

IEA GHG Weyburn CO₂ Monitoring and Storage Project

THEME 1
GEOLOGICAL CHARACTERIZATION OF THE GEOSPHERE AND BIOSPHERE

THEME 2
PREDICTION, MONITORING AND VERIFICATION OF CO₂ MOVEMENTS

THEME 3
CO₂ STORAGE CAPACITY AND DISTRIBUTION PREDICTIONS AND THE APPLICATION OF ECONOMIC LIMITS

THEME 4 LONG-TERM RISK ASSESSMENT OF THE STORAGE SITE

Theme Leader: Rick Chalaturnyk, University of Alberta

Third Annual Conference on Carbon Sequestration
Alexandria, VA
May 3-6, 2004

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Objectives of Assessment Program

- Apply risk assessment techniques to predict the long-term fate of CO₂ within the storage system
 - Identify risks associated with geologic storage
 - Assess ability of oil reservoirs to securely store CO₂ (where CO₂ migrates to and what are the fluxes)
- Derive how much CO₂ is stored in the Weyburn reservoir as a function of time
- Explore consequences of any leakage
- Provide assessment results primarily in terms of flux of CO₂ from the geosphere as function of time



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Risk Assessment Methodology

- FEP's (Features, Events and Processes)
- Systems Analysis
- Scenario Development
 - Base Scenario
 - Alternative Scenario's
- Deterministic Risk Assessment
- Probabilistic Risk Assessment



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RA Terminology

- **Geosphere/Biosphere:** geological and hydro-geological system (including but not limited to the RA domain to be studied) and populated with petrophysical and other properties.
- **System Model:** The physical system of the RA domain to be studied and the processes that govern the movement and migration of CO₂ within this domain.
- **Conceptual Model:** an abstraction of the geosphere/biosphere within the domain of the System Model, as the framework for running the long term CO₂ migration simulations.



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Benchmarking Program

- Develop a consistent dataset and modelling approach that provides an optimal degree of comparison between the deterministic and probabilistic methodologies
- Upscaling eliminated
- Considered three cases:
 - No Wells case (I.e. only geological model)
 - Wells with flow in annulus only
 - Wells with flow in casing only

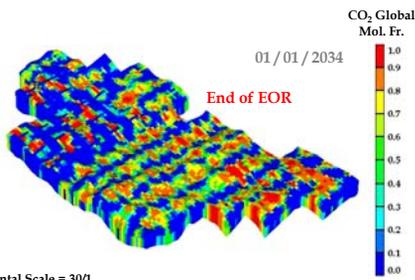


Deterministic Approach

- Eclipse E300 Compositional Simulator
- Full System Model treatment
- Integration with 3D 75-pattern reservoir simulation



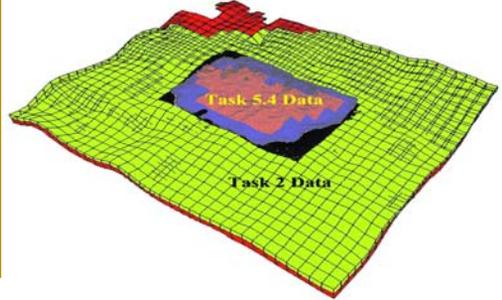
75-Pattern Simulation Model and Results



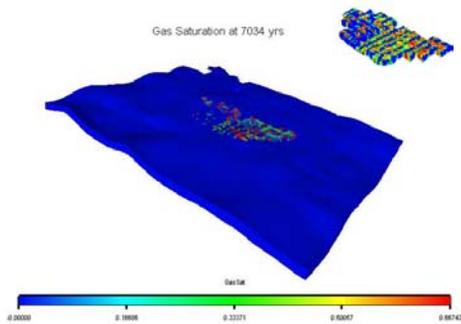
Vertical/Horizontal Scale = 30/1



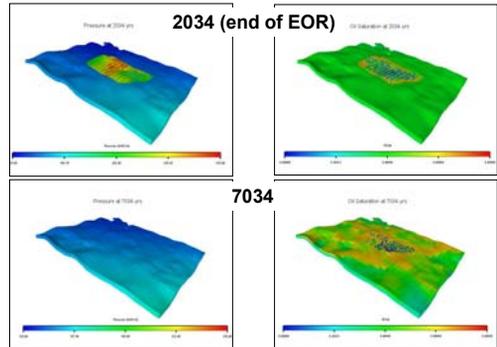
Geosphere Migration Model: Integration (1)

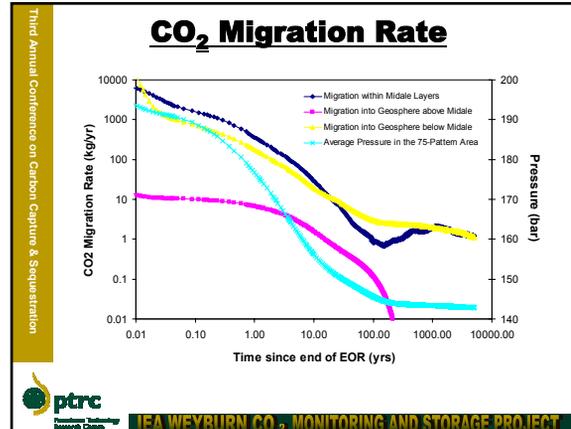
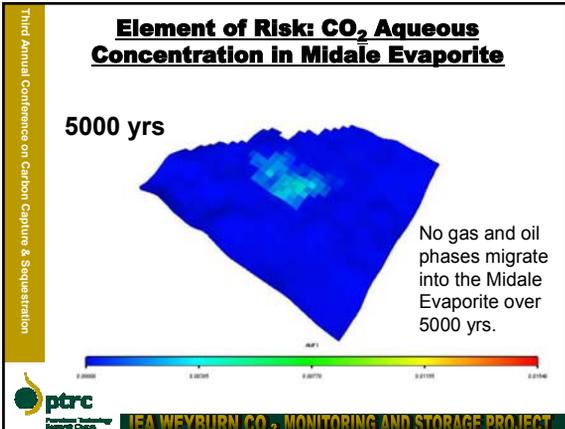


Gas Saturation Results

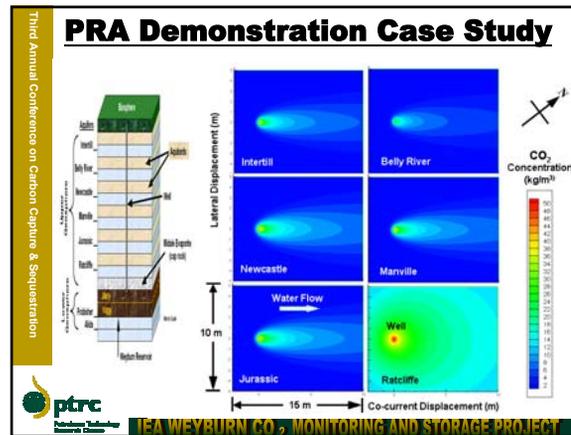
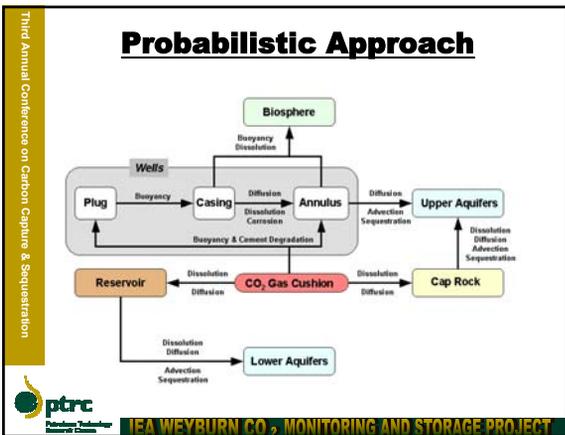
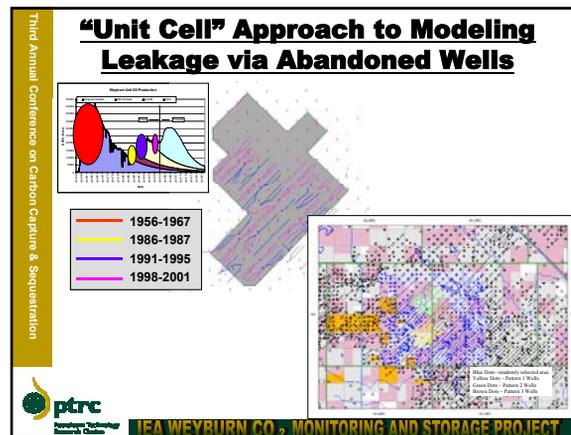


Pressure and Oil Saturation



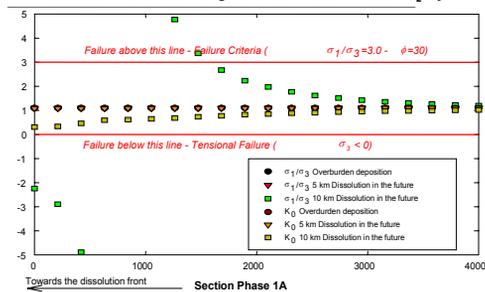


- Third Annual Conference on Carbon Capture & Sequestration
- ### Summary of Results – Geosphere Migration
- Up to 5000 yrs, 12.5% of the initial CO₂-in-place moves out of 75-pattern area
 - 6.59% goes to the geosphere below the Midale reservoir via water phase and is confined within, and in the vicinity of, the EOR perimeter.
 - 5.56% migrates to the Midale reservoir outside the 75-pattern area (laterally), generally moving updip
 - 0.05% goes to the geosphere above the Midale reservoir via water phase and confined within, and in the vicinity of, the EOR perimeter.
 - No CO₂ ever migrates to the biosphere.
- ptcr
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Salt Dissolution Processes

Dissolution Front Advancing Towards Phase 1A Post CO₂ Injection



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