DOE-ARRA Geologic Sequestration Training and Research
2012 Yearly Review Meeting
Project DE-FE0000032
Title: A Modular Curriculum for Training University Students in Industry Standard CO2 Sequestration and Enhanced Oil Recovery Methodologies

Presenter: Dr. Emily Stoudt, Department of Math and Sciences University of Texas of the Permian Basin

August 23, 2012

U.S. Department of Energy
National Energy Technology Laboratory
Carbon Storage R&D Project Review Meeting
Developing the Technologies and Building the Infrastructure for CO_2 Storage
August 21-23, 2012

Presentation Outline

- Benefits of program
- Project Overview
- Technical Status
  - Modules – FutureGen sequestration
  - Road Logs/Field Trips
  - Core Descriptions
  - CO2 EOR projects
  - Presentations
- Summary

Benefits to the Program

- Develop technologies to demonstrate that 99 percent of injected CO_2 remains in the injection zones. Utilization of CO_2 in Enhanced Oil Recovery projects demonstrates advanced knowledge of CO_2 Storage.
- The project is developing Geological, Engineering, and Land Management training modules in CO_2 Enhanced Oil Recovery (EOR) methodologies to prepare university students for careers either in Carbon Utilization or Carbon Storage industries.
- Tertiary EOR projects have been safely injecting CO_2 in siliciclastic and carbonate reservoirs/aquifers for over 40 years. The EOR industry understands the behavior of CO_2 in reservoirs/aquifers and critical to CO_2 Utilization/Storage going forward.
- Documenting this 40 year history of safe injection, and the petroleum industries knowledge contributes to the Carbon Storage Program's effort of ensuring 99 percent CO_2 storage permanence in the injection zones.

Project Overview: Goals and Objectives

- Major Objectives
  - CO_2 Enhanced Oil Recovery (EOR), CO_2 Sequestration, and Monitoring Measuring and Verification (MMV) are topics that are not typically covered in undergraduate and graduate Geoscience and Petroleum Engineering curriculum. Students are typically not exposed to the level of training that would prepare them for CO_2 reservoir /aquifer related projects when they begin CO_2 related assignments in industry.
  - Taking industry standard CO2 related training and create training modules for senior level undergraduate and graduate students that will prepare them to “hit the ground running” and be contributing participants in CO_2 projects without further additional training.
  - Developing a moduled training curriculum for senior level undergraduates and graduates in the geosciences, engineering and land management to meet these needs.
  - Develop technologies to demonstrate that 99 percent of injected CO_2 remains in the injection zones.

Technical Status - Introduction
Why is knowledge of CO_2 utilization in Enhanced Oil Recovery (EOR) Projects important?

- ~3 Billion Cubic Feet (BCF) of CO_2 is injected daily into EOR Projects in the Permian Basin.
- ~2 BCF CO_2 is brought via pipelines into the Permian Basin daily.
- ~ ¼ of the 2 BCF brought into the basin is needed to replace CO_2 that remains in the reservoirs during the EOR process.

- Anticipated benefits:
- Knowledge of Petroleum Industry Standard pipeline, surface facility , and well bore CO_2 related issues.
- Introduction to utilization of CO_2 where it is considered a commodity and not a waste.
- Introduction to 40 year history of large scale, safe CO_2 related operations surface and subsurface operations.
- Introduction to Petroleum Industry CO_2 related reservoir/aquifer characterization and response based on long term historical data.

- *Task 1 Classroom Modules*
- *Task 2. Sequestration Related Modules*
- *Task 3. Engineering and Geoscience Reservoir Studies Modules*
- *Task 4. Field Seminars*
- *Task 5. Field Trips to Analogs of CO_2 Sequestration, EOR, and ROZ EOR Targets*
- *Task 6. Sequestration Reservoir Core Study Sets*
- *We will present examples of Tasks 2, 4, 5, and 6*

Task 2. Sequestration Related Modules

Sub Task A. FutureGen -Sequestration Site & Water Issues

Picking a Sequestration Site

Chosen University Lands acreage blocks. Blocks 21, 23, 24, & 25 in Pecos County

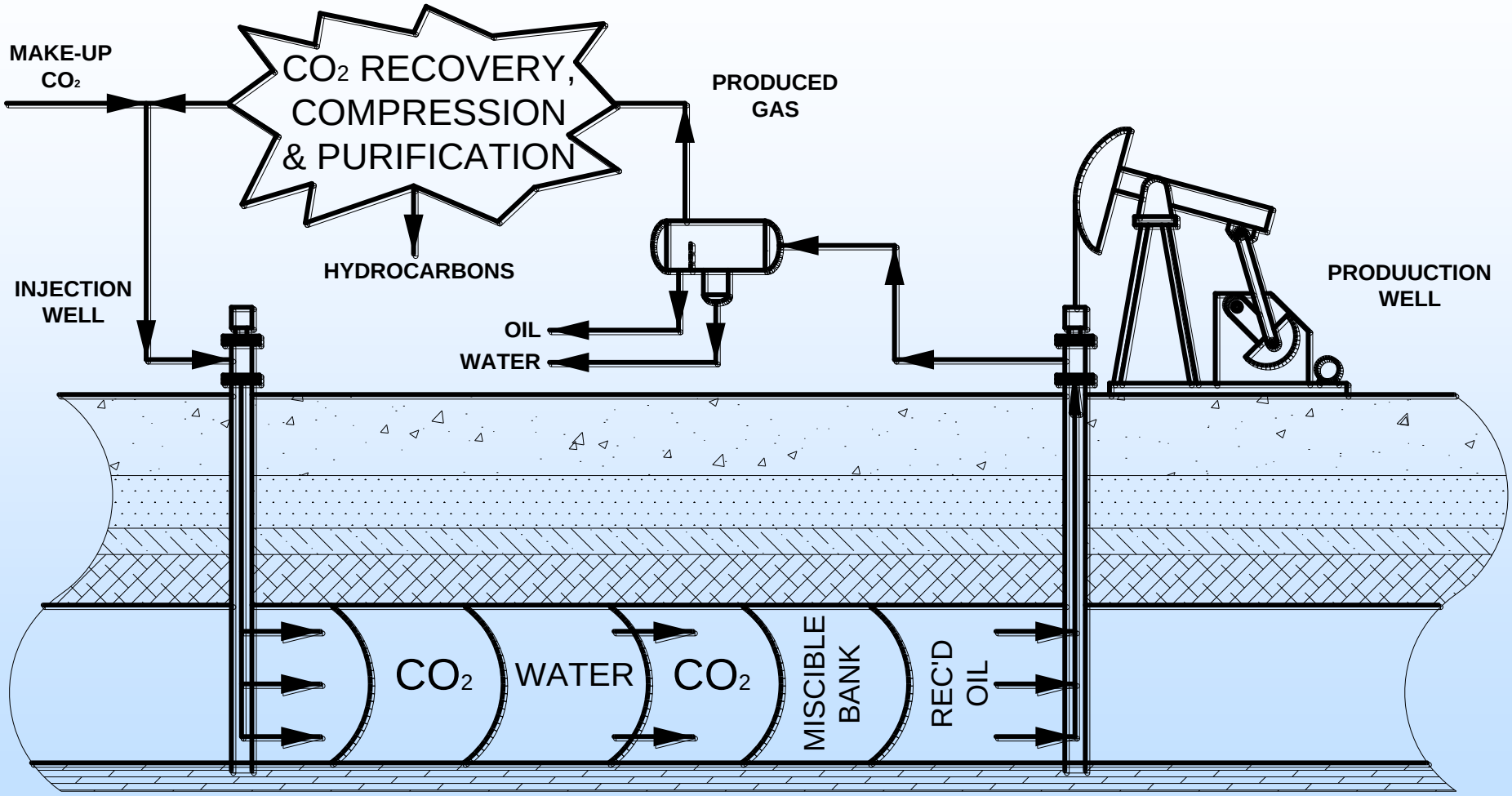
The Delaware Mountain Group in the Sheffield Channel as a Target for CO2 Sequestration, Pecos County, Texas. Presented at Sul Ross in 2010 & 2011.

Although FutureGen was never constructed. Summit Energy is planning to build "NowGen" at the site. They have a contract to sell 140MMCF of CO2 for EOR projects!

The Texas FutureGen team required site be "a township of land with (as close to) a single surface and minerals owner and minimal well bores". University Lands blocks in Andrews, Ward, Reagan and Terrell Counties were all considered before settling on Blocks 23, 24, and 25 in Pecos County.

Task 4. Field Seminars

Sub Task B. "Well Bore Management Issues"



There are also Road Logs from CEED to each of the Plant locations

Compliments of Nicholas Consulting Group

NCG NICHOLAS CONSULTING GROUP, INC.

Task 5. Field Trips to Analogs of CO_2 Sequestration, EOR, and ROZ EOR Targets

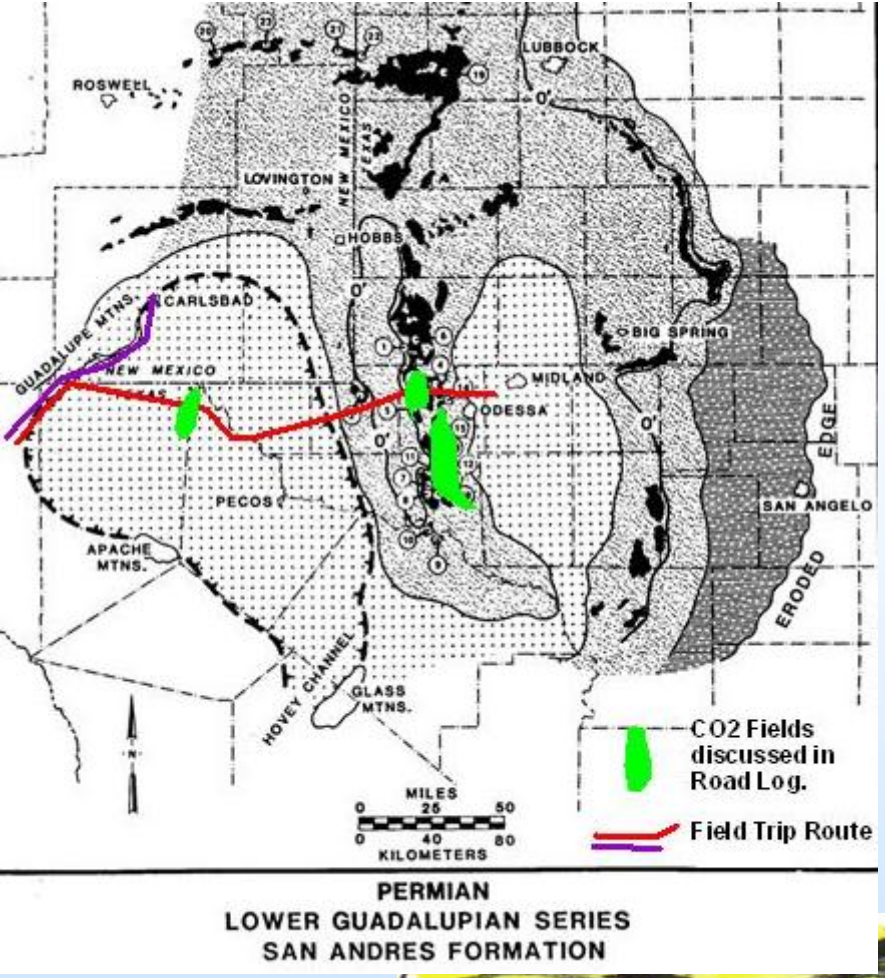
- Sub Task A. Central Texas
  - Ellenburger Karsted Reservoirs and Cambrian Sands
- Sub Task B. Guadalupe Mountains
  - Upper Permian Shelf Carbonates and Sands, Upper Permian Basinal Sands
- Subtask C. Marathon Overthrust
  - Naturally occurring source of CO2 separated from gas production in multiple overthrust targets
- Sub Task E. Van Horn Area
  - Cambrian Sands, Permian Ramp Carbonates

2010
Carbon Capture and Storage Field Trip
Odessa – Kermit – Orla – Salt Flat - Carlsbad
By Bob Trentham
Modified from road logs by Bob Lindsay, Bob Ward and Bob Trentham & Peter Scholle.

Interval Mileage	Cumulative Mileage	Description
		Welcome to the Carbon Capture and Storage Field Trip to the Guadalupe Mountains. Today, we will leave the Center for Energy and Economic Diversification located at the intersection of SH 191 and FM 1788 in western Midland County between Midland and Odessa and head west on SH 191 through Odessa. We will then be driving west on SH 302 thru Notrees, Kermit and Mentone. Turn north on US 285 to Orla and west on FM 652 to US 62 /180, west/south on US 62/180 to Pine Spring and the Salt Flat Graben. Then backtrack to . On this trip we will be reviewing the Permian Guadalupian basin and shelf deposits in the Delaware and Guadalupe Mountains and the utilization of CO2 in Enhanced Oil Recovery project in the Permian Basin. CO2 has been utilized in Enhanced Oil Recovery projects in the basin for the past 40 years. Today, 4 billion cubic feet of CO2 is "handled" daily in over 60 producing oil fields. Over 200,000 barrels of oil per day is recovered as a direct result of injecting CO2 into the oil reservoirs. To date, over 1 Billion barrels of oil has been produced from field as a result of CO2 flooding. We will be crossing a number of fields and pipelines where CO2 is transported, injected, produced, and separated on a daily basis.
3.5	19.2	Town of Goldsmith and Refinery to north. A CO2 flood of a portion of the Goldsmith Landreth San Andres Unit producing zone was initiated in 2009. In a "pilot" project in the field approximately ½ north of SH 158, there is 1 producing well and 6 injectors, as of December, 2010, Legado Resources was injecting 27.7 MMCF CO2 a day. Over the next few years, CO2 injection will commence in a major portion of the field. This enhanced oil recovery project was initiated by a small producing company proving that CO2 EOR is not restricted to major oil companies. The company is flooding the Residual Oil Zone where the original oil saturation at discovery was ~30%. This is compared to the "main pay" where original oil saturations were 70-80%. The efficiency of CO2 in "sweeping" oil out of the reservoirs is so high that even at these low saturations, the ability of CO2 to recover high percentages of the remaining oil makes this process economic.

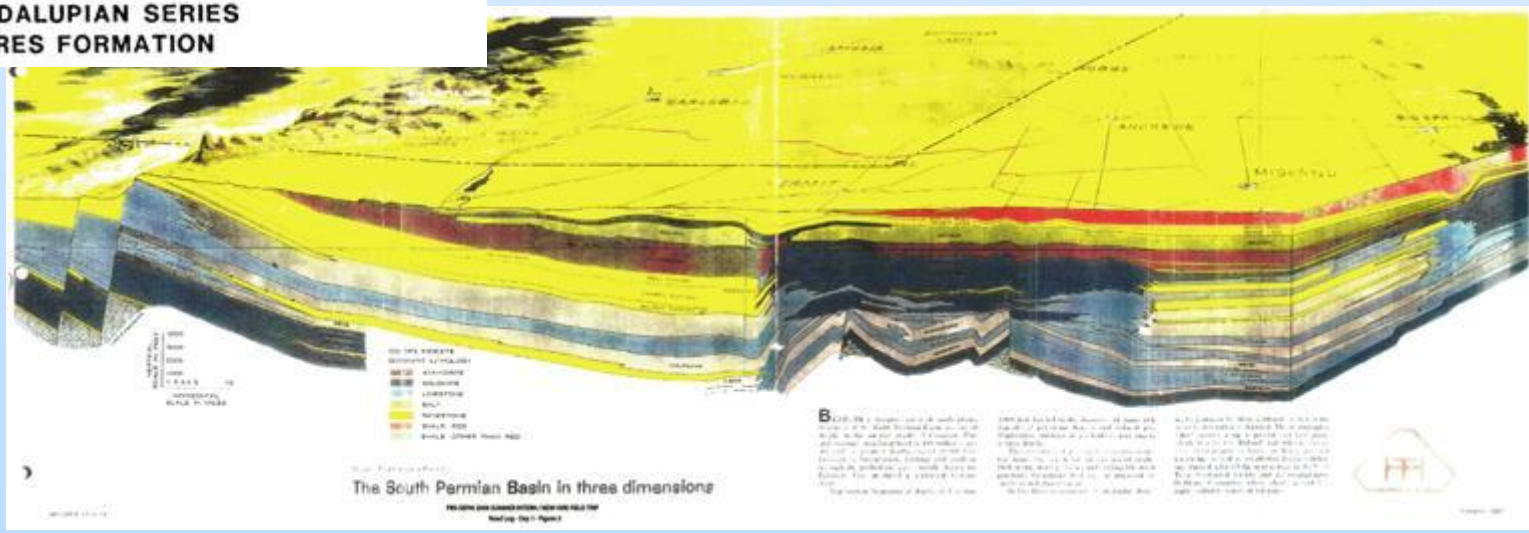
ROAD LOGS include information on the oil & gas reservoirs as well as CO2 Utilization/Sequestration Targets

An example is the Goldsmith-Landreth San Andres Unit in the Goldsmith Field. We drive along the southern boundary of the project.

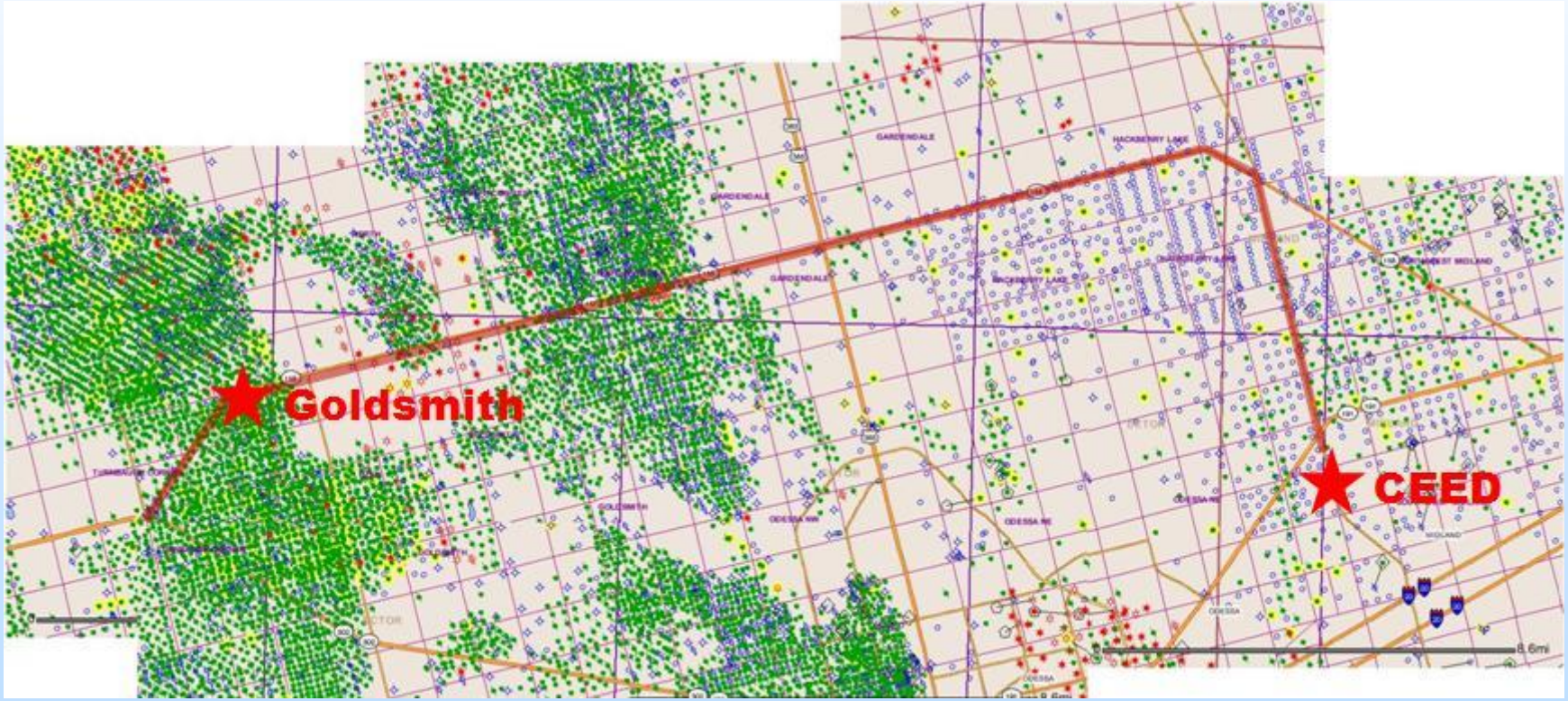


Our Trip today will cross most of the major physiographic features of the Permian Basin.
We begin in the Midland Basin, Cross the Central Basin Platform, then the Delaware Basin and end today at the base of slope of the Northwest Shelf.

An introductory power point is being added for each Road Log as student often "doze" during the trips



We'll head north on FM 1788, then west on SH 158. After crossing SH 385, we will be climbing onto the Central Basin Platform. Crossing North Cowden (Grayburg and San Andres), East Goldsmith (San Andres) and Goldsmith(San Andres and Clearfork) fields. Goldsmith is an example of an old field (discovered in 1935) that has been revitalized by CO2 EOR. Legado has taken the northern part of the field from less than 100 BOPD to ~1,000 BOPD with a CO2 flood of the Main Pay and the Residual Oil Zone.



Task 6. Sequestration Reservoir Core Study Sets

- Sub Task A. Vacuum Field – San Andres and Grayburg Shelf Carbonates - Stoudt, students
- Sub Task B. North Ward Estes – Yates and Queen Shelf Sands
- Sub Task C. Ford Geraldine, East Ford – Upper Permian Basinal Sands - Trentham, students
- Sub Task D. McCamey Field – San Andres Karsted Reservoirs [20%] - Stoudt, Trentham, students
- Sub Task E. Residual Oil Zone EOR/Storage targets

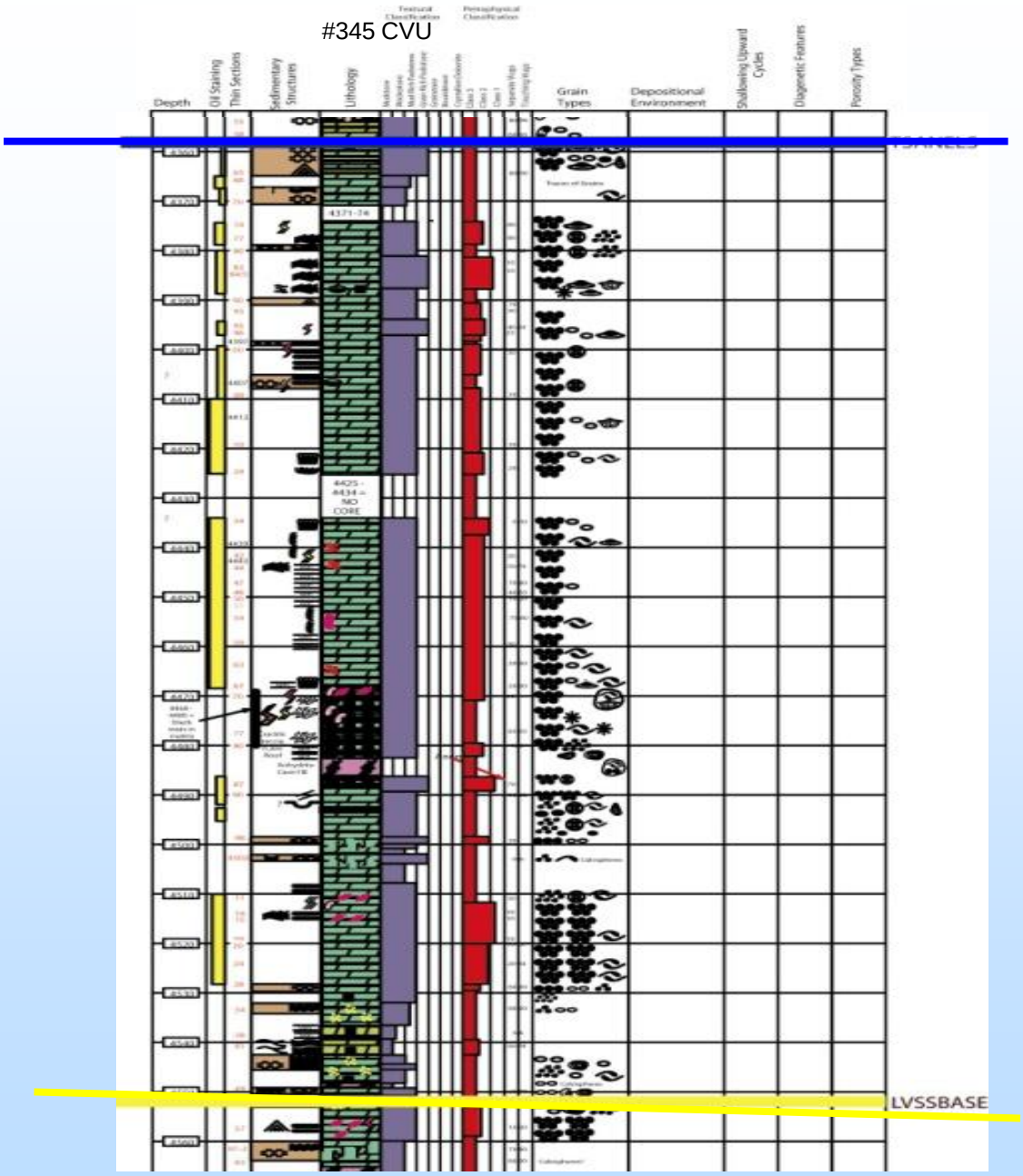
Cores now at UTPB

SUBTASK A	Lease	Core	Depth	Sec	TWN	RGE
Texaco	**#345 CVU**	**4338**	**4750**	**36**	**17S**	**34E**
Texaco	#140 VGSAU	4344	4763	1	18S	34E
SUBTASK D	Lease	Core	Depth	Sec	Blk	Survey
Continental	#2 Russell "4"	3949	4071	4	58 T2	T&P
Continental	#6 Ramsey"26"	3893	4035	26	58,T1	T&P
Penrose	#1 Bateman	2690	2776	28	45	PSL
Continental	#3-31 TXL	3980	4201	31	57 T1	T&P
SUBTASK E	Lease	Core	Depth	Sec	Blk	Survey
Meridian	#19 A.A.Reese (N244)	2433	2829	2	3	MK&T
Meridian	#51-R J.F. Lane "A" 2	2000	2215	5	J	GC&SF
Burlington	#N549W McCamey Unit	2225	2425	5	J	GC&SF
Burlington	#1087 McCamey Unit	2040	2336			JNidever
Meridian	#3R J.F.Lane (3622)	2270	2450	36	1	MK&TRR
Burlington	#353 McCamey Unit	2625	2802.4	3	3	MK&TRR
ROZ	Lease	Core	Depth	Sec	Blk	Survey
Anschutz	#1 Keating	4338	4750	447	G	CCSD&RGNG
Chevron	**#1548 H. S. A.**	**3748**	**4023**	**82**	**N**	**G&MMB&A**

Original Core Description for Chevron Central Vacuum Unit Core.

Tested with students in June 2010, it was determined that a different, simpler format was needed.

Presentation is Abode Illustrator format. A new simpler format has been developed and is illustrated on the following slide



Well or Measured Section Name: CENTRAL VACUMM UNIT #345

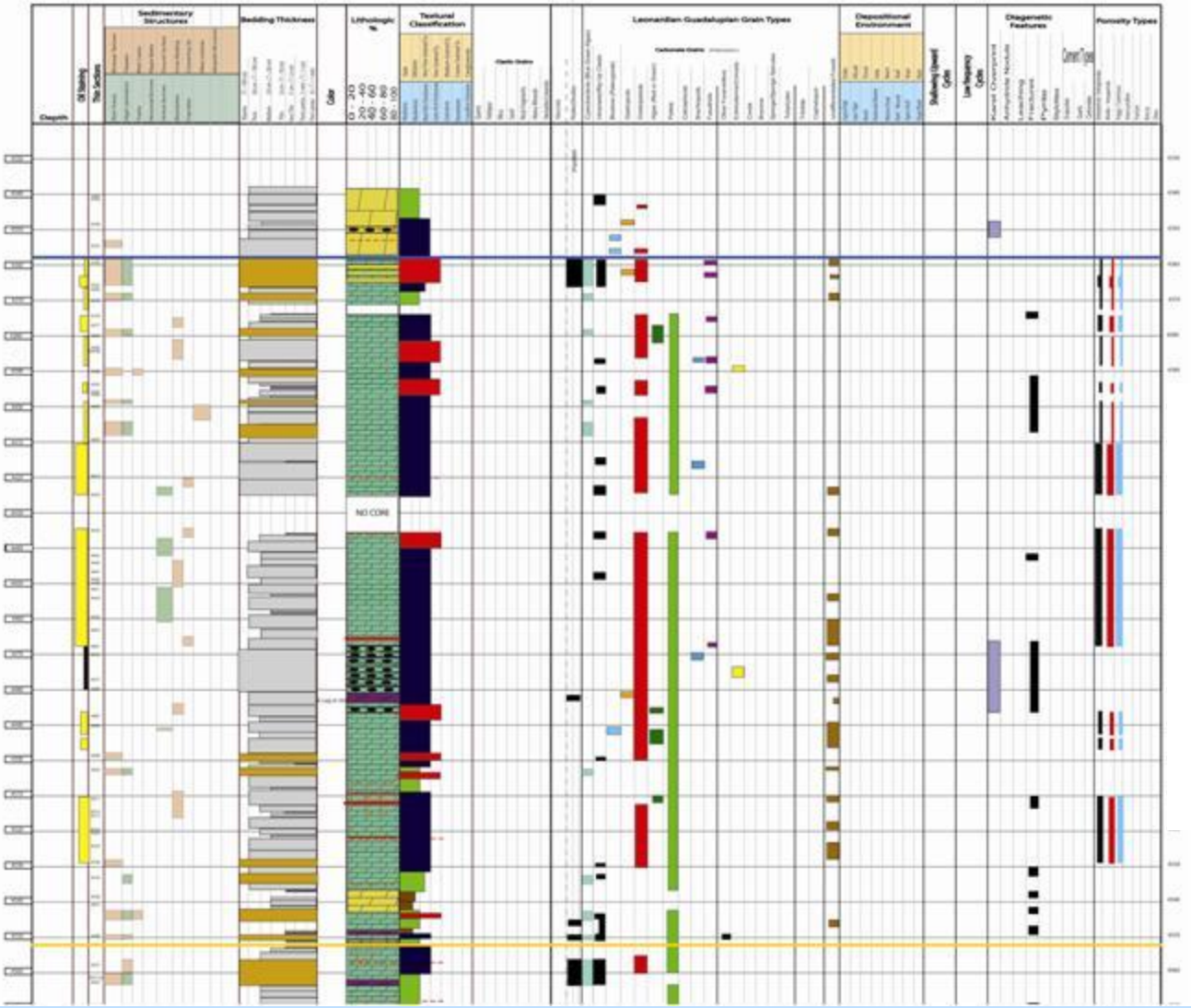
Location: LEA COUNTY, NEW MEXICO

Logged by: Ibukun Bode-Omoleye

Date Logged: 11/04/2010

Formation(s): Grayburg, San Andres

Depth or Outcrop Interval: 4340ft- 4750ft



We are developing PowerPoint presentations to instruct students on how to describe cores utilizing the new core description forms.

Presentations – Southwest AAPG June 2011

Potential for long term uses of Anthropogenic CO_2 in the Permian Basin.

Dr. Bob Trentham, University of Texas of the Permian Basin & L. Steven Melzer, Melzer Consulting.

Abstract

Presently, 3+ BCF of CO_2 are processed daily in the Permian Basin. In addition to the 1+ BCF of daily re-cycle CO_2 utilized in the EOR projects in the basin, an additional 2 BCF of "new" CO_2 are imported into the basin. It is estimated that a volume of CO_2 equal to the new CO_2 or ~2 BCF a day in our EOR projects is incidentally sequestered. Since 1986, the number of CO_2 EOR projects in the basin has grown from <20 to 62, including 9 projects where CO_2 is being injected into the Residual Oil Zones beneath the Main Pay. This total volume of new CO_2 is estimated to have a value near $700 million per year and is currently restricted by the sources or, in the case of the Cortez line from Cortez, CO to Denver City, Tx, by pipeline capacity. CO_2 from the Marathon Thrust Belt and expansions at McElmo Dome and Doe Canyon, in Colorado, have the potential for adding additional supplies but a significant backlog of EOR projects remain. Two CO_2 capture equipped coal fired power plants are being permitted in the basin; however, additional long term supplies of anthropogenic CO_2 will be needed.

With the addition of Residual Oil Zone EOR projects and the long term potential for Greenfield CO_2 EOR ROZ projects, significant additional supplies of CO_2 will be necessary in the long term. With the potential for CO_2 utilization in the Permian Basin, and the long term potential for CO_2 utilization in existing fields and Greenfield ROZ projects, it is critical that CO_2 be treated as a commodity and not as a waste product from an industrial source. All CO_2 EOR projects have incidental CO_2 Storage and long term potential for CO_2 Storage in conjunction with additional oil production. For energy security and environmental reasons, these types of projects should be the first place industry and government look to store anthropogenic CO_2.

CO2 in the Permian Basin

3+ BCF of CO_2 are processed daily in the Permian Basin in Enhanced Oil Recovery (EOR) projects. In addition to the 1+ BCF of re-cycle CO_2 utilized in the EOR projects, an additional 2 BCF of "new" CO_2 are imported into the basin daily. It is estimated that a volume of CO_2 equal to that ~2 .0 BCF is incidentally sequestered in the EOR projects daily. This total volume of new CO_2 is estimated to have a value near $700 million per year and is currently restricted by the sources or, in the case of the Cortez line from Cortez, CO to Denver City, TX, by pipeline capacity (Figure 1).

CO_2 from the Marathon Thrust Belt and expansions at McElmo Dome and Doe Canyon, in Colorado, have the potential for adding additional supplies. Bravo and West Bravo will do well to hold their own. However, a significant backlog of EOR projects will remain.

Figure 1

Figure 2

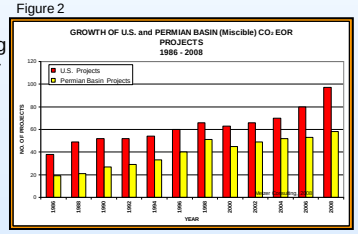
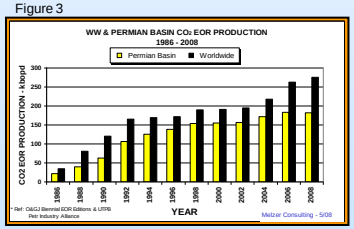


Figure 3



FIELDS

Since 1986, the number of CO_2 EOR projects in the basin has grown from <20 to 62 (Figure 2). The Permian Basin is the only basin in the world where Residual Oil Zones are under CO_2 flood, which include 9 projects where CO_2 is being injected into the Transition Zones/Residual Oil Zones (TZ/ROZ) beneath the Main Pay Zones (MPZ). A similar growth is seen nationwide and worldwide in CO_2 projects in the MPZ's.

PRODUCTION

Over 180,000 BOPD are produced from CO_2 EOR projects daily in the basin, and over 1.2 BBbls of total CO_2 EOR oil have been produced to date (Figure 3). Total daily production from ROZ CO_2 floods is 5-10,000 BOPD. Similar growth is seen nationwide and worldwide in the MPZ's and is anticipated in ROZ floods.

POTENTIAL

Advanced Resources International (ARI) has studied 56 fields in five major Permian Basin San Andres/Grayburg oil plays and identified significant potential in the TZ/ROZ's of those fields. Based on reservoir modeling applying CO_2-EOR to the TZ/ROZ resources, ARI (Figure 4 & 5) estimates that **11.9 Billion BO is technically recoverable from the 30.7 Billion BO of TZ/ROZ oil in-place.** This exceeds the estimated CO_2 recoverable reserves of ~7 Billion Barrels present in the MPZ's in these five Permian Basin oil plays.

With a utilization/sequestration factor of 10 MCF CO_2/Barrel of oil produced, 200 Trillion Cubic Feet of CO_2 will be needed to recover the oil from these projects alone.

Field/Unit	MPZ OOIP (BB)	TZ/ROZ OOIP (BB)	No. of Fields	No. of MPZ Fields with CO_2-EOR Projects	No. of Fields with TZ/ROZ CO_2-EOR Projects
1. Northern Shelf Permian Basin (San Andres)	13.0	13.2	13	5	1
2. North Central Basin Platform (San Andres/Grayburg)	2.9	2.6	6	2	1
3. South Central Basin Platform (San Andres/Grayburg)	9.9	7.9	16	5	0
4. Horseshoe Atoll (Canyon)	5.4	2.9	10	4	2
5. East New Mexico (San Andres)			11	2	0
Total			56	18	4

Field/Unit	Total CO_2-EOR (BB)	MPZ CO_2-EOR (BB)	TZ/ROZ CO_2-EOR (BB)
1. Northern Shelf Permian Basin (San Andres)	8.3	2.8	5.5
2. North Central Basin Platform (San Andres/Grayburg)	1.5	0.6	0.9
3. South Central Basin Platform (San Andres/Grayburg)	4.6	1.7	2.9
4. Horseshoe Atoll (Canyon)	2.7	1.4	1.3
5. East New Mexico (San Andres)	1.7		
Total	18.8	6.9	11.9

Figure 4 & 5. MPZ and TZ/ROZ OOIP in these 56 fields is estimated to be 33.5 and 30.7 Billion Barrels From ARI, 2006. Total CO_2 EOR reserves are conservatively estimated to be >20 BBO .

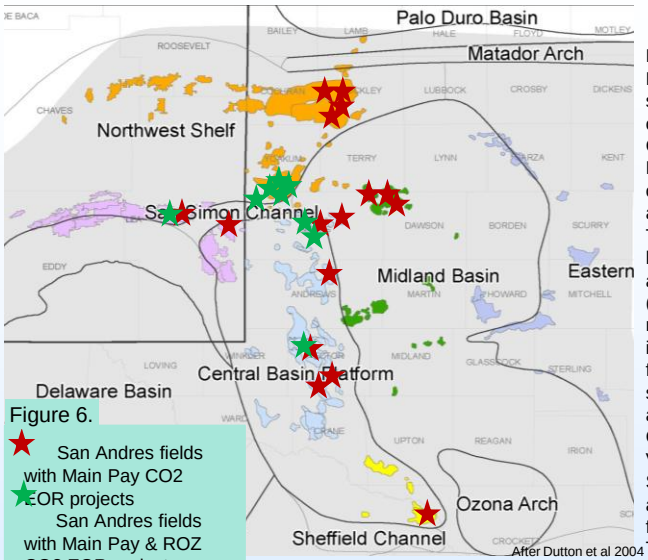


Figure 6.

★ San Andres fields with Main Pay CO2 EOR projects

★ San Andres fields with Main Pay & ROZ CO2 EOR projects

After Dutton et al 2004

CO_2 Projects

Many of the major San Andres Fields, in a variety of different stratigraphic settings ,are currently, or soon will be, in CO_2 EOR (**RED STARS**). However, there are many other potential floods awaiting a source of CO_2.

Today, only a few projects have, or will have both MPZ and TZ/ROZ CO_2 floods (**GREEN STARS**). This number is anticipated to increase sharply over the next few years as economically successful TZ/ROZ CO_2 floods are reported.

Central Vacuum, East Vacuum, Means and East Seminole are all recent additions to the list of ROZ floods.

There are presently no "Green Field" CO_2 floods.

GREEN FIELDS

What is a "Green Field"? A Green Field is an area where an original oil column has been swept during geologic time by a naturally occurring lateral flushing event. These areas exist between producing fields as well as within field boundaries where they are isolated vertically from production and associated TZ/ROZ's in producing horizons. These intervals have similar reservoir fluid properties to those of efficient MPZ waterfloods and TZ/ROZ's prior to CO_2 EOR. In the future, these areas will become important "Carbon Sequestration" targets as they are both EOR and Geologic Sequestration targets.

Figure 7

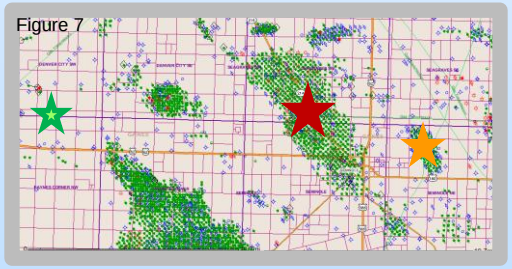


Fig 7. Relationship of an established CO_2 flood in the MPZ which is being expanded into the TZ/ROZ at Seminole Field [**RED STAR**]; a field being investigated for ROZ potential, Seminole East Field [**ORANGE STAR**]; and "Green Field" area with no established production but potential for TZ/ROZ EOR development [**GREEN STAR**].

With the potential for CO_2 utilization in the MPZ's in existing fields, the near term potential for CO_2 utilization in TZ/ROZ's beneath existing fields, and the long term potential for "Greenfield" ROZ projects in the Permian Basin, significant additional supplies of CO_2 will be required. Anthropogenic CO_2 must be considered as a component of the long term supply. In the short term, therefore, it is critical that CO_2 be treated as a commodity and not as a waste product from an industrial source.

The old rule of thumb for recycle = newly purchased volumes is true for very mature projects but goes out the window for new projects where recycle volumes are low. Large volumes have been added in recent years so it therefore follows that the ratio of recycle to new is probably closer to 0.65-0.75 today.

Permian Basin Geologic Sequestration of Carbon Dioxide

All CO_2 EOR projects have incidental CO_2 Storage and long term potential for CO_2 Storage in conjunction with additional oil production. For Energy Security and Environmental reasons, these types of projects should be the first place industry and government look to store anthropogenic CO_2.

The oil industry has over 40 years of experience in CO_2 Geologic Sequestration. Yet, few outside our industry know about our expertise.

Hard Lessons:

During the 40+ years that operators have been injecting CO_2 into our reservoirs, we have learned many valuable (and expensive) lessons that can be passed on to those researchers studying geologic sequestration elsewhere.

The primary lesson is that the behavior of CO_2 in even a simple reservoir will be more complex than modeled. Our heterogeneous reservoirs should serve as models for geologic sequestration in brine aquifers. Breakthroughs, sweep efficiencies, injectivity, and cross formation migration (out of zone) are all issues that have been a part of CO_2 EOR from the beginning. Multiple approaches to these and other problems have been tried and the most economic solutions determined.

Our understanding of TZ/ROZ's reservoirs and their potential EOR targets has expanded greatly over the past 15 years. We are only now beginning to realize the huge potential for TZ/ROZ EOR. This, in turn, leads us to the real potential for Geologic Sequestration in the Permian Basin. Research into the TZ/ROZ's potential in other basins will eventually lead to the development of multiple plays in multiple basins nationwide. Already, CO_2 EOR is being developed in the Main Pay Zones in a number of basins in Wyoming, and the potential TZ/ROZ targets identified.

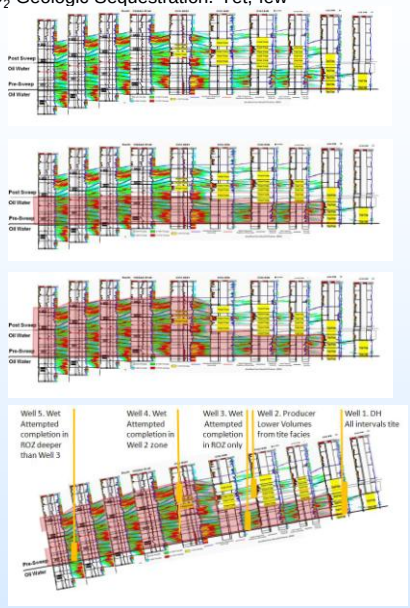


Figure 8. Model for the development of "Mother Natures Waterflood" and the types of production responses expected.

The Price Is Right

As a result of recent studies of the potential for CO_2 utilization in Residual Oil Zone Enhanced Oil Recovery, the mindset that geological sequestration has 10 or 20 fold capacity of CO_2 EOR for the long term sequestration of CO_2 is proving to be unsupportable. For both short term CO_2 EOR and Long Term Geologic Storage, the best, least risky, most practical, and least expensive method of storing CO_2 is in EOR projects.

There are five components of cost related to CO_2 Capture and Storage:

- Capture
- Compression
- Transportation
- Injection and
- Monitoring Verification and Accounting.

For a Coal Fired Power Plant, each of these have an attached cost which offset potential profits (and our cost of electricity). If the CO_2 is captured at the plant and sold for EOR, the CO_2 Marketer will assume the cost of the Transportation, Injection, and Monitoring Verification and Accounting (MVA). Although the value of "Carbon Credits" the power generator will receive is unknown at this time, this will greatly reduce the cost and liability of the power generator. The CO_2 therefore goes from being a Toxic Waste to a Product. The value of 1 MMCF CO_2 is presently close to 50% of the price of 1 MMCF of Natural Gas.

Potential Anthropogenic Sources

Over 83% of the CO_2 utilized in EOR today is from pure, natural sources (Figure 9). Neither the present natural, nor anthropogenic sources, are capable of supplying the long term incremental need.

Coal fired power plants are both the largest and lowest cost potential long term sources of CO_2 (Figure 10).

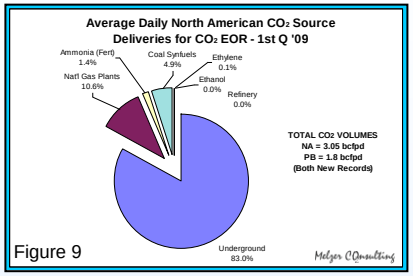
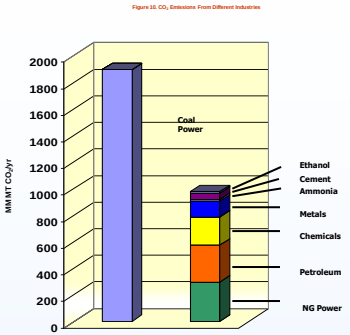


Figure 9



Source: EIA/Emissions of Greenhouse Gases in the United States 2004

Anthropogenic Sources…Sooner than you think

Two CO_2 capture equipped coal fired power plants are being permitted in the basin and one, the Summit Plant at Penwell, is scheduled to break ground before the end of the year. The fact that a near zero emissions coal fired power plant at Penwell and a post combustion coal fired power plant near Sweetwater will soon begin construction speaks volumes about the potential for CCS in Enhanced Oil Recovery Projects .

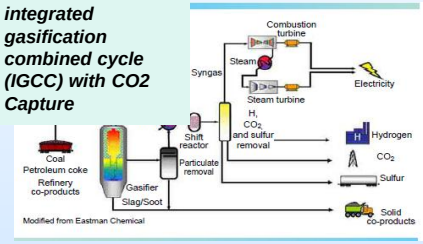
Blue Source has already agreed to be Summit's marketer to provide for the sale of the captured CO_2 into the Central Basin Pipeline less than 1 mile to the east of the Penwell plant.

Though it will be a minimum of 2-3 years before the CO_2 is available, when it comes on line, daily volumes are expected to be in the ~140 MMCF CO_2 range.

Blue Source plans to oversee the Monitoring and Verification of the geological sequestration of the project's CO_2 in Permian Basin oil fields.

Summit Penwell integrated gasification combined cycle (IGCC) with CO2 Capture

Figure 11



Tenaska Trailblazer traditional pulverized coal post combustion capture plant

References

Koperna, George J., and Vello A. Kuuskraa (2006) *TECHNICAL OIL RECOVERY POTENTIAL FROM RESIDUAL OIL ZONES: PERMIAN BASIN. Prepared for U.S. Department of Energy Office of Fossil Energy - Office of Oil and Natural Gas., by Advanced Resources International.* http://www.adv-res.com/pdf/ROZ_Permian_Document.pdf

Pickett, Al, 2011. Ready and Waiting. Basin Looks to Summit, Tenaska to meet CO_2 needs. *in* PBOil&Gas, 5/2011, p.12-18.

Dutton, S. P., E. M. Kim, R. F. Broadhead, C. L. Breton, W. D. Raatz, S. C. Ruppel, and C. Kerans, 2004, Play analysis and digital portfolio of major oil reservoirs in the Permian Basin: Application and transfer of advanced geological and engineering technologies for incremental production opportunities: UT Austin, Bureau of Economic Geology, final report prepared for the U.S. Department of Energy, under contract no. DE-FC26-02NT15131, 408 p.

Various, 2003-2009, Enhanced Oil Recovery Editions. Oil and Gas Journal. p. various.

Accomplishments to Date

- *Task 2. Sequestration Related Modules – Sequestration*
- *Task 4. Field Seminars - Engineering*
- *Task 5. Field Trips to Analogs of CO_2 Sequestration, EOR, and ROZ EOR Targets - Road Logs and PowerPoints*
- *Task 6. Sequestration Reservoir Core Study Sets – Vacuum Field, McCamey Field, Goldsmith Field, Ford Geraldine Field*

Summary

- Geology and Engineering students outside the Permian Basin have not been exposed to the “lingo” of the oil patch and more introductory material is necessary.
- The Road Logs are the first to highlight Carbon Utilization and Sequestration. Introductory power points for the Road Logs are necessary. As were the CO2 EOR project power points.
- A simpler version of the Core Descriptions was necessary. This was accomplished in Adobe Illustrator Format.
- **The “take-away” message is: as Utilization has become a focus of the DOE, the project has become one of the first to stress Utilization. http://energy.gov/articles/adding-utilization-carbon-capture-and-storage**

Appendix

Organization Chart

Gantt Chart

Bibliography

Organization Chart

Dr Robert Trentham, Co-PI Dr Emily Stoudt, Co-PI		Geology
L. Steven Melzer, Melzer CO_2nsulting Robert Kiker, R. D. Kiker		Engineering
Vacant		Land Management
Abdullayev, Toyly	Core Description	Graduate Student
Bode-Omoleye, Ibukunoluwa	Core Description	Graduate Student
~~Ede, Emmanuel~~	~~Adobe Illustrator~~	~~Graduate Student~~
Gunn, Chris	Geology	Graduate Student
Irvin, Ethan	Web Design	Undergraduate Student
Tyler Chesworth	Adobe Illustrator	Undergraduate Student
Felicia Wu	Adobe Illustrator	Undergraduate Student

Gantt Chart

- Gantt chart will be forthcoming.

Bibliography

- No peer reviewed publications.
- A number of Power Point and Poster presentations were made at local and regional geological societies.