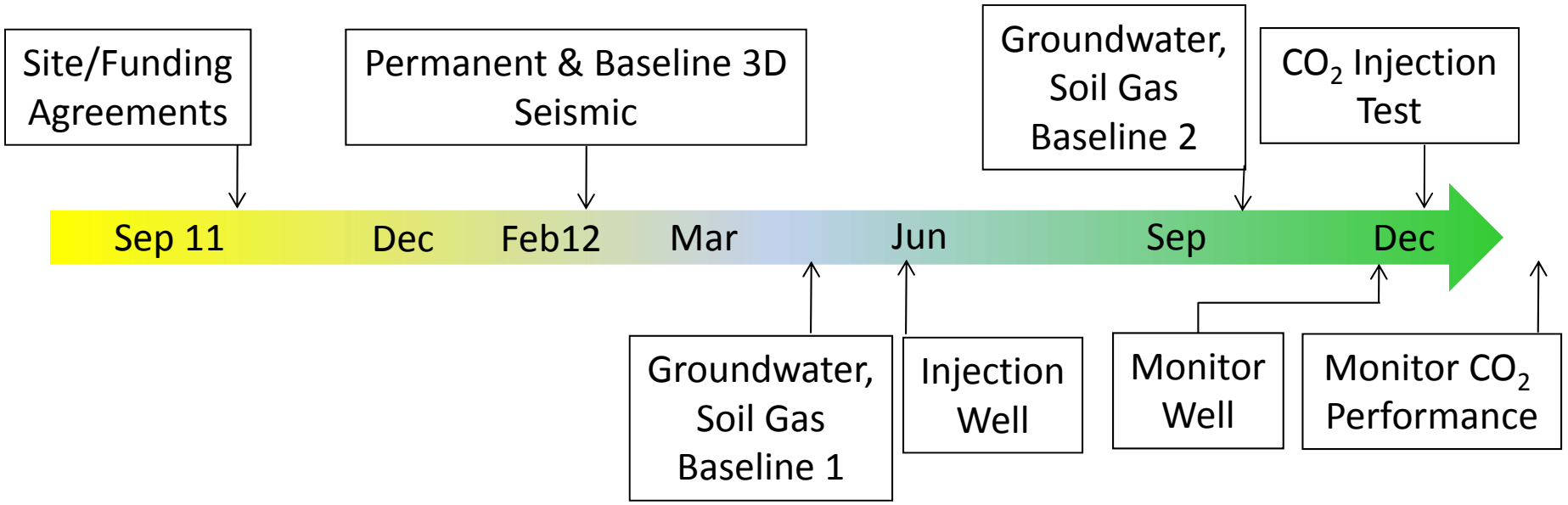
- Survey covered ~30 sq km area

Permanent Array Design

- 630 geophone array covering a ~12 sq km area
- Seismic drilling rig used to drill 20m holes for the geophones



Project Schedule Summary



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CCS Consortium

- Projects
- Knowledge sharing
- Public outreach
- Best practices

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Thank You

谢谢