WESTCARB Phase I Results Review

Geologic Sequestration of CO_2 in California

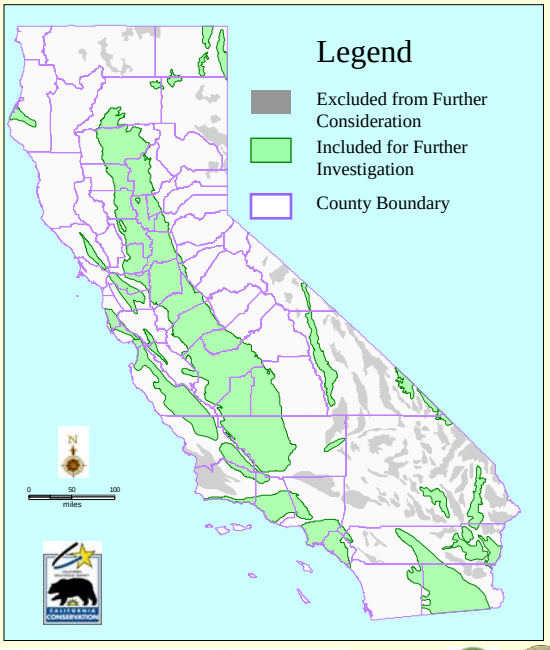
Cameron Downey
Engineering Geologist
California Geological Survey
(916) 323-7696;
jclinken@consrv.ca.gov

Berkeley, CA
November 9, 2005

Sedimentary Basin Evaluation

- 104 basins were screened
- 77 basins were eliminated from further consideration due to:
  - Lack of porous & permeable formations
  - Lack of suitable seals
  - Sediment thickness < 800 meters
  - Being within parklands, Indian lands, or Military Installations
- 27 basins met the initial screening criteria

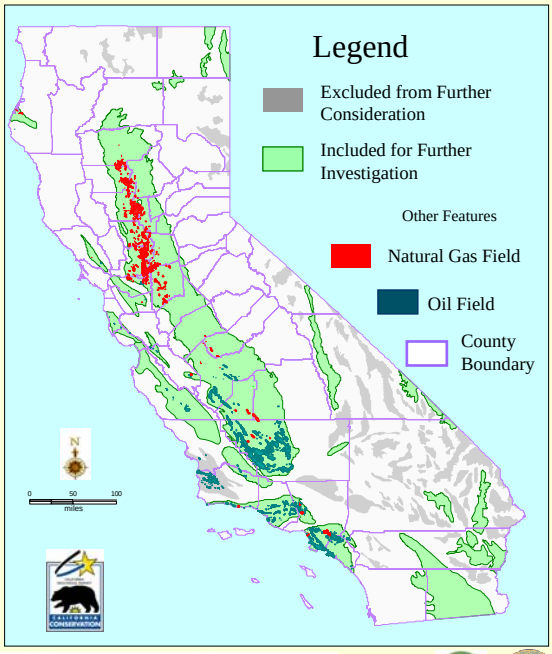
Status of Sedimentary Basins In California



Oil and Gas Fields

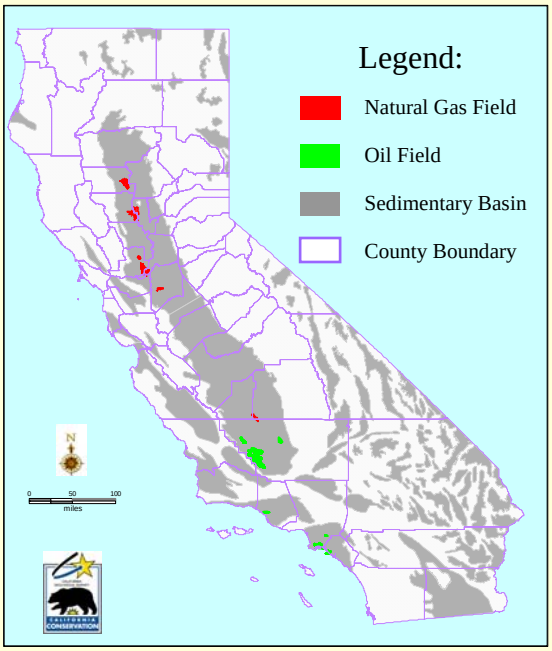
- Information about physical rock and fluid properties (porosity, permeability, depth, pressure, etc.) were compiled.
- Of the 465 oil & gas fields, 119 are less than 800m deep.
- 209 oil fields are > 800m deep.
- 137 gas fields are > 800m deep.

Sedimentary Basins, Natural Gas and Oil Fields in California

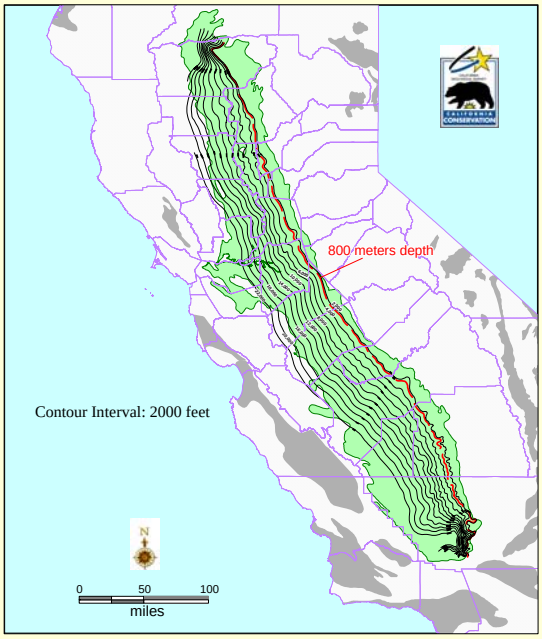


20 Largest Oil and Gas Fields In California

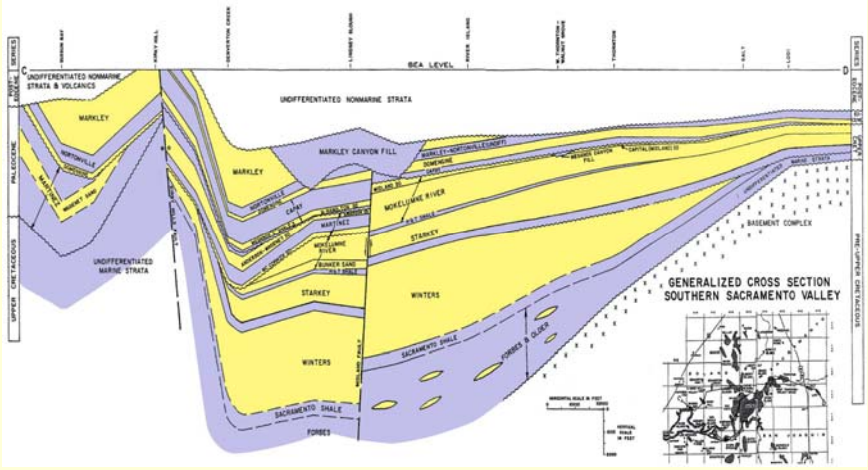
(greater than 800 meters deep)



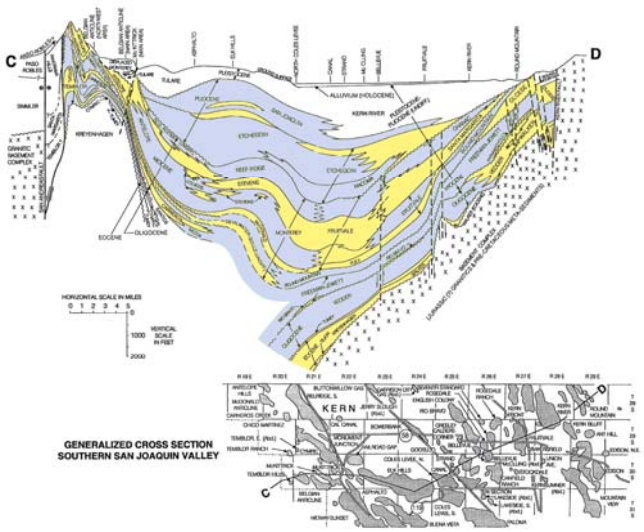
Depth to Basement, Sacramento and San Joaquin Basins



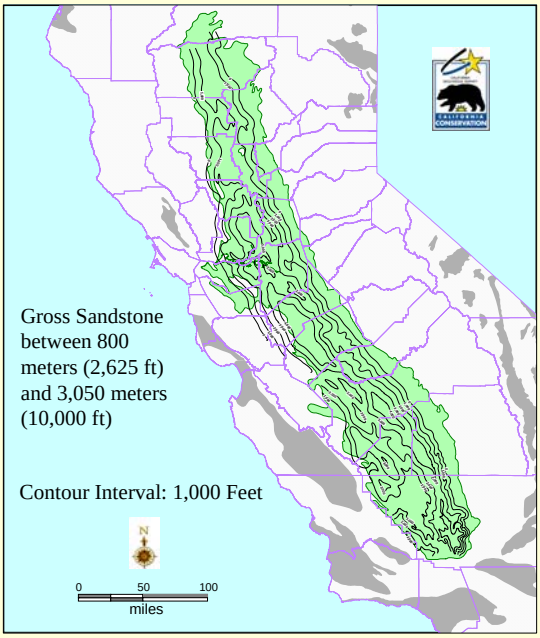
Generalized Cross-Section of Southern Sacramento Basin



Generalized Cross-Section of Southern San Joaquin Basin



Isopach Map, Sacramento and San Joaquin Basins



Sacramento and San Joaquin Basins

- Areally extensive (22,368 sq. mi.)
- Large sparsely populated areas.
- Tectonically stable (relatively)
- Depths from 800 meters (2,625 ft.) to > 12,200 meters (40,000 ft.)
- Abundant saline aquifers, oil & gas fields, and seals
- Good porosity and permeability (15-40%, 10-10,000 md)

Sacramento Basin Porosities and Permeabilities*

Cretaceous:	Forbes	(15 – 30%, 15 – 108 md)
	Lathrop	(18 – 27%, 60 md)
	Winters	(25 – 38%, 10 – 1,700 md)
	Tracy	(20 – 28%, na)
	Blewett	(20 – 30%, 70 – 597 md)
	Starkey	(14 – 35%, 50 – 100 md)
	Mokelumne	(15 – 35%, 250 – 1,500 md)
Eocene:	Domengine	(18 – 32%, 15 – 70 md)

* California Division of Oil, Gas, and Geothermal Resources

San Joaquin Basin Porosities and Permeabilities*

Eocene:	Gatchell	(14 – 20 %, 65 – 421 md)
	Kreyenhagen	(12 – 38 %, 10 – 4,950 md)
Oligocene:	Vedder	(12 – 40 %, 15 – 2,400 md))
Miocene:	Jewett/Pyramid Hills	(15 – 39 %, 6 – 5,000 md)
	Olcese	(20 – 34 %, 150 – 2,000 md)
	Temblor	(10 – 40 %, 7 – 10,000 md)
	Stevens	(10 – 35 %, 0.2 – 6,500 md)
	Santa Margarita	(20 – 40 %, 1 – 10,000 md)
	Chanac	(20 – 40 %, 1 – 10,000 md)
Pliocene:	Etchegoin	(12 – 40 %, 1 – 22, 320 md)
	San Joaquin	(28 – 34 %, 135 md)

Conclusions

- 27 basins with varying potential for CO_2 sequestration.
- Aggregate area of more than 38,000 square miles.
- Cenozoic marine basins exhibit most potential.
  - Thick sedimentary sections, multiple objectives, sealing shales
  - Widespread saline aquifers
  - Oil and gas pools (for EOR or permanent containment)
  - Relatively abundant information from oil and gas operations
- Most promising: Sacramento, San Joaquin, Ventura, Los Angeles, and Eel River basins.
- Storage estimates for 10 largest marine basins of 146-840 Gt CO_2 (Myer, et al, 2005).
- Detailed, formation specific mapping and characterization needed to identify pilot sequestration objectives.

Department of Conservation
California Geological Survey

http://www.conservation.ca.gov/CGS/