





**WESTCARB Annual Business Meeting**

**Nevada Geologic CO<sub>2</sub> Storage Characterization**

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Seattle, WA  
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**We are finalizing a report on the**

**“Potential for**

**CO<sub>2</sub> Sequestration in Nevada using Mafic and Ultramafic Rocks**

**and Enhanced Oil Recovery”**

**CONCLUSIONS:**

- 1. There are sufficient mafic (Mg- and Fe-rich) rocks in Nevada to consider CO<sub>2</sub> sequestration through mineral carbonation.**
- 2. There is not much potential for storing CO<sub>2</sub> through EOR in Nevada oil fields.**



**IN OTHER WORDS:**

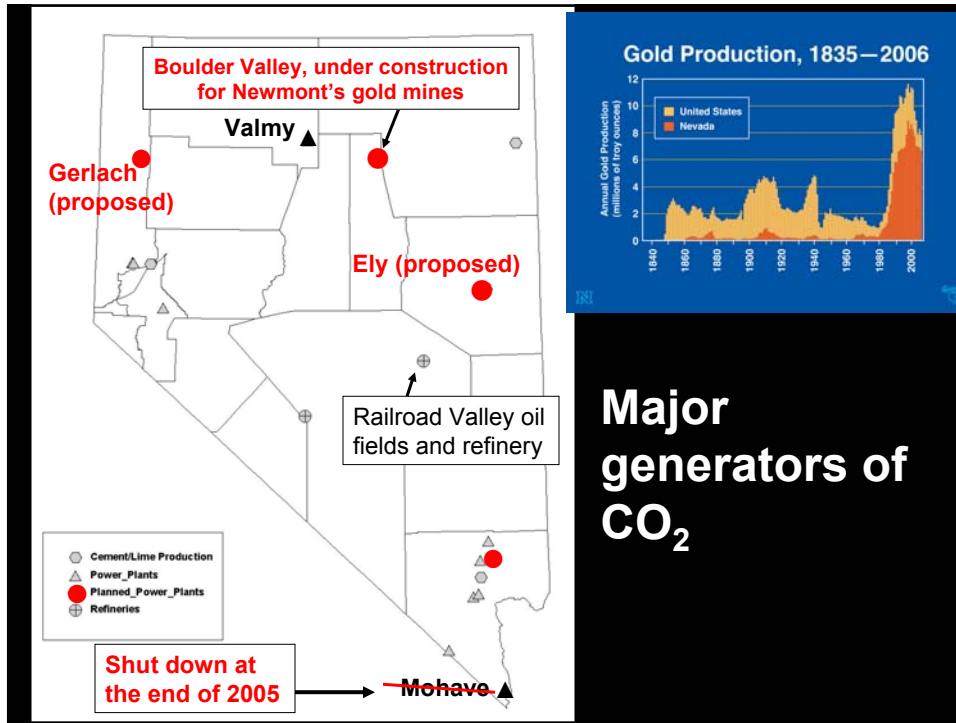
**1. There is a lot of basalt in Nevada.**

**2. There hasn't been much oil produced in Nevada.**

**We burn a lot of fossil fuel in the U.S. and Nevada.**

Fossil fuels are the source of 85% of energy consumption in the U.S., and coal accounts for 23% (EIA, 2006). Similarly in Nevada, fossil fuels are the source of 93% of energy consumed, and coal accounts for 27% (EIA, 2004).





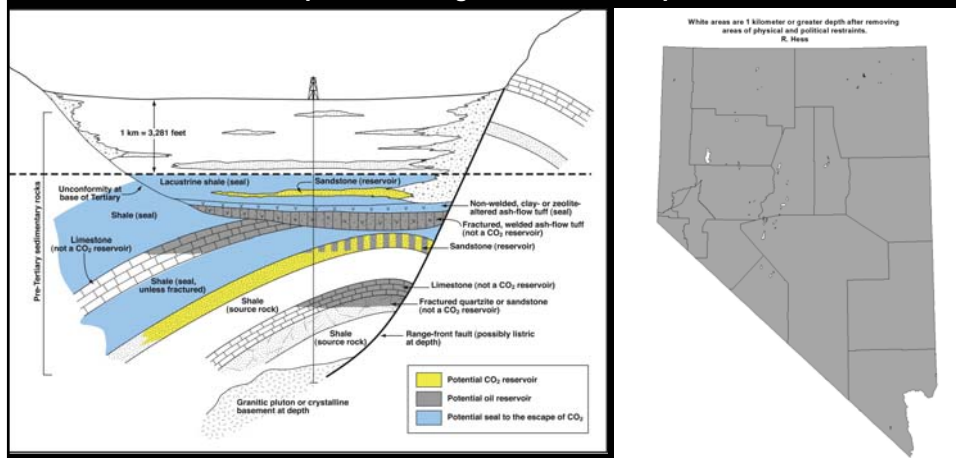
In our earlier WESTCARB-supported study, we concluded that there is not much potential for conventional CO<sub>2</sub> sequestration in Nevada.

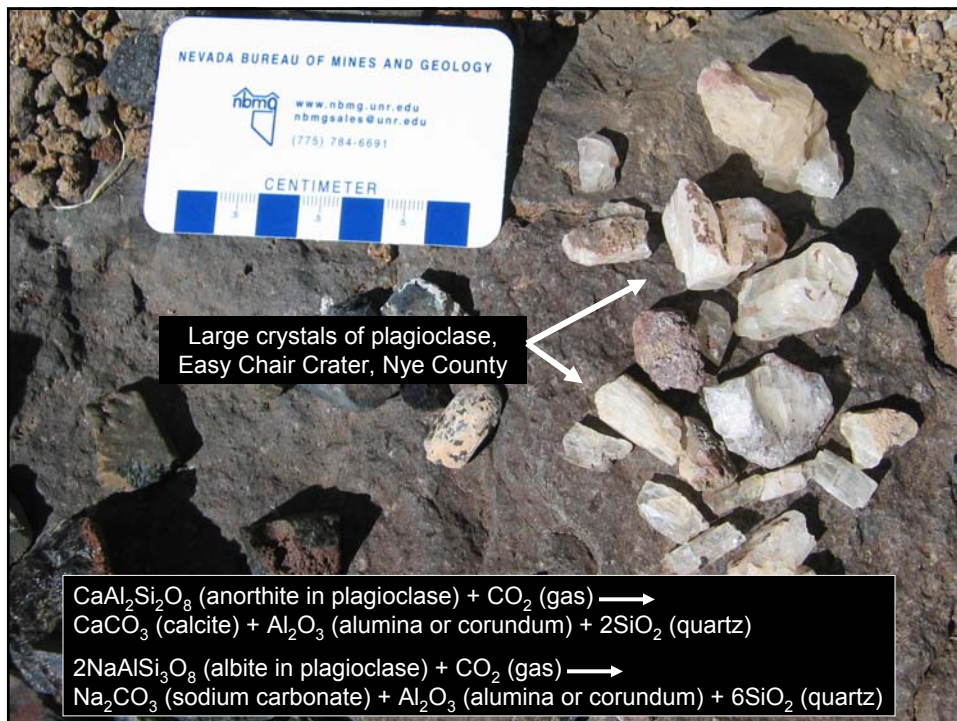
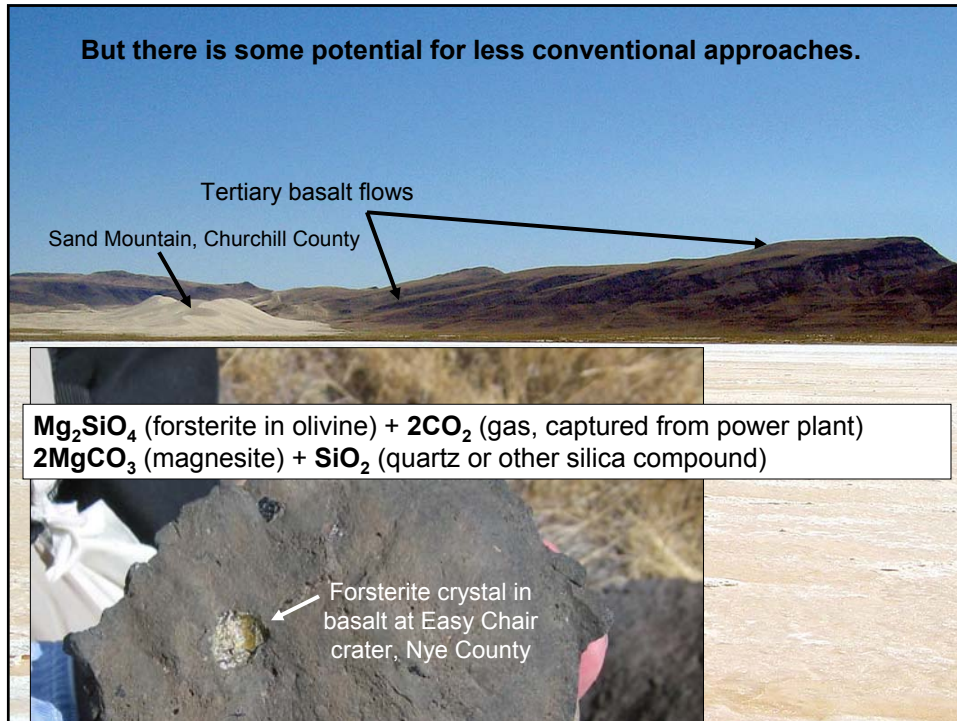
**“Preliminary Assessment of the Potential for Carbon Dioxide Disposal by Sequestration in Geological Settings in Nevada”**

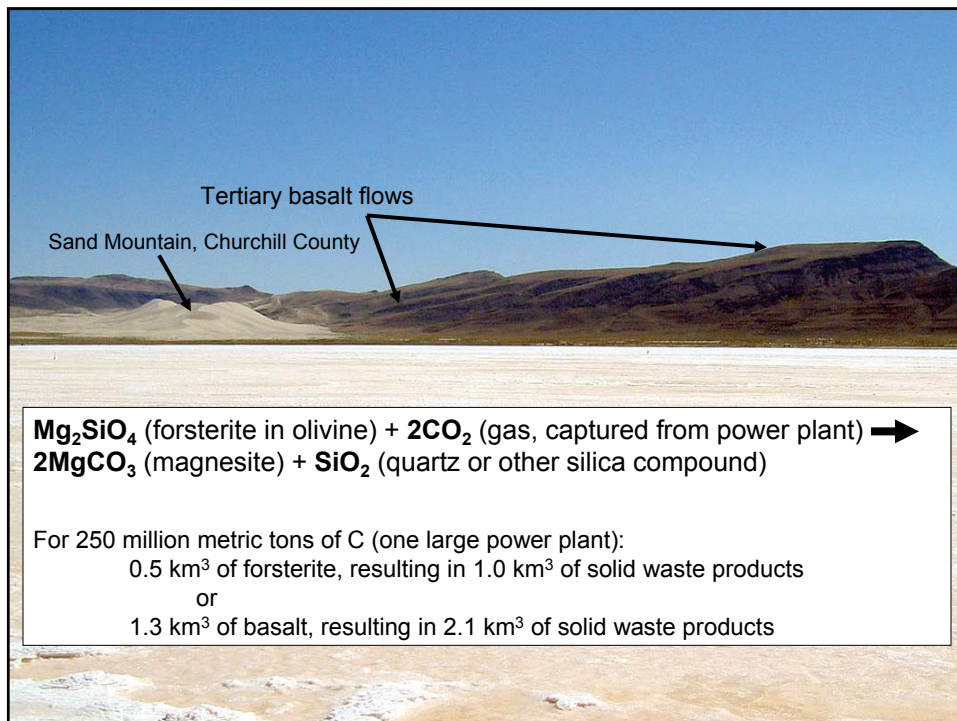
Jonathan G. Price, Ronald H. Hess, Shane Fitch, James E. Faulds, Larry J. Garside, Lisa Shevenell, Sean Warren

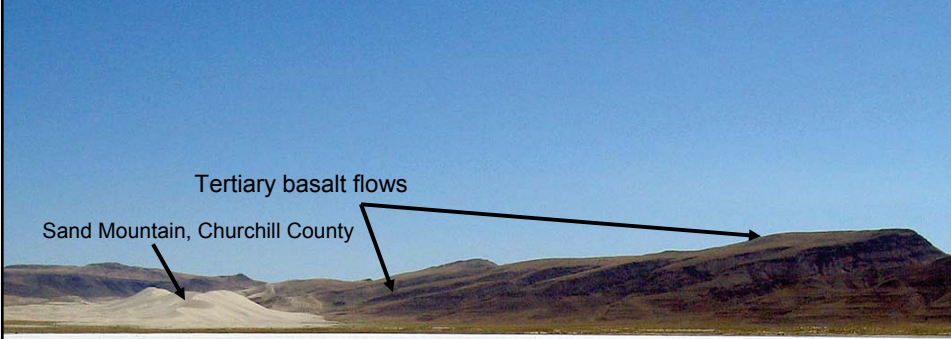
Nevada Bureau of Mines and Geology Report 51 (2005)

<http://www.nbmgs.unr.edu/dox/r51.pdf>









Sand Mountain, Churchill County

Tertiary basalt flows

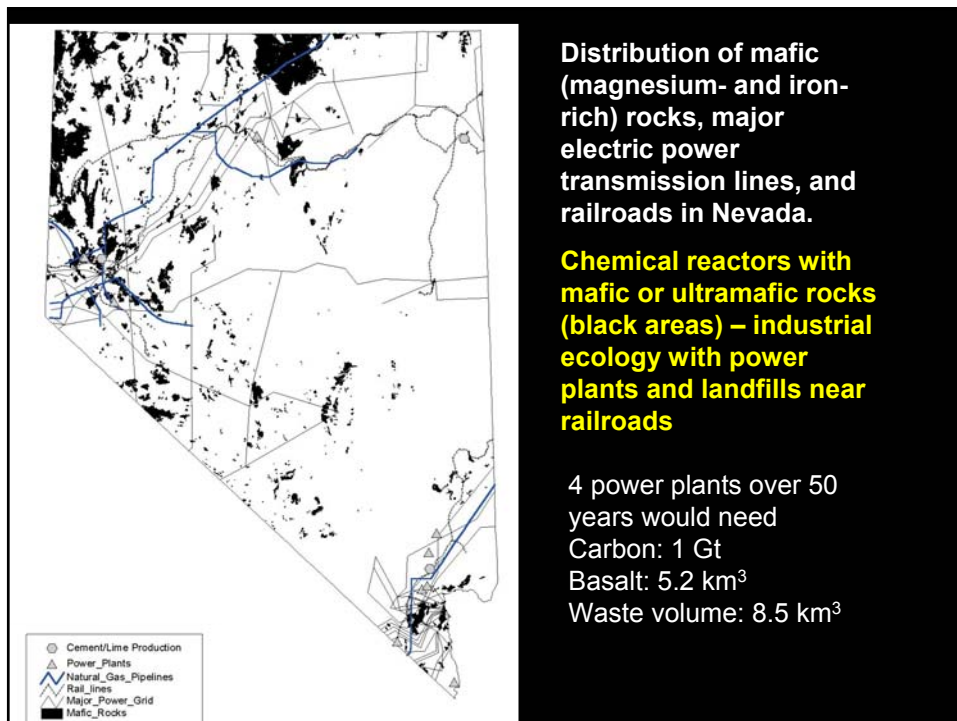
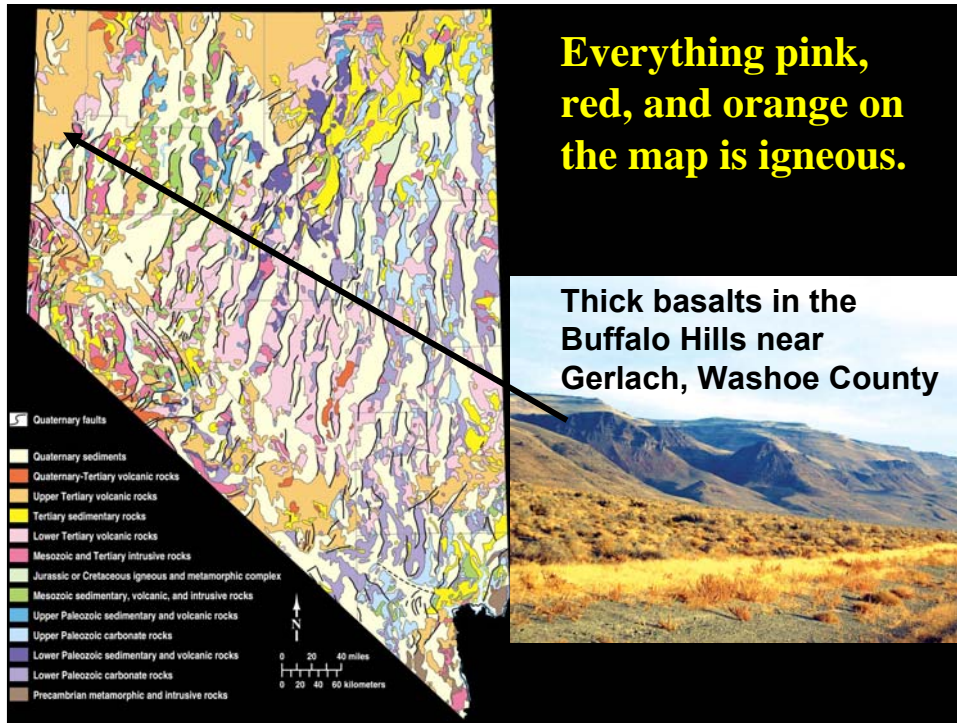
**$\text{Mg}_2\text{SiO}_4$  (forsterite in olivine) +  $2\text{CO}_2$  (gas, captured from power plant)  $\rightarrow$   
 $2\text{MgCO}_3$  (magnesite) +  $\text{SiO}_2$  (quartz or other silica compound)**

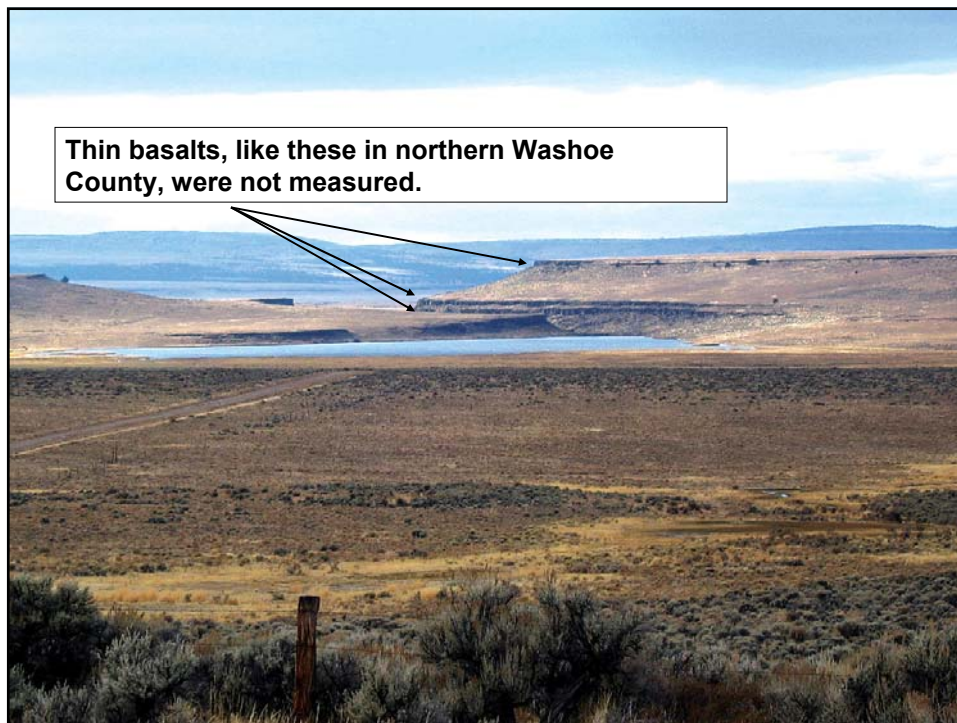
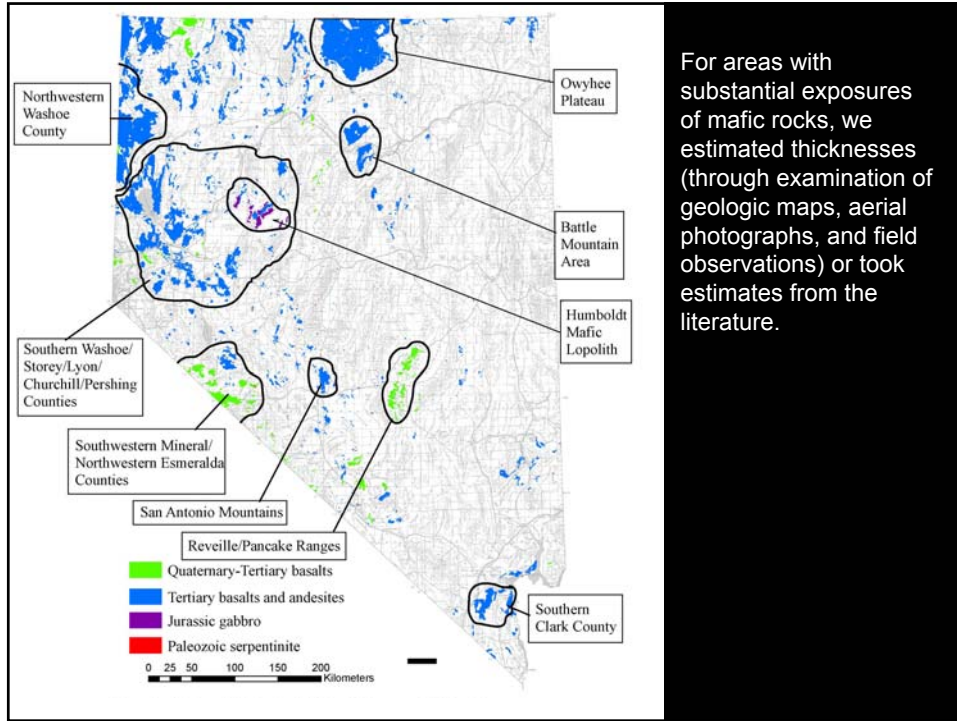
**WHY IN-SITU MINERAL CARBONATION WON'T WORK:**

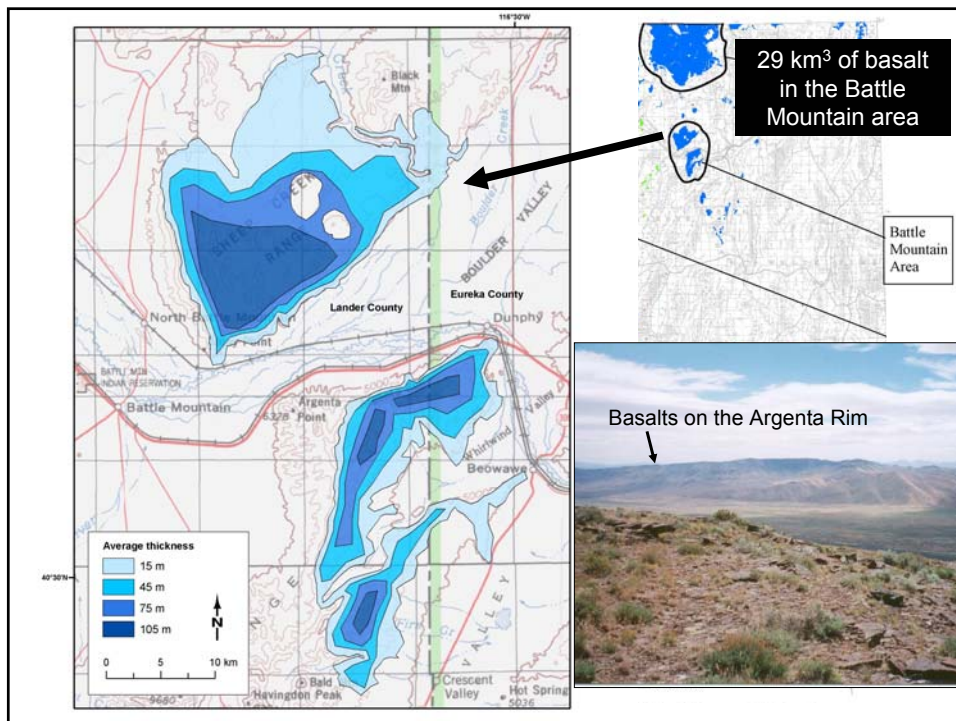
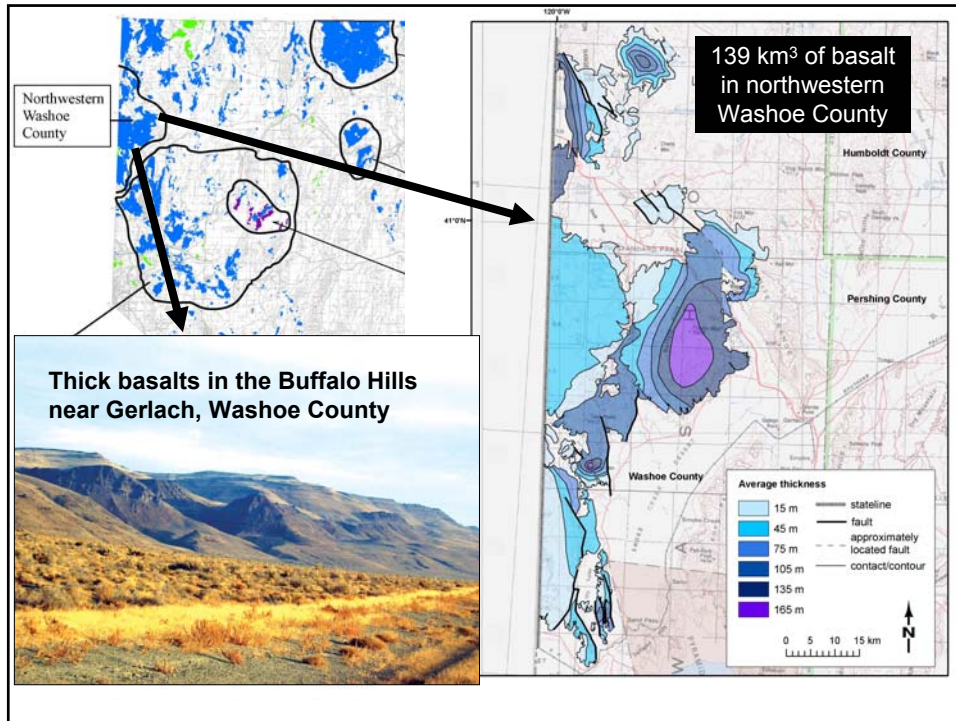
**$\Delta V_r$  (forsterite) = 80% volume increase;  $V_{\text{products}}/V_{\text{reactants}} = 1.80$**

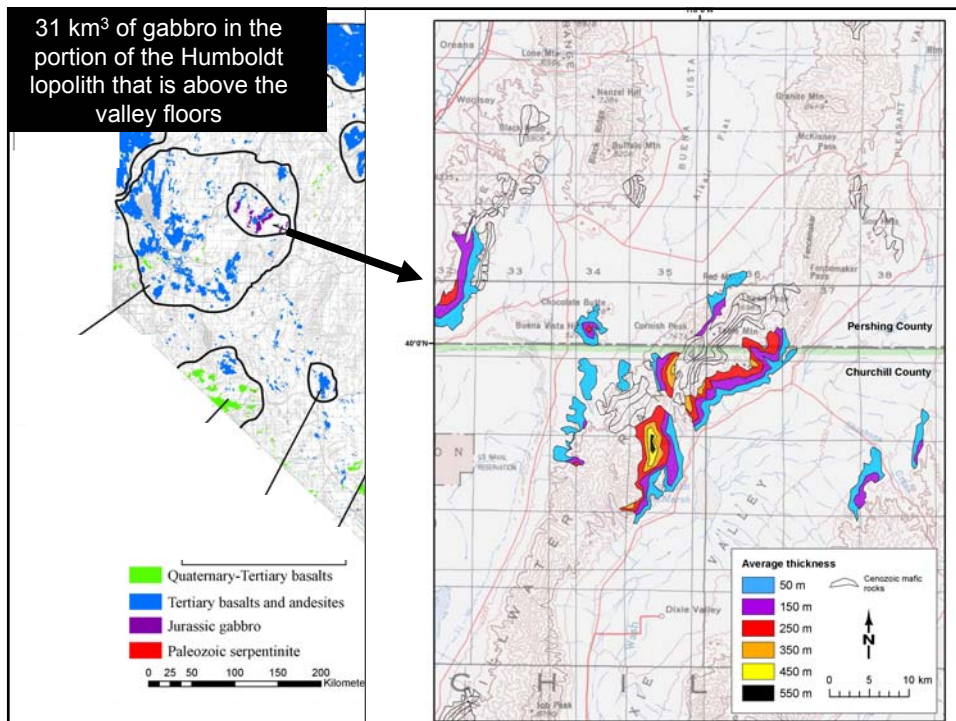
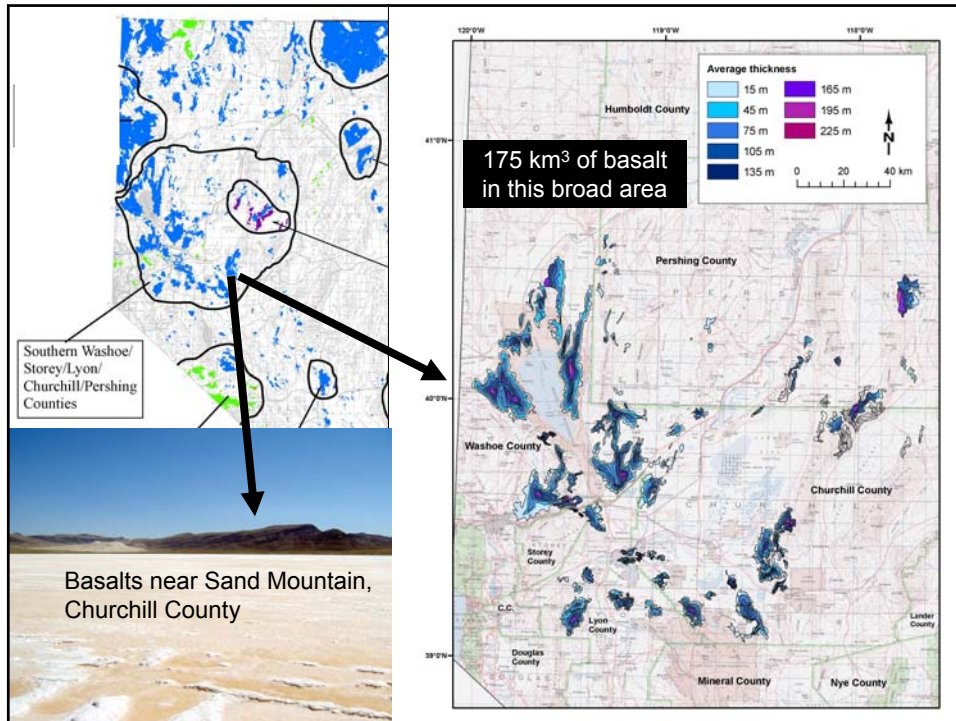
**$\Delta V_r$  (basalt) ~ 31% volume increase;  $V_{\text{products}}/V_{\text{reactants}} = 1.31$**

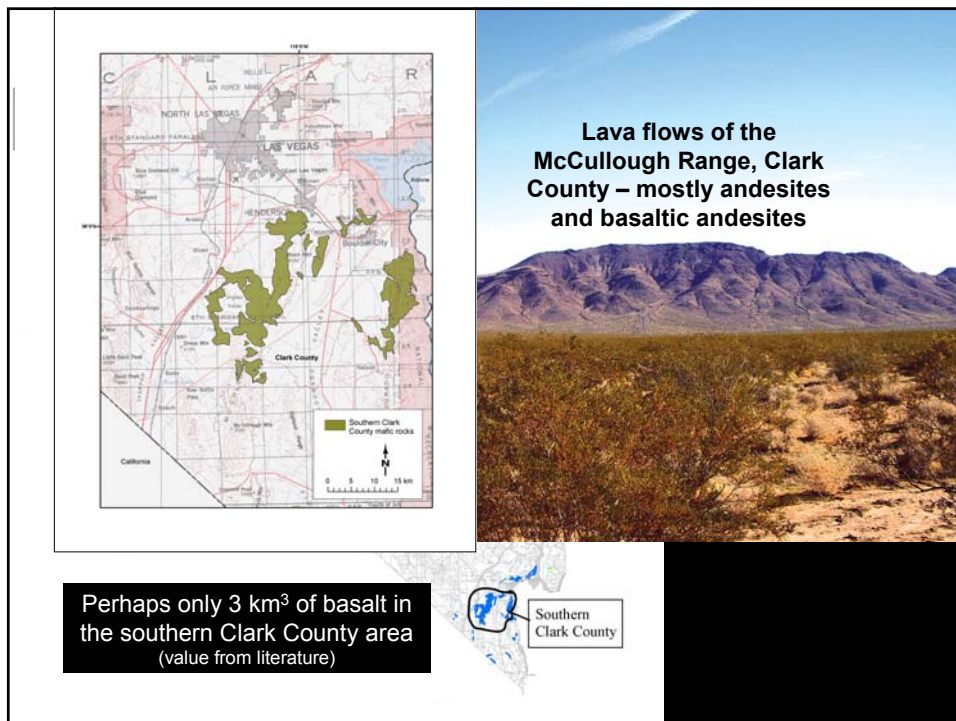
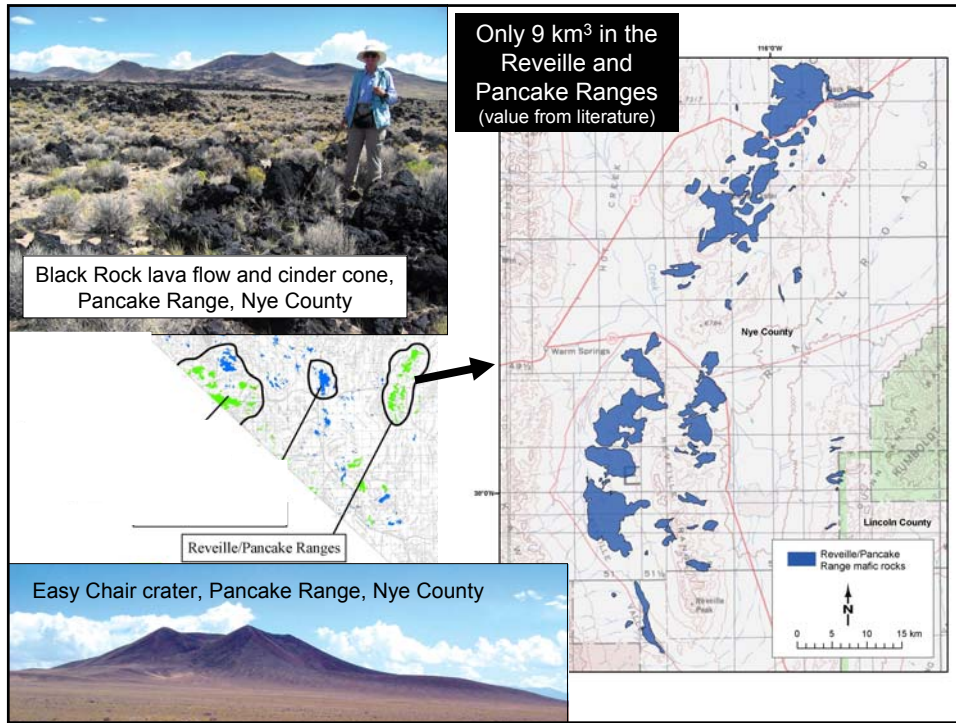












<u>Field</u>	<u>Estimated Volume (km<sup>3</sup>)</u>
Northwestern Washoe County	139
Owyhee Plateau	177
Battle Mountain area	29
Southern Washoe/Storey/Lyon/ Churchill/Pershing Counties	175
Humboldt Iopolith	31
Southwestern Mineral/ Northwestern Esmeralda Counties	41
Reveille/Pancake Ranges	9
San Antonio Mountains	13
Southern Clark County	<u>3+</u>
TOTAL in Nevada	~620

~5.2 km<sup>3</sup> needed for four large power plants for 50 years.



Reactions with oxidized forms of Fe and Mn are not thermodynamically favorable at 25°C and 10<sup>5</sup> pascals (surface conditions).

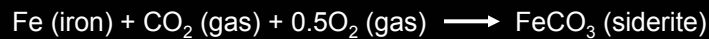
Estimated volumes of potential rock and mineral reactants available in Nevada, compared with what is needed for a large power plant.

Rock type	Volume required for power plant that burns 0.25 gigaton of C (km <sup>3</sup> )	Locality	Volume of rock or mineral (km <sup>3</sup> )
<b>Basalt</b>	<b>1.3 &lt;&lt;</b>	<b>Various</b>	<b>~620</b>
Magnetite, Fe <sub>3</sub> O <sub>4</sub>	0.31 >>	Buena Vista	0.00027
		Jackson Mtns	0.00019
		Dayton area	0.012
		Gabbs area	0.000067
		Yerington area	0.048
Hematite, Fe <sub>2</sub> O <sub>3</sub>	0.32 >>	Cortez Mtns	0.00029
Manganosite, MnO*	0.28 >>	Three Kids	0.00024
Wollastonite, CaSiO <sub>3</sub>	0.83 >>	Gilbert deposit	0.00069
Brucite, Mg(OH) <sub>2</sub>	0.51 >>	Gabbs	0.000083

\* The actual Mn ore minerals are thermodynamically less favorable for reaction with CO<sub>2</sub> than manganosite, which has not been reported in this area.



Reactions with oxidized forms of Fe and Mn are not thermodynamically favorable at 25°C and 105 pascals (surface conditions).



**[But reaction with iron (scrap) is highly favorable.]**

**CONCLUSION OF THE FIRST PART OF OUR STUDY:**

- 1. There are sufficient mafic (Mg- and Fe-rich) rocks in Nevada to consider CO<sub>2</sub> sequestration through mineral carbonation.**

**(That is, there is a lot of basalt, but not much in terms of significant volumes of other rocks or minerals.)**

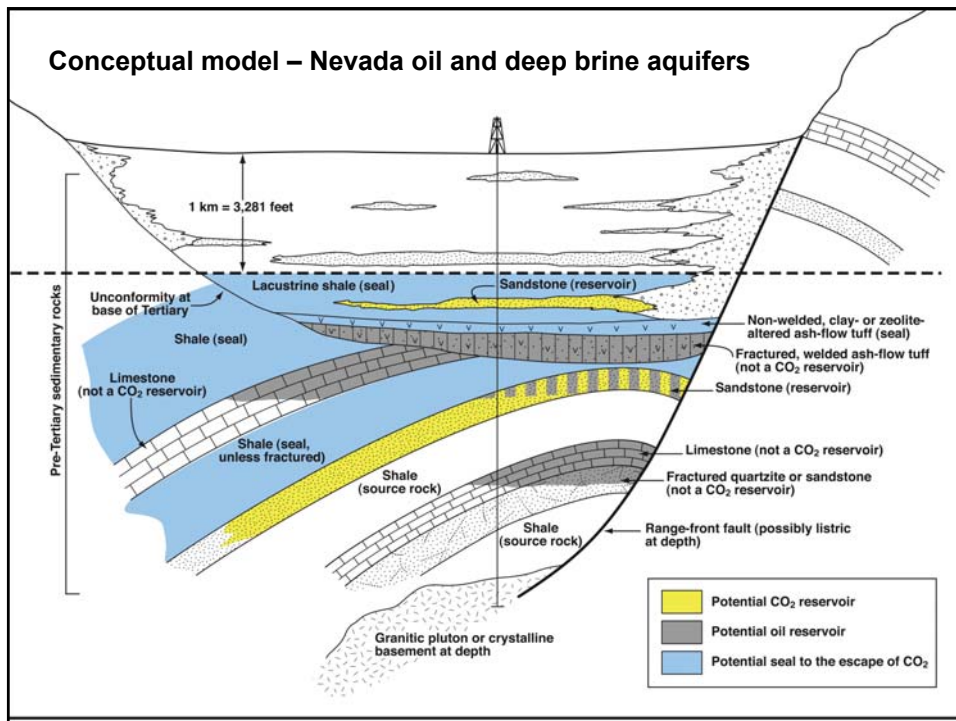
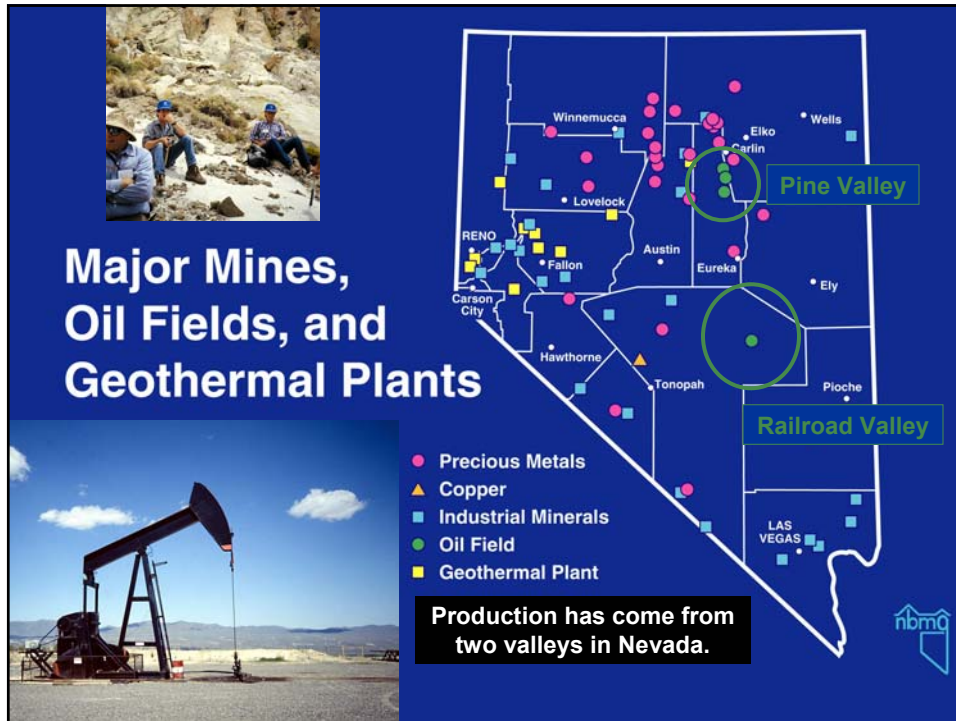


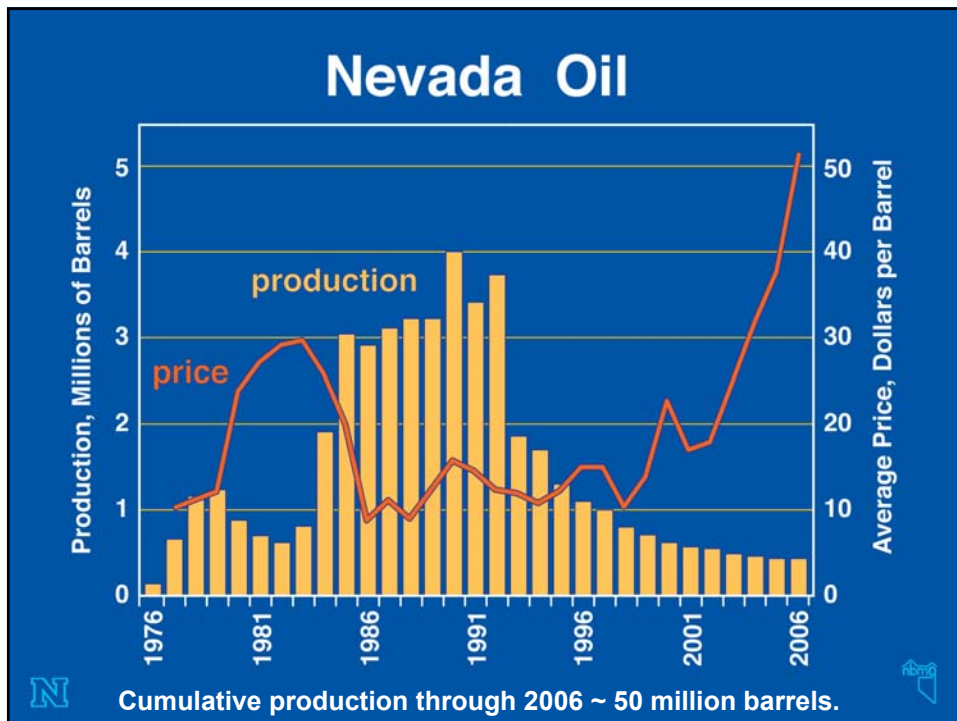
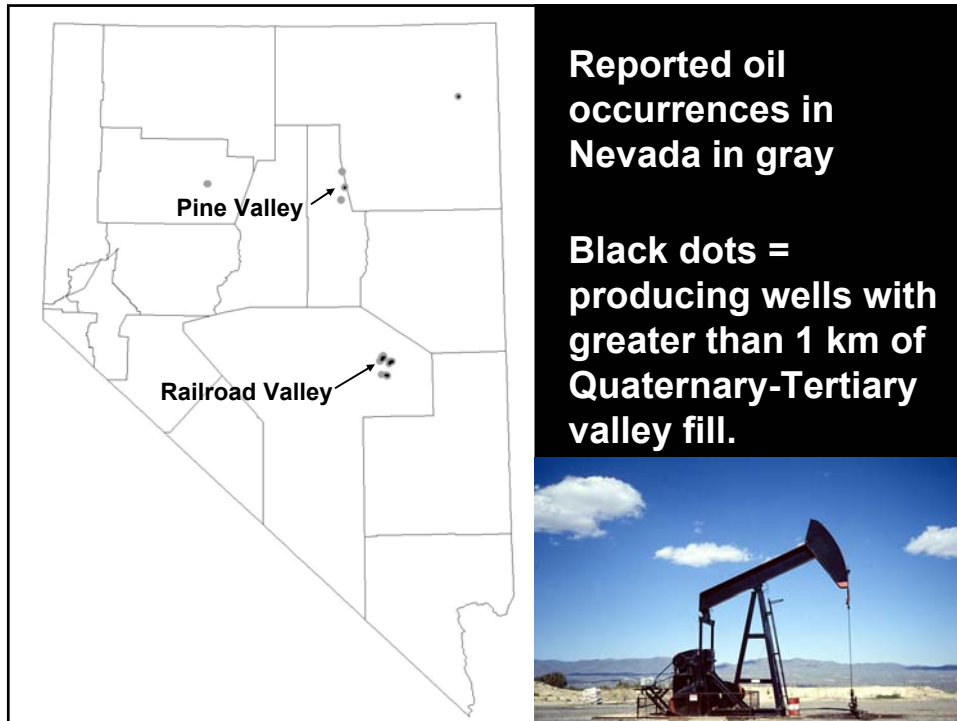
**NOW, THE SECOND PART OF OUR STUDY:**

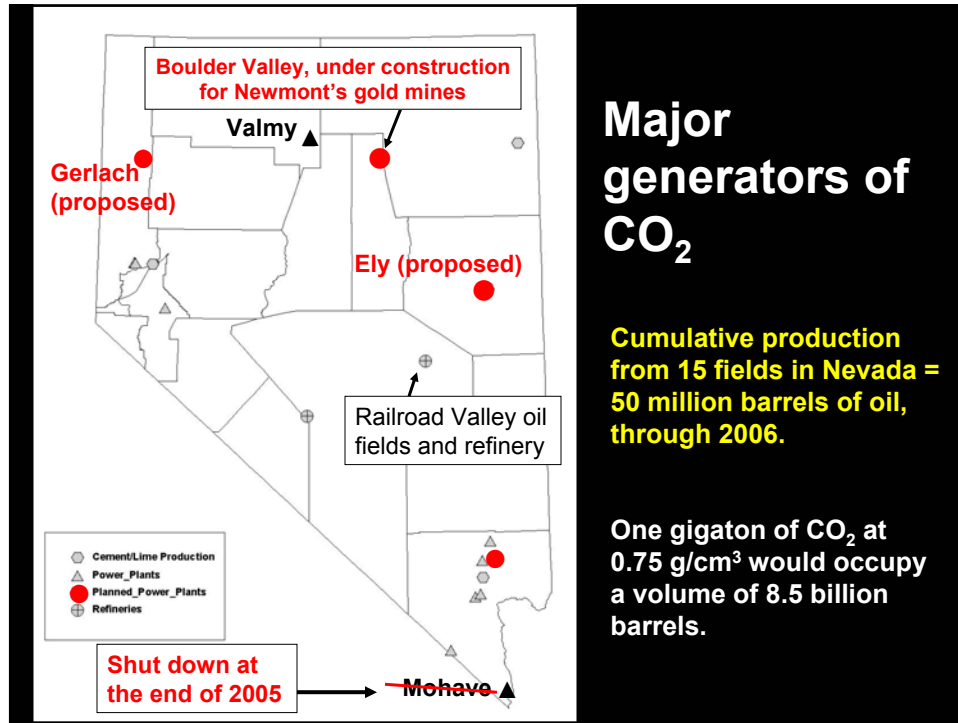
- 2. There is not much potential for storing CO<sub>2</sub> through EOR in Nevada oil fields.**

**(That is, there hasn't been much oil produced in Nevada.)**

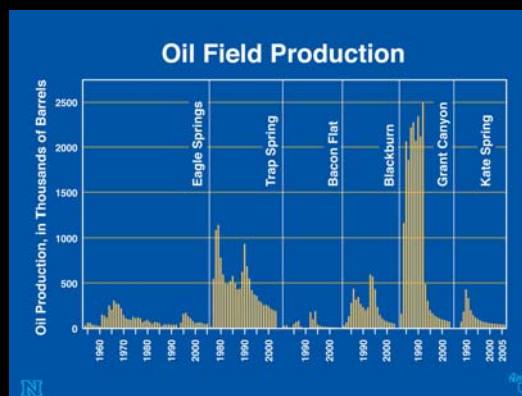








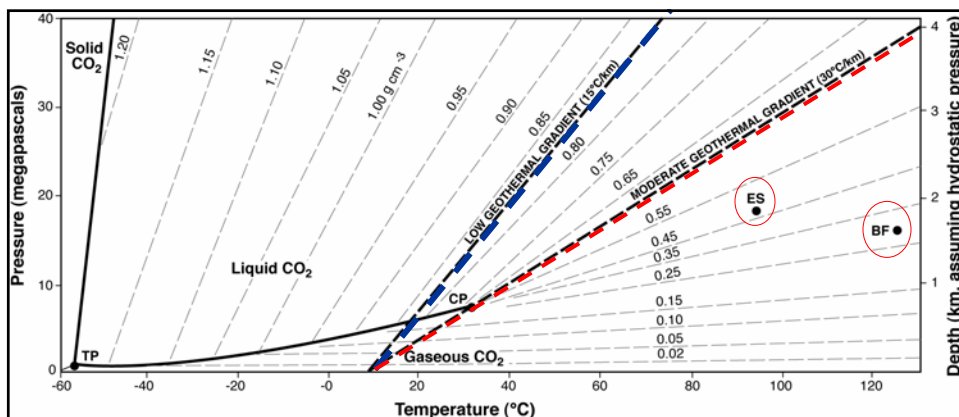
Nonetheless, in case small-volume reservoirs might be useful for pilot studies or in case giant fields are discovered in the future, at the request of WESTCARB, we compiled available CO<sub>2</sub>-relevant data on Nevada oil fields.



Available oil and gas field-level and reservoir-level databases are attributed in a GIS layer.

Field-level data include information such as location, **depth**, field area, **cumulative production**, and depth to the base of fresh water.

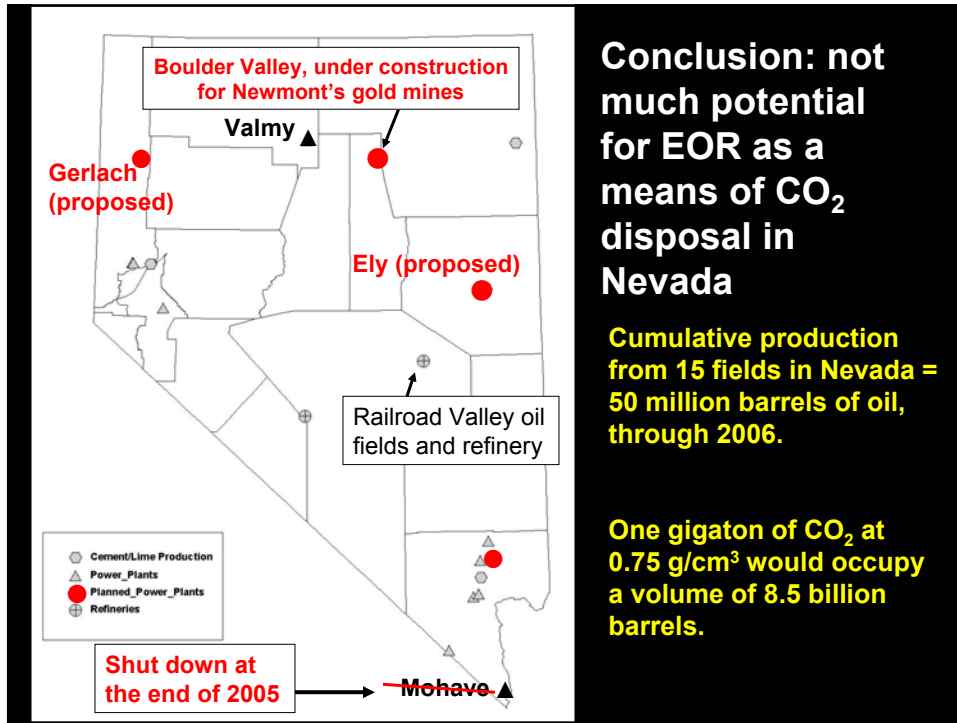
The reservoir-level database contains reservoir-specific parameters, where available, for producing, abandoned, or shut in reservoirs in each field. These data include reservoir fluid (oil, gas, water), zone status (producing, abandoned, shut-in), average depth, average thickness, producing area, porosity, permeability, initial pressure and **temperature**, formation water salinity, seal thickness, trap type (structural or stratigraphic), history of secondary and tertiary recovery efforts, and a measure of “fracture intensity,” if available. The data will be accessible in a GIS layer and summarized in the final report for this task.



ES = bottom-hole temperature (93°C at 1,830 m) in the Eagle Springs oil field

BF = reservoir temperature (120-130°C at about 1,625 m) in the Bacon Flat-Grant Canyon oil fields

Depths greater than 1 km are preferred in Nevada, because of the high geothermal gradient and the need for a dense fluid CO<sub>2</sub> phase.



**Conclusion: not much potential for EOR as a means of CO<sub>2</sub> disposal in Nevada**

**Cumulative production from 15 fields in Nevada = 50 million barrels of oil, through 2006.**

**One gigaton of CO<sub>2</sub> at 0.75 g/cm<sup>3</sup> would occupy a volume of 8.5 billion barrels.**

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP  
westcarb.org

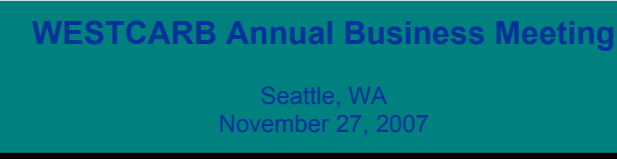

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Statewide • Worldwide



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