

Oil & Natural Gas Technology

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Research Performance Progress Report

Quarterly Report: April 2013 to June 2013

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



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A handwritten signature in black ink, appearing to read "Michael D. Vanden Berg".

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Office of Fossil Energy



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EXECUTIVE SUMMARY

During the past quarter, the Principal Investigator's (PI) efforts focused on preparing and presenting a poster at the 2013 American Association of Petroleum Geologists (AAPG) annual conference detailing the geology, resource potential, and current drilling activity of the Uteland Butte member of the Green River Formation (GRF). The poster included several core descriptions, a regional play map, and a regional west-east cross section. A representative Uteland Butte core was also displayed with the poster. The poster generated significant interest and stakeholders seem eager to see further progress on this project, both concerning the regional geology and the geomechanical properties of the target interval.

Additionally, research continues on the Paradox Formation's Cane Creek shale in the Paradox Basin, including further analyses of the Remington 21-1H core and the development of a formation tops database. Several raster images of geophysical logs were digitized to aid in the construction of regional stratigraphic cross sections and the collection of representative cuttings samples was started for planned geochemical analyses. Current details of the Cane Creek portion of this project will be presented at the AAPG Rocky Mountain Section meeting in Salt Lake City in September 2013.

PROGRESS, RESULTS, AND DISCUSSION

Task 1.0: Project Management Plan

During the month of April, the PI wrote and submitted the project's second quarterly report for January to March 2013. 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 second quarterly report and emailed it to all interested parties. It is also available on the project website.
- The PI presented a poster on the Uteland Butte Member of the GRF at the AAPG annual convention in Pittsburgh in May. Representative Uteland Butte core was displayed with the poster.
- An information panel, detailing the project's goals and objectives, was displayed at the UGS exhibit booth during the 2013 AAPG annual meeting in Pittsburgh.
- Two abstracts were submitted and accepted to the AAPG Rocky Mountain Section meeting, to be held in Salt Lake City in September 2013. One abstract focuses on the Cane Creek shale oil play in general, while the other focuses on the Remington 21-1H Cane Creek core (a portion of the core will be displayed with the poster).
- The PI led two field trips for petroleum companies, both of which stopped to look at Uteland Butte outcrop in Nine Mile Canyon, southeastern Uinta Basin. While looking at the outcrop, the PI presented the goals and objectives of the project.

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

Most efforts on Tasks 3 and 4 involved pulling together materials for the 2013 AAPG annual meeting poster on the Uteland Butte member of the GRF. A detailed play map was developed showing locations of active horizontal wells in the lower GRF (about 90 wells total), as well as the over 200 proposed horizontal wells (APDs) (figure 1). The map also highlights play areas of individual operators and GRF core locations (table 1). An east-west cross section through the central Uinta Basin was constructed and includes many of the wells with Uteland Butte core (cross section trace is displayed on figure 1). This section provides an across-strike regional picture of the GRF (relatively parallel to the paleo shoreline of

the ancient lake), highlighting the relative uniformity of the gamma ray signature within the Uteland Butte member across the basin. The cross section can be found on panel 2 of the AAPG poster, located on the UGS project website. A north-south cross section (trace is displayed on figure 1) is currently under construction. This section will highlight facies changes from near shore to deep lake, including the pinching out of the Uteland Butte member.

No new GRF cores were examined during this past quarter, but efforts were made to draft core logs from the several cores examined in February. These core logs, as well as several new core descriptions will be available at the close of the Budget Period 1.

In addition to research taking place on the GRF in the Uinta Basin, investigation continues on the Cane Creek shale within the Paradox Basin in southeastern Utah. The Cane Creek typically consists of three primary facies informally named from top to bottom, A, B, and C. Facies A and C commonly consist of carbonate, typically dolomite or silty dolomite with nodular anhydrite and scattered anhydrite-filled fractures. Facies B is the primary target for oil development, consisting of dolomite, dolomitic siltstone, and organic-rich shale with some open fractures. Facies B is identified on gamma ray logs with a very high gamma ray spike at the top of the facies and relatively high readings throughout the facies. Facies A and C have a highly variable gamma ray reading with numerous low readings in the anhydrite beds. Additional core is needed to confirm the gamma ray facies definition.

The facies of the Cane Creek shale were correlated in digital well logs (LAS files) and raster log images. Currently 21 wells have been digitized into LAS format (figure 2). A total of 154 wells have been correlated and the following tops picked: (1) Cane Creek top of facies A, (2) top of facies B, (3) top of facies C, and (4) base of Cane Creek base of facies C (figure 2). Several other shale zones in the Paradox Formation have been correlated, which will aid the regional mapping. The tops database will be used to construct structure contour maps of the Cane Creek and other Paradox Formation shale zones, as well as thickness maps of the three facies of the Cane Creek.

Task 6.0: Well Completion Optimization

Currently, production success in the Uteland Butte is most prevalent in the central, over-pressured portion of the Uinta Basin, where Newfield has a significant leasehold (figure 1). In areas farther to the south, east, and west, the Uteland Butte is under normal to only slight over-pressure, making economic production from such target areas more challenging. Goals for Task 6 will be to conduct a comprehensive geomechanical program on cores from normal and over-pressure areas, with the goal of unlocking the economic potential of the more normal pressured areas.

Project team members are collaborating with Newfield in testing fresh core from the Uteland Butte. New coring is anticipated at the end of July 2013. Petrophysical and mechanical properties will be determined to aid in completion decisions (landing depth, fracturing strategy, understanding vertical containment, etc.). The project will cover expenses for “scratch” testing the core in selected lithologic regimes. “Scratch” testing is a method where an indenter, under normal stress, is dragged along the external axis of a core sample or slab. The required shear force to scribe a groove on this surface is used in conjunction with the applied normal stress to infer a continuous measure of the friction angle, the unconfined compressive strength, and ideally other mechanical properties. Additional testing funded by Newfield will determine other petrophysical properties.

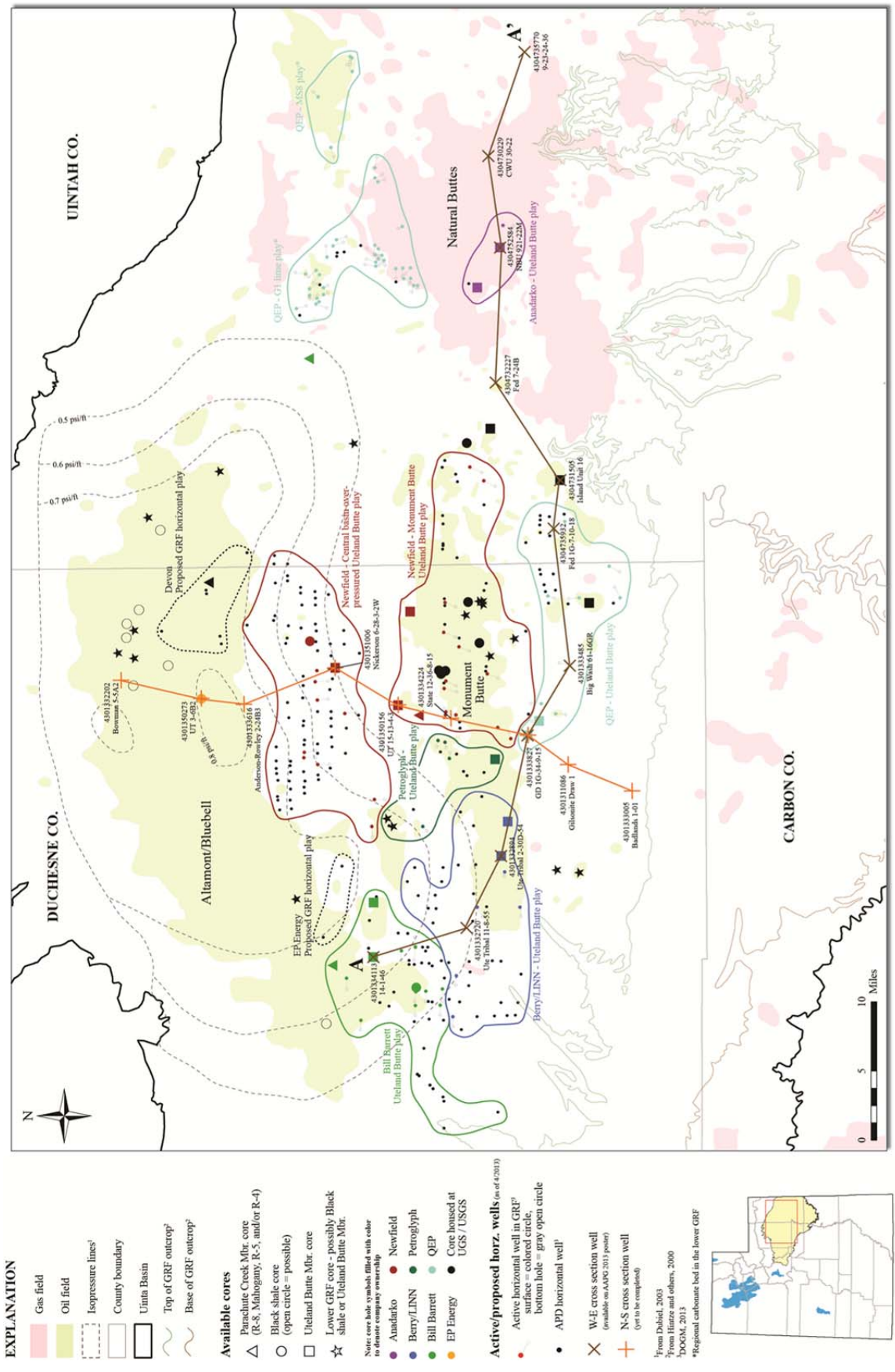


Figure 1. Map of the Uinta Basin, Utah, showing the location of available GRF cores and horizontal wells.

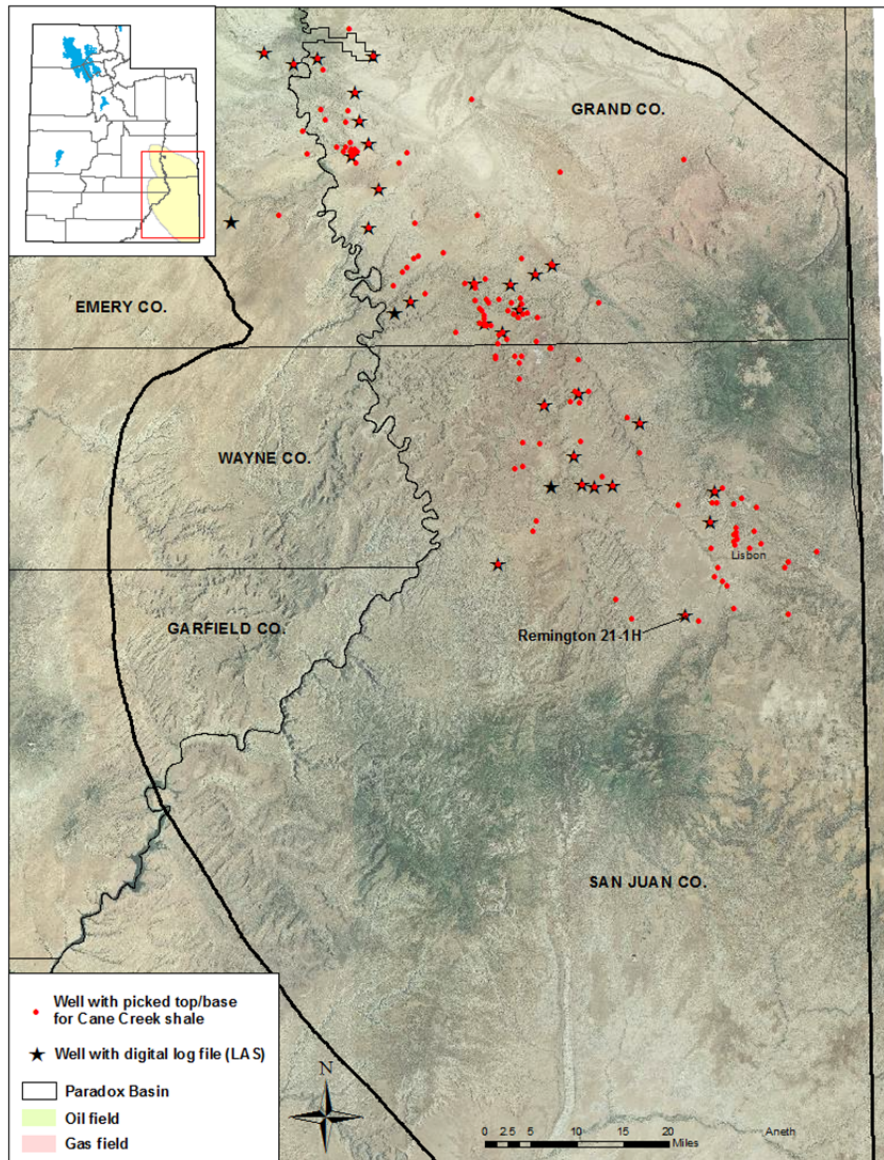


Figure 2. Map of the Paradox Basin, Utah, showing the location of wells with picked Cane Creek shale top/base and digitized log files (LAS files).

Table 1. Selected Green River Formation cores in the Uinta Basin.

API	Operator	Well Name	Twn	Rng	Sec	UTME	UTM N	Cored Footages (ft)	Member/Unit
4301350273	EP Energy	Ute Tribal 3-6B2	2S	2W	6	571573	4465363	9940-10320, 10500-10900	Black Shale
4301350623	Bill Barrett	16X-23D-36	3S	6W	23	540517	4450096	3887-3927, 4501-4637, 5115-5150	Upper R-8, Mahogany, R-5
4301350676	Bill Barrett	14-3-45	4S	5W	3	547848	4445288	7324-7386	Uteland Butte
4301334113	Bill Barrett	14-1-46	4S	6W	1	541444	4445336	6647-6670, 6672-6707	Uteland Butte
4301350351	Bill Barrett	14X-22-46	4S	6W	22	537940	4440293	5450-5633	Black Shale
4304751509	Bill Barrett	Aurora 15-8-7-20	7S	20E	8	611223	4452826	6225-6307	R-4
4301333948	Newfield	Ute Tribal 14-19-4-1W	4S	1W	19	581716	4441002	6670-6754	Uteland Butte
4301350156	Newfield	Ute Tribal 15-13-4-3	4S	3W	13	570812	4442439	6846-7138	Uteland Butte
4301350165	Newfield	Ute Tribal 8-26-4-3	4S	3W	26	569647	4440029	2724-2847	R-8 - Parachute Creek
4301351006	Newfield	Nickerson 6-28-3-2W	3S	2W	28	575149	4449737	8189-8279	Uteland Butte
4301351044	Newfield	Mullins 11-14-3-2W	3S	2W	14	578257	4452724	8168-8305	Black shale
4301332541	Berry	MT 12-27-54	5S	4W	27	557277	4429703	5632-5694	Uteland Butte
4301332894	Berry	UT 2-30D-54	5S	4W	30	553238	4430434	5785-5847	Uteland Butte
4301333827	QEP	GD 1G-34-9-15	9S	15E	34	567309	4427321	5850-5870, 5875-5883, 5892-5901	Uteland Butte
4301333833	QEP	GD 16G-35-9-15	9S	15E	35	568983	4426024	5497-5505	Uteland Butte
4304752584	Anadarko	NBU 921-22M	9S	21E	22	624184	4430569	4354-4447, 4822-4914	Uteland Butte, Black Shale
4304750536	Anadarko	NBU 921-18C4BS	9S	21E	18	619497	4433231	4490-4584, 4741-4828	Uteland Butte, Black Shale
4301334051	Petroglyph	UT 20-15	5S	3W	20	564515	4430960	~6077-6083	Uteland Butte

CONCLUSION

The focus of this quarter was primarily on completing and presenting the AAPG poster of the Uteland Butte and drafting core logs from descriptions performed in the previous quarter. The data collection part of the project continues as team members add to well databases and continue to look for additional core material to study. Discussions will continue on the direction of the geomechanics program; more definitive plans will be available later this year.

COST STATUS

Table 2. Project costing profile for Budget Period 1.

	Apr 2013		May 2013		Jun 2013	
	Plan	Actual	Plan	Actual	Plan	Actual
UGS-personnel	\$7,607	\$11,290	\$7,607	\$4,649	\$7,607	\$12,674
Travel Expenses ¹		\$1,557	\$3,834	\$2,097		
Analyses						
Miscellaneous ²	\$200			\$280		\$102
SUBTOTALS	\$7,807	\$12,847	\$11,441	\$7,026	\$7,607	\$12,776
UGS OVERHEAD (34.44%)	\$2,689	\$4,424	\$3,940	\$2,420	\$2,620	\$4,400
SUBCONTRACTS						
EGI	\$6,771	\$0	\$6,771	\$0	\$6,771	\$0
Eby						
GRAND TOTALS	\$17,266	\$17,271	\$22,152	\$9,445	\$16,997	\$17,176

¹Travel to 2013 AAPG annual meeting in Pittsburgh, PA

²May – Core shipping to Pittsburgh, exhibit booth materials, and poster lamination; June – Core shipping

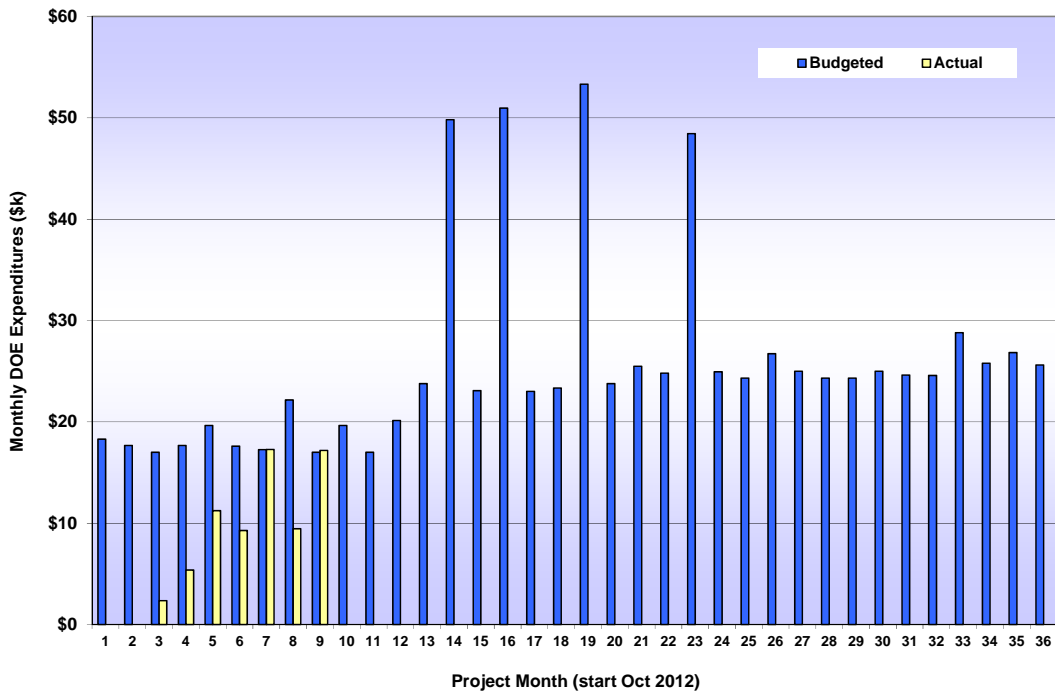


Figure 3. Project costing profile.

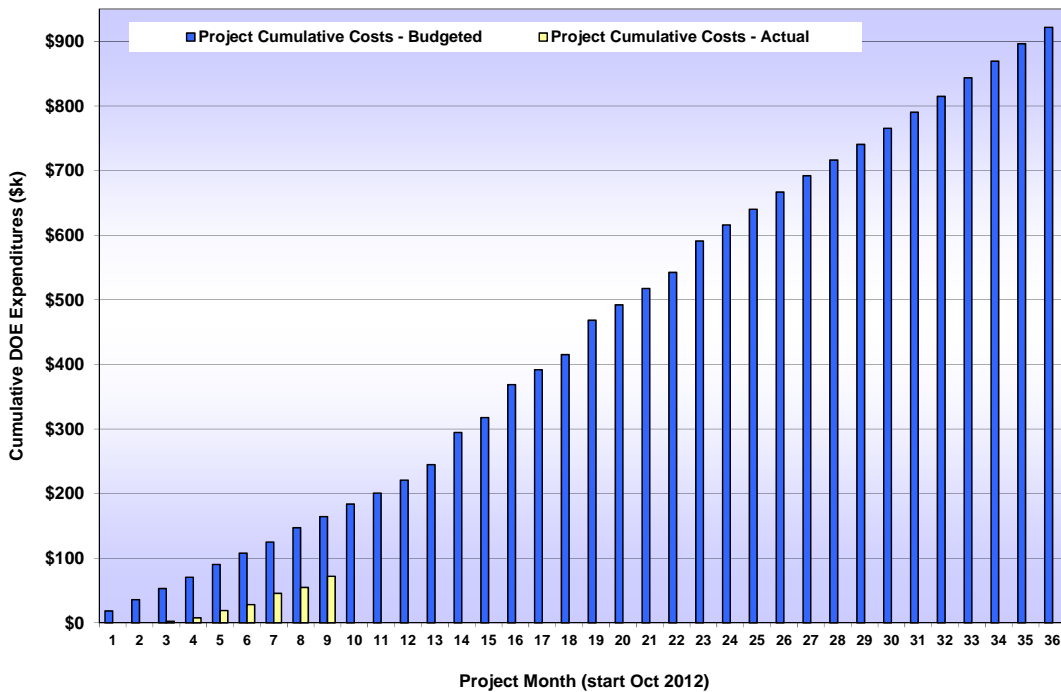


Figure 4. Project cumulative costs.

MILESTONE STATUS

Table 3. Milestone log for Budget Period 1.

	Title	Related task or subtask	Completion Date	Update/comments
Milestone 1	Project Management Plan	Task 1	12/21/2012	Completed and approved by DOE
Milestone 2	Establish project website	Subtask 2.1	12/31/2012	Website is up and running
Milestone 3	Quarterly website updates	Subtask 2.1	Quarterly	Ongoing
Milestone 4	Quarterly reports	Subtask 2.2	Quarterly	Ongoing
Milestone 5	Select bibliography	Subtask 3.1	3/31/2013	Completed
Milestone 6	Prelim. Well database – cores/cuttings info	Subtask 3.2	3/31/2013	Completed
Milestone 7	Technical presentations at National AAPG	Subtask 2.4, 2.5	5/20/2013	Poster on Uteland Butte was presented at the National AAPG in Pittsburgh (May 2013)
Milestone 8	Updated select bibliography	Subtask 3.1	9/30/2013	
Milestone 9	Final well database	Subtask 3.2	9/30/2013	
Milestone 10	Core descriptions	Subtask 4.1	9/30/2013	Six core descriptions completed
Milestone 11	First debriefing meeting	Subtask 2.3	9/2013	
Milestone 12	Technical presentations at Regional AAPG	Subtask 2.4, 2.5	9/2013	Two abstracts on Cane Creek accepted to AAPG-RMS in Salt Lake City (Sept 2013)
Milestone 13	BP 1 decision point	Task 1	9/30/2013	

ACCOMPLISHMENTS

- Presented poster on the Uteland Butte at 2013 AAPG annual meeting in Pittsburgh in May.
- Submitted two abstracts on the Cane Creek shale to the 2013 AAPG Rocky Mountain Section meeting, to be held in Salt Lake City, Utah, in September.

PROBLEMS OR DELAYS

A contract has been set up with the Energy and Geoscience Institute (EGI), University of Utah, but research will not begin until a new PhD or Masters student is found, tentatively scheduled for fall 2013. As a result, the overall project will be under-billed until research begins at EGI.

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 2013
 - Completed late April and is available on the project website.

- Poster presented at AAPG annual meeting in Pittsburgh, PA, May 19-22, 2013.
 - The PI presented a poster titled “The Uteland Butte Member of the Eocene Green River Formation: An Emerging Unconventional Carbonate Tight Oil Play in the Uinta Basin, Utah.” Representative Uteland Butte core was displayed along with the poster.
 - The poster is available on the UGS project website.
- Exhibit booth panel displayed at AAPG annual meeting.
 - A panel detailing the projects goals and objectives was displayed at the UGS exhibit booth during the 2013 AAPG annual meeting in Pittsburgh, PA. In addition, flyers containing the Project Summary were available for those interested.
- Abstracts – 2013 AAPG-RMS meeting, Salt Lake City, UT, September 22-24, 2013.
 - Two abstracts on the Cane Creek shale were submitted and accepted to the 2013 AAPG Rocky Mountain Section meeting to be held in Salt Lake City in September.
 - Abstract #1: Current understanding of the Sedimentology, Stratigraphy, and Liquid-Oil Potential of the Pennsylvanian Cane Creek Shale of the Paradox Formation, Southeastern Utah.
 - Abstract #2: Detailed Sedimentology and Stratigraphy of the Remington 21-1H Cane Creek Shale Core, Pennsylvanian Paradox Formation, Southeast Utah: Implications for Unconventional Hydrocarbon Recovery.
 - Both abstracts are available on the UGS project website.

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