EERC Technology… Putting Research into Practice

The Plains CO_2 Reduction (PCOR) Partnership

Zama Field Validation Project Update

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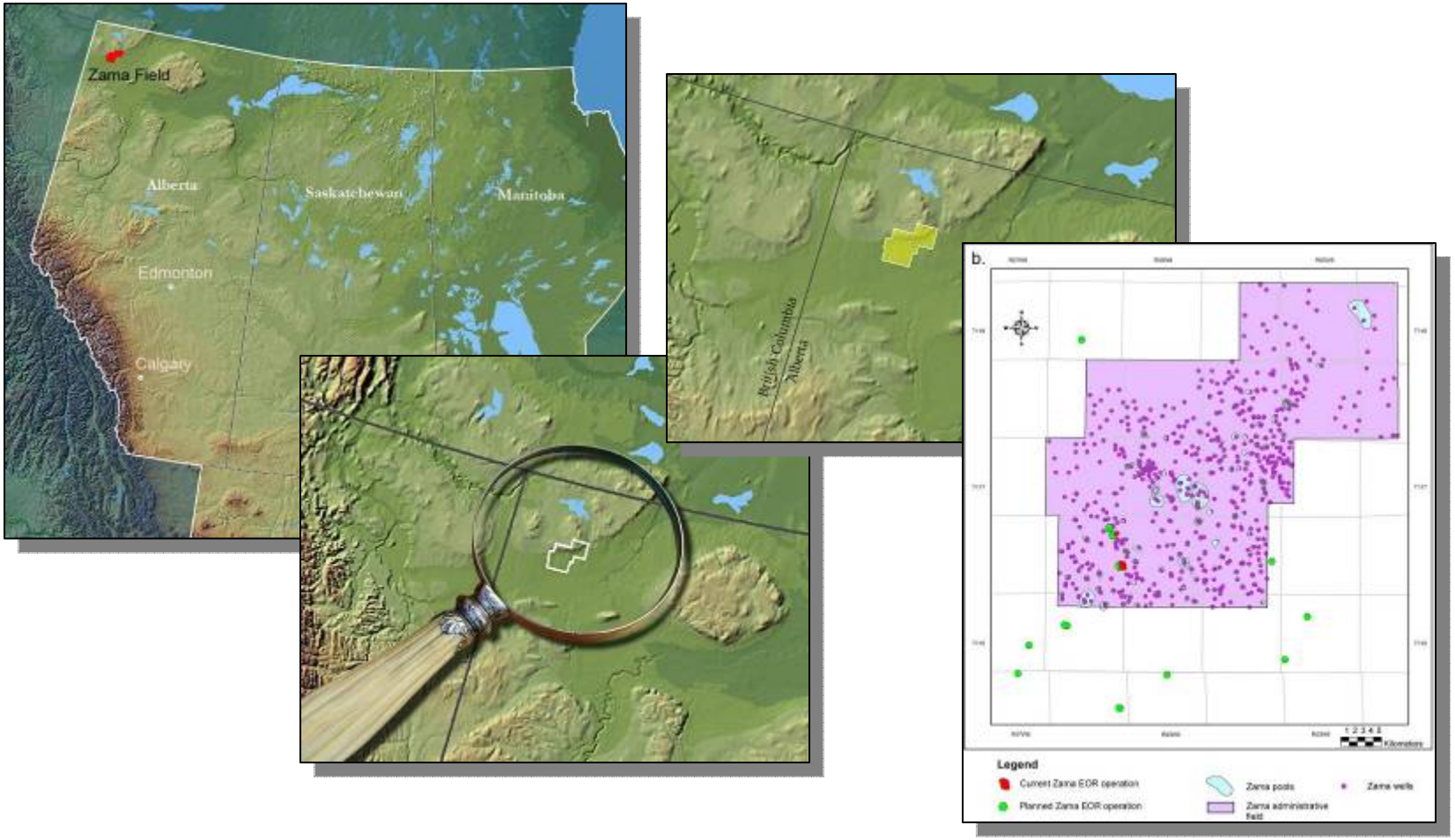
Acknowledgments to "The Zama Team"

- Bill Jackson – Apache Canada, Ltd
- Doug Nimchuck – Apache Canada, Ltd
- Rob Lavoie – CalPetra
- Stefan Bachu – Alberta Energy and Utilities Board (EUB)
- Matt Grobe – Alberta Geological Survey
- Maja Buschkuehle – Alberta Geological Survey
- Pat Mclellan – Advanced Geotechnology, Inc
- Lyle Burke – APA Petroleum Engineering

Where's Zama?


Zama Field
Alberta
Saskatchewan
Manitoba
Edmonton
Calgary
British Columbia
Alberta
b.
Legend
Current Zama EOR operation
Planned Zama EOR operation
Zama pools
Zama administrative field
Zama wells
Kilometers

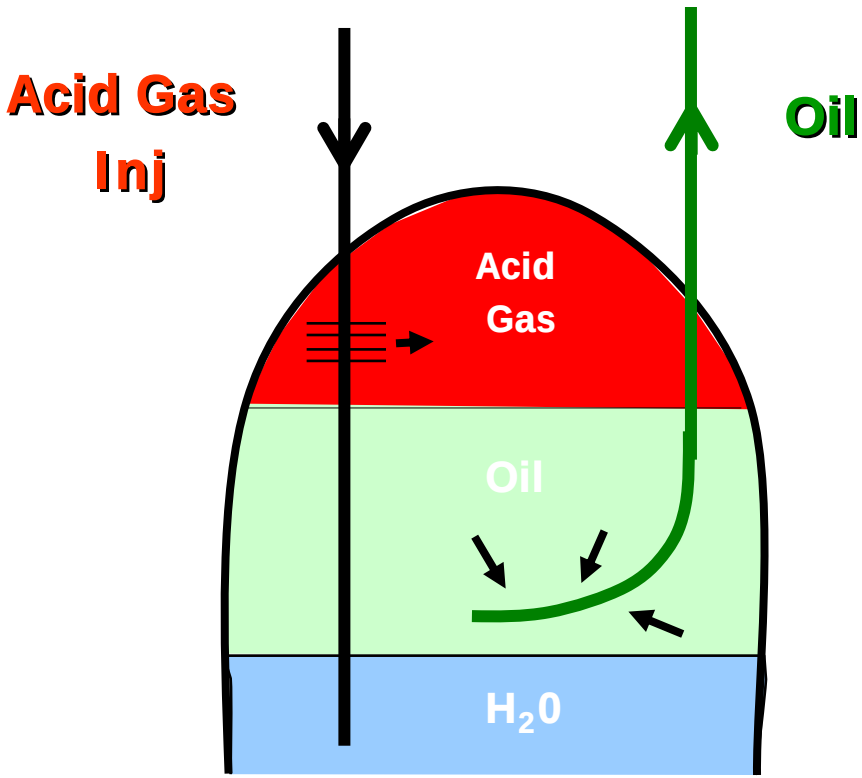
Zama Acid Gas EOR Project

- One of four Alberta demonstration projects to receive royalty credits for injecting CO_2 for EOR
- Unique approach combining acid gas disposal and CO_2 EOR
- Potential to expand to over 600 additional pinnacles

PCOR Partnership Involvement

- Collaborative effort with Apache Canada Ltd. and Alberta EUB to perform MMV program at Zama
- Compilation of Best Practices Manual for MMV at Acid Gas Injection Sites
- Demonstrate that geologic sequestration is an effective method to mitigate GHG emissions

PCOR Partnership Objectives



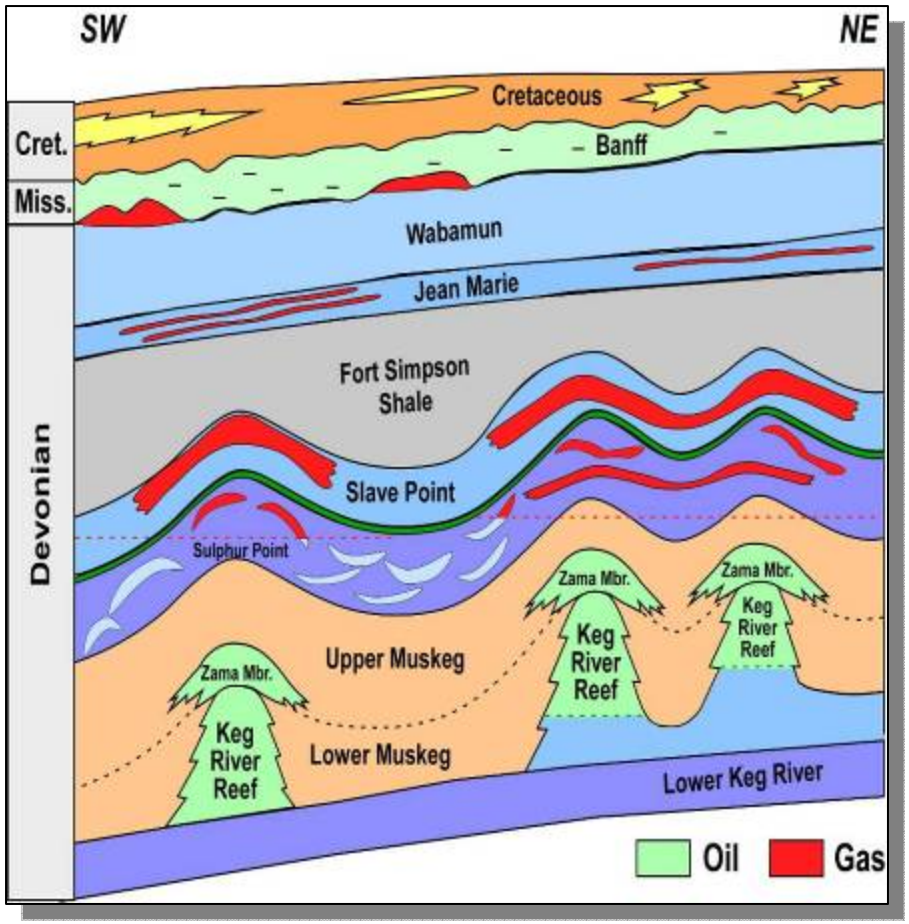
- Predict, monitor, and evaluate fate of the injected acid gas
- Determine affect of H_2S on CO_2 sequestration
- Develop BMP for MMV

Benefits of Acid Gas Injection

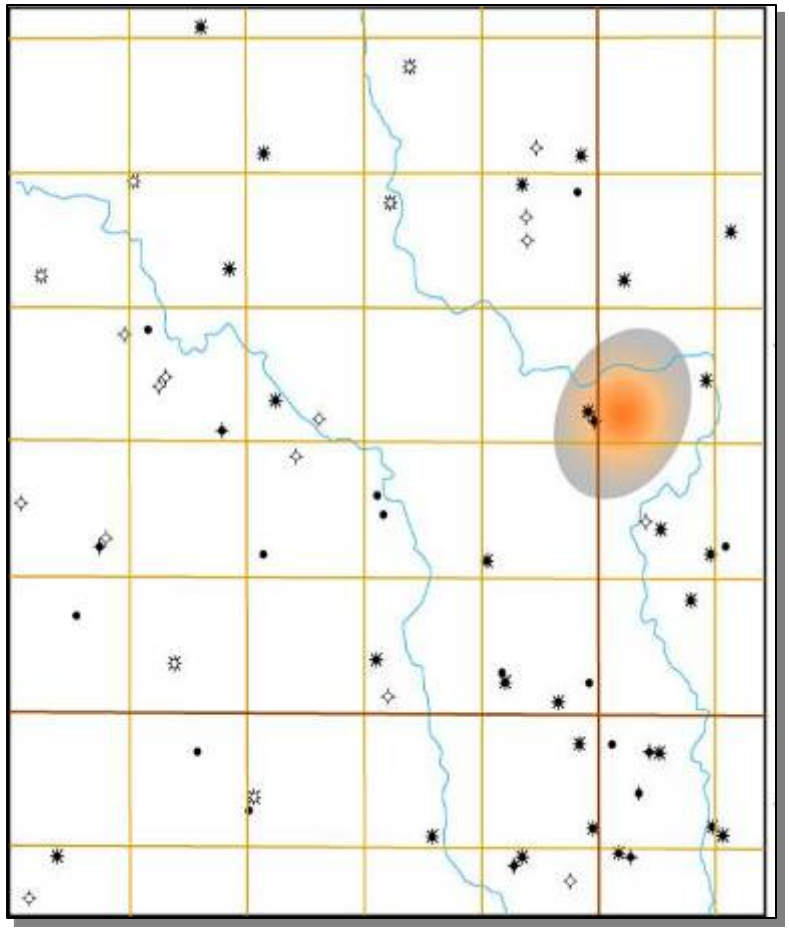
- Shut down of Claus Unit eliminates the need to stockpile elemental Sulfur
- 10 – 15% incremental oil recovery
- No longer venting CO_2 to the atmosphere
- No longer flaring SO_2

Technical Goals

- Ensure that acid gas is not migrating to adjacent strata
- Determine the integrity of the cap rock
- Understand the effect of acid gas injection on this system



Zama Pinnacle



- About 40 acres at the base (.16 Km^2)
- 400 feet tall (120 m)

- Currently utilizing 1 production well and 1 injection well

Zama Pinnacle Cross-Section

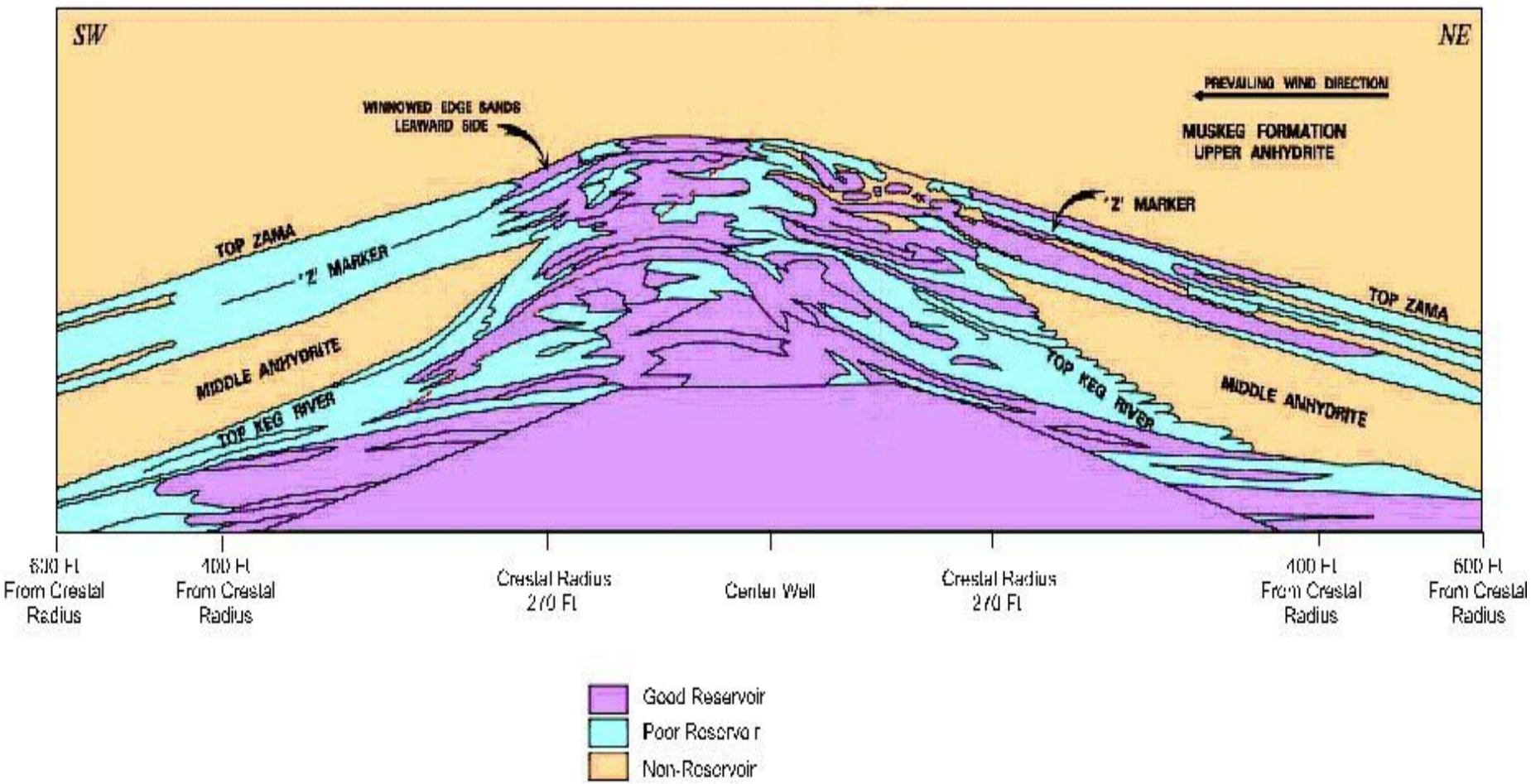
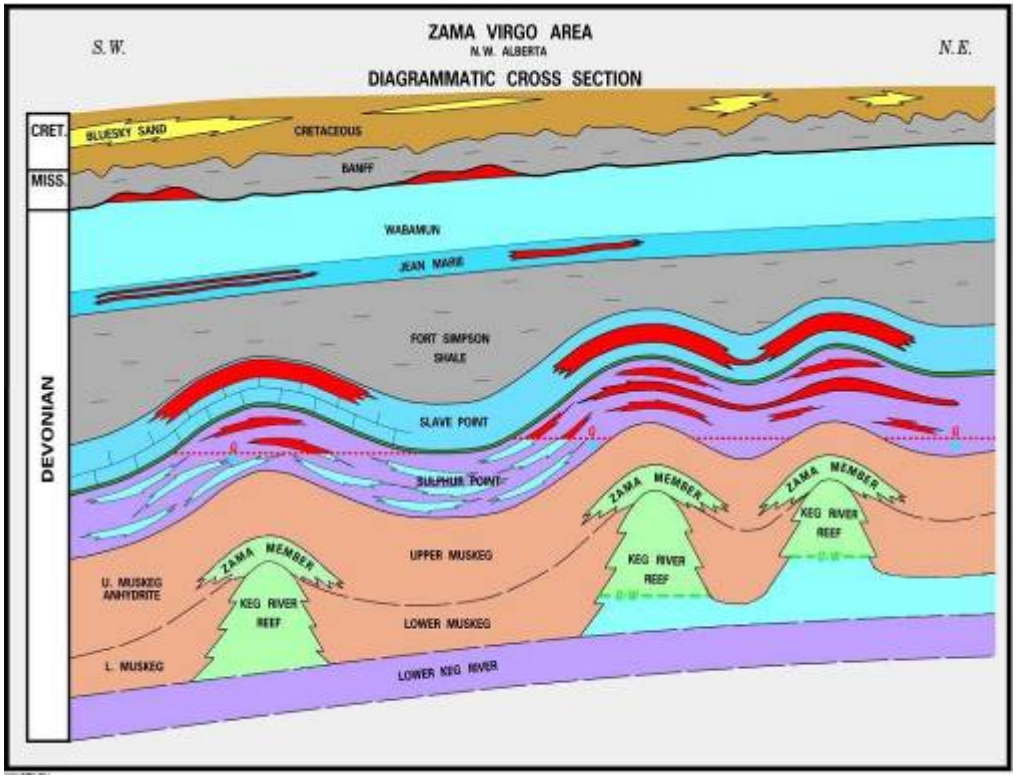


Figure courtesy Apache Canada Ltd.

Injection Zone Characteristics



- Carbonate reservoir
- Injection depth = 1600 m (5300 ft)
- Reservoir P = 2210 psig (15.3 Mpa)
- Permeabilty = 100-1000md
- CO_2 Capacity = >1MMT
- OOIP = 2.2 to 3.5 MMSTB

Injection Gas

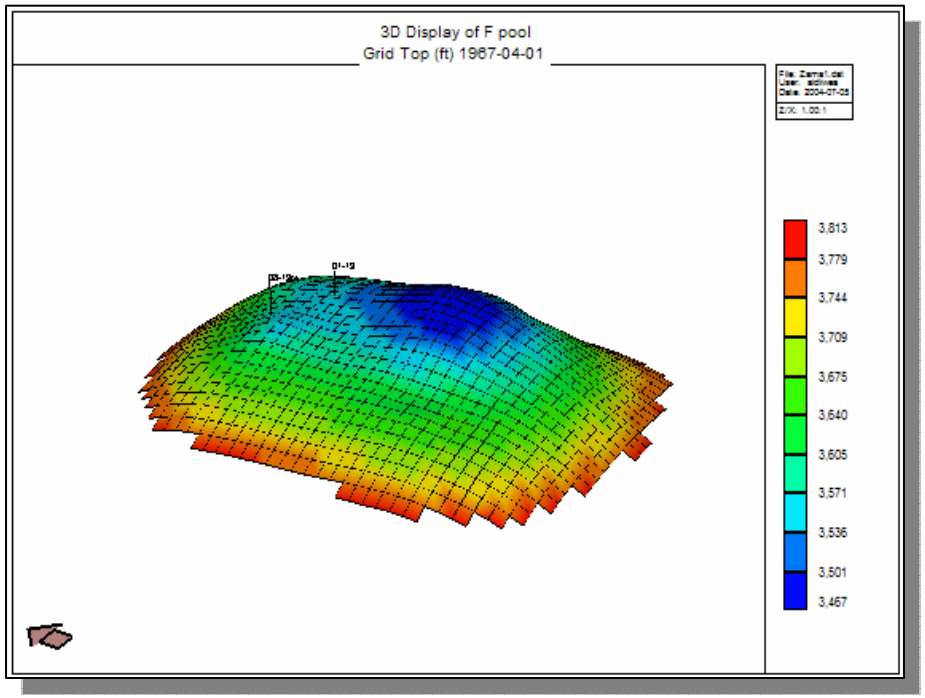
- 70% CO_2
- 30% H_2S
- Will inject up to 90 tons/day (1,700 Mcf) of Acid Gas

Research Activities

- Baseline Data Collection
- Geological Characterization
- Geomechanical Characterization
- Sampling Program

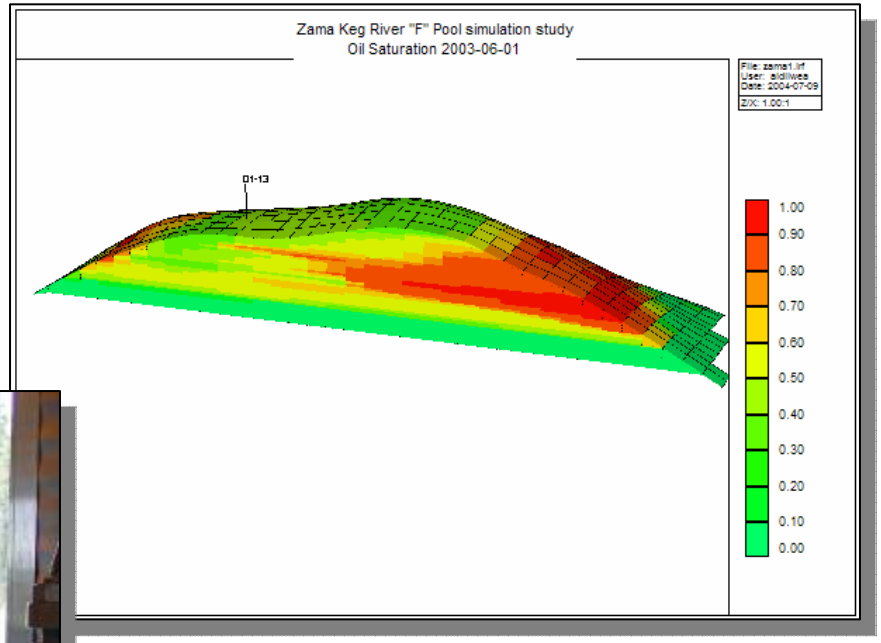
Baseline Data Collection

- Retrieve well/reservoir information
- Extract data and organize a database on drilling, completion, and stimulation/workover records
- Establish digital production/injection history of all wells



Baseline Data Collection (cont.)

- Geological and Geophysical information, including maps, seismics
- Fluid sampling of the pool for geochemical baseline determination



PCOR Partnership

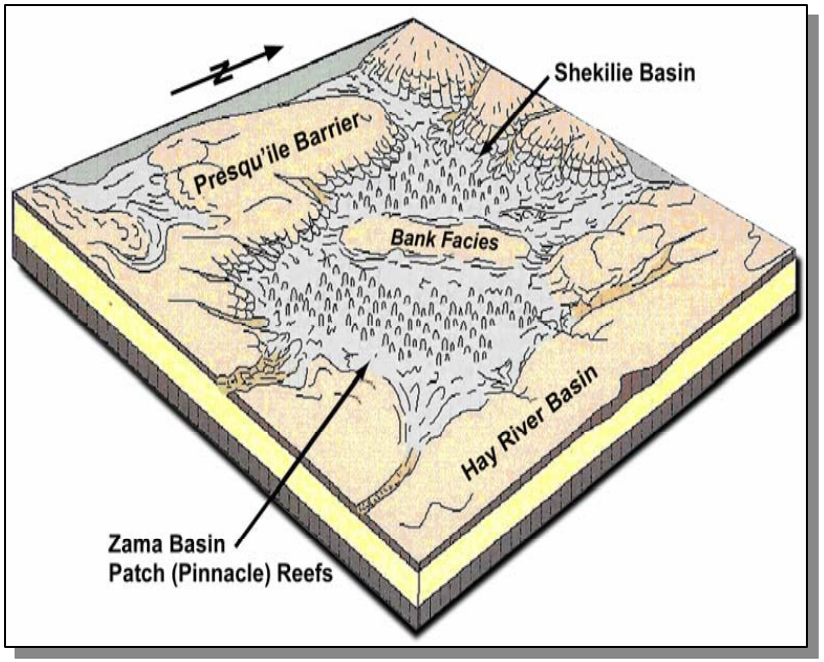
NETL

EERC Energy & Environmental Research Center

UND University of North Dakota

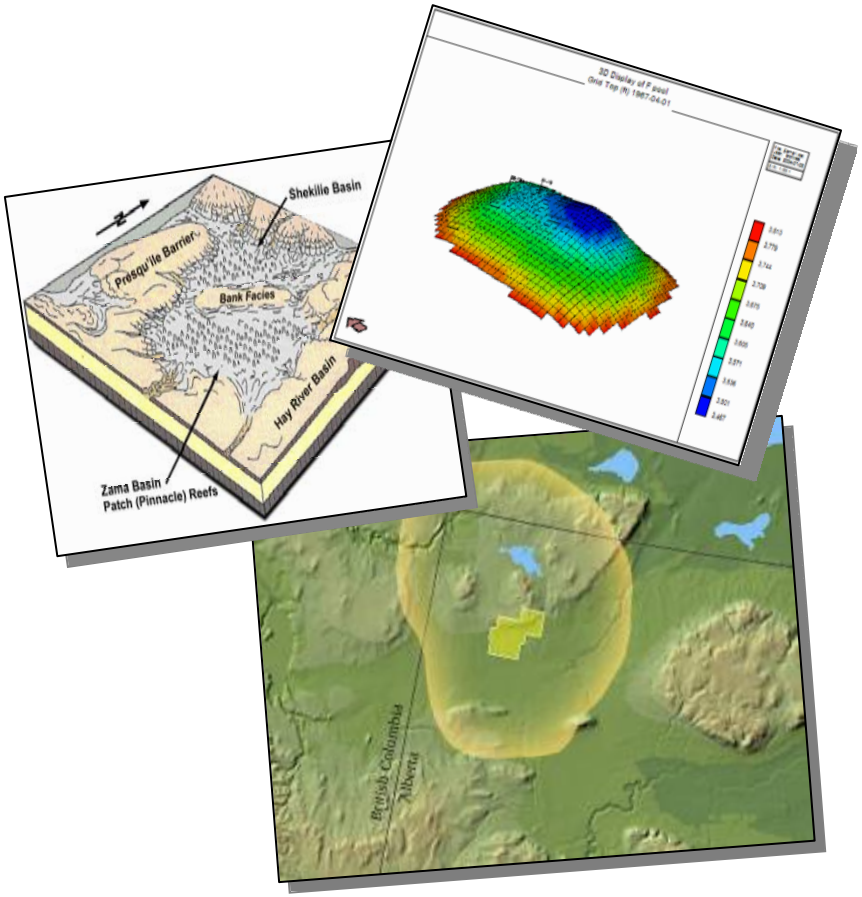
Geological Characterization

- Baseline geology
- Rock mineralogy and composition of formation water
- Baseline hydrogeology
- Mechanical rock properties and stress regime
- Assessment of geochemical interactions between formation and injected fluids and reservoir rock and caprock



Scales of Examination

- Reservoir scale
  - Zama F Pool and immediately underlying and overlying confining units
- Local scale
  - Zama F Pool and a few adjacent pinnacle reefs.
  - Entire stratigraphic column from basement to surface.
- Regional or subbasin scale
  - Relevant data from basement to surface over the entire Zama oil field/subbasin.
- Basin scale
  - Flow regime of the underlying Keg River aquifer.



Geomechanical Work

Laboratory Testing Program

- Compression Tests
  - Strength
  - Static and Dynamic Elastic Properties
  - Compressibility
  - Stress-dependent Permeability
- Sonic Tests
  - Compressional and Shear Wave Velocities

Geomechanical Work (cont.)

Field Testing Program and Analytical Work

- Wireline Logging
  - Dynamic Elastic Properties
  - Stress Regime
- Analytical Work
  - Correlation of Static-to-Dynamic Elastic Properties
  - Geomechanical Simulation
  - Assessment of Rock Integrity

Sampling Program

Injected miscible	biweekly
Produced gas	monthly basis
Slave Point Formation	bimonthly basis
Reservoir Pressure Monitoring	Twice yearly
Perfluorocarbon tracer	biweekly to bimonthly

Summary

- Injection is anticipated at any time
- Will inject up to 90 tons per day
- Sequestration of 25,000 tons (375 MMcf) of CO_2 per year
- Production is expected to increase by 10-15%

Thanks!

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