Oil & Natural Gas Technology

DOE Award No.: DE-FE0010667

Research Performance Progress Report

Quarterly Report: April 2016 to June 2016

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 March 31, 2017)

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Submitted: July 29, 2016

Office of Fossil Energy

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EXECUTIVE SUMMARY

As the project progresses through its 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. The PI recently requested another 6-month no cost extension, which was approved by DOE, to give graduate students working on the project a little more time to finalize their theses. This puts the project ending date at March 31, 2017.

Technology transfer remains a vital tool for communicating the project results with interested stake holders. Two posters focusing on the Uteland Butte were presented at the AAPG meeting held in Calgary, Alberta, in June 2016, and three project-related abstracts were submitted to the AAPG Rocky Mountain and Pacific Section meeting, to be held in Las Vegas, NV, in early October 2016.

PROGRESS, RESULTS, AND DISCUSSION

Task 1.0: Project Management Plan

During the month of April 2016, the PI wrote and submitted the project's 14th quarterly report for January to March 2016. This report was subsequently sent via email to all interested parties and posted on the UGS project website. The PI also updated the Project Summary in May 2016.

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 14th quarterly report and emailed it to all interested parties. The report is also available on the UGS project website.
- Two poster presentations were given at the AAPG Annual Meeting in Calgary, Alberta, Canada, in June 2016. University of Alberta M.S. student, Federico Rueda, presented a poster titled *Dolomitization in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah: Implications for Petroleum Production*, and Colorado School of Mines M.S. student (graduated), Katie Logan, presented a poster titled *Lacustrine Lithofacies, Depositional Processes and Diagenesis of the Uteland Butte Member, Uinta Basin.*
- Three project-related abstracts were submitted to the AAPG Rocky Mountain and Pacific Section meeting, to be held in Las Vegas, NV, in early October 2016.
    - Zannoni, J. (University of Utah Ph.D. student), Tran, T. (U of U student), Vanden Berg, M.D., and McLennan, J. (U of U and EGI professor) – *Fracture Toughness and Geomechanical Analysis of the Uteland Butte and Cane Creek Tight Oil Plays in Utah.*
    - Rueda, F., Vanden Berg, M.D., and Machel, H.G. – *Origin of Petroliferous Dolomitic Beds in the Uteland Butte Member, Lower Green River Formation, Uinta Basin, Utah.*
    - Birdwell, J.E. (USGS), Vanden Berg, M.D., Johnson, R.C. (USGS), and Boehlke, A.R. (USGS) – *Geochemistry and Mineralogy of the Uteland Butte Member of the Green River Formation, Uinta Basin, Utah.*

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), with the PI as third author, on the eastern outcrops of the Uteland Butte is nearly ready for publication as a UGS Open File Report (should be finalized in August 2016). Our collaboration with USGS is ongoing. Recently, USGS researchers

extensively sampled several Uteland Butte cores for detailed mineralogy and organic geochemistry analyses (the subject of a submitted abstract for the 2016 AAPG-RMS meeting). Research at the University of Alberta is ongoing, including detailed thin section petrography and mineralogy focused on the dolomites of the Uteland Butte (also the subject of a submitted abstract for the 2016 AAPG-RMS meeting). 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 essentially 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. A publication based on her thesis is nearly ready for publication as a UGS Open-File Report.

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 October-December 2015 quarterly report. Research is ongoing and will continue throughout the no-cost extension. The Task 6 team will be making a presentation on their progress at the upcoming AAPG Rocky Mountain/Pacific Section meeting in Las Vegas, NV, in early October.

CONCLUSION

The project is half-way through the first, one-year, no-cost extension. However, the PI recently requested another 6-month extension, which was approved by DOE, to give graduate students working on the project more time to finish their theses. This puts the project ending date at March 31, 2017. The PI and other UGS geologists are currently finalizing research tasks and synthesizing collaborator research into a comprehensive final report. In addition, several project team members continue to share their results at regional and national meetings.

COST STATUS

Table 1. *Project costing profile for one-year no-cost extension.*

	Apr 2016		May 2016		Jun 2016	
	Plan	Actual	Plan	Actual	Plan	Actual
UGS-personnel		$1,812		$3,201		$10,615
Travel Expenses[1]						$1,440
Analyses						
Miscellaneous[2]		$300				
SUBTOTALS		$2,112		$3,201		$12,055
UGS OVERHEAD (34.44%)		$727		$1,103		$4,152
SUBCONTRACTS						
EGI		$5,913				$9,458
Eby[3]		$1,805				
CSM						
EGI - Moore						
U. of Alberta						
GRAND TOTALS		$10,557		$4,304		$25,664

[1]Jun – AAPG in Calgary
[2]Apr – Software maintenance
[3]Apr – Includes $360 in cost share

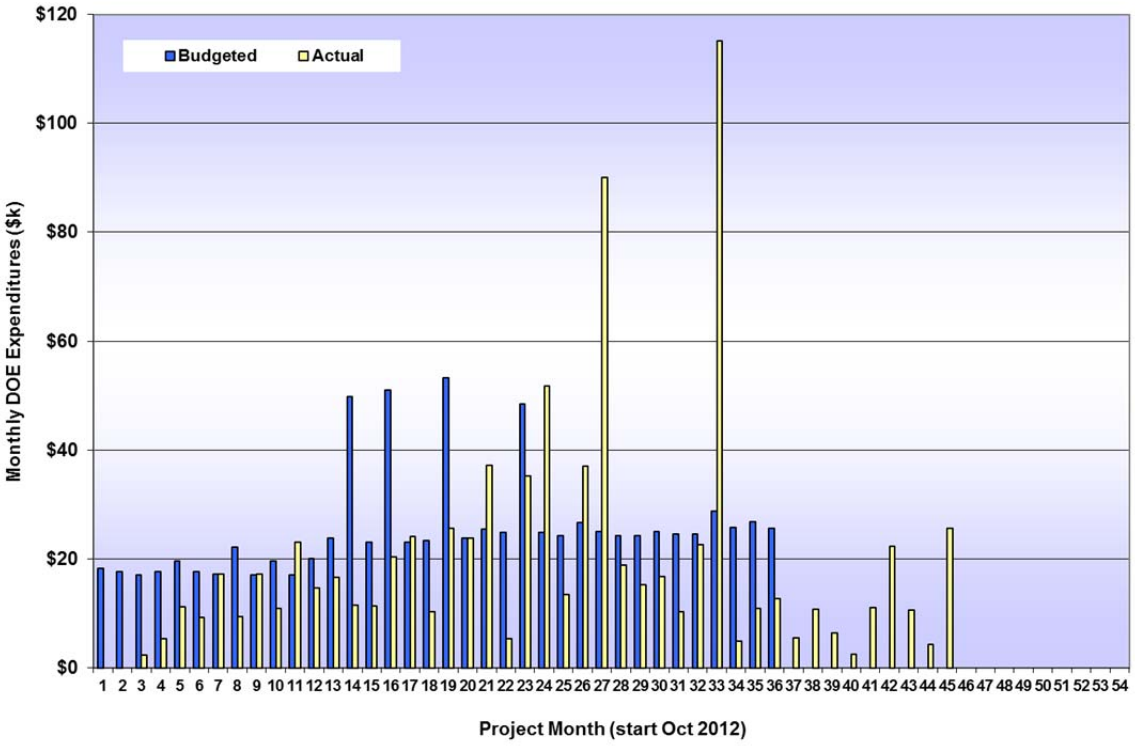

Figure 1. *Project costing profile.*

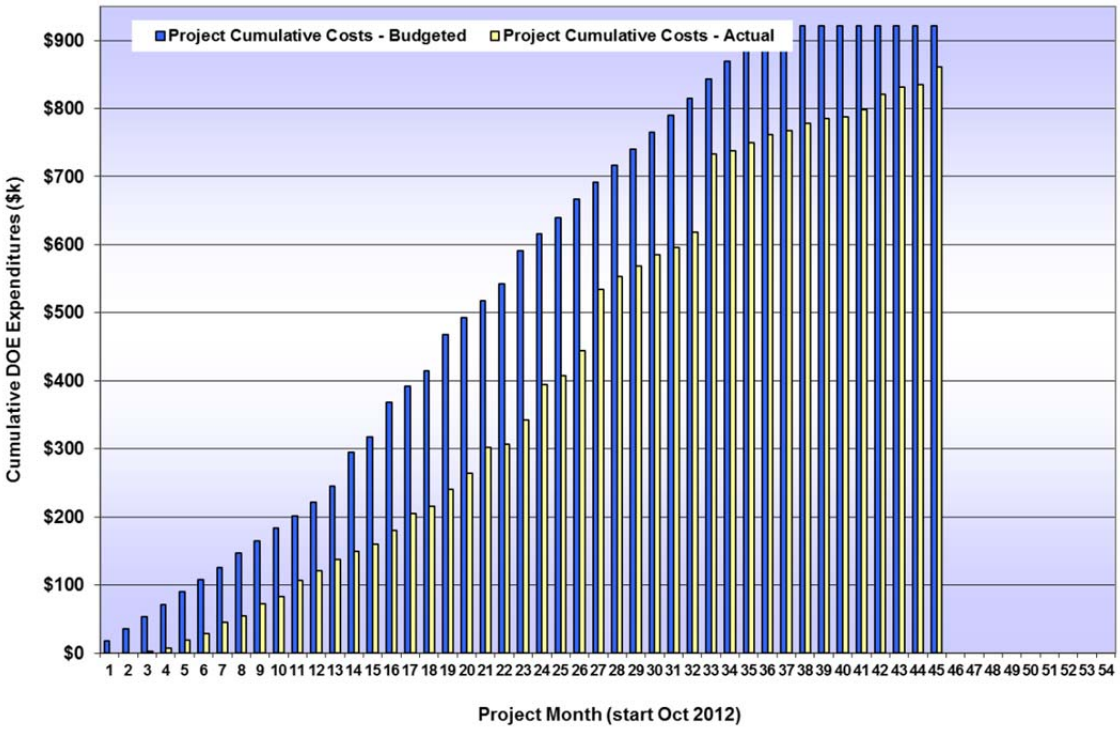

Figure 2. *Project cumulative costs.*

MILESTONE STATUS

Table 2. *Milestone log for 1.5-year no-cost extension*

	Title	Related task or subtask	Completion Date	Update/comments
Milestone 32	Quarterly updates of website	Subtask 2.1	Quarterly	Ongoing, 1.5-year extension
Milestone 33	Quarterly reports	Subtask 2.2	Quarterly	Ongoing, 1.5-year extension
Milestone 34	Profiles of mechanical stratigraphy	Subtask 6.5	31-Mar-15	Ongoing, 1.5-year extension
Milestone 35	Regional correlation and mapping	Subtask 7.1	31-Mar-15	Ongoing, 1.5-year extension
Milestone 36	Regional cross sections	Subtask 7.2	31-Mar-15	Ongoing, 1.5-year extension
Milestone 37	Sweet spot maps	Subtask 7.3	31-Mar-15	Ongoing, 1.5-year extension
Milestone 38	Technical presentations at National AAPG	Subtask 2.4 & 5	Apr-15	2 abstracts accepted at AAPG 2016
Milestone 39	Core workshop and/or field trip	Subtask 2.7	Jul-15	Delayed until fall 2016
Milestone 40	Locating completions	Subtask 6.4	30-Sep-15	Ongoing, 1.5-year extension
Milestone 41	Stimulation diagnostics modeling	Subtask 6.6	30-Sep-15	Ongoing, 1.5-year extension
Milestone 42	Reservoir simulations/stimulation locating	Subtask 6.7	30-Sep-15	Ongoing, 1.5-year extension
Milestone 43	Final publications	Subtask 2.6	30-Sep-15	1.5-year extension
Milestone 44	Final interpretation	Task 8	30-Sep-15	1.5-year extension

ACCOMPLISHMENTS

- Three major publications are currently "in press" and should be published in the next few months:
    - Logan, S.K., Sarg, J.F., and Vanden Berg, M.D., in press, Lithofacies, Deposition, Early Diagenesis, and Porosity of the Uteland Butte Member, Green River Formation, Eastern Uinta Basin, Utah and Colorado: UGS Open-File Report 652. (due out in August 2016)
    - Chidsey, T.C., and Eby, D.E., in press, Potential Oil-Prone Areas in the Cane Creek Shale Play, Paradox Basin, Utah, Identified by Epifluorescence Microscopy Techniques: UGS Special Study. (due out in fall 2016)
    - Birdwell, J., Vanden Berg, M.D., Johnson, R., Mercier, T., Boehlke, A., and Brownfield, M., in press, Geological, Geochemical, and Reservoir Characterization of the Uteland Butte Member of the Green River Formation, Uinta Basin, Utah: RMAG Source Rock Compendium. (due out fall 2016).
- Two poster presentations were made at the AAPG annual meeting in Calgary, Alberta, Canada, in June 2016. Both posters were well received and generated significant feedback (see titles below).
- Three project-related abstracts were submitted to the joint AAPG Rocky Mountain and Pacific Section meeting, to be held in Las Vegas, NV, in October 2016 (see titles below).

PROBLEMS OR DELAYS

The project is three quarters into the original one-year no-cost extension, but the PI recently requested, and DOE approved, a second no-cost extension taking the project to March 2017. This second extension is mostly to give graduate students working on the project enough time to finish and publish their research. The PI did not project expenditures for each month of the extension, but sufficient funds remain to take the project to March 2017. The project is currently 93.4% of total budget.

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 – January to March 2016
    - Completed late April and is available on the project website.
- Poster presentation – 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 poster was presented on Monday, June 20, 2016, in the Modeling of Carbonate and Evaporite Systems session.
    - The abstract has been uploaded to the UGS project website and the poster will be available soon.
- Poster presentation – AAPG Annual Meeting, Calgary, Alberta, Canada, June 19-22, 2016
    - Logan, K. (M.S. [graduated] student Colorado School of Mines) and Sarg, R. (Professor at Colorado School of Mines) – *Lacustrine Lithofacies, Depositional Processes and Diagenesis of the Uteland Butte Member, Uinta Basin.*
    - The poster was presented on Tuesday, June 21, 2016, in the Advances in Carbonate Diagenesis session.

    - The abstract has been uploaded to the UGS project website.
- Abstracts – Three project-related abstracts were submitted to the AAPG Rocky Mountain and Pacific Section meeting, to be held in Las Vegas, NV, October 2-5, 2016.
    - Zannoni, J. (University of Utah PhD student), Tran, T. (U of U student), Vanden Berg, M.D., and McLennan, J. (U of U and EGI professor) – *Fracture Toughness and Geomechanical Analysis of the Uteland Butte and Cane Creek Tight Oil Plays in Utah.*
    - Rueda, F., Vanden Berg, M.D., and Machel, H.G. – *Origin of Petroliferous Dolomitic Beds in the Uteland Butte Member, Lower Green River Formation, Uinta Basin, Utah.*
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    - All three abstracts have been posted on the UGS project website.

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