Oil & Natural Gas Technology

DOE Award No.: DE-FE0010667

Research Performance Progress Report

Quarterly Report: July 2015 to September 2015

Liquid-Rich Shale Potential of Utah's Uinta and Paradox Basins: Reservoir Characterization and Development Optimization

Project period: October 1, 2012 to September 30, 2015 (extended to September 30, 2016)

Submitted by:
Utah Geological Survey
1594 W. North Temple, Suite 3110
Salt Lake City, UT 84114
DUNS # 176871572

Principal Investigator: Michael D. Vanden Berg
michaelvandenberg@utah.gov, 801-538-5419

Prepared for:
United States Department of Energy
National Energy Technology Laboratory

Submitted: October 29, 2015

Office of Fossil Energy

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

As the project enters a one-year no-cost extension, several different research activities are still on track to help better characterize Utah's tight oil plays. Core analysis, outcrop examination, and regional mapping activities are helping to create a clearer understanding of the Uteland Butte tight oil play and several research projects on the Cane Creek shale are nearing completion. For example, geomechanical data measured on cores from both the Uteland Butte and Cane Creek are currently being analyzed by collaborators at the Energy & Geoscience Institute, University of Utah. This data will be vital in helping inform better well completion strategies and potentially improve production.

Technology transfer remains a vital tool for communicating the project results with interested stake holders. An abstract on the dolomites of the Uteland Butte was submitted to the 2016 AAPG meeting to be held in Calgary, Alberta in June 2016 and the PI continues to lead core workshops and field trips which highlight the project.

PROGRESS, RESULTS, AND DISCUSSION

Task 1.0: Project Management Plan

During the month of July 2015, the PI wrote and submitted the project's eleventh quarterly report for April to June 2015. This report was subsequently sent via email to all interested parties and posted on the UGS project website.

Task 2.0: Technology Transfer

- The UGS project website was updated with new information - http://geology.utah.gov/emp/shale_oil
- The PI completed the eleventh quarterly report and emailed it to all interested parties. The report is also available on the UGS project website.
- An abstract was submitted for the 2016 AAPG Annual Meeting to be held in Calgary, Alberta, from June 19-22, 2016. University of Alberta Master's student, Federico Rueda, submitted the paper titled *Dolomitization in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah: Implications for Petroleum Production.*
- A delegation of Chinese energy scientists toured the Utah Core Research Center on August 25, 2015. On display were Uteland Butte and Cane Creek cores and the PI gave a presentation describing the project's goals and objectives.
- The PI led a Utah Geological Association sponsored field trip in September 2015 for several geologists and geology students that included a stop to look at the Uteland Butte in outcrop and discuss this project.
- With assistance from the PI, the U.S. Geological Survey (USGS) published a new oil and gas assessment of the Uinta Basin's Uteland Butte play. USGS Fact Sheet 2015-3052 is available on the UGS project website.

Tasks 3.0 and 4.0: Data Compilation and Core-Based Geologic Analysis

Uteland Butte Member: Various projects are still underway on the Uinta Basin portion of the project. A paper by Dr. Rick Sarg and Katie Logan (M.S. student) on the eastern outcrops of the Uteland Butte is currently in preparation and is planned to be published as a UGS Special Study in the next few months. Our collaboration with USGS is ongoing. Recently, USGS researchers extensively sampled several Uteland Butte cores for detailed mineralogy and organic geochemistry analyses. Research at the University of Alberta is ongoing, including detailed thin section petrology and mineralogy focused on the dolomites of the Uteland Butte. Over the duration of the no-cost extension, the PI will work to finalize all

core descriptions, regional mapping, and facies analyses and synthesize collaborator research into a comprehensive final report.

Cane Creek Shale: Research on the Cane Creek shale in the Paradox Basin is nearly finished and the focus has shifted to preparing a comprehensive final report.

Task 5.0: Outcrop Examination and Characterization – Uinta Basin

An important collaboration was set up with Dr. Rick Sarg, prominent carbonate geologist at the Colorado School of Mines (CSM). UGS partially funded a CSM graduate student, S. Katie Logan, to research the Uteland Butte on the eastern side of the Uinta Basin. Logan measured several Wasatch-Green River-transition outcrop sections on the western flank of the Douglas Creek arch and compared them to the Anadarko Uteland Butte cores from the Natural Buttes gas field. Logan recently completed the study and defended her thesis titled *Lacustrine Lithofacies, Depositional Processes, and Diagenesis of the Uteland Butte Member, Green River Formation, Eastern Uinta Basin, Utah & Colorado.* As stated above, this study is planned to be published as a UGS Special Study in the coming months.

Task 6.0: Well Completion Optimization

Dr. John McLennan, Energy and Geoscience Institute, University of Utah, and Task 6 team leader, provided an extensive update to this portion of the project in the January-March 2015 quarterly report. Research is ongoing and will continue throughout the no-cost extension.

CONCLUSION

The project is tranistioning into a one-year no-cost extension and is projected to be finished in September 2016. Several collaborations are still underway, including research with students at the University of Utah and the University of Alberta. The PI and other UGS geologists are currently finalizing research tasks and synthesizing collaborator research into a comprehensive final report.

COST STATUS

Table 1. *Project costing profile for Budget Period 3.*

	Jul 2015		Aug 2015		Sep 2015	
	Plan	Actual	Plan	Actual	Plan	Actual
UGS-personnel	$11,027	$3,613	$11,027	$5,606	$11,027	$4,169
Travel Expenses[1]	$1,092		$1,876	$259	$961	$442
Analyses						
Miscellaneous[2]				$41		
SUBTOTALS	$12,119	$3,613	$12,903	$5,906	$11,988	$4,611
UGS OVERHEAD (34.44%)	$4,174	$1,244	$4,444	$2,034	$4,129	$1,588
SUBCONTRACTS						
EGI	$6,771		$6,771		$6,771	$6,560
Eby[3]	$2,724		$2,724	$3,010	$2,724	
CSM						$2,171
EGI - Moore						
U. of Alberta						
GRAND TOTALS	$25,788	$4,858	$26,842	$10,949	$25,612	$14,929

[1]Aug/Sep – Trip to Denver to finalize epifluorescence study
[2]Aug – Shipping samples
[3]Aug – Includes $600 in cost share

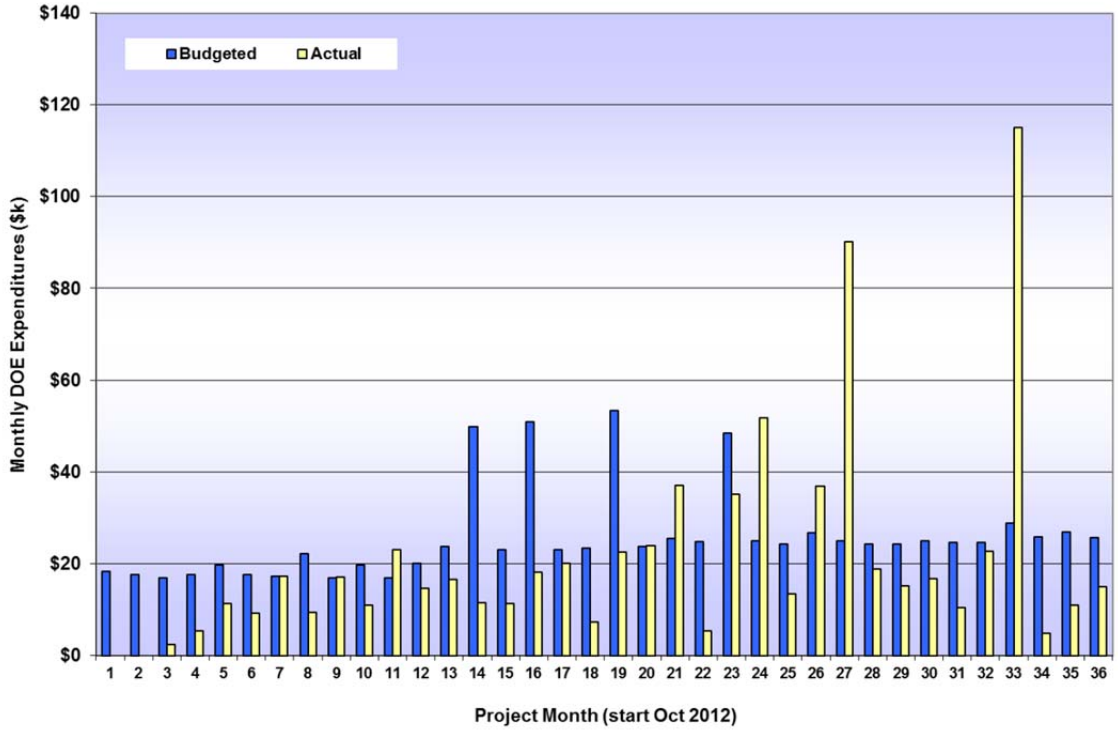

Figure 1. *Project costing profile.*

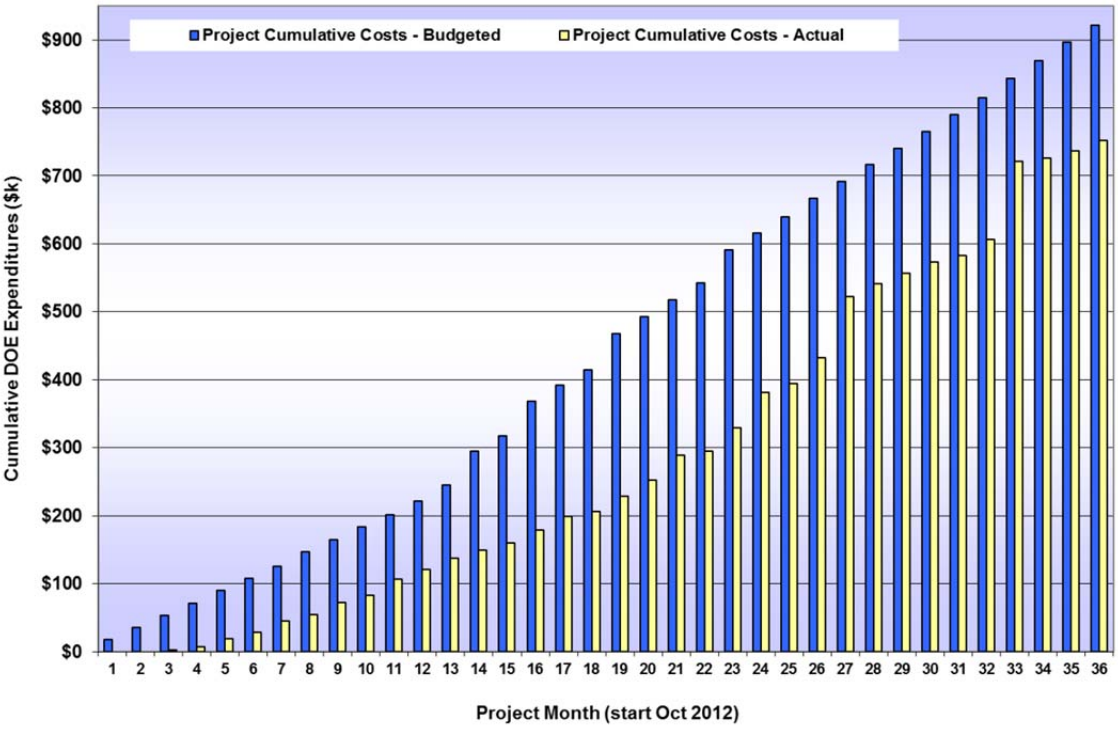

Figure 2. *Project cumulative costs.*

MILESTONE STATUS

Table 2. *Milestone log for Budget Period 3.*

	Title	Related task or subtask	Completion Date	Update/comments
Milestone 32	Quarterly updates of website	Subtask 2.1	Quarterly	Ongoing, 1-year extension
Milestone 33	Quarterly reports	Subtask 2.2	Quarterly	Ongoing, 1-year extension
Milestone 34	Profiles of mechanical stratigraphy	Subtask 6.5	31-Mar-15	Ongoing, 1-year extension
Milestone 35	Regional Correlation and Mapping	Subtask 7.1	31-Mar-15	Ongoing, 1-year extension
Milestone 36	Regional cross sections	Subtask 7.2	31-Mar-15	Ongoing, 1-year extension
Milestone 37	Sweet spot maps	Subtask 7.3	31-Mar-15	Ongoing, 1-year extension
Milestone 38	Technical presentations at National AAPG	Subtask 2.4 & 5	Apr-15	1 abstract submitted to AAPG 2016
Milestone 39	Core workshop and/or field trip	Subtask 2.7	Jul-15	Delayed until summer 2016
Milestone 40	Locating completions	Subtask 6.4	30-Sep-15	Ongoing, 1-year extension
Milestone 41	Stimulation diagnostics modeling	Subtask 6.6	30-Sep-15	Ongoing, 1-year extension
Milestone 42	Reservoir simulations/stimulation locating	Subtask 6.7	30-Sep-15	Ongoing, 1-year extension
Milestone 43	Final publications	Subtask 2.6	30-Sep-15	1-year extension
Milestone 44	Final interpretation	Task 8	30-Sep-15	1-year extension

ACCOMPLISHMENTS

- USGS published a new assessment of the Uteland Butte play using data from this study.
    - Johnson, R.C., Birdwell, J.E., Mercier, T.J., Brownfield, M.E., Charpentier, R.R., Klett, T.R., Leathers, H.M., Schenk, C.J., and Tennyson, M.E., 2015, Assessment of Undiscovered Oil and Gas Resources in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah: USGS Fact Sheet 2015-3052.

PROBLEMS OR DELAYS

Several subcontracts (EGI, TerraTek, Eby Petrography & Consulting, and University of Alberta) were significantly delayed due to new, unanticipated, and exceedingly cumbersome State of Utah contract procedures; therefore the PI requested and DOE approved a one-year no-cost extension, pushing the project end date to September 30, 2016. Sufficient project funds are available for the extension as the project is currently only at 81.6% of budget (as of September 30, 2015).

PRODUCTS AND TECHNOLOGY TRANSFER ACTIVITIES

- Project website
    - The project website has been updated with new reports and abstracts.
    - http://geology.utah.gov/emp/shale_oil
- Quarterly Report – April to June 2015

    - Completed late July and is available on the project website.
- Abstract (submitted) – 2016 AAPG Annual Meeting, Calgary, Alberta, Canada, June 19-22, 2016
    - Rueda, F. (M.S. student at the University of Alberta), Vanden Berg, M.D., and Machel, H.G. (Professor at the University of Alberta) - *Dolomitization in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah: Implications for Petroleum Production.*
    - The abstract has been uploaded to the UGS project website.
- A delegation of about 15 Chinese government energy scientists toured the Utah Core Research Center on August 25, 2015. On display were Uteland Butte and Cane Creek cores and the PI gave a presentation describing the project's goals and objectives.
- Utah Geological Association field trip – September 17-19, 2015
    - The PI led a Utah Geological Association sponsored field trip for 27 geologists and geology students that included a stop to look at the Uteland Butte in outcrop and discuss this project.
- With assistance from the PI, the USGS published a new assessment of the Uinta Basin's Uteland Butte play.
    - Johnson, R.C., Birdwell, J.E., Mercier, T.J., Brownfield, M.E., Charpentier, R.R., Klett, T.R., Leathers, H.M., Schenk, C.J., and Tennyson, M.E., 2015, Assessment of Undiscovered Oil and Gas Resources in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah: USGS Fact Sheet 2015-3052.
    - The fact sheet can be found on the UGS project website.

National Energy Technology Laboratory

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

One West Third Street, Suite 1400
Tulsa, OK 74103-3519

1450 Queen Avenue SW
Albany, OR 97321-2198

2175 University Ave. South
Suite 201
Fairbanks, AK 99709

Visit the NETL website at:
www.netl.doe.gov

Customer Service:
1-800-553-7681