

## Reid B. Grigg

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### EDUCATION

**Post-Doctorate** Research Associate, University of Lethbridge, Lethbridge, Alberta, Canada, 1979-80;

**Ph.D.** Physical Chemistry, Brigham Young University, Provo, UT; Aug. 1979;

**B.S.** Chemistry, Brigham Young University, Provo, UT; May 1975.

### PROFESSIONAL EXPERIENCE

**2015-present: Senior Engineer Emeritus: New Mexico Institute of Mining and Technology (NMT):**

Retired and working quarter time consulting for Southwest Regional Partnership on Carbon Sequestration (SWP) Phase III, CarbonSAFE Phase III, and CUSP West Projects.

**1992-2015: Senior Engineer/Section Head: Gas Flooding Processes and Flow Heterogeneities, New Mexico Petroleum Recovery Research Center (PRRC), a division of NMT, Socorro, NM**

*Co-PI 2007-2015:* U.S. Department of Energy/National Energy Technology Laboratory (DOE/NETL) sponsored project, "Southwest Regional Partnership on Carbon Sequestration (SWP), Phases II & III," a \$100 million effort involving government, industry, and academic partnership with a multidisciplinary team of researchers from numerous institutes and research organizations, for which NMT is the prime. The (SWP) is one of seven regional partnerships on carbon sequestration sponsored by the DOE. The project is currently engaged in analyzing enhanced oil recovery with injected CO<sub>2</sub> with a focus on carbon capture, utilization, and storage (CCUS) using numerous surface and subsurface analytical and experimental techniques.

*General Interest:* Research related to phase behavior of pressurized geological formation fluids, of fluid properties and flow behavior of high-pressure liquids and gases, and of high-pressure gas flooding processes in porous media. Gas injection for improved oil recovery and carbon sequestration, reservoir fluid phase behavior, and flow behavior of multi phase systems such as gas condensate and enhanced oil production mechanisms; their effects on flow in porous media; and improving and understanding mechanisms for improved mobility control.

*General Duties:* Direct carbon sequestration and improved oil recovery research. To maintain project momentum requires the writing of proposals and promoting ideas to support a research group. Funds come from federal, state, and private sources. Transfer of information through reports, papers, and presentations. Managing the section also requires hiring, evaluating, promoting, etc section members.

*Laboratory Determination and Simulation of Reservoir Fluid - Injection Gas Phase Behavior:* Principal interests have been the phase behavior of injected pure and impure carbon dioxide into reservoir fluids to improve oil recovery and sequester carbon as a greenhouse gas. Other work interests include hydrocarbon and nitrogen injection gases and gas condensate production. This work includes high-temperature, high-pressure experimental work and the development of improved equation-of-state models.

*Liquid-Gas Flow Conditions:* To improve fluid production from hydrocarbon reservoirs, an understanding of mobility, relative permeability, and flow patterns is necessary. Much of the work has centered on systems related to effects of injection gas such as CO<sub>2</sub>, but a project has been done to examine high gas flow rates at near wellbore conditions. This was done to increase our

understanding of the effects that liquid drop out, liquid saturation, and mobile liquid may have on the near wellbore flow of gas at high velocity.

*Selective Mobility Reduction:* The principal project was related to improving CO<sub>2</sub>-foam efficiency by identifying and defining foam systems that not only reduce the mobility, but selectively reduces mobility in higher permeability to a greater extent than in the lower permeability regions of a hydrogenous reservoir. This work includes the determinations of physical properties of surfactant that are useful in this phenomena, synergistic effects of mixed surfactant systems, and the determination of sacrificial agents to reduce the absorption of more expensive surfactants.

*Laboratory Tests of CO<sub>2</sub>-Foam in Porous Media:* Mechanistic studies, both in reservoir rock and two-dimensional visual micromodel, of CO<sub>2</sub>-foam under reservoir temperature and pressure. These have been used to determine optimum surfactant concentration for CO<sub>2</sub>-foam systems, foam quality, and effects of flow rates and patterns.

*Reservoir Simulation:* Develop models for simulating improved oil recovery miscible gas injection processes. Principal interests have been in incorporating and testing fluid phase behavior, foam mobility modification mechanisms, and horizontal wells.

*Technology Transfer:* A major objective of the PRRC is technology transfer. Much of this is done through various publications, presentations, and forums.

*Field Verification of CO<sub>2</sub>-Foam:* We have been a part of a several joint PRRC/US DOE/Industry projects set up to field test concepts developed in the laboratories to improve oil recovery and/or store CO<sub>2</sub> by injected dense CO<sub>2</sub> into deep reservoirs.

*Carbon Sequestration/Storage:* Due to similarities of CO<sub>2</sub> injection into geological formations for improving oil and coal methane recoveries to using the same formations to sequester carbon, sequestration of green house gases has gained interest in my research. Other interests such as gas hydrates provide background that might be of interest in ocean sequestration and in cold climates. These include a number of field tests: Phillips East Vacuum Foam Pilot (New Mexico), Strata West Pearl Queen Carbon Sequestration Pilot (New Mexico), SACROC EOR/Sequestration pilot area (Texas), Aneth Unit EOR/Sequestration Study Area (Utah), and Farnsworth Unit EOR/Storage project (Texas)

**1992-present: Adjunct Professor at NMT.** Research tenure was granted May 1997. To date I have been research advisor to a number of graduate students, listed below for both PhD and M.S. degrees. In addition I have been on the committee of many other graduate students. My primary function is directing a research group, though I taught a graduate class (Phase Behavior and Properties of Petroleum Fluids) every other year from 1994 through 2008 and I coordinate directed studies on continuing bases with individual students in the areas related to CO<sub>2</sub>-EOR and sequestration.

*List of Graduate Students for whom I was Research Advisor:*

1. Karim Salehpoor, "Effects and Mechanisms in Carbon Dioxide Foam Flooding, A Micromodel Visualization Study," MS December 1993.
2. Tzu-Cheich Huang, "Simulation of the Phase Behavior of Carbon Dioxide and Hydrocarbon Systems," PhD August 1994.
3. Chao Li, "Using Neural Networks to Predict Phase Behavior," MS April 1997.
4. Uco WR Siagian, "A laboratory Study of the Extraction of Hydrocarbons form crude Oil by High Pressure Carbon Dioxide," MS June 1997.
5. Sakesh Ganda, "A Laboratory Study of the Effect of Overburden Pressure, Flow Rates and Temperature in Permeability and non-Darcy Flow Coefficient," MS March 2001.
6. Laxman Bethapudi, "Comprehensive Literature Review of Foams and A Laboratory Study of CO<sub>2</sub> Flowing in Indiana Limestone versus Flow Rate, Temperature, and Stress," MS August 2003.
7. D.B. Gupta, "The Effect of Hydrostatic Stresses, Flow Rate, Temperature and Pore Pressure on Pressure Gradient," MS 2003.

8. Baojun Bai, "Sorption of Surfactant and Sacrificial Agent used in CO<sub>2</sub> Foam Flooding," PhD June 2005.
9. Yi Liu, "Characteristics of Static Bulk Foam and Behavior of Foam Flowing in a Porous Medium," PhD April 2006.
10. Guoqiang Yin, "Experimental Study of CO<sub>2</sub>-Foam Flooding in Berea Sandstone at Reservoir Conditions," MS March 2007.
11. Rashid Kassim, "Modeling of Adsorption and Desorption of Surfactants Used in CO<sub>2</sub> Flooding," MS July 2007.
12. Solomon K. Ampim, "Screening of Surfactants for N<sub>2</sub> Flooding," MS December 2008.
13. Pinyok Kovisuth, "Effects of pH on Surfactant Solutions and Gas on IFT, Foaming, and Adsorption on Rock," MS April 2009.
14. Alexander Mikhailin, "Adsorption Behavior of Commercially Available Surfactant "Chaser CD 1045" for Carbon Dioxide Foam Flooding," MS August 2009.
15. Gael Tawatieu Yota, "Storage and Utilization of CO<sub>2</sub>," MS March 2013.
16. Edward Ennin, "Reservoir Evaluation of Farnsworth Field in Texas," MS August 2015.
17. Dhiraj Gunda, "Experimental Evaluation of Minimum Miscibility Pressure for CO<sub>2</sub> Miscible Flooding at Farnsworth Field, Texas & Burbank Field, Oklahoma," MS June 2017

**1991-92: Director of Reservoir Fluid Technology, Core Laboratories, Dallas, TX**

*Instructional:* Instructed courses in Reservoir Fluid Phase Behavior inside and outside Core Laboratories.

*PVT and Improved Oil Recovery Projects:* Supervised and designed special projects, and proposed new or improved services. Projects included identifying causes of asphaltene deposition due to pressure change or solvent injections and developing new procedures for quantitative determination of asphaltene precipitation at reservoir conditions. Supervised phase behavior and PVT tests on gas injection, gas cycling, gas condensate, and conventional black oil tests for reservoir projects in North America, South America, and the Middle East.

*Intercompany Liaison:* Company liaison with petroleum company research and engineers centers on matters regarding reservoir fluids and to exchange ideas with research personnel for developing new services. Company visits included: Shell, Exxon, Texaco, British Petroleum, Arco, Mobil, Oryx, Chevron, Unocal, Conoco, Phillips, Amoco, Kerr-McGee, Enron, and Hunt.

**1980-91: Senior Research Scientist (1989-91), Senior Research Chemist (1983-89), and Research Chemist (1980-83), Conoco Inc., Production Research, Ponca City, OK**

*Instruction:* Taught reservoir fluid phase behavior to personnel at various technical levels, and trained staff in instrumentation and interpretation of high-temperature and high-pressure experimental work.

*Numerous Short Courses between 1980 and 1991.* Oil field and management related topics each course ranging from three to ten days in length.

*Phase Behavior Expert:* Acted as the principal company consultant on reservoir fluid sampling and pressure-volume-temperature tests for conventional oil, volatile oil, and gas condensate reservoirs. Directed research and technical services, both experimental and simulated, on the phase behavior of reservoir fluids with emphasis on mixtures of dense gas with reservoir fluids for improved oil recovery. Also, determined the phase behavior of water and gas in the formation of hydrates in drilling mud and other aqueous mixtures such as water and CO<sub>2</sub>.

*Hydrocarbon Fluid Physical Properties:* Analyzed and determined the factors resulting in 3% to 5% (~\$1200/day) oil loss at a specific production facility during the summer months and recommended several solutions. Supervised design, construction, and utilization of facilities to measure physical properties and composition of petroleum fluids at reservoir conditions for primary,

secondary, and tertiary reservoir development. This included fluid tests for conventional black oil, volatile oil, and gas condensate reservoirs.

*Improved Oil Recovery Tests:* Researched the technical feasibility of injecting high-pressure gas into several specific oil reservoirs. These included improved oil recovery projects, two using enriched hydrocarbon injection gas and numerous CO<sub>2</sub> projects, in North America, Northern Europe, Africa, Middle East, and Southeast Asia. Methods were investigated and developed to add hydrocarbon impurities to CO<sub>2</sub> that would aid in developing miscibility fluids. These tests resulted in a method for testing samples that saved 60% on materials and 75% on time and labor. Another project investigated nitrogen as a miscible injection gas for high pressure-high temperature reservoirs. This included three field pilot tests: Maljamar (New Mexico), West Sussex (Wyoming), and Misriff (Near East).

*Direct Thickeners for Improved Oil Recovery:* Organized project and advised personnel from several research locations (Marshall Labs in Philadelphia, University of Delaware, Dupont Experimental Station in Wilmington, Conoco Research in Ponca City, and Conoco Engineering in Houston) that establishing the feasibility of formulating dense gas viscosifiers. Analyzed the economic viability for these products and advised Conoco on the direction to proceed.

*Reservoir Modeling: Interpreted* results from reservoir fluid experimental work for computer simulations for specific reservoir models.

*Gas Hydrates Research: Conceived,* designed, and supervised utilization of apparatus to monitor and control temperature < 0.01 degree C and pressure < 0.1 psi, and observe phase changes of fluid. Primary use was for determining effects of temperature, pressure, and system compositions on gas hydrates formation and dissociation conditions. Recommended guidelines to avoid multi-million-dollar hazardous plugging for deep water and arctic drilling.

*Industrial Consortiums and DOE Review Committee:* During my industrial experience I worked with a number of Industrial Consortium Projects, which in most cases included government participation and a DOE appointed project review committee. Committees included:

1. CO<sub>2</sub> Project (1982-1986), New Mexico Petroleum Recovery Research Center (Socorro, NM), Industry Representative.
2. Heavy Oil - CO<sub>2</sub> Project (1983-1985), HyCal (Calgary, Alberta, Canada), Industry Representative.
3. Hydrates Inhibition in Drilling Mud Project (1985-1989), Colorado School of Mines (Golden, CO), Industry Representative.
4. IOR Project (1987-1989). Heriot-Watt University (Edinburgh, Scotland), Industry Representative: During these visits and interaction I assessed their gas condensate project which included both phase behavior and flow behavior in reservoir cores.
5. Gas Hydrates Review Committee (1988) - A panel set up to review, critique, and make recommendations for all DOE-sponsored Gas Hydrates projects.

### **1979-80: Research Associate, University of Lethbridge, Lethbridge, Alberta, Canada.**

Determined and analyzed thermodynamic properties of mixtures of water, clay, hydrocarbons, and surfactant. The work was related to the extraction of heavy oil from the extensive oil sands deposits in Alberta Canada and was supported by AOSTRA.

### **1975-79: Research Assistant, Brigham Young University, Provo, UT.**

Taught under graduate labs in physical, analytical, and organic chemistry and assisted in a graduate Quantum Chemistry course. Research interest included the determination of thermodynamic properties (excess volume, heat and Gibbs free energy of mixing) required to develop solution theories on binary hydrocarbon solutions. Dissertation Title: "Thermodynamics of Non-electrolyte Binary Solutions: Excess Volumes, Enthalpies, Gibbs Free Energies, and Entropies

for Hydrocarbon Mixtures and Excess Volumes for Several Systems Containing Carbon Tetrachloride.”

### **MAJOR FUNDING: PRRC**

1. “Southwest Regional Partnership on Carbon Sequestration”, Multi-year DOE project – Phase II October 1, 2005 - December 31, 2010 and Phase III October 1, 2007 – ~October 1, 2022. Co-Principal Investigator. Total Estimated Budget over \$100,000,000 (DOE ~\$80,000,000) with State of New Mexico-Academic-National Laboratory-Industrial Partnership contributing well over \$20,000,000).
2. “Improved Gas Flooding Efficiency.” Multi-year DOE project April 1, 2005-March 31, 2008, Project Manager and Principal Investigator. Total Estimated Budget over \$1,200,000 (DOE-Stake of New Mexico-Industrial Consortium).
3. “Improving CO<sub>2</sub> Efficiency for Recovering Oil in Heterogeneous Reservoirs,” Multi-year DOE project September 28, 2001-March 31, 2005, Project Manager and Principal Investigator. Total Estimated Budget over \$1,500,000 (DOE-Stake of New Mexico-Industrial Consortium).
4. “Long-Term CO<sub>2</sub> Storage; Using Petroleum Industry Experience.” Project with the CCP (Carbon Capture Project) an industrial consortium to develop carbon sequestration technologies, contract October 2001 to March 2003 for \$110,000.
5. “Sequestration of CO<sub>2</sub> in a Depleted Oil Reservoir: A Comprehensive Modeling and Site Monitoring Project.” Three-year project: July 2000 – June 2003. Project Managed by Los Alamos and Sandia National Laboratories. Total Expenditures \$2,295,000 (DOE), PRRC subcontract over three years of over \$150,000.
6. “Improved Efficiency of Miscible CO<sub>2</sub> Floods and Enhanced Prospects for CO<sub>2</sub> Flooding Heterogeneous Reservoirs.” Three-year project continuation: June 1997-September 2000. Project Manager and Co-Principal Investigator. Total Estimated Budget: \$2,300,000 (DOE-State of New Mexico-New Mexico Petroleum Recovery Research Center-Industrial Consortium).
7. “Improved Efficiency of Miscible CO<sub>2</sub> Floods and Enhanced Prospects for CO<sub>2</sub> Flooding Heterogeneous Reservoirs.” Three-year project: April 1994-April 1997. Project Manager and Co-Principal Investigator. Total Expenditures: \$2,245,000 (DOE-State of New Mexico-New Mexico Petroleum Recovery Research Center-Industrial Consortium).
8. “Near Wellbore Non-Darcy Wet Gas Flow experiments,” Budget: \$67,000 (Mobil)
9. “Reservoir Pressure Reduction and Miscibility Determination for the Wellman Field,” Budget: \$50,000 (The Wiser Oil Company)
10. “CO<sub>2</sub> Injection in a Tight Blinbry Reservoir,” \$40,000 (Arch Petroleum)

### **MAJOR PRESENTATIONS and MEETINGS ATTENDED**

1. U.S. Department of Energy and National Energy Technology Laboratory Carbon Storage R&D Project Review Meetings 2007, 2008, 2009, 2010, 2011, 2012, 2014, 2015.
2. Society of Petroleum Engineers Annual Technical Conference and Exhibition: 1982, 1983, 1986, 1987, 1989, 1992, 1994, 1996, 1997, 1999, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2012, 2014.
3. SPE/DOE Symposium on Improved Oil Recovery (Tulsa, OK): 1981, 1984, 1987, 1994, 1996, 1998, 2000, 2002 (Program Chair), 2004, 2006, 2008, 2010, 2012.
4. SPE International Symposium on Oilfield Chemistry, Houston, 1995, 1999, 2003, 2005, 2007.
5. SPE Forum Series:
  - a. 1993 – “Reservoir Fluids: Phase Behavior and Physical Properties”;
  - b. 1998 - European Forum Series: “Oil Recovery by Gas Injection - From Design to Operation”;
  - c. 2006 – “Enhanced Oil Recovery: What’s Next?” (Member of Steering Committee)

- d. 2009 – “CO<sub>2</sub> Capture and Storage.”
6. Gordon Conference on Fluid Flow in Porous Media (New Hampshire): 1983, 2002.
7. Annual DOE/NETL Carbon Capture and Sequestration Conference, 2001, 2003, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2013.
8. CO<sub>2</sub> Conference, Midland: 1996, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2011, 2013.
9. CO<sub>2</sub> Carbon Management Workshop, Midland: 2003, 2004, 2006, 2008, 2009
10. US-Norway Summer School – Carbon Capture & Storage in Geologic Formations, Santa Fe, August 2004
11. CO<sub>2</sub> Capture Project (CCP) Workshop, Santa Cruz, CA, Oct. 21-22, 2002 and Berlin, Nov, 2001.
12. DOE Workshop on R&D Priorities for Carbon Sequestration (Washington D.C. 1999)
13. Innovations in CO<sub>2</sub> Management & Sequestration (Santa Fe 1998)
14. Chapman Conference on the Science and Technology of Carbon Sequestration, San Diego, 6-20 January 2005.
15. Gas Technology Symposium (Calgary, Canada): 1998
16. American Chemical Society National meeting: 1985, 1988.
17. Permian Basin Oil and Gas Recovery Conference, Midland: 1994, 1996, 1998, 2000, 2001.
18. CO<sub>2</sub> Oil Recovery Forum (Socorro, NM): 1996, 1997, 1998, 1999.
19. Calorimetry Conference (Logan, UT): 1978.

## OTHER RELEVANT ACTIVITIES

- Society of Petroleum Engineer (SPE) TIC Section Director: North Central Oklahoma Section (1982-1985)
- SPE Section Program Chairman: Roswell Section (1993-1994)
- SPE Section Chairman: Roswell Section (1994-1995)
- SPE Director Roswell Section (1995-1998)
- SPE Section Membership Chairman: Roswell Section (1999-2000)
- SPE/DOE Thirteenth Symposium on Improved Oil Recovery, Technical Program Chairman, 2002.
- New Mexico Tech Institute Senate Nominating Committee (1994-1996)
- New Mexico Tech Institute Senate Budget, Funding and Support Functions Committee (1994-1997) Chair (1995-1997)
- New Mexico Tech Institute Senate Research and Development Committee (1999-2002)
- Adjunct Professor of Petroleum Engineering at New Mexico Institute of Mining and Technology (1992-present)

## PUBLICATIONS

1. Lindsey Rasmussen, Tianguang Fan, Alex Rinehart, Andrew Luhmann, William Ampomah, Thomas Dewers, Jason Heath, Martha Cather, Reid Grigg, (2019), “Carbon Storage and Enhanced Oil Recovery in Pennsylvanian Morrow Formation Clastic Reservoirs: Controls on Oil–Brine and Oil–CO<sub>2</sub> Relative Permeability from Diagenetic Heterogeneity and Evolving Wettability.” *Energies*, January, v. 12 (19).
2. W Ampomah, R Balch, RB Grigg, M Cather, E Gragg, RA Will, M White, N Moodie, Z Dai, (2017), “Performance assessment of CO<sub>2</sub>-enhanced oil recovery and storage in the Morrow reservoir,” *Geomechanics and Geophysics for Geo-Energy and Geo-Resources*, September 2017, v. 3 (3), p. 245-263.
3. William Ampomah, Robert S Balch, Reid B Grigg, Brian McPherson, Robert A Will, Si-Yong Lee, Zhenzue Dai, Feng Pan, (2017), “Co-optimization of CO<sub>2</sub>-EOR and Storage Processes in Mature Oil Reservoirs.” *Greenhouse Gases: Science and Technology*, v. 7(1), p. 128-142.

4. Robert Balch, Brian McPherson, Reid Grigg, (2017), “Overview of a large scale carbon capture, utilization, and storage demonstration project in an active oil field in Texas, USA”, *Energy Procedia*, July 2017, v. 114, p. 5874-5887
5. George El-kaseeh, Robert Will, Robert Balch, Reid Grigg, (2017), “Multi-scale seismic measurements for CO<sub>2</sub> Monitoring in an EOR/CCUS project”, *Energy Procedia*, July 2017, v. 114, p. 3656-3670.
6. Bulbul Ahmmed, Martin S Appold, Tianguang Fan, Brian JOL McPherson, Reid B Grigg, Mark D White (2016) “Chemical effects of carbon dioxide sequestration in the Upper Morrow Sandstone in the Farnsworth, Texas, hydrocarbon unit” *Environmental Geosciences*, 1 June 2016, v. 23 (2), p. 81-93
7. Balch, R., B. McPherson and R. Grigg. (2016) “Overview of a Large Scale Carbon Capture, Utilization, and Storage Demonstration Project at an active Oil Field, Farnsworth, Texas.” *Greenhouse Gas Control Technologies 13* Nov. 14-18, 2016, Lausanne, Switzerland.
10. Ahmmed, B., Appold, M. S., Fan, T., McPherson, B. J. O. L., Grigg, R. B., White, M. D., (2016). “Chemical effects of CO<sub>2</sub> sequestration in the Upper Morrow Sandstone in the Farnsworth, Texas hydrocarbon unit”. *Environmental Geosciences Journal*, v. 23, p. 1-13 (DOI:10.1306/eg.09031515006).
11. Ennin, E. and Grigg, R. (2016) “CO<sub>2</sub> Flooding and Minimum Miscibility Pressure Study in Texas Farnsworth Field.” Paper SPE 180854 presented at the SPE Trinidad and Tobago Section Energy Resources Conference, June 13-15
12. Ennin, E., Grigg, R. B., & Petmecky, C. (2016). “Laboratory Review of Effect of Salinity on CO<sub>2</sub> Storage Potential in Farnsworth Field”. *SPE Europec at 78th EAGE Conference and Exhibition*, Vienna, Austria, 30 May–2 June 2016. <http://dx.doi.org/10.2118/180161-MS>.
13. Ampomah, W., Balch, R., Grigg, R., Cather, M., Will, R., and Lee, S. Y. (2016) “Optimization of CO<sub>2</sub>-EOR Process in Partially Depleted Oil Reservoirs.” Paper SPE-180376-MS presented at the SPE Western Regional Meeting, Anchorage, Alaska, May 23-26.
14. Ampomah, W., Balch, R., Grigg, R., Will, R., Dai, Z., and White, M. (2016). “Farnsworth Field CO<sub>2</sub>-EOR Project: Performance Case History”, paper SPE-179528-MS presented at SPE Improved Oil Recovery Conference, Tulsa, Oklahoma USA, April 11-13.
15. Ampomah, W., Balch, R. S., Grigg, R. B., McPherson, B., Will, R. A., Lee, S. Y., Dai, Z., and Pan, F., (2016). Co-optimization of CO<sub>2</sub>-EOR and storage processes in mature oil reservoirs, *Greenhouse Gas Sci Technol.* 00:1–15 (2016); DOI: 10.1002/ghg.
16. Ampomah, W., Balch, R. S., and Grigg, R. B. (2015). Analysis of Upscaling Algorithms in Heterogeneous Reservoirs with Different Recovery Processes. *SPE Production and Operations Symposium*. March 1-5, 2015, Oklahoma City, Oklahoma, USA doi:10.2118/173588-MS
17. Gunda, D., Ampomah, W., Grigg, R., and Balch, R. (2015). “Reservoir Fluid Characterization for Miscible Enhanced Oil Recovery.” Paper CMTC-440176-MS presented at Carbon Management Technology Conference, Sugarland, Texas, USA November 16-19.
18. Ampomah, W., Balch, R.S., Grigg, R.B., Dai, Z. and Pan, F. (2015) Compositional Simulation of CO<sub>2</sub> Storage Capacity in Depleted Oil Reservoirs. *Carbon Management Technology Conference*. Nov. 17-19, 2015, Sugarland-Houston, TX. <http://dx.doi.org/10.7122/439476-MS>.
19. Balch, B., R. Will, G. El-Kaseeh, R. Grigg, A. Hutton, and P. Czoski. (2015) Integrating Multi-Scale Seismic Measurements for EOR/CCUS. *SEG Annual Meeting*, Oct. 18-23, 2015, New Orleans, Louisiana. DOI <http://dx.doi.org/10.1190/segam2015-5919900.1>
20. Dai, Z., Viswanathan, H., Middleton, R., Pan F., Ampomah W., Yang C., Jia W., Lee S., McPherson B., Balch R., Grigg R., White M. (2016). CO<sub>2</sub> Accounting and Risk Analysis for CO<sub>2</sub> Sequestration at Enhanced Oil Recovery Sites. *Environmental Science & Technology*, 50 (14), 7546-7554. <http://pubs.acs.org/doi/abs/10.1021/acs.est.6b01744>

21. Dai, Z., H. Viswanathan, J. Fessenden-Rahn, R. Middleton, R. Pan, W. Jia, S. Lee, B. McPherson, W. Ampomah, and R. Grigg. (2014) Uncertainty Quantification for CO<sub>2</sub> Sequestration and Enhanced Oil Recovery. *Energy Procedia*, 63:7685-7693, ISSN 1876-6102
22. Dai, Z., H. Viswanathana, R. Middleton, F. Pan, W. Ampomah, C. Yang, Y Zhou, W. Jia, S. Lee, B. McPherson, R. Balch, R. Grigg and M. White. (2016) CO<sub>2</sub> Sequestration and Enhanced Oil Recovery at Depleted Oil/Gas Reservoirs. *Greenhouse Gas Control Technologies 13* Nov. 14-18, 2016, Lausanne, Switzerland
23. El-Kaseeh, G., R. Will, R. Balch and R. Grigg. (2016) Multi-Scale Seismic Measurements for CO<sub>2</sub> monitoring in EOR/CCUS Project. *Greenhouse Gas Control Technologies 13* Nov. 14-18, 2016, Lausanne, Switzerland.
24. Esser, R., N. Liu, B. McPherson R. Grigg, R. Balch, L. Garcia and T. Fan. (2015) MVA Activities - SWP Farnsworth Unit Project. *2015 DOE Carbon Storage Meeting*. Aug 18-20, 2015, Pittsburgh, PA.
25. Grigg, R.B., Ampomah, W. and Gunda, D. (2015) Integrating CO<sub>2</sub> EOR and CO<sub>2</sub> Storage in Farnsworth Field. *2015 DOE Carbon Storage Meeting*. Aug 18-20, 2015, Pittsburgh, PA.
26. Rose-Coss, D., Ampomah, W., Hutton, A., Balch, R.S., Cather, M., Grigg, R., and P Mozley. (2015) Geologic Characterization for CO<sub>2</sub>-EOR Simulation: A Case Study of the Farnsworth Unit, Anadarko Basin, Texas. *Search and Discovery* (2015).  
[http://www.searchanddiscovery.com/pdfz/documents/2015/80484rosecooss/ndx\\_rosecooss.pdf.html](http://www.searchanddiscovery.com/pdfz/documents/2015/80484rosecooss/ndx_rosecooss.pdf.html).
27. White, M.D. , B.J. McPherson, R.B. Grigg, W. Ampomah and M.S. Appold. (2014) Numerical Simulation of Carbon Dioxide Injection in the Western Section of the Farnsworth Unit. *Energy Procedia*, 63 ( 2014 ) 7891 – 7912, ISSN 1876-6102.
28. Achanta, D. S. Balch, R., and Grigg, R. (2012) “Simulation of leakage scenarios for CO<sub>2</sub> storage at Gordon Creek, Utah. Paper 151483 presented at the Carbon Management Technology Conference, Orlando, 7-9 February, 2012.
29. Chongwei Xiao, C; Lee Harris, M.L: Wang, F; and Grigg, R.: “Field Testing and Numerical Simulation of Combined CO<sub>2</sub> Enhanced Oil Recovery and Storage in the SACROC Unit”, Paper CSUG/SPE 147544 presented at the Canadian Unconventional Resources Conference, Calgary, 15-17 November 2011.
30. Grigg, R.; McPherson, B.; and Lee, R.: “Phase II Final Scientific/Technical Report, Reporting Period: October, 2005 – December 31, 2010”, DOE Contract # DE-FC26-05NT42591, August 2011
31. Bai, B., Grigg, Reid B.; Svec, Yi; Wu, Y., Adsorption of a foam agent on porous sandstone and its effect on foam stability, *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 2010, 353 (2-3), 189-196.
32. Ning Liu, N., Ghorpade, S., Harris, L., Li, L., Grigg, R., and Lee, R.: “The Effect of Pressure and Temperature on Brine-CO<sub>2</sub> Relative Permeability and IFT at Reservoir Conditions”, Paper SPE 139029 presented at the SPE Eastern Regional Meeting, Morgantown, 12-14 October 2010.
33. Harris, M.L. and Grigg, R.B.: “Validation and Comparison of Carbon Sequestration Project Cost Estimation Models with Project Cost Data Obtained from the SWP”, Paper presented at DOE-NETL Ninth Annual Conference on Carbon Sequestration, (Seventh Annual Carbon Capture and Sequestration Conference, Pittsburgh, PA. May 10-13, 2010.
34. Ghorpade, S., Liu, N., Harris, L., Li, L., Grigg, R., and Lee, R.: “Effects of pressure and temperature on relative permeability of CO<sub>2</sub>-brine system”, Paper presented at DOE-NETL Ninth Annual Conference on Carbon Sequestration, (Seventh Annual Carbon Capture and Sequestration Conference, Pittsburgh, PA. May 10-13, 2010.
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**PROFESSIONAL SOCIETIES**

American Chemical Society (1975-2010), Society of Petroleum Engineers (1980-present), Sigma Xi (since 1978).