The Uteland Butte Member of the Eocene Green River Formation: An Emerging Unconventional Carbonate Tight Oil Play in the Uinta Basin, Utah

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Panel 1

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ABSTRACT

The dominantly carbonate Uteland Butte Member of the lower Green River Formation has historically been a secondary oil target of wells primarily tapping shallower overlying reservoirs and deeper fluvial-lacustrine sandstone units in the western Uinta Basin, Utah. Recently, companies have targeted the relatively thin porous carbonate beds of the Uteland Butte via horizontal drilling and hydraulic fracturing.

The Uteland Butte Member records the first major transgression of Eocene Lake Uinta after the deposition of the fluvial Colton Formation. The Uteland Butte ranges in thickness from less than 60 ft to more than 200 ft and consists of limestone, dolomite, organic-rich calcareous mudstone, siltstone, and rare sandstone. The dolomite, the new horizontal drilling target, often has more than 20% porosity, but is so finely crystalline that the permeability is very low (single mD or less). Currently, low-volume conventional production occurs in the thin proximal Uteland Butte sandstone beds (Uteland Butte field) in the south-central part of the basin, and the distal carbonates in the northwestern part of the basin (Greater Monument Butte field).

Several companies have had recent success targeting the Uteland Butte with horizontal wells in both the central, normally pressured, part of the basin near Greater Monument Butte field and farther north in the overpressured zone in western Altamont field. Initial production from these wells averages 500-1500 BOE per day from horizontal legs up to 4000 ft in length. Core from the productive carbonate zone was obtained from the Bill Barrett 14-3-45 BTR well (southwestern Altamont field) and is displayed with this poster. The horizontal drilling objective, as analyzed in the core, is a 5-ft interval of fractured dolomite, with porosities between 14 and 26%, interbedded with organic-rich limestone. TOC values for the 60 ft of recovered core range between 2 and 5%, while Ro values range between 0.7 and 1.1, indicating these rocks are self-sourcing.

A refined reservoir characterization study of the Uteland Butte Member using newly acquired core, cuttings, and geophysical logs will help determine new areas within the basin having potential for unconventional oil recovery and help maximize ultimate recovery.

PROJECT GOALS

The overall goal of our three-year DOE-funded project, which commenced December 2012, is to provide reservoir-specific geological and engineering analyses of the emerging Green River Formation (GRF) tight oil plays in the Uinta Basin, Utah. Specific goals are as follows:

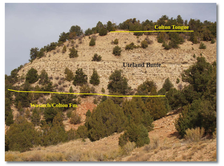
1) Characterize geologic, geochemical, and geomechanical rock properties of GRF horizontal targets by compiling data and by analyzing available cores, cuttings, and well logs.

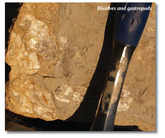
2) Describe outcrop reservoir analogs of GRF plays and compare them to subsurface data.

3) Map major regional trends for targeted intervals and identify "sweet spots" that have the greatest oil production potential.

4) Determine optimal well completion design for GRF horizontal plays (not included on this poster).

Uteland Butte Outcrop Photos from Nine Mile Canyon





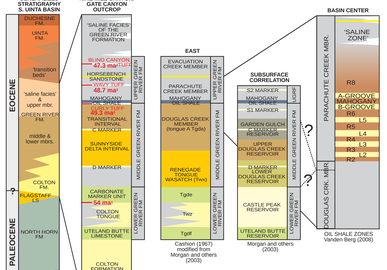
BACKGROUND

Uinta Basin Geology and Green River Formation

The Uinta Basin is a topographic and structural trough encompassing an area of more than 9300 square miles (14,900 km²) in northeast Utah. The basin is sharply asymmetric, with a steep north flank bounded by the east-west trending Uinta Mountains and a gently dipping south flank.

The Uinta Basin formed in the Late Cretaceous Maastrichtian time, creating a large area of internal drainage, which was filled by ancestral Lake Uinta during the Paleocene and Eocene. Deposition in and around Lake Uinta consisted of open- to marginal-lacustrine sediments that make up the Green River Formation (GRF). Alluvial red-bed deposits that are laterally equivalent to, and intertongue with, the GRF make up the Colton (Wasatch) Formation. The southern shore of Lake Uinta was often very broad and flat, which allowed large transgressive and regressive shifts in the shoreline in response to climatic and tectonic-induced rise and fall of the lake. The cyclic nature of the GRF deposition in the southwest Uinta Basin resulted in numerous stacked deltaic deposits. Distributary-mouth bars, distributary channels, and nearshore bars are the primary producing sandstone reservoirs in the area. Recently, companies have targeted the thinner carbonate layers, such as the Uteland Butte Member, as horizontal drilling targets.

Uinta Basin Stratigraphy



The stratigraphic nomenclature used to describe the Green River Formation in the Uinta Basin is as diverse as the rocks themselves. The nomenclature is based on facies, which are often bounded by subtle and interfingering relationships that are difficult to carry with confidence and great distance within the basin. Above are just a few of the different naming conventions from different researchers.

Conceptual map of ancient Lake Uinta, which coverd the present day Uinta and Piceance Basins, and ancient Lake Gosiute, which covered the Green River and Washakie Basins.

Uteland Butte Member

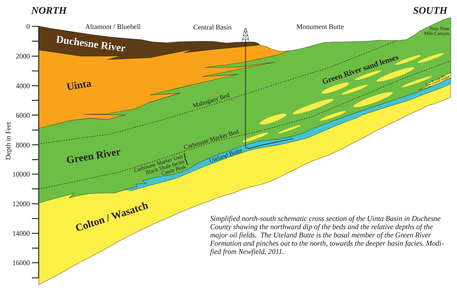
The Uteland Butte reservoir is the first major transgression of the lake after deposition of the fluvial Colton (Wasatch) Formation. The Uteland Butte ranges in thickness from less than 60 feet to more than 200 feet in the southwest Uinta Basin. The Uteland Butte is equivalent to the first lacustrine phase of Bradley (1931), black shale facies of Picard (1955), lower black shale facies of Abbott (1957), basal limestone facies of Little (1988) and Colbern and others (1985), the Uteland Butte limestone of Osmond (1992), and the basal limestone member of Crouch and others (2000).

The Uteland Butte consists of limestone, dolostone, calcareous mudstone and siltstone, and rare sandstone. Most of the limestone beds are ostracodal grain-supported or mud-supported grainstone, packstone, or wackestone. Grainstone is more common near the shallow shoreline of the lake, whereas deeper distal deposits are commonly argillaceous limestone. A cryptocrystalline, dolomitized, composited wackestone with ostracods has been found near the top of the Uteland Butte in some core. The dolomite often has more than 20 percent porosity, but is so finely crystalline that the permeability is low (single millidarcy or less).

The Uteland Butte reservoir was deposited during a rapid and extensive lake-level rise. The Uteland Butte is distinctive in the abundance of carbonate and the lack of sandstone, which could have been caused by one or both of the following situations: (1) the rapid lake-level rise caused siliciclastic sediments to be deposited in the proximal alluvial channels, or (2) the main inflow into the lake was far from the southwest Uinta Basin area, perhaps flowing into the southern arm of the lake south and west of the San Rafael uplift.

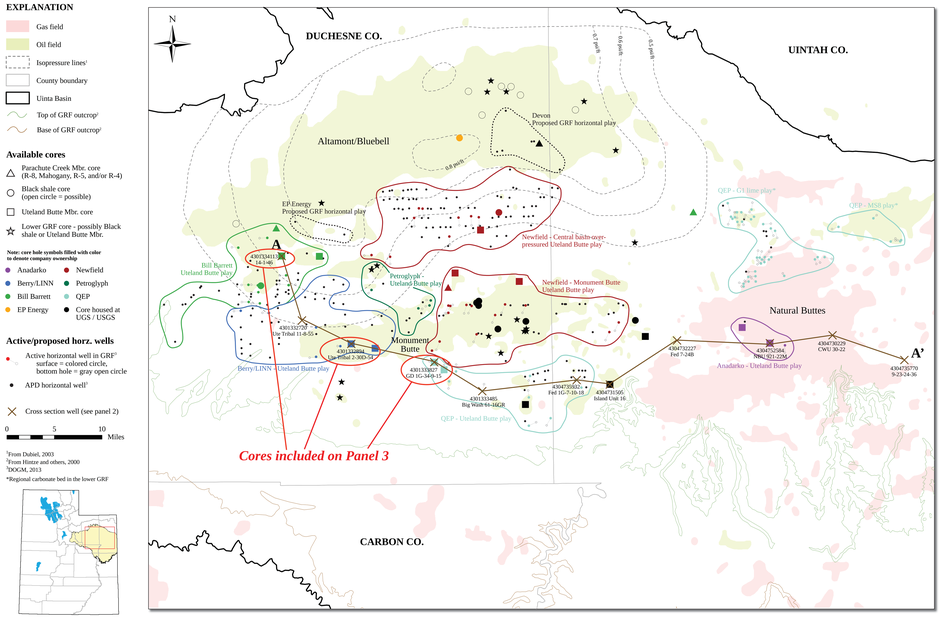
The Uteland Butte reservoir is oil productive throughout most of the southwest Uinta Basin. The Uteland Butte was a secondary objective in most vertical wells and was usually perforated along with beds in the Castle Peak, lower Douglas Creek, and upper Douglas Creek reservoirs.

The cryptocrystalline dolomitic wackestone has only recently been extensively explored. This bed, widely distributed throughout the central and southern Uinta Basin, has become a recent target for extensive horizontal drilling, with limited success in the southern part of the basin, but more success in the over-pressured central basin area.



Simplified north-south schematic cross section of the Uinta Basin in Duchesne County showing the northward dip of the beds and the relative depths of the major oil fields. The Uteland Butte is the basal member of the Green River Formation and pinches out to the north, towards the deeper basin facies. Modified from Newfield, 2011.

UTELAND BUTTE PLAY MAP



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