

# Unconventional Oil & Gas Report

Providing the E&P community with the latest information,  
data and resources for the unconventional resource industry.  
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**July Feature**  
**Lower Smackover/Brown Dense**  
Arkansas, Louisiana, Mississippi.

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Larry Prado, Editor.

## JULY FEATURE: Brown Dense

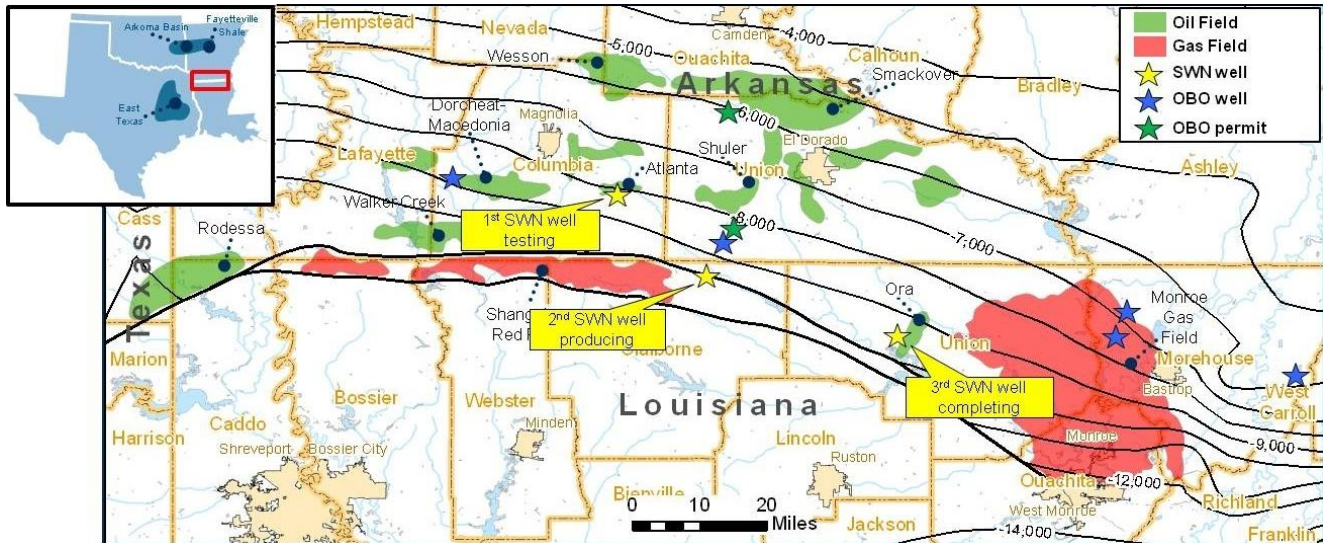
### Overview

#### The Smackover/Brown Dense Lime Source Rocks and Maturity

<http://www.swn.com/operations/pages/browndense.aspx>

The Lower Smackover Brown Dense formation is an unconventional oil reservoir found in southern Arkansas and northern Louisiana. The formation ranges in vertical depths from 8,000 to 11,000 feet and appears to be laterally extensive over a large area ranging in thickness from 300 to 550 feet.

Following is a map indicating the company's general area of interest in the play.



**Figure 1: Southwestern Energy: Brown Dense Play** ([www.swn.com/operations/pages/browndense.aspx](http://www.swn.com/operations/pages/browndense.aspx))

The Lower Smackover Brown Dense formation is an Upper Jurassic age, kerogen-rich carbonate source rock found across the Gulf Coast region of the southern United States from Texas to Florida. The company extensively reviewed the Brown Dense across the region and has indications that the right mix of reservoir depth, thickness, porosity, matrix permeability, sealing formations, thermal maturity and oil characteristics are found in the area of Southern Arkansas and Northern Louisiana. This region of Arkansas and Louisiana has produced oil and gas from the Upper Smackover since the 1920s. The Brown Dense formation is the source rock for these Upper Smackover fields. It has the critical properties necessary to be a successful play and compares favorably to other productive oil plays in the United States. However, it has never been exploited with horizontal drilling technology until now.

## A Quick Look at the Brown Dense

Justin Birmingham, November 15, 2011

<http://info.drillinginfo.com/urb/emerging-plays/operators/2011/11/a-quick-look-at-the-brown-dense-2/>

Earlier this year Southwestern Energy, SWN, announced that they have leased 460K net acres for \$150M in the emerging unconventional oil play the Lower Smackover Brown Dense formation, aka the Brown Dense. The formation runs through southern Arkansas and Northern Louisiana and is the source rock for the Upper Smackover fields which have been producing both oil and gas since the 20s. As you can see below, SWN has outlined several of the fields in the area with their first permitted well in the Atlanta field in AK.

A quick search in Drillinginfo shows that this well looks to be the Roberson 1-15H and the permit was issued August 25 in Columbia County. SWN will drill the Roberson this quarter, has plans for a second well in Claiborne Parish, LA in Q4, and expects to drill 10 more wells in 2012 in the play. A few other tidbits about the Brown Dense according to SWN:

- Upper Jurassic age, kerogen-rich carbonate
- Vert. depth 8,000 to 11,000 ft.
- Thickness 300 to 530 ft.
- SWN will be targeting high gravity oil window which are believed to be 40 to 55 deg API
- Porosity from 3% to 10%
- Anticipated pressure gradient is 0.62 psi/ft (over pressured)

Devon is also exploring the Brown Dense with a recent permit for a vertical well, the Crossett 31 No. 1. In their latest earnings conference call they mentioned having around 40,000 net acres in the area of the Brown Dense and expect to spud their first horizontal well in the play in the coming months.

## Hydrocarbon Potential of the Lower Smackover Formation in the North-Central Gulf of Mexico (Arkansas, Louisiana, and Mississippi)

**Ezat Heydari**

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<http://www.qcags2010.com/Abstract.PDFs/Abstracts/2010.heydari.pdf>

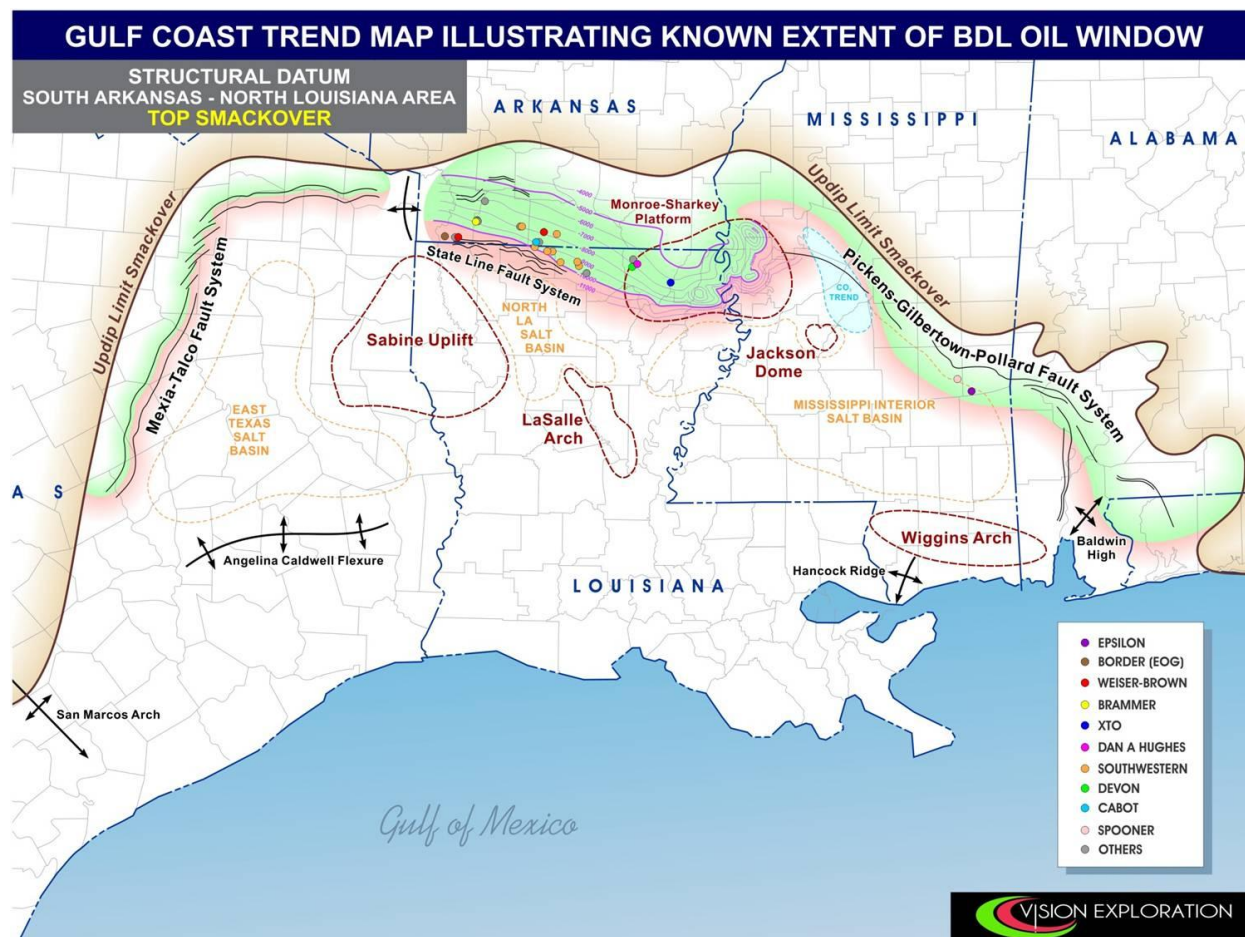
## Abstract

"The Smackover Formation has historically been viewed as having two members. The Lower Member consists of a lime mudstone that is rich in organic carbon generating oil and gas upon maturation. The Upper Member is made up of ooid grainstone with high porosity and permeability forming prolific reservoirs. Approximately, two-thirds of the over 1,200 feet maximum thickness of Smackover Formation is comprised of the Lower Member. In one of the first descriptions of the Smackover Formation, Weeks (1938) referred to the lower member as "gray to brown, dense, cryptocrystalline limestone," and perhaps the term "brown-dense member" was born. This description implied a nonporous, non-permeable unit devoid of any hydrocarbon potential. With rare exceptions, attention has been concentrated exclusively on the Upper Oolitic Member for over 70 years. Although systematic studies are still lacking, conventional core observations, sequence stratigraphic studies, and geochemical analyses indicate that the Lower Member of the Smackover Formation shows abrupt variations some of which are listed below. In places, as much as 50 feet of pure sandstones are sandwiched between laminated limestones. These sandstones were delivered into the basin during one of 3 major sea-level lowstands and could form reservoirs. In other areas, as much as 100 feet of dolomite with excellent porosity and permeability occurs in the middle of tight lime mudstone lithologies. The origin of dolomite remains unclear. The uppermost part of the Lower Member is chalky showing micro-porosity. Major variations in carbon and oxygen isotope compositions are observed in the Lower Member perhaps indicative of major fluctuations in seawater salinity in the basin. Other lithofacies variations and characteristics are possible and need detailed investigations."

## The Smackover of Alabama & Mississippi: Prolific Source Rock and Reservoir

<http://www.visionexploration.com/smackover.htm>

"Oil was first discovered in the Jurassic Smackover when a "deep" test was drilled in the shallow Smackover Field in Union County, Arkansas in 1937. With that notable discovery, the Smackover became one of the most sought-after Jurassic objectives in the Gulf Coast. The Smackover Formation does not outcrop and is only encountered in subsurface penetrations located in the U.S. Gulf Coast area.



**Figure 1: Smackover-Brown Dense (Lime) Window: Vision Exploration ([www.visionexploration.com/index.htm](http://www.visionexploration.com/index.htm))**

Within that region, the Smackover is a carbonate facies that grades laterally into an evaporitic facies in certain areas of the Mississippi Interior Salt Basin. Typically, within the Middle and Upper Smackover, reservoir porosity grades upward from algal and thrombolitic boundstones to

higher energy peloid and ooid grainstones and lateral sabkha equivalents. Some of the localized facies changes can be abrupt; for example, in Clarke County, Alabama, the upper 150 to 200 feet of the Smackover grades laterally (and abruptly) into a series of anhydrite and halite beds - resulting in the juxtaposition of a shallow-water restrictive lagoonal area with what appears to be an algal barrier reef.

Further west, localized sabkha facies grade into more "open-water" (but apparently, highly saline) oolitic grainstones in central Choctaw County, Alabama. Proximity of these upper Smackover grainstones to magnesium-rich brines associated with lateral sabkha equivalents and overlying Buckner anhydrites led to extensive dolomitization of the oolitic, peloidal, and oncolitic grainstones. The resulting oomoldic and pelmoldic dolomite is exceptionally porous but uniformly low in permeability. The low permeability results from the following diagenetic mechanism, focusing on oomoldic reservoirs only in this simplified example: (1) aragonitic ooids are deposited; (2) calcite cement precipitates within, and effectively occludes, the pore space between the ooids; (3) the aragonitic ooids are then "preferentially" leached out, leaving void spaces ("molds") where the spherical ooids once were, encapsulated in the very calcite cement that had earlier occupied all interstitial pore space - effectively leaving only the calcite cement matrix; finally, (4) the remaining calcite cement is extensively dolomitized, creating an incredibly fine matrix of oomoldic porosity.

The presence of the large ooid molds creates significantly high porosity (depending of course upon the size of the original ooids), however, the dolomitization of the once impermeable calcite cement creates what this geologist refers to as "fractal" permeability - micropermeability so uniformly fine as to create a latticework that, while "poor" by normal standards, is well-suited to the production of gas and gas liquids. However, such micropermeability is not conducive for the commercial production of oil, and most attempts to produce oil from the Upper Smackover oomoldic dolomite facies in Mississippi and Alabama have failed.

To view a prolific example of gas-condensate productive Smackover oomoldic porosity, [click here](#).

Significant opportunities still exist for the discovery and development of oomoldic gas-condensate reservoirs within the Alabama/Mississippi Smackover Trend because many explorers are unfamiliar with such reservoirs, their characteristics, and their hidden potential.

Algal patch reefs are also observed within the Upper Smackover, especially in southwest Alabama. The algal facies within both the Upper and Lower Smackover is especially noted for good porosity and very good permeability, especially when dolomitized, because dolomitization of the algal facies results in complete destruction of the original algal fabric, accentuation of the fairly common vugular porosity, and the formation of exceptionally large saddle dolomite rhombs that are striking in appearance and accompanied by good inter-rhombic permeability. A dolomitized algal facies is also common within the Lower Smackover Brown Dense Limestone in Mobile and Escambia Counties, Alabama, and Escambia County, Florida, just across the state line; this facies is a prolific gas-condensate producer in several large Smackover fields in that area.

In Little Cedar Creek Field, the principal reservoir is an intriguingly unaltered version of this facies, characterized as a leached microbial (thrombolitic) limestone framework with good porosity and permeability, and the excellent work of Drs. Ernie Mancini, Wayne Ahr, Larry Baria, Ezat Heydari, and their grad students and colleagues have further refined the understanding of this important reservoir in that area. Deposited near the top of the Smackover Formation, this microbial facies underlies a separate (unaltered) oolitic facies, which is more restricted in aerial extent and less porous and permeable than the leached thrombolitic facies. Little Cedar Creek Field production peaked at just over 200,000 BO/Month in 2010, and the field is the largest oilfield discovered in the Gulf Coast in 20 years, with an estimated 125 MMBOIP and an oil column height already documented to be in excess of 2,100 feet. Little Cedar Creek Field is also intriguing in that the Upper Smackover trap appears to lack the Buckner anhydrite topseal that is considered critically necessary for entrapment elsewhere in the Trend. The absence of the anhydrite also accounts for the rare but understandable absence of dolomitization in the oolitic ("A") and thrombolitic ("B") limestone reservoirs. It should also be noted that the low acoustic contrast of the thin "A" and "B" reservoirs makes them extremely difficult to individually map on even the best and most modern 3D seismic data. Accordingly, the use of 3D data to directly map a reservoir, typically an excellent risk-mitigating tool, is essentially ineffective in the stratigraphically-controlled Little Cedar Creek area; but it does provide an excellent understanding of the geomorphology of the greater Conecuh Embayment, the synclinal trough developed between two Appalachian compressional ridges ("arches").

Petrophysically, productive Smackover reservoirs can exhibit an amazing range of induction log resistivities, ranging anywhere from less than one ohm-meter to over 2,000 ohm-meters. Click on the following links to view two examples of productive, low-resistivity Smackover carbonate and sandstone reservoirs: for Mississippi, [the producing reservoir at East Barber Creek Field in Scott County](#) is a good example of a low-resistivity sandstone facies, while in Alabama, [the discovery well for Movico Field](#) (Mobile County) is an excellent example of a low-resistivity carbonate reservoir that flowed oil at rates exceeding 2,300 BOPD.

Because of their position at the top of the unit, and the enhanced dolomitization that accompanies proximity to the overlying Buckner Anhydrite (an obviously excellent, but not necessarily requisite, top seal), the Upper Smackover grainstones and framestones represent the most prolific and widely distributed reservoirs within the Smackover of the Gulf Coast. For example, it appears that the Upper Smackover Oil Trend of central Choctaw County, Alabama, ranks at or near the top of Gulf Coast oil trends with regard to per-well production statistics, with the average oil well having produced over 900,000 barrels from a depth interval of between 11,000 and 12,000 feet. An excellent example of the prolific nature of the Choctaw County Trend is the 400-acre North Choctaw Ridge Field, which has produced over 8.7 million barrels of oil - 6 million barrels having been produced from two 3 million-barrel wells atop this diminutive structure.

Elsewhere in the Interior Salt Basins of Mississippi and North Louisiana, it is clear that several Jurassic rivers - most notably the ancestral Mississippi River - contributed large volumes of quartz sand to the Smackover (especially the Brown Dense Limestone) during deposition. A series of fan deltas have been identified within the Smackover, of varying geometries and thicknesses. The prolific but highly overpressured Deep Smackover Gas Trend of west-central Mississippi has produced over 750 billion cubic feet of gas from one such delta complex; this trend includes that state's most prolific gas well, which has produced over 192 billion cubic feet of gas over three decades - and is still producing at significant commercial rates. The Smackover C Sand reservoir of north Louisiana is another prolific sandstone "play". Sandstone lenses deposited within the Smackover - especially the Lower Smackover Brown Dense Limestone - are readily observed on induction resistivity logs as intervals of uniformly lower resistivity within the much higher resistivity of the surrounding micritic limestone. Because of this high

resistivity contrast, to the inexperienced observer, the log profile of many productive Smackover sandstone reservoirs initially appears "wet" inasmuch as the surrounding, impermeable carbonate matrix is much more resistive than even the hydrocarbon-bearing sandstone facies.

Vision believes that considerable potential still exists for new, sizable discoveries within the overall Smackover Sand Trend, and is currently pursuing a large prospect within its perimeter. As with all carbonate trends, reservoir trapping mechanisms within the Smackover vary greatly and range from the simplest four-way (anticlinal) closure to the subtlest stratigraphic entrapment of hydrocarbons on a monoclinal ramp with no apparent structural component. Where present, the overlying Buckner Anhydrite or Haynesville shales and evaporites provide excellent barriers to vertical hydrocarbon migration. Fault juxtaposition of the Smackover against salt - either LouAnn or Haynesville/Buckner - is a proven trapping mechanism and a popular wildcat target for explorers. The juxtaposition against the older Early Jurassic LouAnn Salt occurs when the Smackover slides down a fault/salt interface on the steep flank of a salt wall or anticline, creating a three-way downthrown fault closure; an example of this trapping style would be the Chaparral Field in Wayne County, Mississippi.

Conversely, the juxtaposition of younger Haynesville/Buckner evaporites occurs when those beds are dropped down against the Smackover reservoir, creating a three-way upthrown fault closure; Buccatunna Creek Field in Choctaw County, Alabama is representative of this trapping style. Lateral facies changes combined with a structural component often create enormous Smackover traps, including the giant Jay - Big Escambia Creek Field Complex that straddles the Alabama - Florida state lines.

Algal/thrombotic patch reef Smackover traps represent another example of a combination structural / stratigraphic trapping mechanism, with development, leaching, and encasement of the reefal porosity having occurred atop topographically high paleo-structures in an otherwise non-porous (deeper water) area. A considerable portion of the deeper, gas-prone trend in southeast Mississippi has recently been imaged with 3D seismic data, resulting in a succession of several new discoveries. This part of the trend (also known as the Wayne County Trend), typified by high-relief salt structures, had escaped earlier development because of the associated steep dips, deep depths, and structural complexity.

The lower unit of the Smackover is aptly named the Brown Dense Limestone. It represents the most important source rock within the Mississippi Interior Salt Basin. This limestone is an organic-rich mudstone that was deposited as the ancestral Smackover sea transgressed across and inundated the post-Norphlet Gulf of Mexico geosyncline. Typically 200 - 300 feet thick, this brittle stylonitic limestone is remarkably uniform, with only rare developments of porosity such as the carbonate porosity that develops in limited areas of southeast Mississippi and south Alabama and the sandstone lenses that are deposited within the south-central Mississippi area (as described above). Fracturing of the Brown Dense Limestone is also common, manifested by oil and gas shows and enhanced by structural deformation and/or proximity to faulting.

The Brown Dense Limestone has been proven to be a prolific generator of oil and gas, contributing large volumes to both the Middle and Upper Smackover porosity facies as well as the underlying Norphlet Sandstone (once the Smackover porosity has been totally filled). The remaining oil and gas expelled from the Brown Dense Limestone found its way into the majority of Jurassic and Cretaceous reservoirs distributed throughout the Gulf Coast.

Beginning in 2009/2010, a number of operators in extreme South Arkansas began drilling horizontal wells through the Brown Dense Lime in an attempt to establish a new fractured oil resource play. Interest in this potentially new play remains high, and a number of companies have leased large areas of the "river counties" in extreme west central Mississippi (and extreme eastern Louisiana) with a similar intent to test the Brown Dense Lime in that area, despite the fact that in this area the Jurassic was uplifted, tilted (and in many areas, eroded) in early Tertiary time (the Monroe-Sharkey Uplift), and commonly intruded by Tertiary-age igneous dikes and sills. These "late" igneous intrusions are confined to the Monroe-Sharkey and Jackson Dome areas, and have insignificant impact upon the hydrocarbon constituency of Smackover reservoirs.

Another significant challenge for the Brown Dense Lime explorer is the risk that larger fractures within the Brown Dense extend vertically, either (1) upward, high enough to reach and establish "communication" with the overlying Middle and/or Upper Smackover porous facies (described above), or (2) downward, such that the fractures establish communication with the underlying Norphlet sandstone, if it is present. In either case, any pressure drawdown within the Brown Dense fracture system would rapidly introduce large volumes of extraneous brine, overwhelming the production of oil from the Brown Dense. It is also clear that one cannot fracture-stimulate the Brown Dense Lime in an area where such proximal brine-filled porosity exists, for the obvious reason that the frac would only exacerbate the potential for extraneous brine production.

Thus the optimal area for Brown Dense Lime exploration is an area where there is nil porosity development within the overlying Middle and/or Upper Smackover porous facies, and where the underlying Norphlet sandstone is absent. Vision takes this a step further in certain areas, preferring to target areas where the overlying Middle and/or Upper Smackover porous facies has transitioned laterally to an evaporitic facies, further thickening the topseal over the Brown Dense. However, even in such areas the Norphlet may be present. Thus the explorer needs to have a detailed understanding of not just the regional Smackover facies distribution, but also the aerial extent of the Norphlet sandstone.

Like the other "oily" resource plays, *storage* is the key. In other words, the microfracturing created as a consequence of the source rock *in-situ* hydrocarbon generation is, in and of itself, not sufficient to provide for the production of oil from the Brown Dense Lime in commercial quantities. There must be additional matrix porosity and permeability present to provide storage (volume); this additional reservoir volume can consist of enhanced fracturing caused by stress (drape over a paleo-structure), or the presence of localized siliciclastics. Because the west central Mississippi area is an area where the Brown Dense Limestone is encountered at a relatively shallow depth, and where sandstones are commonly encountered within the Brown Dense Limestone (an optimal sourcing/entrapment scenario), it would appear that this area represents a potential Bakken-type analog (a siliciclastic lens (*the primary storage tank*) deposited within a prolific source rock). However, many sand lenses in the updip area are low in porosity and permeability, which presents a challenge for those who would pursue the oil play (which requires, for commercial production rates, much better porosity and permeability than the gas play). Vision has focused its exploration efforts instead within the condensate "window", which is moderate in depth (12,000' to 15,000') and rich in BTU content. The presence of hematite and other iron constituents within the sandstone lenses of the Brown Dense Limestone aids in "scrubbing" a substantial amount of



hydrogen sulfide from those reservoirs, and in certain areas of great interest to us, it is clear that certain clay constituents also preserved above-average porosity and permeability by preventing the subsequent formation of diagenetic quartz overgrowths. Thus there are some areas within the trend where *above average* porosity and permeability harbors exceedingly rich (1,200 BTU) gas and condensate at moderate depths, with nil hydrogen sulfide and very little carbon dioxide. Given the modest lease bonus and royalty terms of the area, and the potentially rich liquids yield, this play makes good economic sense even at \$3/MMBTU gas.

The Smackover thickens into the center of the Mississippi Interior Salt Basin, but many geologists mistake the thick Jurassic carbonates of that area to consist entirely of "Smackover" Limestone, when the carbonate section actually consists of a fairly uniform Smackover equivalent section that rarely exceeds 500 feet, topped by an additional Haynesville/Buckner carbonate section that can exceed 1000 feet in total thickness. It is interesting to note that in western Alabama, the total isopachous thickness of the combined Top Haynesville - Top Norphlet section is approximately 2,000 feet, consisting of approximately 500 feet of Smackover carbonate and 1500 feet of Haynesville/Buckner evaporites; but, moving west into the western Jasper County area of Mississippi, the same combined Top Haynesville - Top Norphlet section is still approximately 2,000 feet, but now appears to consist of approximately 1500 feet of "Smackover" carbonate and 500 feet of Haynesville/Buckner evaporites. In actuality, lateral facies changes have simply caused the lower 1000 feet of Haynesville/Buckner evaporites to transition into 1000 feet of limestone and dolomite that is indistinguishable (to most geologists) from the underlying, "true" Smackover carbonate. Where this becomes important is the observation that the critical structural movement (timing) "window" for Smackover trapping has been well documented in Alabama to have occurred during early Haynesville / late Buckner time - i.e., relatively soon after Upper Smackover deposition. In other words, critical structural timing and hydrocarbon entrapment is closely associated with an isopachous interval approximately 600 - 800 feet above the base of the Smackover (i.e., top of the Norphlet).

Conversely, later structural growth, located some "distance" (stratigraphic time) above that critical early Haynesville / late Buckner migration "window", has been proven in most circumstances to have occurred too late to have trapped hydrocarbons in the underlying Smackover reservoir. It is clear, therefore, that this observation becomes critical as one moves west from Alabama into Mississippi. Recall that the apparent top of the "Smackover" there appears to be 1,500 feet above the base of the Smackover (when actually, this is the top of a Haynesville carbonate that is laterally an evaporite facies in Alabama). Structural growth at that isopachous level - 1,500 feet above the base of the Smackover - might be observed and appear to be favorable for hydrocarbon entrapment in the Smackover, but - as demonstrated definitively across the state line in Alabama - the growth history actually occurred too late for favorable entrapment of hydrocarbons in the real Smackover "equivalent", fully 1,000 feet below the so-called "top Smackover".

Fields in Jasper County such as Vossburg and Lake Utopia bear testimony to this observation: most of the oil and gas produced from these fields comes from the "Lower Smackover", while relatively little production has come from the "Upper Smackover", much higher in the section - and which actually represents the local (Mississippi) equivalent of its mid-Haynesville evaporitic facies in Alabama.

Since the Haynesville carbonates rarely produce commercial quantities of oil or gas, it is important to recognize just what the local carbonate facies really represents - and to risk one's exploration targets accordingly. Vision Exploration cites this observation as an example of how experience and familiarity with a given trend - in this case, Vision's 30-year record of experience in Smackover exploration - can aid newcomers to the area and help one to avoid the geologic pitfalls that are not readily apparent upon first inspection of a prospect or proposed drilling venture.

As evidenced by Little Creek Field, considerable potential remains for the discovery and development of significant Smackover oil and gas fields across the Mississippi / Alabama / Louisiana area. For example, the Grayson Field, discovered in the early 1990's near Magnolia, Arkansas, is a rather small Smackover structure that is projected to produce in excess of 16 million barrels of oil; however, the Grayson Field structure - a simple anticlinal closure, with a stratigraphic porosity pinchout on its west flank - escaped detection for decades after the surrounding area had been heavily explored, developed, and written off as having no future for any additional significant oil or gas discoveries. [Click here](#) to view the log for the discovery well for Grayson Field, which also happens to represent another excellent example of low-resistivity oil pay in the greater Smackover Trend. "

## Smackover's 'Brown Dense' to Get Tested

[www.aapg.org/explorer/2011/10oct/brown\\_dense1011.cfm](http://www.aapg.org/explorer/2011/10oct/brown_dense1011.cfm)

The highly publicized Haynesville shale gas play, which is concentrated principally in northwest Louisiana, may soon be overshadowed by a whole new unconventional play. This one's the hydrocarbon flavor du jour - oil.

It's the Brown Dense lime, which is the lower section of the Upper Jurassic Smackover formation, a thick carbonate that immediately underlies the Haynesville in the region. Geographically, the fledgling play is concentrated in southern Arkansas, parts of northern Louisiana and the river counties in extreme west-central Mississippi and extreme eastern Louisiana.

The Smackover formation per se has been drilled extensively since oil was first discovered in a test well drilled in the shallow Smackover Field in Union County, Arkansas, in 1937. It rapidly became the darling of Gulf Coast operators, and over the years numerous wells have successfully completed in the higher sections of the formation, in both carbonate and sandstone facies. In most areas, the Lower Smackover lacks the reservoir qualities to produce commercially via conventional technologies, according to AAPG member Steve Walkinshaw, president of Madison, Miss.-based Vision Exploration LLC.

It may be a tough nut to crack production-wise, but it's loaded with hydrocarbons. "The lower unit of the Smackover is aptly named the Brown Dense," Walkinshaw said, "and it's the most prolific source rock in the Gulf Coast." AAPG member Randy Ponder, vice president of New Ventures at Southwestern Energy Company in Houston concurs.

"The organic-rich Brown Dense zone extends from Mexico to the Florida panhandle and on to offshore Florida, extending into the offshore of the Gulf of Mexico basin, where it's the source rock for some of the fields on the GOM shelf as well as many of the deepwater fields," Ponder said. "It truly is the most prolific source rock in the Gulf Coast."

In essence, limestone is a bit of a misnomer for the zone. "In most areas, it's an organic-rich mudstone, a very muddy carbonate," Walkinshaw said. "The brittle micritic limestone is remarkably uniform, with only rare developments of significant porosity. In many areas it's fractured," he added, "and wells drilled there typically encounter a lot of good oil and gas shows."

### Entering the Play

The Brown Dense has fed significant volumes of hydrocarbons to other reservoirs, but it has never been exploited with horizontal drilling technology – until now. That's changing somewhat quickly, as some laterals already have been drilled into it by a handful of smaller companies. However, a completion indicative of commercial potential has remained elusive. Enter Southwestern, which is poised to determine if this can be realized.

The company has accumulated 460,000 net acres prospective for oil in the Brown Dense along the Arkansas-Louisiana state line. It has invested \$150 million in undeveloped acreage where the Brown Dense is 300-550 feet thick at 8,000-11,000 feet in depth over a considerable area.

"We extensively reviewed the Brown Dense across the region and have indications that the right mix of reservoir depth, thickness, porosity, matrix permeability, sealing formations, thermal maturity and oil characteristics are found in the area of southern Arkansas and northern Louisiana," Ponder emphasized.

He mentioned also that the principal differences between the Brown Dense in Louisiana-Arkansas compared to Mississippi are hydrocarbon type and depth, which is greater in Mississippi. Ponder noted that Southwestern received the permit approval for its first horizontal well August 23. The well is planned to spud late in the third quarter of 2011 with a scheduled TVD of 8,950 feet, including a 3,500-foot lateral. It will be drilled east of the Dorcheat-Macedonia oilfield in Columbia County, Arkansas. This is the field where Brammer Engineering drilled and completed a well in the Brown Dense in 2010. The well reportedly produced a paltry 49 bopd and 137 mcf of natural gas for a time and was shut-in. It also was reported that the well encountered 2 percent H<sub>2</sub>S in the gas; this impacts profitability of a well, because it must be removed. However, as with any yet unproven play, mum's the word for the most part relative to critical information the already-drilled wells have revealed to the operators.

Southwestern plans to drill a second horizontal well in the play this year in Claiborne Parish, Louisiana. It is scheduled to have a 6,000-foot lateral and a TVD of 10,700 feet. Eight more wells are planned for 2012.

### Increasing Activity

Unconventional Barnett shale play kingpin Devon Energy announced early in August it's hopping into the Brown Dense action, with its first horizontal well scheduled for September. The company holds about 40,000 net acres prospective in the play. The drill site for the initial well is in Morehouse Parish, Louisiana, and proposed TD is 9,000 feet. Vision Exploration has opted to focus its efforts in the Brown Dense condensate window, which ranges in depth from 12,000 to 15,000 feet in Mississippi and is rich in Btu content. Walkinshaw noted that commercial production of gas and condensate doesn't require the advanced levels of porosity and permeability as oil production.

His take on the Brown Dense is that like other oily resource plays, storage is key – and microfracturing created in the source rock via in-situ hydrocarbon generation is insufficient for oil production in commercial volumes at current prices and technology. He emphasized the need for additional matrix porosity and permeability, e.g., interbedded sandstone facies, to provide ancillary storage.

In the areas that appeal to Vision, certain clay constituents preserved above-average porosity and permeability by preventing the subsequent formation of diagenetic quartz overgrowths. Walkinshaw said such reservoirs can contain excessively rich gas and condensate at moderate depths with essentially no hydrogen sulfide and little carbon dioxide. He theorizes the occurrence of hematite and other iron constituents within the sandstone lenses of the Brown Dense served to "scrub" a significant amount of hydrogen sulfide from those reservoirs as soon as they were charged.

Walkinshaw emphasized the modest lease bonus and royalty terms of the area, along with the potentially rich liquids yield, enable the play to make good economic sense, even at \$4 per MMBtu gas. Still, resource plays are resource plays, with all of the baggage that entails. "Economics ultimately will drive the success of this play," Ponder said. "As with all resource plays at this stage, we have very little data to help us model the performance."

"Only drilling will tell us," he emphasized. Ponder said they noticed that leasing activity picked up following Southwestern's announcement July 28 about entering the play. "It's obvious from broker activity observed in the local courthouses," he commented, "that other people are getting into the play."

## Energy Industry Looks to Northeast Louisiana

<http://dnr.louisiana.gov/index.cfm?md=newsroom&tmp=detail&id=900>

*Recent and prospective leasing activity spreads potential Brown Dense/Lower Smackover footprint east into new frontier*

November 16, 2011

**"BATON ROUGE –** Today, Louisiana Department of Natural Resources (DNR) Secretary Scott Angelle said that interest in mineral leasing has made a relatively sudden surge in Northeast Louisiana, centered on East Carroll Parish – an area that has struggled for decades with high poverty rates and difficulty in attracting new business and industry.

In the wake of this summer's announcement of the new energy exploration interest area referred to as the "Brown Dense" or the "Lower Smackover," spanning portions of north Louisiana and southern Arkansas, the mineral rights for more than 6,000 acres of state-owned land

was leased in early October in south-central East Carroll Parish, netting more than \$1.8 million in lease bonuses. Two bidders were competing for the leasing rights, and the per-acre price of more than \$300 was on level with some of the stronger lease bonus offers anywhere else in the state, excepting only the Haynesville Shale area of northwest Louisiana.

Recently, private interests have nominated an additional 3,000-plus acres of state-owned water bottoms centering on the southwest quarter of East Carroll Parish for bid in the December state mineral lease sale. The area nominated encompasses almost all of the state-owned water bottoms in that area of the parish – and also touches on neighboring areas of West Carroll Parish and Richland Parish, as well as the eastern border of East Carroll. East Carroll Parish Clerk of Court staff report that private mineral lease transfers have accelerated to rate unprecedented in the parish in recent years.

The Brown Dense/Lower Smackover prospect is believed to be a layer of limestone at the base of the Smackover Formation – which itself is a well-known formation that has long been a source for traditionally produced oil and natural gas in North Louisiana.

“A lot of work remains in permitting, testing and drilling before anyone can estimate how successful this play will be or how much will be invested there,” Angelle said. “However, the level of interest brings the potential for new economic activity, both in jobs and companies directly tied to exploration and in possible new spending creating business and job opportunities in an area that has battled one of the highest poverty rates in the nation for decades.”

East Carroll Parish has hosted relatively little energy exploration in its history, with only about 125 wells ever drilled for oil or natural gas. Louisiana Office of Conservation records show that the last 30-plus wells drilled there since 1981 were all dry holes.

Initial development of the Brown Dense formation has begun further to the west, with Southwestern Energy having received a permit for a Brown Dense/Lower Smackover well in Claiborne Parish, even as Devon Energy converted a Morehouse Parish well originally permitted as a traditional vertical well to a horizontally drilled well – the kind expected to be needed to effectively tap the Brown Dense/Lower Smackover.

The Devon well was the first permitted in Morehouse Parish in three years, and has been quickly followed by the permitting of two more targeting the lower portion of the Smackover – including one by ExxonMobil subsidiary XTO Energy. In Claiborne Parish, three other wells have joined Southwestern’s prospect in being permitted for deep portions of the Smackover, with drilling having already begun on one of them.

“When the Haynesville Shale boom came to northwest Louisiana, it made an incredible positive economic impact on an area that already had a strong economy,” Angelle said. “Responsible exploration of this new prospect, even if it does not reach the same fever pitch, could mean a welcome strengthening of the northeast Louisiana economy and greater opportunities for businesses and jobs.”

## Online Resources

### Websites

American Association of Petroleum Geologists	<a href="http://www.aapg.org/explorer/2011/10oct/brown_dense1011.cfm">http://www.aapg.org/explorer/2011/10oct/brown_dense1011.cfm</a>
Arkansas Geological Survey	<a href="http://www.geology.ar.gov/home/index.htm">http://www.geology.ar.gov/home/index.htm</a>
Smackover/Brown Dense	<a href="http://smackoverbrowndense.com/">http://smackoverbrowndense.com/</a>
State of Arkansas	<a href="http://portal.arkansas.gov/Pages/default.aspx">http://portal.arkansas.gov/Pages/default.aspx</a>
Geological Survey	<a href="http://www.geology.ar.gov/home/index.htm">http://www.geology.ar.gov/home/index.htm</a>
Geological Commission	<a href="http://www.state.ar.us/agc/agc.htm">www.state.ar.us/agc/agc.htm</a>
Oil and Gas Commission	<a href="http://www.aogc.state.ar.us/">http://www.aogc.state.ar.us/</a>
State of Louisiana	<a href="http://louisiana.gov/">http://louisiana.gov/</a>
Louisiana Geological Survey	<a href="http://www.lgs.lsu.edu/">http://www.lgs.lsu.edu/</a>
Louisiana State University	<a href="http://uiswcmsweb.prod.lsu.edu/geol/">http://uiswcmsweb.prod.lsu.edu/geol/</a>
Department of Natural Resources	<a href="http://dnr.louisiana.gov/">http://dnr.louisiana.gov/</a>
State of Mississippi	<a href="http://www.new.ms.gov/Pages/PortalHome.aspx">http://www.new.ms.gov/Pages/PortalHome.aspx</a>
Department of Environmental Quality	<a href="http://www.deq.state.ms.us/mdeq.nsf/page/geology_home">http://www.deq.state.ms.us/mdeq.nsf/page/geology_home</a>
Oil and Gas Board	<a href="http://www.oqb.state.ms.us/">http://www.oqb.state.ms.us/</a>
US Oil & Gas Association	
Mississippi/Alabama Division	<a href="http://www.usoga.com/">http://www.usoga.com/</a>
Louisiana Oil & Gas Association	<a href="http://loga.la/index.html">http://loga.la/index.html</a>
Vision Exploration LLC	<a href="http://www.visionexploration.com/smackover.htm">http://www.visionexploration.com/smackover.htm</a>
Oil & Shale Gas Discovery News	<a href="http://oilshalegas.com/smackoverbrowndense.html">http://oilshalegas.com/smackoverbrowndense.html</a>
Go Haynesville Shale	<a href="http://www.qohaynesvilleshale.com/group/brown-dense-lower-smackover">http://www.qohaynesvilleshale.com/group/brown-dense-lower-smackover</a>

### News

Eldorado News-Times Online	<a href="http://www.eldoradonews.com/">http://www.eldoradonews.com/</a>
The Magnolia Reporter.com	<a href="http://www.magnoliareporter.co/">http://www.magnoliareporter.co/</a>
Shreveport Times	<a href="http://www.shreveporttimes.com/">http://www.shreveporttimes.com/</a>
The Advocate	<a href="http://theadvocate.com/">http://theadvocate.com/</a>
Arkansas Business	<a href="http://www.arkansasbusiness.com/">www.arkansasbusiness.com/</a>



## Selected Operators

AIX Energy, Inc.	<a href="http://www.liveoakenergy.com/home.html">http://www.liveoakenergy.com/home.html</a>
Cabot Oil & Gas	<a href="http://www.cabotog.com/">http://www.cabotog.com/</a>
Dan A. Hughes Co.	<a href="http://danahughescompany.bzzp.net/index.html">http://danahughescompany.bzzp.net/index.html</a>
Devon Energy Corp.	<a href="http://www.dvn.com/">http://www.dvn.com/</a>
Southwestern Energy, Co.	<a href="http://www.swn.com/Pages/default.aspx">http://www.swn.com/Pages/default.aspx</a>
Vision Exploration	<a href="http://www.visionexploration.com/">http://www.visionexploration.com/</a>
Weiser-Brown Operating Co.	<a href="http://www.weiser-brown.com/">http://www.weiser-brown.com/</a>

## Selected Active Operators

<b>Cabot Oil &amp; Gas Corp.</b>	<a href="http://www.cabotog.com/">http://www.cabotog.com/</a>
Annual Report	<a href="http://www.cabotog.com/annual_reports.html">http://www.cabotog.com/annual_reports.html</a>
Events and presentations	<a href="http://www.cabotog.com/presentations.html">http://www.cabotog.com/presentations.html</a>
<b>Devon Energy Corp.</b>	<a href="http://www.dvn.com">http://www.dvn.com</a>
Annual Report	<a href="http://www.dvn.com/Newsroom/Pages/media_resources.aspx">http://www.dvn.com/Newsroom/Pages/media_resources.aspx</a>
Events and presentations	<a href="http://www.dvn.com/global/SearchResults/Pages/SearchResults.aspx?k=presentations">http://www.dvn.com/global/SearchResults/Pages/SearchResults.aspx?k=presentations</a>
<b>Southwestern Energy Co.</b>	<a href="http://www.swn.com/Pages/default.aspx">http://www.swn.com/Pages/default.aspx</a>
Annual Report:	<a href="http://www.swn.com/investors/pages/annualreports.aspx">http://www.swn.com/investors/pages/annualreports.aspx</a>
Events and presentations:	<a href="http://www.swn.com/investors/pages/eventspresentations.aspx">http://www.swn.com/investors/pages/eventspresentations.aspx</a>
<b>Vision Exploration LLC</b>	<a href="http://www.visionexploration.com/">http://www.visionexploration.com/</a>
Contact	<a href="http://www.visionexploration.com/contact_us.htm">http://www.visionexploration.com/contact_us.htm</a>
Presentations	<a href="http://www.visionexploration.com/presentations.htm">http://www.visionexploration.com/presentations.htm</a>

## U.S., State Government Sites

<b>Arkansas Geological Survey</b>	<a href="http://www.geology.ar.gov/home/index.htm">http://www.geology.ar.gov/home/index.htm</a>
	<a href="http://www.geology.ar.gov/maps_pdf/fossilfuels/SmackOver.pdf">www.geology.ar.gov/maps_pdf/fossilfuels/SmackOver.pdf</a>
<b>Louisiana Geological Survey</b>	<a href="http://www.lgs.lsu.edu/">www.lgs.lsu.edu/</a>
<b>Louisiana Dept. of Natural Resources</b>	<a href="http://dnr.louisiana.gov/">http://dnr.louisiana.gov/</a>
<b>Mississippi Oil and Gas Board</b>	<a href="http://www.oqb.state.ms.us">www.oqb.state.ms.us</a>

## Hart Energy A-D Center Transactions

### A-D Center Transactions (www.a-dcenter.com)

Seller	State	County/Parish	Acreage gross	Acreage net	Comments
Black Stone Minerals Co.	Ark., Miss.	Miller, Lafayette, Columbia (Ark.)  Union, Clarke, Jasper (Miss.)	130,000	97,000	Black Stone Minerals Co. is offering 26,000 net acres in the Smackover/Brown Dense play in Miller, Lafayette, Columbia and Union counties in Arkansas. Additionally, it has 130,000 gross (97,000 net) acres in Clarke and Jasper counties, Mississippi, on trend with the Smackover/Brown Dense. Contact Jane Pereski, 713-445-3288.
Samson Resources Co. (The Oil & Gas Asset Clearinghouse)	Ark.	Lafayette	N/A	N/A	Samson Resources Co. has retained The Oil & Gas Asset Clearinghouse's mid-value transaction unit to sell its operated 80.9% working interest (69.3% net revenue interest) in the Midway Field unit, Lafayette County, Arkansas. Gross production is 319 barrels of oil per day (221 net) from Smackover. Net operating income per month is \$88,000.
Avro Energy Inc. (buyer)	Ark., La.	N/A	N/A	N/A	Avro Energy Inc., Vivian, La., (OTCBB: AVOE) plans to acquire 11 producing oil wells in southern Arkansas from an undisclosed seller for \$385,000. The assets are north of Hosston, La., with seven currently in production from the Rodessa, Paluxy, Pettit, Smackover and Tuscaloosa formations, and the other four capable of production after work-over operations. In addition, the company will acquire three disposal wells. The consideration will be paid over a seven-month period. The effective date is Nov. 1.
BTE Energy LLC (Lantana Oil & GasPartners)	Louisiana, Gulf Coast Basin	Morehouse, East Carroll and West Carroll parishes	N/A	N/A	BTE Energy LLC has retained Lantana Oil & Gas Partners to sell certain assets in northern Louisiana. The package includes 100% working interest (75% net revenue interest) in more than 60,000 net acres in Morehouse, East Carroll and West Carroll parishes. The leases feature three and half years remaining on the primary lease terms, targeting the Lower Smackover Brown Dense lime. The leases reach from 7,000 to 11,000 feet in vertical depths. The bid due date is July 17. The effective date is July 1. Contact Melinda Faust, 713-426-9001, <a href="mailto:mel@lantanaog.com">mel@lantanaog.com</a> 713-426-9001

# News

## Southwestern Energy Tests First Lower Smackover Brown Dense Well in Southern Arkansas

IHS Inc. Feb. 28, 2012

"If the company's Lower Smackover Brown Dense drilling program yields positive results, Southwestern Energy expects that activity in the play could increase significantly over the next several years. Southwestern owns 520,619 net acres in the play along the Arkansas-Louisiana state line. According to the company, the acreage was obtained at an average cost of \$375 per acre and Southwestern has an 82% average net revenue interest in the leases with an average primary lease term of four years (which may be extended for an additional four years)."

## U.S. Industry Highlights December 2011-January 2012

IHS Inc. Feb. 15, 2012

"Lower Smackover Brown Dense: Along the Louisiana-Arkansas state line, the Lower Smackover Brown Dense play continues to gather momentum. Southwestern Energy recently scheduled a remote horizontal wildcat in North Louisiana's Union Parish. The 1 BML Prop 31-22-1H is scheduled to reach a total depth of 19,892 ft from a surface location in section 31-22n-1w. The lateral is expected to bottom almost two miles to the north beneath at a true vertical depth of 10,875 ft.

Twenty-five miles to the west-northwest, the company's first horizontal Brown Dense wildcat in Claiborne Parish, LA - The 1 Garrett 7-23-5 H, 7-23n-5w - is permitted to a total depth of 20,200 ft (11,000 ft, true vertical depth). The 6000-ft lateral is expected to bottom to the north.

Cabot Oil & Gas was last reported waiting on completion tools at its first Lower Smackover Brown Dense wildcat in southeastern Arkansas' Union County. The 1-32H Denny was drilled to a total depth of 13,000 ft from a surface location in section 32-19s-17w. The leg was slated to reach a true vertical depth of 9550 ft. "

## Cabot Asks to Flare Gas during Testing of Lower Smackover Brown Dense Wildcat

IHS Inc. Feb. 9, 2012

"Houston-based Cabot Oil & Gas Corp has filed an application with the Arkansas Oil & Gas Corp for permission to flare gas produced during the completion and testing phase from the company's first Lower Smackover Brown Dense well.

Located in southern Union County, over a mile north of the Louisiana state line, # 1-32H Denny reached a total depth of 13,000 ft. in January. Production casing has been set to an unreported depth. The horizontal venture was drilled from a surface location in Section 32-19s-17w. The leg was slated to reach a true vertical depth of 9,550 ft. and bottom to the south.

Cabot expects testing and flaring to occur on an irregular basis of no more than 120 days. Rates are not expected to exceed 3 million cu. ft. of gas daily. According to the company, the nearest pipeline capable of receiving natural gas is eight miles away. Once a determination is made on the commerciality of #1-32H Denny and other Brown Dense wells, a gas gathering system could be installed if it proves economically justifiable.

A public hearing will be held on February 22 at 9:00 a.m. at the Embassy Suites Hotel in Hot Springs at 400 Convention Blvd.

Just northeast of #1-32H Denny is #1 Chester, which Cabot noted as the only well in the vicinity that had previously penetrated the entire Brown Dense zone. Drilled in the early 1950s by Murphy Oil, gas was recovered from cores at 9,013-47 ft., 9,428-78 ft. and 9,566-9,616 ft. in the Smackover. Log tops included the Buckner at 8,774 ft., Smackover at 9,002 ft. and Norphlet at 9,856 ft.

In January, Cabot announced plans to drill a second Brown Dense wildcat in adjacent section 28 to the northeast. Although still unpermitted, #1-28H Palmer is expected to be horizontally drilled. True vertical depth is estimated at 9,400 ft., with a 4,666-ft. northward-trending lateral. The operator filed a request with the state to integrate unleased mineral interest owners and uncommitted working interest holders in the 640-acre unit comprising all of section 28. Cabot reported gross estimated well costs of nearly \$8.36 million for a completed producer and \$2.87 million for a dry hole.

## AIX Energy Reports More Drilling Success in Northern Claiborne Parish

IHS Inc. Feb. 7, 2012

"AIX Energy Inc. has completed a third North Louisiana well in the northern Claiborne Parish portion of Haynesville East field.

Haynesville East field currently produces from almost 160 Claiborne Parish wells, half of which produce from the Smackover. Only a handful of wells in the field reached 12,000 ft. or deeper.

AIX has drilled several deep Smackover tests in this part of Claiborne Parish over the past six months, including #1 Camp in section 35 and #1 E. Crump Estate in section 9. AIX has permits for #2 Camp and #1 Merrit.

West of AIX's latest Smackover gas well is the proposed #1 Collier Heirs in section 33. Proposed total depth is 12,500 ft. in Smackover. Several miles to the north is the operator's #1 MCA Resources, another 12,500-ft. test in section 9.

Roughly 10 miles east of AIX's drilling program, Southwestern Energy is active at #1 Garrett 7-23-5 H in Section 7-23n-5w, the company's first horizontal Lower Smackover Brown Dense wildcat in the parish."

## **U.S. Industry Highlights, October-November, 2011**

IHS Inc. Dec. 22, 2011

"Southeastern Region: The Lower Smackover Brown Dense play has ramped up, including a remote wildcat being drilled in North Louisiana's Morehouse Parish. ExxonMobil subsidiary XTO Energy permitted #1 ExxonMobil 2H to a total depth of 13,000 ft. (8,000 ft., true vertical depth) from a surface location in Section 2-20n-8e. The horizontal lateral is expected to bottom more than a mile to the northeast. There has been no commercial production in the vicinity.

Two other operators have initiated Lower Smackover Brown Dense programs in northwestern Morehouse Parish. Over 20 miles west-northwest of the XTO venture, Devon Energy is currently drilling an exploratory horizontal test in the Monroe Field area. Originally permitted as an 8,350-ft. vertical test, #1 Crossett 31H in Section 31-22n-5e, was spud during the fall. Devon has secured 40,000 acres in mineral leases for the Brown Dense play.

Four and a half miles to the north-northeast, Dan A. Hughes has staked a vertical Lower Smackover Brown Dense wildcat on the northern flank of Monroe Field: #1 Plum Creek, Section 7-22n-5e, is slated to reach 7,700 ft.

In the Arkansas portion of the play, Cabot Oil & Gas is active at a wildcat in southern Union County. The #1-32H Denny is in Section 32-19s-17w, was spud in mid-November. The horizontal venture is slated to be drilled to 13,000 ft, with a proposed true vertical depth of 9,550 ft. over a mile north of the Louisiana state line.

Also in Claiborne Parish, AIX Energy recently permitted its fourth deep test in the Haynesville East field area. Plans call for #1 Camp, Section 35-23n-7w, to be drilled to 12,500 ft. The Smackover venture is apparently part of the emerging Lower Smackover Brown Dense play. Less than a half-mile to the southeast, the company recently spud #1 Garrett L&T."

## **Louisiana Dept. of Natural Resources Spotlights Lower Smackover/Brown Dense**

IHS Inc. Sept. 1, 2011

"Louisiana Department of Natural Resources (DNR) secretary Scott Angelle announced that the energy exploration industry has begun work on developing yet another new oil and natural gas shale play in Louisiana — giving the state one proven and producing shale formation and two that are being watched closely as the early stages of activity begin.

The potential new interest area, spanning portions of North Louisiana and southern Arkansas, is referred to as the Brown Dense or the Lower Smackover, and is believed to be a layer of limestone at the base of the Smackover.

DNR said the Brown Dense joins the Tuscaloosa Marine shale as the second half of Louisiana's duo of dense rock plays believed to have the kind of production potential that has made shale plays such as Louisiana's Haynesville and the Barnett and Eagle Ford shales of Texas the new normal in energy exploration. The Tuscaloosa Marine shale is believed to underlie much of Central Louisiana, with potential productive areas currently being explored from Vernon Parish to East Feliciana Parish.

The energy industry is watching the development of the Tuscaloosa Marine shale and the Brown Dense closely, as both are believed to have the potential to contain oil reserves, in addition to natural gas. New processes and technology have led to rapid gains in domestic oil and natural gas reserves, making them recoverable from ultra-dense formations once thought uneconomical to produce.

"We in Louisiana have a long and distinguished history of providing the energy that fuels this nation, and I am bullish on the future of energy production in this state and the role it will play in providing jobs and economic strength," Angelle said. "We are seeing that exploration companies and investors share that optimism and belief in Louisiana's natural resources as they seek new domestic reserves of oil and natural gas. The development of the Haynesville shale natural gas play, the top-producing natural gas play in the nation, has helped give them that confidence."

Initial development of the Brown Dense formation, generally believed to underlie northern Claiborne, Union and Morehouse parishes in North Louisiana, has begun -- with Southwestern Energy drilling its first well in Arkansas and having announced that it will seek a permit to begin drilling for a Brown Dense well in Claiborne Parish before the end of 2011.

Southwestern Energy previously announced that it has invested \$150 million in leasing mineral rights for 460,000 acres to develop the play. The company recently applied to the Louisiana Office of Conservation for approval of an area of the Lower Smackover in Claiborne Parish near the Arkansas border as a designated unit for drilling.

Devon Energy has also announced that it has secured 40,000 acres in mineral leases for the Brown Dense and that it intends to drill a test for the play. Devon has already received a permit for a well targeting the deeper section of the Smackover in Morehouse Parish.

Devon is also active in the Tuscaloosa Marine shale, where the company has secured 250,000 acres of mineral leases and is in the process of drilling two wells in the shale. About half a dozen wells targeting the Tuscaloosa Marine Shale -- long thought to contain substantial reserves, but considered uneconomical to reach through previous methods -- are currently in the process of permitting or drilling.

"New exploration methods have changed the game for development of energy prospects in Louisiana and the nation, as we saw firsthand with the incredible upswing investment and economic activity in North Louisiana in 2008," said Angelle. "This is yet another opportunity for Louisiana to show that we can be an inviting and exciting province to do the business of finding and providing new sources of domestic energy that provide economic strength and opportunity for our state and our nation."

State conservation commissioner Jim Welsh said that companies drilling for the Brown Dense formation have informed the Office of Conservation they intend to use surface water and recycled water for hydraulic fracturing, in conformance with guidelines and advisories issued in nearby areas experiencing stressed ground water conditions.

The anticipated Brown Dense area of development in Louisiana underlies the Sparta Aquifer, which is currently experiencing improved water levels after combined state and local efforts to manage ground water use in the area.

We are still discouraging new high-volume users from using ground water in that area, and giving guidance on alternative sources for water," Welsh said."

## Seeking Alpha Transcripts

### Southwestern Energy - Street Proves Dense Regarding New Play

February 29, 2012

"Yesterday, Southwestern Energy ([SWN](#)) released their first early results from the Lower Smackover Brown Dense play in southern Arkansas and northern Louisiana and the Street was less than impressed. Southwestern's first well, the Roberson 18-19 #1-15H in Columbia County, AR, is still recovering frac fluid and has been on production/flow back for 20 days with a best rate in a 24 hour period *so far* of 103 barrels of oil, 200 Mcf of gas and was at the time producing 1,009 barrels of water per day from 8 stages out of an 11 stage design."

<http://seekingalpha.com/article/399751-southwestern-energy-street-proves-dense-regarding-new-play>.

### Southwestern Energy's CEO Discusses Q4 2011 Results - Earnings Call Transcript

February 28, 2012

"Let's begin. 2011 was another record year for Southwestern Energy. We set new records in production reserves and as a result of our 24% production growth, we achieved the highest earnings and cash flow in our company's history. We produced 500 Bcfe, driven largely by our Fayetteville Shale play, where our production grew 25% to 437 Bcf. Our production from Marcellus Shale also grew from 1 Bcf in 2010 to 23 Bcf in 2011, while our Ark-La-Tex production declined from 54 Bcf in 2010 to 40 Bcf in 2011."

<http://seekingalpha.com/article/398981-southwestern-energy-s-ceo-discusses-q4-2011-results-earnings-call-transcript>

### Bonanza Creek Energy: A New Oily Small Cap Player With A Brown Dense Twist

January 3, 2012

#### A Simple Oily Small Cap E&P Story

"Mid continent – Southwest Arkansas. Bonanza ([BCEI](#)) has 13,000 net acres located in Columbia and Lafayette counties AR, accounting for 70% of their reserve base and a little over half of their production as November 2011. Production comes primarily from Cotton Valley sands, uphole to the Lower Smackover (Brown Dense) we've been chatting about as being the target of [COG's](#) and [SWN's](#) next big exploratory tests, and BCEI thinks 5,672 net acres could be prospective for the Brown Dense."

<http://seekingalpha.com/article/317030-bonanza-creek-energy-a-new-oily-small-cap-player-with-a-brown-dense-twist>

### Chesapeake/Southwestern Energy Add New Plays; Plus Gas Review and More

July 29, 2011

"New Horizontal Oil Play - Lower Smackover Brown Dense (mudstone – basically a dirty limestone) Massive position in potential oil play built: They spent \$150mm over the last two years acquiring leases on 460,000 net acres prospective for the Lower Smackover Brown Dense (mudstone) in southwest Arkansas and northwest Louisiana. That works out to \$326 / acre. Depth of 8 to 11,000 feet with a thickness of 300 to 550 feet. This is potentially a big play stretching from the Texas Gulf Coast to Alabama if not Florida."

<http://seekingalpha.com/article/283178-chesapeake-southwestern-energy-add-new-plays-plus-gas-review-and-more>



# Selected Hart Energy Articles

## DUO 2012: Tuscaloosa, Smackover Resource Plays Light Up Louisiana

[http://www.ugcenter.com/US-Shales/DUO-2012-Tuscaloosa-Smackover-Resource-Plays-Light-Louisiana\\_101232](http://www.ugcenter.com/US-Shales/DUO-2012-Tuscaloosa-Smackover-Resource-Plays-Light-Louisiana_101232)

Peggy Williams June, 2012

Louisiana has been an excellent place to look for oil and gas for many decades. Now that the great [Haynesville](#) hype has died down, thanks to sagging natural gas prices, attention is turning to other areas of the Pelican State. Both the emerging Tuscaloosa Marine [Shale](#) (TMS) and Brown Dense plays straddle Louisiana parishes and spill over into counties in neighboring states.

The TMS play covers central-eastern Louisiana's Avoyelles, Pointe Coupee, West Feliciana, East Feliciana, St. Helena and Tangipahoa parishes, and also extends into southwestern Mississippi's Wilkinson and Amite counties. That's according to Kirk Barrell, president, Amelia Resources LLC. Barrell spoke at Hart Energy's DUO Conference in May in Denver.

The TMS is a rich, world-class source rock that's age-equivalent to the Cretaceous [Eagle Ford](#) play. The prime portion of the TMS is demarked by high-resistivity log signatures, which can be correlated to high total organic carbon (TOC) contents.

Major TMS acreage holders include Encana Corp., Devon Energy, Indigo Minerals, Goodrich Petroleum and EOG Resources. Between October 2010 and March 2012, lease costs in the region have risen from \$100 to as much as \$450 an acre, noted Barrell.

To date, some 10 horizontal rigs are working in the TMS area. About 20 horizontal wells have been permitted or drilled, and another 10 or so are in the pre-permit stage. Current activity is focused in the eastern portion of the play, east of the LaSalle Arch.

Top discoveries announced to date are both operated by Encana: the Anderson #17H-1 tested at 1,082 Boepd in Amite County, and the Weyerhaeuser #73H-1 tested at 837 Boepd in St. Helena Parish. Of the small handful of results that have been released to date, two wells with such stout volumes have certainly piqued industry interest.

So far, drilling issues are a concern in the deep and overpressured reservoir. Various problems have pushed costs to as high as \$20 million per well, said Barrell. That's double the \$10 million-per-well cost that operators are targeting. "We don't have the drilling costs where they need to be."

[Completions](#) have gone very well, however. Operators have been experimenting with lateral lengths and [frac](#) designs. Laterals as long as 8,900 feet have been drilled, and up to 30 [frac](#) stages have been deployed per well. Proppant per stage has also varied widely, from averages of 150,000 to 350,000 pounds, noted Barrell. Early indications are that more proppant per stage and longer lateral lengths yield superior flow rates.

"The play is still economically unproven," said Barrell. "It's going to take a year's results for many wells to see what the declines are like and to obtain a type curve. But so far the results are encouraging."

To the north, a newer play is gaining some traction. The Jurassic-age Lower Smackover Brown Dense trend is centered in northern Louisiana and southern Arkansas, and could also slide over into western Mississippi. Steve Walkinshaw, president, Vision Exploration LLC, noted that the Brown Dense Lime is the most prolific source rock in the U.S. Gulf Coast. "Interest is increasing as several operators attempt to establish its viability as an oil-resource play," he said.

The Brown Dense is a remarkably diverse tan-colored limestone, with many different types of primary and secondary porosity. One caution: minor amounts of hydrogen sulfide will likely be present in many Brown Dense reservoirs, and this will add to the cost of drilling and production operations, noted Walkinshaw.

It's fair to say that uneven results from recent Brown Dense tests have both teased and frustrated explorers Southwestern Energy, Weiser-Brown, Devon Energy, Cabot Oil & Gas and XTO Energy are among the companies working the play, and of those Southwestern has been the most active to date.

"There have some very significant wells drilled with very encouraging results. And there have been disappointments to be sure, but most are attributable to the learning curves we all face in exploring tight oil and gas reservoirs," said Walkinshaw.

With several key wells planned in coming months, the productive potential of the Brown Dense should begin to come into focus.

## DUO 2012: Assessing Oily Shale Plays

[http://www.ugcenter.com/US-Shales/DUO-2012-Assessing-Oily-Shale-Plays\\_100532](http://www.ugcenter.com/US-Shales/DUO-2012-Assessing-Oily-Shale-Plays_100532)

Larry Prado May, 2012

The key to maximizing the economics of any play--getting good results while not spending a lot of money on drilling--according to speaker Bill Boykin, vice president of business development for NuTech Energy Alliance, "is to study existing data and develop the smartest possible strategy before you even put the bit in the ground."

Hart Energy's DUO 2012 panel, "Assessing Oily Shales" addressed regional geology, reservoirs studies and industry understanding of two western plays, Bakken and Niobrara. According to speaker Professor Steven Sonnenberg's unconventional checklist, both plays have sweet spots, continuous accumulations, are hydrocarbon saturated and abnormally pressured, have low permeability and porosity, big generation windows and large volumes of oil or gas in place.

Niobrara [shale](#) is in most basins in the Rocky Mountain area, especially in northeastern Colorado, southeastern Wyoming, northwestern Kansas and southwestern Nebraska. The reservoirs are chalk and marls with biogenic and thermogenic accumulations that are up to 40 ft. in thickness with a total organic content (TOC) between 2-6%. The normal-to overpressured source rocks are found in Niobrara A, B and C. The best producing areas have mature source beds with natural fractures and matrices.

Sonnenberg noted that Niobrara faults and fracturing consists of wrench faults, force folds, recurrent movement on basement faults with a regional stress field and "polygonal fault systems".

In his study of polygonal faults systems, which can be quite clearly seen with 3-D modeling, Sonnenberg said that "They show how the reservoirs are connected--seeing the connection between the reservoirs and comparing it to production mapping can show you where the greatest chances of success lie. Understanding polygonal systems will improve production."

The pressurized Bakken [shale](#) is found in North Dakota and Montana and stretches northward into Saskatchewan and Manitoba. The world class source rocks are the upper and lower black shales that are hard, siliceous and organic rich with average TOCs of about 11%. The Middle member of Bakken is the most productive and ranges from a dolomitic siltstone to a silty dolomite, both with low porosity and permeability.

In addition, the Bakken is abnormally pressured with good hydrocarbon generation. Bakken faulting and fracturing consists of wrench faults and force folds with recurrent movement on basement faults. Regional fracturing lies along northeast-southwest lines.

The Upper Three Forks horizontal target is a dolostone and Sonnenberg suggested that Pronghorn (also a dolostone) could be an exciting new target for production.

But the increasing production from these two plays hasn't come together overnight and likely resulted from key teams working together.

Boykin pointed out that making it all come together begins with "a common goal to shorten the learning curve from acquisition through development/divestment to maximize economics."

NuTech's experience began by studying existing [Eagle Ford](#) fields and it has also done studies in [Marcellus](#), the Permian Basin's Wolfcamp, Niobrara and [Haynesville](#) plays.

At NuTech, engineering and geology teams get together to define and understand parameters from existing fields to help identify the sweet spots. The geology team maps rock fabrics including brittleness, hydrocarbon pore feet, permeability and porosity, and oil in place. The geophysics teams dive into examining and mapping stress and fracture zones and the reservoir and completion teams look into how many wells per section would be required to maximize reservoir production.

"Mapping natural fractures can be done with existing well data while the regional geology sets the stage. But you have to do your petrophysics first."

Nearing the end of the presentation, Boykin expressed concern that the Utica play seems to be developing rapidly without using existing data.

The Bakken, originally discovered in the 1950s, is one of the biggest and most successful resource plays in the world and with its rapid development and production in the 2000s, but there are ancillary issues which require attention.

According to speaker Jim Sorenson of the Energy & Environment Research Center, Bakken development has raised public concern and awareness about land use, roads, water consumption, air quality and the use of fracturing [fluids](#).

"Gas flaring is also becoming an issue thanks to The New York Times reporting about gas flaring in the Williston Basin."

Oil field development similar to the Bakken will also follow present and future Niobrara development.

"Public perception issues in western North Dakota include the construction of thousands of well pads and truck traffic for the drilling and fracturing of thousands of wells, wear and tear on roads and highways, traffic jams in rural communities and increased airborne dust" which, according to Sorenson "adversely affects the 'viewshed'".

The industry can plan ahead for new areas using Williston Basin issues to resolve public concerns. Sorenson suggests that companies can "Increasingly use technologies to drill multiple wells from a single pad to reduce the overall footprint of drilling operations, construct truck routes around communities and use environmentally friendly dust control materials."

The economic projections for North Dakota from the Energy & Environment Research Center report show that by the end of 2012, 21,250 new wells could be drilled, 12,000-19,800 jobs could be gained and 3,000-3,500 long-term jobs could be added in the state."

In addition, "A single Bakken well is projected to produce more than 575,000 barrels of oil, generate more than \$20 million in net profit and pay \$4.25 million in taxes, \$6.9 million royalties to mineral owners and salaries and wages of 1.55 million."

Sorenson also said that there are still "plenty of Bakken drilling opportunities and sweet spots including Parshall and Dunn counties." Also, Sonnenberg predicted that the new Three Forks exploration in Montana "could be exciting."

When the speakers were asked about transferring lessons learned to other up-and-coming plays--Woodbine, Brown Dense and Tuscaloosa marine shale--they indicated that Woodbine stands out, Smackover/Brown Dense is very interesting and Tuscaloosa reservoir characteristics don't stand out--yet.

## Southwestern Energy Ramps Up Capex For 2012 Projects

[http://www.ugcenter.com/Canadian-Tight-Gas/Southwestern-Energy-Ramps-Capex-2012-Projects\\_93317](http://www.ugcenter.com/Canadian-Tight-Gas/Southwestern-Energy-Ramps-Capex-2012-Projects_93317)

Dec. 2011

Southwestern Energy Company (NYSE: SWN) has reported its planned capital investment program and guidance for 2012. The company's total capital investment program in 2012 is planned to be approximately \$2.3 billion, compared to approximately \$2.1 billion in 2011. The company's 2012 capital program includes approximately \$2.0 billion for its exploration and production segment, \$210 million for its midstream segment and \$90 million for corporate purposes.

"I am excited about what lies ahead for Southwestern Energy in 2012. Our low-cost operations and financial flexibility, along with our significant positions in two world-class [shale](#) plays and our drilling in several New Ventures plays, give us the ability to create significant value for our stockholders," says Steve Mueller, president and CEO of Southwestern Energy.

"Our 2012 capital investments in the Fayetteville [Shale](#) will be slightly lower when compared to 2011, while our capital program in the [Marcellus](#) Shale in Pennsylvania will almost double and our New Ventures investments will increase due to additional exploratory drilling activities. We plan to be drilling in at least three of our New Ventures ideas during the year including the Brown Dense play in Arkansas and Louisiana, New Brunswick, Canada and a new oil play in 2012. As a result of our planned activities, our 2012 production is expected to be in a range of 570 to 580 Bcfe, which is an increase of approximately 15% compared to our expected 2011 level."

"Our capital program is flexible and may be adjusted to correspond with significant changes in gas prices. Meanwhile, our hedges in place for 2012 provide a secure level of earnings and cash flow and our vertical integration gives us meaningful protection against higher costs in the future. Our 2012 investments are expected to be funded through cash flow and borrowings on our revolving credit facility. The combination of our best-in-class gas assets and New Venture opportunities, coupled with one of the lowest cost structures in the industry and our strong balance sheet, have us well positioned as we enter 2012," stated Mueller.

Southwestern expects to participate in approximately 670 to 680 total gross wells (580 to 590 operated) in 2012, compared to an estimated 681 total gross wells in 2011 (approximately 600 operated). The company's 2012 net well count is expected to be approximately 440 to 450 wells compared to approximately 479 net wells in 2011.

In 2012, Southwestern plans to participate in approximately 580 to 590 gross wells in the Fayetteville Shale play, 490 to 500 of which will be operated. Nearly all of the company's drilling in the Fayetteville Shale in 2012 will be on multi-well pads, which should result in faster drilling times and other efficiencies. The company expects that the average time to drill its operated horizontal wells to total depth from re-entry to re-entry will decrease in 2012 to approximately 7.4 days from approximately 8.0 days projected for 2011.

In the [Marcellus](#) Shale, Southwestern has increased its acreage position to approximately 181,500 net acres located in northeastern Pennsylvania. The company plans to begin the year drilling with two operated rigs and end the year with four operated rigs and plans to participate in a total of 80 to 85 gross wells, all of which will be operated. In New Ventures, the company plans to participate in up to 10 gross wells, all of which will be operated.

Of the approximate \$2.0 billion E&P capital budget for 2012, \$1.6 billion (or 78%) will be invested in development and exploratory drilling, \$30 million in seismic and other geological and geophysical (G&G) expenditures, \$105 million in leasehold and \$340 million in capitalized interest and expenses and other equipment, facilities and technology-related expenditures.

### Southwestern Issues Guidance for 2012

Southwestern is targeting total gas and oil production of 570 to 580 Bcfe, up approximately 15% over the company's expected 2011 level. Approximately 475 to 480 Bcf of the 2012 targeted gas production is projected to come from the company's activities in the Fayetteville Shale play, up from the 2011 projected production of approximately 433 to 435 Bcf. Approximately 60 to 65 Bcf of the 2012 targeted gas production is projected to come from the company's activities in the Marcellus Shale, up from the 2011 projected production of approximately 20 to 22 Bcf.

As of December 19, 2011, the company had NYMEX hedges in place on notional volumes of 265.7 Bcf of its 2012 projected natural gas production hedged through fixed price swaps and collars at a weighted average floor price of \$5.16 per Mcf. The company's projected results for 2012 are as follows:

### Estimated Production by Quarter in 2012

Assuming a NYMEX commodity price of \$4.00 per Mcf of gas for 2012, the company is targeting net income of \$650 to \$660 million and net cash provided by operating activities before changes in operating assets and liabilities of \$1,930 to \$1,940 million in 2012. The company expects its operating income to approximate \$1,120 to \$1,130 million and its net income plus interest, income tax expense, depreciation, depletion and amortization to be approximately \$1,950 to \$1,960 million in 2012. The company has also provided additional price scenarios and their corresponding estimated financial results for 2012 in the table below:

### Current Update on New Ventures Activities

At December 19, 2011, Southwestern held 2,518,518 net undeveloped acres which were located in New Brunswick, Canada and approximately 1,054,000 net undeveloped acres in connection with other New Ventures prospects.

Included in the approximately 1,054,000 net acres are 500,000 net acres located in the in the Lower Smackover Brown Dense formation located in southern Arkansas and northern Louisiana. The company finished drilling its first well in late-November, the Roberson 18-19 #1-15H located in Columbia County, Arkansas. This well has a vertical depth of approximately 9,200 feet and a horizontal lateral length of

approximately 3,600 feet. The well is currently being completed with results expected in the first quarter of 2012. The company has spud its second well, the Garrett 7-23-5H #1 located in Claiborne Parish, Louisiana and this well is currently drilling below 7,500 feet. This well has a planned total vertical depth of approximately 10,700 feet and the company will attempt a 6,000-foot horizontal lateral. Southwestern plans to drill additional wells to test the concept in 2012. If the company's drilling program yields positive results, it expects that activity in the play could increase significantly over the next several years.

## Brown Dense

[http://www.ugcenter.com/item/Brown-Dense\\_88939](http://www.ugcenter.com/item/Brown-Dense_88939)

Nissa Darbonne, Sept. 2011

From one rock sample, a new U.S. horizontal oil field may grow. Southwestern Energy Corp. will attempt this fall to prove commercial oil production from the nearly century-old, Texas-to-Florida, conventional Upper Smackover play's source rock—the unconventional Lower Smackover's Brown Dense.

The company has put together 460,000 net acres over the carbonate along the Louisiana-Arkansas border in the backyard of the prolific Fayetteville [shale](#)-gas play it discovered in 2004. Today, Southwestern is making 1.8 billion cubic feet equivalent a day from the formation. "It is interesting to note that this happens to be almost the same number of acres we had when we announced the Fayetteville," says Steve Mueller, Southwestern president and chief executive officer.

Southwestern provided a peek earlier this year: It now reveals the Brown Dense is on the cover of its annual report, published this spring. The image shows a piece from one of two cores it found during more than two years spent researching the formation. The team started with logs on 1,145 wells in five states, reprocessed some 1,000 miles of 2-D seismic, and found data from cores and cuttings from 70 wells that at least touched Brown Dense.

"We currently have more data about the Brown Dense than we had on the Fayetteville [shale](#) when it was announced," Mueller says. The piece of core sample that it was able to test is brittle. "I can't tell you the whole play is going to be brittle. But that's kind of a basis for encouragement for what we're doing."

Michael Bodino, E&P analyst for Global Hunter Securities, says the Jurassic-age Brown Dense is a "dirty carbonate, as it has streaks of porosity, fractures and shale throughout it."

At between 8,000 and 11,000 feet below the surface, it is 300 to 530 feet thick, Mueller says, and the oil is believed to be light—between 40- to 55-degrees API gravity. Porosity ranges from 3% to 10% in Southwestern's lease window, it is over-pressured at 0.62 psi per foot, and permeability is less than 0.1 to more than 1 millidarcy. "Both porosity and matrix permeability are comparable to metrics reported in the [Eagle Ford](#) play in South Texas," Mueller adds.

Subash Chandra, E&P analyst for Jefferies & Co. Inc., says, "Horizontal technology could ignite the Lower Smackover play...A long lateral effectively capturing the potential of 10 vertical producers is the trick."

Southwestern plans a first horizontal in Brown Dense in this quarter in Columbia County, Arkansas, drilling 8,900 feet vertically and 3,500 feet laterally for a completed cost of \$10 million. Mueller says \$2 million of that is for gathering data, including core of the entire prospective interval. A second horizontal, later this year, will go some 10,700 feet vertically and a 6,000 feet horizontally in Claiborne Parish, Louisiana. Future wells—at least 10 are planned for 2012—may cost \$7 million each, Mueller says.

EOG Resources Inc. put a vertical hole, #1-24H Endsley, into Brown Dense in 2009 and made noncommercial gas. Mueller says the well, which was near the Louisiana-Arkansas-Texas border, "was in the deeper part of the play than what we're really targeting." A short horizontal in Columbia County by Brammer Engineering Inc. and Anderson Exploration Energy Co. last year met with mechanical and fracture-[stimulation](#) problems; it tested a noncommercial 40 barrels of oil per day.

Southwestern has put together its leasehold for an average of \$326 per acre. Should the formation prove commercial horizontally, it has the dry powder to aggressively develop it, says Andrew Coleman, E&P analyst for Raymond James & Associates Inc. Southwestern's long-term-debt to capitalization ratio is 27% while that of its peers is an average of 47%, "giving us faith management can accelerate the Brown Dense, if it works."

Devon Energy Corp. also plans a horizontal in Brown Dense this fall. It holds 40,000 net acres. Chandra notes that many producers, including Chesapeake Energy Corp. and Petrohawk Energy Corp., which has been acquired by BHP Billiton Ltd., have legacy acreage over Brown Dense, which sits below the [Haynesville](#) shale-gas play in northwestern Louisiana.

Lower Smackover is the source of hydrocarbons in several large conventional producing fields, says Mueller. "Our hope is to use horizontal-drilling technology to unlock at least as much potential."

## Let's Talk Some Smack(Over)

[http://www.ugcenter.com/US-Tight-Gas/Lets-Talk-SmackOver\\_76845](http://www.ugcenter.com/US-Tight-Gas/Lets-Talk-SmackOver_76845)

Peggy Williams, March 2011

A new oily play is popping up in southern Arkansas and northern Louisiana. Actually, it's an application of new-era, unconventional technology to a decades-old play, the Upper Jurassic Smackover.

While the Smackover occurs across a broad region, interest is particularly high these days in Lafayette, Columbia and Union counties, Arkansas, and Bossier, Webster and Claiborne parishes, Louisiana. This area falls in one of the interior Gulf Coast sedimentary basins, referred to as the North Louisiana Salt Basin or the Ark-La Basin. Its package of prospective sediments lies wedged between the Sabine and Monroe uplifts.

According to the Arkansas Geologic Survey, the Smackover formation takes its name from Smackover Field, in Union County, Arkansas. There, the formation is 700 feet thick. Its upper portion is composed of shallow-water carbonates, such as oolites, chalky limestones and corals. For many decades, explorers have targeted high-quality zones in the upper Smackover, and most existing Smackover fields in the region produce from porous oolite zones.

Interest has recently shifted to the lower portion of the formation, which lacks the reservoir qualities to produce at commercial rates with conventional technologies. The lower member is an extremely fine-grained carbonate mudstone, often called the Brown Dense. The lower and middle mudstone beds are excellent source rocks. They are quite thick, thermally mature and rich in kerogen, according to work done by Ernest Mancini, research professor at Texas A&M University. Much of the oil and gas produced in the North Louisiana Salt Basin has been generated in these mudstone beds.

"The upper Smackover play is fairly mature, but horizontal technology could ignite the lower Smackover play," says a new report by analysts at Jefferies & Co. Inc., led by Subash Chandra. "Horizontal development of the Smackover—a zone just below the Haynesville—may be nearing proof of concept."

Explorationists are closely watching a key well, Brammer Engineering's #1-12 H Watson-Scott in Section 12, T18S-R22W, Columbia County, Arkansas, to see if it will provide that proof. The Shreveport-based contract operator drilled the horizontal test on the flank of Dorcheat Macedonia Field and has completed it as an oil well, according to IHS Inc. No flow rates were reported, but the 13,880-foot well is producing from an openhole Smackover lateral between 12,483-13,043 feet.

Brammer and its partner Anderson Energy Co. also applied to the Arkansas Oil and Gas Commission to integrate Section 7-T18S-R22W for a horizontal Smackover test. The companies propose drilling that well to a vertical depth of 9,900 feet in Smackover, and then taking a lateral out 4,500 feet if the vertical wellbore confirms the presence of hydrocarbons. No activity is reported yet at that site.

A vibrant land play has been in progress in the region for several months, with field reports of positions of several hundred thousand acres being assembled. To add more spice, Core Lab offers one of its well-regarded studies in the area. Its Arkansas-Louisiana State Line Trend study analyzed 1,546 feet of conventional Smackover core pulled from 20 wells.

Now, Dallas-based J-W Operating Co. has an integration request in front of the Arkansas commission for Section 32-T19S-R17W in Union County. The company is proposing a horizontal well; vertical depth to Smackover is approximately 9,400 feet at its location. It has projected a lateral length of approximately 3,700 feet.

While there is not yet an announced success in the Smackover play, it is of strong interest due to its possible overlap onto leases originally acquired for the Haynesville shale, a dry-gas reservoir. That once-hot play is no longer economic because of low gas prices.

"We wouldn't be surprised if operators more aggressively switch their attention to the liquids-rich Smackover," says Chandra. The lower Smackover could be another example of a low-permeability/low-porosity zone that can be made commercial through horizontal drilling and multistage fracture stimulation.

Companies with existing positions in the potential lower Smackover area include Chesapeake Energy Corp., EOG Resources Inc., El Paso Corp., Forest Oil Corp., Petrohawk Energy Corp., Marathon Oil Corp., QEP Resources Inc., SM Energy Co., Exxon Mobil Corp. and ConocoPhillips.

## Hart Energy A&D Articles

For more detailed information see Hart's A&D site at: <http://www.a-dcenter.com/>

### **BTE Energy Offers Louisiana Brown Dense Lime Package**

[http://www.a-dcenter.com/Acquisitions-Divestitures/BTE-Energy-Offers-Louisiana-Brown-Dense-Lime-Package\\_101894](http://www.a-dcenter.com/Acquisitions-Divestitures/BTE-Energy-Offers-Louisiana-Brown-Dense-Lime-Package_101894)

BTE Energy LLC has retained Lantana Oil & Gas Partners to sell certain assets in northern Louisiana.

The package includes 100% working interest (75% net revenue interest) in more than 60,000 net acres in Morehouse, East Carroll and West Carroll parishes. The leases feature three and half years remaining on the primary lease terms, targeting the lower Smackover "Brown Dense" lime. The leases reach from 7,000 to 11,000 feet in vertical depths.

The bid due date is July 17. The effective date is July 1. Contact Melinda Faust, 713-426-9001, [mel@lantanaog.com](mailto:mel@lantanaog.com).

### **Covering Your Assets**

[http://www.a-dcenter.com/Acquisitions-Divestitures/Covering-Assets\\_98246](http://www.a-dcenter.com/Acquisitions-Divestitures/Covering-Assets_98246)

We are entering the shoulder season, when demand for natural gas and oil wanes just as winter wanes—although this year, winter was a non-event, being 10% warmer than usual. Gas fundamentals reflect that ugly truth: Storage volume is 33% above the five-year average; prices are down 20% since New Year's Day alone.



"Why give it away?" asks one E&P executive who has stopped drilling dry-gas wells.

The industry is doing what it should: changing where it drills, selling underperforming assets and jumping on any deal that has oil or liquids potential. Some companies have made a splash by announcing big cuts in dry-gas drilling and shutting in wells, while others have more quietly done so. The chief financial officer of one large public independent told me confidentially that the company will not drill a single dry-gas well this year.

Although everyone insists the Marcellus is the only gas play that's still economic at \$3 gas, Talisman Energy says it will cut spending there from \$1.2 billion last year to \$600 million this year, and from 10 rigs last year to three now.

Others backing away from dry-gas drilling activity include Chesapeake Energy Corp., cutting 26 gas rigs; Noble Energy, deferring 40 Marcellus wells; Consol, suspending Huron drilling; Pioneer Natural Resources, reducing its dry-gas Eagle Ford drilling; and WPX Energy (formerly Williams E&P), cutting its Marcellus and Piceance drilling program to eight rigs from 18.

But the Jefferies E&P research team says in a recent note, "Cuts now are too late to stem 2012 production growth." Jefferies cited Energen, which said it will cut its 2012 capex in the gassy San Juan Basin by more than half. "Yet...it will still drill through mid-year...gas production is still expected to grow 0% to 9% year-over-year. Despite the reduction in activity, EQT, CNX, and NFG are expected to grow volumes 30%, 12%, and 33% this year, while WPX expects production to be flat."

It's quite a turn of events compared to the high-rolling days of the Barnett, Woodford, Fayetteville and Haynesville shales. But it illustrates why companies and investors should never put all their eggs in one basket.

A corollary is this: There are assets, and then there are better assets.

"You can always fix a balance sheet that has a little too much debt on it, but you can't fix bad assets as easily," declared Aubrey McClendon. Did he say this recently? Probably. But my notes indicate the Chesapeake chairman and CEO said this in March 2009 at the Howard Weil energy conference.

As you recall, that was a bad year. The world economy had tanked, capital was nearly impossible to access, and oil and gas prices weren't helping. The U.S. rig count plunged. Service companies were laying off employees. Plains E&P chairman and CEO Jim Flores said at the time, "Like everyone else, we have some closets to clean out." PXP was reducing debt by selling assets in the Piceance and Permian basins, yet buying in South Texas and the Haynesville. That kind of asset rotation is still the answer.

Now we've come full circle some three years—and a ton of shale-gas production—later. You can relate to the fact that the worst assets are getting worse and the best ones are getting better.

Tudor, Pickering & Holt Securities says it still looks for \$4 gas in 2013.

I asked the CEO of a private Houston E&P recently, what do traditional and smaller companies do if they are not in a shale play? How do they attract investor dollars, get acreage, and tie up a rig and frac crew? He replied that it is tough. After looking at several plays, he is getting into the Brown Dense now, because the acreage there is still affordable. In other resource plays, it is not. "I am not going to pay \$1,000 an acre."

Then too, he was participating in other companies' wells as a way to be involved in a hot play, since he could not go it alone.

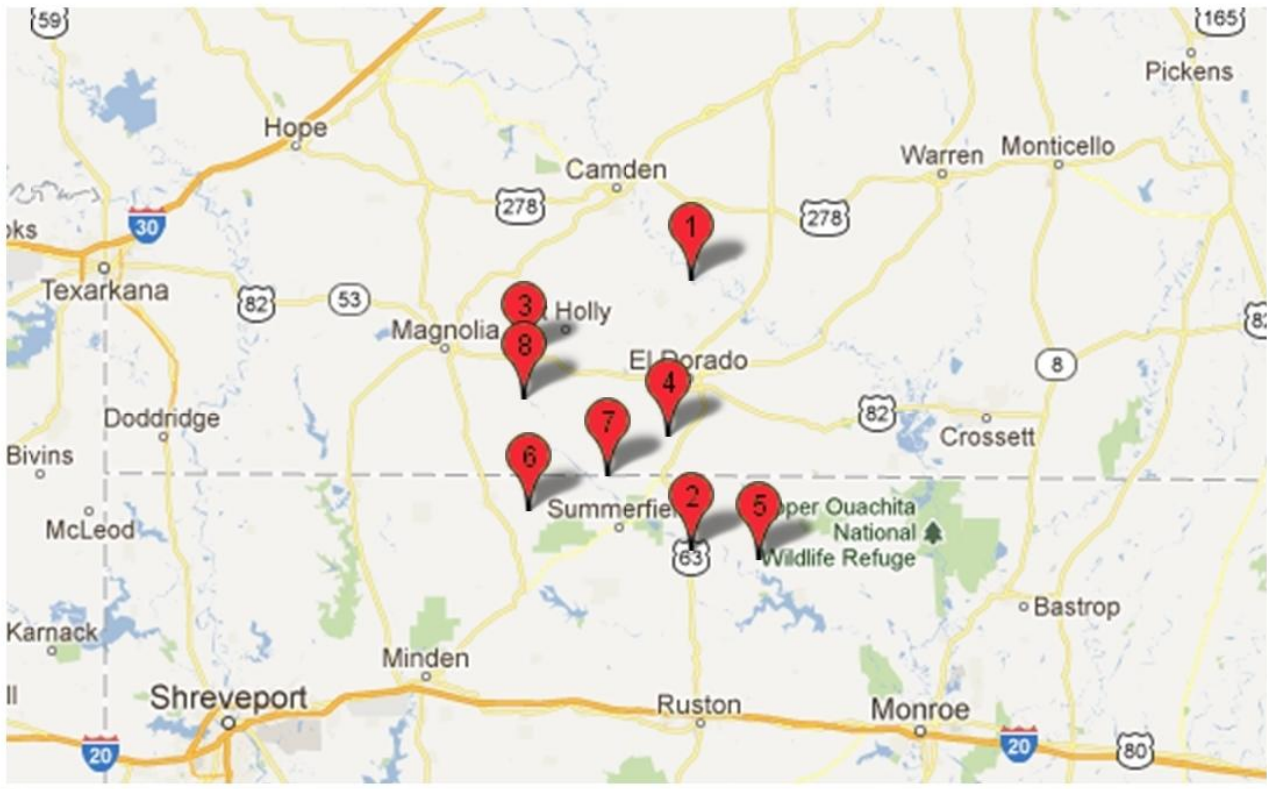
There is no sense spending money on the way down, so wait until service costs are really low. Prioritize all decisions based on rate of return. Even in the good old days, when natural gas commanded a much higher price, CEOs admitted the shale plays would not be cash-flow positive until 2012 or 2013—too many wells to drill first, to hold leases.

If a 6.5-Bcf Haynesville well made a 10% return at \$3.30 gas, what now? That cash-flow positive event has been pushed out another year.

We look forward to seeing you and sharing what's new at the 3rd annual Marcellus Midstream Conference & Exhibition in Pittsburgh, March 19-21; and at the 7th annual DUG in Fort Worth on April 23-25. Both events continue to evolve just as the industry does. See you there.

For more commentary from Leslie Haines, see [OilandGasInvestor.com](http://OilandGasInvestor.com).

# Selected Hart Energy Activity Highlights



## 1 Four R Operating

7/25/12

### **Snow Hill Field Smackover Oil Discovery**

According to IHS Inc., Four R Operating has completed a second Smackover oil well in Arkansas' Snow Hill Field. The Ouachita County well, #1 Berg, was tested at a daily rate of 10 bbl. of crude through Smackover perforations at 4,598-4,604 ft. The development well was drilled to 4,800 ft. in Section 20-15s-15w. To the east in Section 21 are two recent Snow Hill Field wells. Four R drilled #2 Reynolds in September 2011 to 4,830 ft. Similar to its latest well, #2 Reynolds was tested at a rate of 10 bbl. of crude per day from Smackover at 4,598-4,602 ft. with no reported production. In late 2009, #1 Reynolds was tested by Weiser-Brown Operating flowing 10 bbl. of crude and 35 bbl. of water per day through Smackover perforations at 4,654-59 ft. Four R Operating is based in Smackover, Ark.

## 2 Southwestern Energy Co.

6/22/12

### **Lower Smackover/Brown Dense Exploratory Planned in Union Parish, La.**

In Union Parish, La., Southwestern Energy Production Co. has added another Lower Smackover Brown Dense exploratory test. The #1 Hollis 27-22-3H will be horizontally drilled in Section 27-22n-3w with a proposed depth of 19,698 ft., 11,011 ft. true vertical. The exploratory test is slated to bottom 1.5 miles to the north beneath section 22. The drillsite is within 1 mile of two Smackover tests abandoned more than 20 years ago — #1 Hollis was drilled to 11,060 ft. and #1 Terral Industries was drilled to 11,000 ft. About 10 miles to the east in Union Parish, Southwestern's #1 BML Prop 31-22-1H is under way and the proposed total depth is 19,892 ft., (10,875 ft. true vertical). The horizontal wildcat is in Section 31-22n-1w. Southwestern's headquarters are in Houston.

## 3 Southwestern Energy Co.

4/20/12

### **Horizontal Lower Smackover Brown Dense Results Announced by Southwestern Energy Co.**

According to IHS Inc., Southwestern Energy Co. announced the initial results from its first horizontal well in the southern Arkansas portion of the Lower Smackover Brown Dense play. The #1-15H Roberson 18-19 is in Section 15-18s-19w of Columbia County. The venture is producing

from eight of 11 fracture-stimulated stages for the first 20 days of an expected 20- to 30-day cleanup period. On the eighth day of testing, the well had a 24-hour rate of 103 bbl. of oil, 200,000 cu. ft. of gas and 1,009 bbl. of water (45% of load recovered to date). Drilled to 12,878 ft., 9,369 ft. true vertical, the well has a 3,600-ft. north-trending horizontal leg that landed in the lower third of the zone and subsequent core analysis indicated this section had some of the lowest permeability in the entire interval. Houston-based Southwestern Energy also has two Smackover Brown Dense wells under way in Claiborne and Union Parishes in Louisiana.

#### **4 Southwestern Energy Co.**

4/09/12

##### **Lower Smackover Brown Dense Horizontal Permitted in Union County, Ark.**

Southwestern Energy Co. has received a permit for a Lower Smackover Brown Dense wildcat in Union County, Ark. The #1-1H Dick James 19-16 will be drilled in Section 1-19s-16w to 13,500 ft. A horizontal leg will bottom less than a mile to the north beneath the same section at a true vertical depth of 8,500 ft. Nearby, Cabot Oil & Gas Corp. is testing its first Lower Smackover Brown Dense well in Union County: #1-32H Denny reached a total depth of 13,000 ft. Cabot filed an application in 2012 for permission to flare gas produced during the completion and testing phase. The horizontal venture is in Section 32-19s-17w. Southwestern's headquarters are in Houston.

#### **5 Southwestern Energy Co.**

3/15/12

##### **Southwestern Energy Schedules Lower Smackover Brown Dense Wildcat in Union Parish, La**

A Lower Smackover Brown Dense wildcat has been scheduled by Houston-based Southwestern Energy Co. in Union Parish, La. The #1 BML Prop 31-22-1H will be horizontally drilled to 19,892 ft. in Section 31-22n-1w, and the lateral is expected to bottom almost two miles to the north beneath Section 30. The proposed true vertical depth is 10,875 ft. Abandoned Smackover production in the vicinity comes from Coney Bayou Field to the south and Shiloh Field to the southwest.

#### **6 AIX Energy Inc.**

3/14/12

##### **AIX Announces Lower Smackover Discovery**

Dallas-based AIX Energy Inc. has completed a third North Louisiana well in the Claiborne Parish portion of Haynesville East Field. The #1 Garrett L&T was tested flowing 800,000 cu. ft. of gas, 110 bbl. of 58-degree-gravity condensate and 10 bbl. of water per day through Lower Smackover Brown Dense perforations at 11,442-75 ft. The vertical well was drilled to 12,317 ft. in Section 36-23n-7w. A recent AIX completion in Section 28, #1 Hardin, was tested for an initial daily potential of 100 bbl. of 46-degree-gravity oil, 350,000 cu. ft. of gas and 110 bbl. of water from an acidized zone in Smackover at 10,430-10,520 ft. Total depth is 10,728 ft. AIX's #2 Hardin produced 344,000 cu. ft. of gas, 100 bbl. of 46.8-degree-gravity oil and 5 bbl. of water daily from Haynesville at 10,132-10,247 ft. after drilling to 12,040 ft.

#### **7 Cabot Oil & Gas Corp.**

2/24/12

##### **Cabot Plans Second Lower Smackover Brown Dense Wildcat in Union County, Ark.**

A second Lower Smackover Brown Dense wildcat is planned by Cabot Oil & Gas Corp. in Union County, Ark. The #1-28H Palmer is to be horizontally drilled in Section 28-19s-17w with an estimated true vertical depth of 9,400 ft., and a 4,666-ft. northward-trending lateral. The Houston-based operator has filed a request with the Arkansas Oil & Gas Commission to integrate unleased mineral interest owners and uncommitted working interest holders in the 640-acre unit comprising all of Section 28. Cabot is currently active at its #1-32H Denny, a Lower Smackover Brown Dense test in Section 32-19s-17w. The emerging Lower Smackover Brown Dense play straddles the Arkansas-Louisiana border. The formation sits below the productive Haynesville shale and Smackover.

#### **8 Southwestern Energy Co.**

10/21/11

##### **Southwestern Stakes Horizontal Exploratory in Emerging Lower Smackover/Brown Dense**

Southwestern Energy Production Co. has staked a horizontal exploratory test in the emerging Lower Smackover Brown Dense play. The Houston-based company's #1-15H Roberson 18-19 is planned for the eastern flank of Atlanta Field in Columbia County, Ark. It is slated to be drilled to 13,020 ft. in Section 15-18s-19w and bottom a mile to the north beneath the same section. The Lower Smackover Brown Dense play straddles the Arkansas-Louisiana border and the formation sits below Haynesville shale and Smackover.

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January 2007	Woodford Shale	January 2009	Cotton Valley Tight Gas
February 2007	Gas Hydrates	February 2009	Caney/Woodford Update
March 2007	Floyd Shale	March 2009	Chattanooga Shale
April 2007	Piceance Tight Gas	April 2009	U.S. Coalbed Methane Update
May 2007	Palo Duro Basin	May 2009	Western Australia Tight Gas
June 2007	Indonesian Coalbed Methane	June 2009	Marcellus Shale Update
July 2007	Bossier Shale and Tight Gas	July 2009	Ohio and Huron Shales
August 2007	Conasauga Shale	August 2009	McLure Shale, Monterrey Formation, CA.
September 2007	Powder River Basin Review	September 2009	Australia/China CBM Update
October 2007	Marcellus Shale	October 2009	Niobrara Shale
November 2007	Utica Shale	November 2009	Barnett Shale
December 2007	Gothic Shale	December 2009	Mako Trough, Hungary
January 2008	Baxter & Hilliard Shales	January 2010	Granite Wash Tight Gas, OK, TX.
February 2008	Jonah Field	February 2010	Poland Shales
March 2008	Raton Coalbed Methane	March 2010	Eagle Ford Shale
April 2008	Australia Coal Seam Gas	July 2010	Cardium Tight Oil, Alberta, CA
May 2008	Cherokee Basin Update	October 2010	Permian Basin Unconventional
June 2008	Haynesville Shale	January 2011	Cleveland Tight Sand
July 2008	Montney Tight Gas	April 2011	Mississippi Lime/Chat
August 2008	Mancos Shale	July 2011	Tuscaloosa Marine Shale
September 2008	Muskwa Shale, Horn River, BC Canada	October 2011	Heath Shale
October 2008	Bakken Shale	January 2012	U.S. Utica Shale
November 2008	Pearsall Shale	April 2012	Duvernay Shale Canada
December 2008	New Albany Shale		

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