Introduction to the Illinois Basin-Decatur Project Test Site

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Illinois State Geological Survey
Schlumberger Carbon Services
Archer Daniels Midland Company

IEA GHG Summer School
20 June 2011
A collaboration of the Midwest Geological Sequestration Consortium, the Archer Daniels Midland Company (ADM), Schlumberger Carbon Services, and other subcontractors to inject 1 million metric tons of anthropogenic carbon dioxide at a depth of 7,000 +/- ft (2,000 +/- m) to test geological carbon sequestration in a saline reservoir at a site in Decatur, Illinois.
Mt. Simon Sandstone
Regionally most significant sequestration resource in the Midwest: 11 to 151 Gtonnes capacity (DOE Atlas, 3rd edition)
MGSC Illinois Basin-Decatur Project (IBDP) Site

MGSC Injection and geophone wells
MGSC monitoring well

0.5 mile

photo by Illinois Dept. of Transportation, 8 November 2010
Illinois Basin-Decatur Project Organization

ADM:
- global crop processing company
- 29,000 employees
- operates in 60 countries

Schlumberger Carbon Services

Archer Daniels Midland Company

Trimeric Corporation

10 Other Subcontractors and Cooperators

Subcontractors for drilling, oilfield services, geophysics, modeling, well log analysis, and reservoir simulation

UIC permit holder, provider of ADM-owned site, site infrastructure, injection operations and control, regulatory submittals, engineering services

Specification of equipment/materials for compression & dehydration facility and pipeline, working with ADM

Air sampling, core analysis, basin structure, well test analysis, geophysics, geo-statistics, satellite interferometry
Illinois Basin-Decatur Test Site (on ADM industrial site)

- A Dehydration/compression facility location
- B Pipeline route
- C Injection well site
- D Verification/monitoring well site
- E Geophone well

Prove Injectivity and Capacity
Regional Characterization Validated at ADM CCS No. 1 Well

Prove Injectivity and Capacity

Top Mt. Simon Sandstone

Top Mt. Simon Arkose

IBDP

80 miles (128 km)

Precambrian granite
Injection Well Drilled to 7,230 ft (2,190 m) Completed May 4, 2009
Injection Well
Casing and Cement Program
(to Class VI standards)

- Three casing strings, 20 in., 13 3/8 in. and 9 5/8 in (24.45 cm)
- Bottom ~1,900 ft (585 m) of 13-chrome CO₂-resistant steel
- Tubing is 4 1/2 in (11.4 cm) 13-chrome steel

New Albany
Maquoketa

Intermediate casing landed in upper Eau Claire

Eau Claire

Long string casing landed in granite below the Mount Simon

No Vertical Scale
Injection Well Completion

- **Mt. Simon Core 6,404 – 6,433 feet**
- **Mt. Simon Core 6,751 – 6,780 feet**
- **Perforations: 6,985 -7,015; 7,025 - 7,050**
- **55 ft (16.7 m) open interval**

- **Granite Wash**
- **Base of Mount Simon**
- **Granite**
- **Packer @ 6,365 ft (1,929 m)**
- **10% Porosity Cutoff**

- **6,500 ft**
- **2,000 m**
- **7,000 ft**

- TD=7236
Geophone Well
Completed November 2009

- 3,500 ft (1,060 m) well with 31 geophones cemented into uncased hole on tubing string

Injection Well

Geophone in special carrier strapped to 3.5 inch (8.9 cm) tubing
Instrumenting Injection Well

- Three microseismic sensors added
- Pressure and temperature sensors added

November 2009
Verification
Well Data Collection

Cored 110 m (360 ft) of Lower Mount Simon

November 2010
Plume Monitoring Strategies

- Verification well (location D) based on surface seismic, VSP, and plume modeling (18 months to CO$_2$ arrival)

- Schlumberger Westbay fluid sampling system
  - Pressure/temp. monitoring
  - Cased-hole logging

Cased and cemented November 22 2010
Environmental Monitoring
Conceptual Framework

Near Surface:
- Atmospheric
  - Meteorological monitoring
- Soil and vadose zone
  - Soil CO₂ flux
- Aerial imagery

Deep:
- Shallow groundwater
  - Geophysical surveys
  - Geochemical sampling
  - P/T monitoring
- Above seal
  - Geophysical surveys
  - Geochemical sampling
  - P/T monitoring
- Injection zone
  - Geophysical surveys
  - Geochemical sampling
  - P/T monitoring
Light red: groundwater well
Yellow: soil flux rings
Blue: shallow resistivity points

Injection well
Groundwater Monitoring Wells Installed

Concentration, mg/L

- Calcium
- Magnesium
- Potassium

Well 1-B (60 m)
Shallow geophysics

- 2D resistivity survey to 60m (200ft) where larger values (e.g., orange color) suggest coarser-grained materials

- Bedrock about 34m (112 ft) below ground surface at 166 m (545 ft) elevation

- Resistivity changes may indicate fluid substitution
Soil Flux Observations

118 rings in sampling pattern as of June 2010
Air Sampling Site: One Year Data in Hand

Problem: solar panels inadequate power source in cold weather
Redeployed w/ 110v AC
Baseline 3D Geophysical Survey
Completed January 2010
Line Through 3D VSP Volume

- Data are higher frequency content
- Sensors are subsurface in a dedicated well
Possible Channel in Lower Mt. Simon

Channel

3D VSP Data

350 ft

35 ft
Dual 550 TPD Reciprocating Compressors with Dehydration

- Shell and tube heat exchangers
- Cooling water supply & return
- Suction scrubber
- Pipeline to wellhead
- Compressor
- Motor
- Blower
- Blower aftercooler
- Discharge separator
- Dehy inlet separator
- Dehydration unit contactor
Compressor Skid on Transporter in Houston

Skid weighs 60,000 kg
Blower, Regeneration Skid, and Pump Building

September 2010

February 2011
Injection Wellhead Installed and Pipeline Constructed

Supply end at compressors

January 2010

February 2011
- Real-time remote access
- Multiple backup locations
- Interface with compression facility
Carbon Capture Project is Supporting IBDP Satellite Interferometry

Twenty-one artificial reflectors installed in updip plume direction