Geologic CO$_2$ Sequestration Potential of 42 California Power Plant Sites

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Outline

- Background
  - Previous Work

- This study
  - Four Goals
  - Five Geologic Parameters Considered
  - Preliminary Results
  - Future Work
National Source-Sink Matching

NETL
California Source-Sink Matching
California Geologic Survey (CGS)
This Study: 42 Individual Power Plant Sites
Geology is One Component of the California NGCC – CCS Study

- Above ground: engineering study
  - Stone & Webster

- Below ground: geologic characterization
  - LLNL
4 Goals of this Study

1. Review geology of NGCC sites
2. Combine results with the engineering study
3. Select a promising site for geologic carbon sequestration
4. Construct 3D geologic model of the site

Where is California’s best NGCC source – sink match?
Five Geologic Parameters Considered

1. Distance to nearest potential CO$_2$ sink
2. Proximity to oil or gas fields
3. Subsurface geology
4. Surface expression of nearby faults
5. Groundwater
Geologic Parameters Considered: Distance to Nearest Potential CO₂ Sink

- CGS
- California Division of Oil and Gas and Geothermal Resources (DOGGR)
Geologic Parameters Considered: Proximity to Oil or Gas Fields

- DOGGR
- CGS
Geologic Parameters Considered: Subsurface Geology

Units suitable for injection
Caprocks/seals

- In oil/gas regions:
  - DOGGR, CGS

- Otherwise:
  - Academic papers
  - Field guides
  - USGS
Geologic Parameters Considered: Surface Expression of Nearby Faults

CGS: 2010 Fault Activity Map of CA
Geologic Parameters Considered: Groundwater

Depth to saline aquifers (>10,000 ppm TDS)

- Recent CGS Study
- California Department of Water Resources
- California Energy Commission siting documents
Geologic Parameters Summarized into 42 Profiles: One Example

**Magnolia Power Plant Project**

**Profile of Geologic CO\textsubscript{2} Sequestration Potential**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest Potential CO\textsubscript{2} Sink\textsuperscript{1,2}</td>
<td>8 km; located near the edge of the Ventura Basin, which is one of California’s larger marine basins with potential sequestration opportunities.</td>
</tr>
<tr>
<td>Proximity to Oil or Gas Fields\textsuperscript{2}</td>
<td>Approximately 20 km to the Pacoima Oil Field.</td>
</tr>
<tr>
<td>Subsurface Geology\textsuperscript{3}</td>
<td>Depth to geologic units suitable for injection (desired is &gt;800 m): Not applicable</td>
</tr>
<tr>
<td>Description of geologic unit: Depth to crystalline basement rocks is less than 800 m, according to a depth-to-basement map created by the California Geologic Survey (CGS). The site is located approximately 8 km east of thick sandstone deposits within the Sespe through Pico formations, according to CGS.</td>
<td></td>
</tr>
<tr>
<td>Description of caprock: Not applicable</td>
<td></td>
</tr>
<tr>
<td>Surface Expression of Nearby Faults\textsuperscript{3}</td>
<td>Distance to nearest surface expression of a fault: 1 km</td>
</tr>
<tr>
<td>Description of nearby fault(s): The site is 1 km from the Holocene-age Verdugo Fault and 4 km from another unnamed Holocene-age fault. The nearest Historic-age fault is the San Fernando Fault, located 10 km north.</td>
<td></td>
</tr>
<tr>
<td>Subsurface Water\textsuperscript{4}</td>
<td>Depth to base of fresh water aquifer: Fresh water could extend to the top of crystalline basement, given that the Saugus Formation is the main water-bearing unit in the vicinity, and it could reach depths of 800 m in this area.</td>
</tr>
<tr>
<td>Depth to saline aquifer (&gt;10,000 ppm TDS): Not readily available</td>
<td></td>
</tr>
</tbody>
</table>

Geologic CO\textsubscript{2} Sequestration Potential of 42 California Power Plant Sites, Katherine B. L. Myers and J. L. Wagoner, June 2011, LLNL-TR-489273
Preliminary Results: Distance to Nearest Potential CO2 Sink

Most sites co-located with a potentially suitable sink
Preliminary Results: Proximity to Oil or Gas Fields

Most sites located within 20 km of an oil or gas field
Preliminary Results: Surface Expression of Nearby Faults

Distance to Nearest **Surface Expression** of a Fault

- **0 – 5 km**
- **6 – 20 km**
- **> 20 km**
Future Work

- Combine results with the engineering study
- Select promising site for geologic carbon sequestration
- Model 3D geology to further characterize the site (50 km x 50 km)
Conclusions

- Most California NGCC sites are located:
  - Above a potentially suitable sink
  - Within 20 km of an oil or gas field
  - Within 5 km of the surface expression of a fault

- Geologic storage of CO2 appears practicable for many California NGCC sites.
Thank you
Extra figures
Sources of Geologic Data

- California Division of Oil and Gas and Geothermal Resources (DOGGR)
- California Geological Survey (CGS)
- United States Geological Survey (USGS)
- WESTCARB publications
- Published research
- California Energy Commission siting documents
- California Department of Water Resources
Preliminary Results: Fault Age (Timing of Most Recent Displacement)

Number of Sites

- 200 sites: 2 sites
- 11,700 sites: 8 sites
- 700,000 sites: 14 sites
- 1.6 million sites: 15 sites
- > 1.6 million sites: 1 site
Power Generating Capacity (megawatts)
Distance Between an Injection Site and a Fault Can Change with Depth

From http://www.education.com/reference/article/Ref_Earthquake_Related/
Names of 42 plant sites