



Enhanced Oil Recovery Institute

E-News Spring 2013

Director's Comments

~David Mohrbacher~

The Enhanced Oil Recovery Institute (EORI) and the University of Wyoming have new facilities to provide key information to improve recovery of oil stranded in Wyoming's legacy oil fields. Construction of EORI's new laboratory in the Energy Innovation Center was completed during May. Other new lab facilities allow for evaluation of multi-phase flow with reservoir imaging, and modeling and evaluation of reservoir performance using 3-dimensional audio/visual equipment. Commissioning of laboratory equipment has begun, and we are looking for new project work. Contact EORI's outreach staff to determine how we can help you improve production in your Wyoming fields. The new laboratories have "state of the art" capabilities for the following:

- Determine the composition of oil and water,
- Develop phase behavior data,
- Complete core floods,
- Determine minimum miscibility pressures for miscible floods, and
- Measure physical properties of core and reservoir fluids.

EORI works closely with university staff to access additional laboratory capabilities

including core imaging, geology and geophysics evaluations, economic analyses, and various types of modeling. EORI selects projects based on the following criteria:

- Potential to increase oil reserves, and ultimately taxable revenues from oil production, in the state of Wyoming;
- Opportunity to share results of projects with other operators to catalyze additional development of our oil resources;
- Availability of reservoir data necessary to complete technical evaluations; and
- Willingness of operators to share costs and/or provide "in kind" contributions including field data, core samples, fluid samples, and staff time.

Projects are generally initiated within 3 to 6 months after defining project objectives and completing a preliminary project plan. The time to complete work will vary based on the defined project scope. Now is a good time to discuss scheduling work because our new resources are just coming on line.

Articles in this newsletter provide summaries of recent projects completed by EORI in cooperation with Wyoming operators. Reading our newsletter should provide good examples of projects that your company may want to pursue.

Wyoming operators are encouraged to contact EORI's outreach staff to discuss how we can help improve the efficiency of your waterfloods and use advanced technology to implement enhanced oil recovery techniques to recover more oil from mature oil fields. EORI can be contacted via our website: <http://www.uwyo.edu/eori/> or by contacting either Glen Murrell, gmurrell@uwyo.edu or Laura Dalles dalles@uwyo.edu.

EORI Research Updates

EORI's Modeling and Simulation Capability - Shaochang Wo, Research Scientist

Reservoir modeling and simulation have already become a routine tool for exploration and reservoir management in major oil companies, primarily because they can solve problems that cannot be solved in any other way. Simulation is the only way to describe quantitatively the flow of multiple phases in a heterogeneous reservoir. Adding on EORI's existing strength in the fields of geology, petrophysics and laboratory tests, the advance

of EORI's simulation capability allows us to provide an integrated technical support to the independent oil and gas producers in the state of Wyoming. With the purchase of a new computer cluster and a renewed software donation of ECLIPSE Parallel from Schlumberger, EORI is now able to model and simulate some of the largest oil reservoirs in Wyoming.

Wyoming's oil fields are small by international standards and the average field has been in play for more than 40 years. Through models and simulations, history matching can provide a graphic glimpse of where oil still remains in subterranean oil reservoirs after decades of production. In a simulation model of a reservoir, the reservoir is subdivided into discrete grid blocks. Smaller reservoirs usually mean smaller numbers of grid blocks that are required for representative simulation models. However, for many Wyoming reservoirs, geological features and lithology changes are observed on the order of a few feet, which is much smaller than the commonly used grid block spacing of 20-100 feet. To reduce or eliminate scale-up of geological models, a similar order of definition grid size is desirable to capture subtle geological features of barriers and flow units. This kind of fine-scale simulation, or high resolution simulation, often leads to multi-million grid block models and requires massive computing power and parallel simulators.

For assessing an old oil field and its EOR/IOR options, a reservoir modeling simulation project typically consists of three phases: integrating various static and dynamic data into a simulation model; predicting present oil, gas and water distributions via history matching; and forecasting and evaluating the performance of alternative EOR/IOR scenarios. The EOR/IOR technologies most applicable to Wyoming oil reservoirs are waterflooding, polymer-enhanced waterflooding, surfactant flooding, steamflooding, and CO₂ flooding. Accordingly, different EOR mechanisms must be incorporated in specified reservoir simulators, such as the black-oil, compositional, thermal, and chemical flooding models in the donated ECLIPSE software suite.

2013 Conference & Technology Transfer Update

The workshop and conference season is off and running. EORI just recently completed its first of four scheduled technology transfer events with a highly successful Minnelusa I

workshop. Registration is up and running for the CO2 Conference with over 130 industry professionals already signed up to attend that event in July. The Tensleep III group will meet for their final session prior to the CO2 Conference and the agenda for the IOR/EOR conference in September is nearly complete. Information regarding all of these events is available on our website: <http://www.uwyo.edu/eori/> or by contacting Glen Murrell, gmurrell@uwyo.edu or Laura Dalles dalles@uwyo.edu at the Institute.

Minnelusa I Workshop - Introductory Concepts

On May 6 & 7, the EORI held the first of a series of Minnelusa Workshops at the Technical Education Center of the Gillette College. There were 34 attendees from Ballard Petroleum, Merit Energy, Resolute Energy, Osborn Heirs, Citation, True Oil and TIORCO. During the 2 days the attendees received presentations from EORI researchers as well as Minnelusa operators and service providers on a variety of introductory concepts pertinent to the Minnelusa. These topics covered everything from geology, to waterflood optimization to historic and prospective IOR and EOR practices. TIORCO graciously sponsored a reception on Monday evening. Presentations from the workshop are available for download <http://www.uwyo.edu/eori/technology-transfer/workshops/minnelusa-i-presentations.html> Feedback from the participants was positive and constructive and we are now in the process of planning a repeat of this workshop (Minnelusa I) as well as a follow-up workshop focusing on conformance and incorporating a field trip (Minnelusa II).

7th Annual Wyoming CO2 Conference

July 10-11, 2013 - Casper Events Center

EORI's premier event - The 7th edition of the Annual Wyoming CO2 Conference will take place on July 10th and 11th at the Casper Event Center in Casper, WY. This year the agenda has two themes: Small CO2 EOR operators and Hydrocarbon conversion and CO2 EOR. The Wyoming oil industry is broadly characterized by small to medium sized operations. These typically have significant financial and resource challenges to overcome when considering CO2 floods. Two smaller CO2 EOR operators from outside Wyoming have been invited to present case studies and share their insights. Also, hydrocarbon conversion (Coal to Liquids, IGCC, Coal Gasification, etc.) is an energy technology with a big future in the US and Wyoming. The majority of these projects are now being designed

with CO2 off-take for EOR designed in to the business models. A panel of current and future conversion operations and technical experts will be convened to discuss the implications of the philosophy and its implications in Wyoming. For registration and agenda details please visit <http://www.uwyo.edu/eori/>

TriHydro will be hosting an introductory workshop on permitting in Legacy Fields on the afternoon of the 9th, in conjunction with the conference and EORI. Details will be published later.

Thank you to our Sponsors for supporting the CO2 Conference.

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Tensleep III Workshop - ROZ and CO2 EOR

July 8-9, 2013 - Hilton Garden Inn - Casper, WY

The Enhanced Oil Recovery Institute (EORI), has been conducting a series of workshops to improve application of advanced technology to recover stranded oil in Tensleep reservoirs located in the Bighorn Basin. The third of these workshops (Tensleep III) will take place on July 8 and 9, 2013 at the Hilton Garden Inn in Casper, WY. The previous workshops reviewed introductory waterflooding concepts and general IOR/EOR applications. Tensleep III will focus on the Tensleep Residual Oil Zone (ROZ) and CO2

Flooding. A primary objective of the workshops will be to present real-world case studies demonstrating identified concepts. This workshop is a collaboration with Research Partnership to Secure Energy for America (RPSEA), The University of Texas of the Permian Basin and Melzer Consulting. For more information and to register (Note: This workshop is capped at 50 participants). <http://www.uwyo.edu/eori/> or by contacting Glen Murrell, gmurrell@uwyo.edu or Laura Dalles dalles@uwyo.edu at the Institute.

Mike Ramseier – Marathon Oil

"I attended both the Tensleep I and II workshops and was very impressed at the quality of the presentations and the format of the seminars. There were presentations of great interest for both engineers and geoscientists with topics ranging from water shut-off strategies and CO2 EOR to core analyses and seismic interpretation. I would definitely recommend these workshops for all Wyoming Tensleep operators."



5th Wyoming IOR/EOR Conference

September 9-10, 2013 - Best Western Sheridan Center - Sheridan WY

Plan on spending a couple of days in the Big Horns and join us for this years IOR/EOR Conference in Sheridan Wyoming! The agenda is still a work in progress but Glen is pursuing speakers on MEOR, Historic IOR/EOR in the Minnelusa, 3D Seismic in the Minnelusa, Water-block treatments, a Chem-EOR case study and IOR/EOR in Unconventional Resources. This conference is typically quite broad in scope so if you have something you would like to present on, please contact Glen Murrell, gmurrell@uwyo.edu or Laura Dalles dalles@uwyo.edu at the Institute. We also have sponsor and vendor opportunities, if interested please contact Glen or Laura.

EORI Students in the Field

~KC MacIntyre ~ Having spent half my life in California and half Wyoming, I constantly observe the contrasts of the energy industry from one state to the other. Studying Petroleum Engineering now, I'm even more intrigued by the current involvement of the Enhanced Oil Recovery Institute. Being a strong believer in advanced technologies and

direct integration into the industry, I became interested in the Institute's research. Learning the industry with hands on training with laboratory equipment and speaking with company representatives for my research, I feel my internship has and continues to lay a strong foundation in preparing for other internships and my future career in the energy field. Associate Director, Glen Murrell states, "the EORI intern program is quite selective and we strive to provide a learning experience for our interns rather than a looking at them as a source of cheap labor. With that in mind we place preference on individuals who display initiative and enthusiasm for learning as well as the standard high levels of academic and personal development. Casey displays all of these attributes and he has contributed significantly to the Special Projects Group, and particularly the CO2 economics research that I am working on. Casey is an outstanding individual who will no doubt go on to have a highly productive career in the Energy industry."

~Amy Freye ~ Amy Freye graduated this spring from the University of Wyoming with a Bachelor of Science degree in Energy Resource Management and Development through the School of Energy Resources. Amy has been working for EORI since 2011 during which time she assisted with collecting and compiling information regarding Minnelusa and Tensleep petroleum reservoirs in Wyoming. Amy will be leaving EORI this fall to pursue a Master's degree in Geological Engineering at the South Dakota School of Mines. All of the staff at EORI sincerely appreciates all of Amy's hard work and we wish her all the best in her future endeavors.

New Faces of EORI

EORI is growing in leaps and bounds. We welcome our new staff and feel fortunate to have such a highly qualified and experienced team.

~Riturag Borghain, PhD. ~ Riturag will complete his PhD at the University of Kentucky early this summer. He has expertise regarding analytical evaluation of polymers, colloids, carbon, and oxides. He studied nano-particles as part of his PhD work. Riturag grew up in the oil producing portion of northeast India, and has oil field experience.

~Tashi Herzmark, M.S. ~ Earned his M.S. in chemistry at Colorado State University. He has experience operating a wide range of analytical instruments, and has experience with synthesis of polymer, organic, and organo-metallic materials.

Both Riturag and Tashi will report to work at the end of May, in time to participate in training related to new EORI laboratory equipment.

Save-The-Dates

Tensleep III Workshop - ROZ and CO2 EOR

July 8th & 9th, 2013 – Hilton Garden Inn - Casper WY

TriHydro Corporation Pre CO2 Conference Workshop: “Environmental Challenges Facing EORI Operators”.

Tuesday, July 9th, 2013, Hilton Garden Inn - Casper

7th Annual Wyoming CO₂ Conference

July 10th & 11th, 2013 – Casper Events Center – Casper WY

5th Wyoming IOR/EOR Conference

September 9th & 10th, 2013 – Best Western Sheridan Center – Sheridan WY