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# Oklahoma 2009 Drilling Highlights

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This article is a summary of 2009 Oklahoma drilling activity and highlights results that became public by January 1, 2010. Significant wells registered after this date will appear in next year's summary. Except where noted, all data were supplied online by Petroleum Information/Dwights LLC dba IHS Energy Group, all rights reserved. Without this excellent database this report could not have been completed. Editing was performed by Neil Suneson and cartography by Russell Standridge, both from the Oklahoma Geological Survey.

## General Activity

The number of working drilling rigs is a fundamental barometer of oil and gas activity in any area. The Baker Hughes Company has tracked monthly rotary drilling rig counts for many years for regions all over the world. According to Baker Hughes (2010), the number of active drilling rigs in Oklahoma went from a high of 219 during the week of September 5, 2008 to a low of 69 working rigs about one year later (Figure 1). This loss of 2/3rds of the active rigs in the space of one year is the central theme of this review. The good news is that since reaching its low in September, the trend has been modestly but steadily upward, reaching a year-end level of 95 active rigs. The 2008 to 2009 decline ended a mostly continuous rise in Oklahoma's working rig numbers that began in 2003. This drop in the State's average annual rig count puts us on a par with the level seen in 2002 (Figure 2).

In a State in which gas drilling usually represents 2/3rds to 3/4s of all wells completed, the price of natural gas is by far the most important factor controlling drilling activity in Oklahoma. The close correlation between natural gas prices and drilling activity can be seen by comparing Figure 2 with Figure 3. Sharp drops in price in 2002 and 2009 reduced the

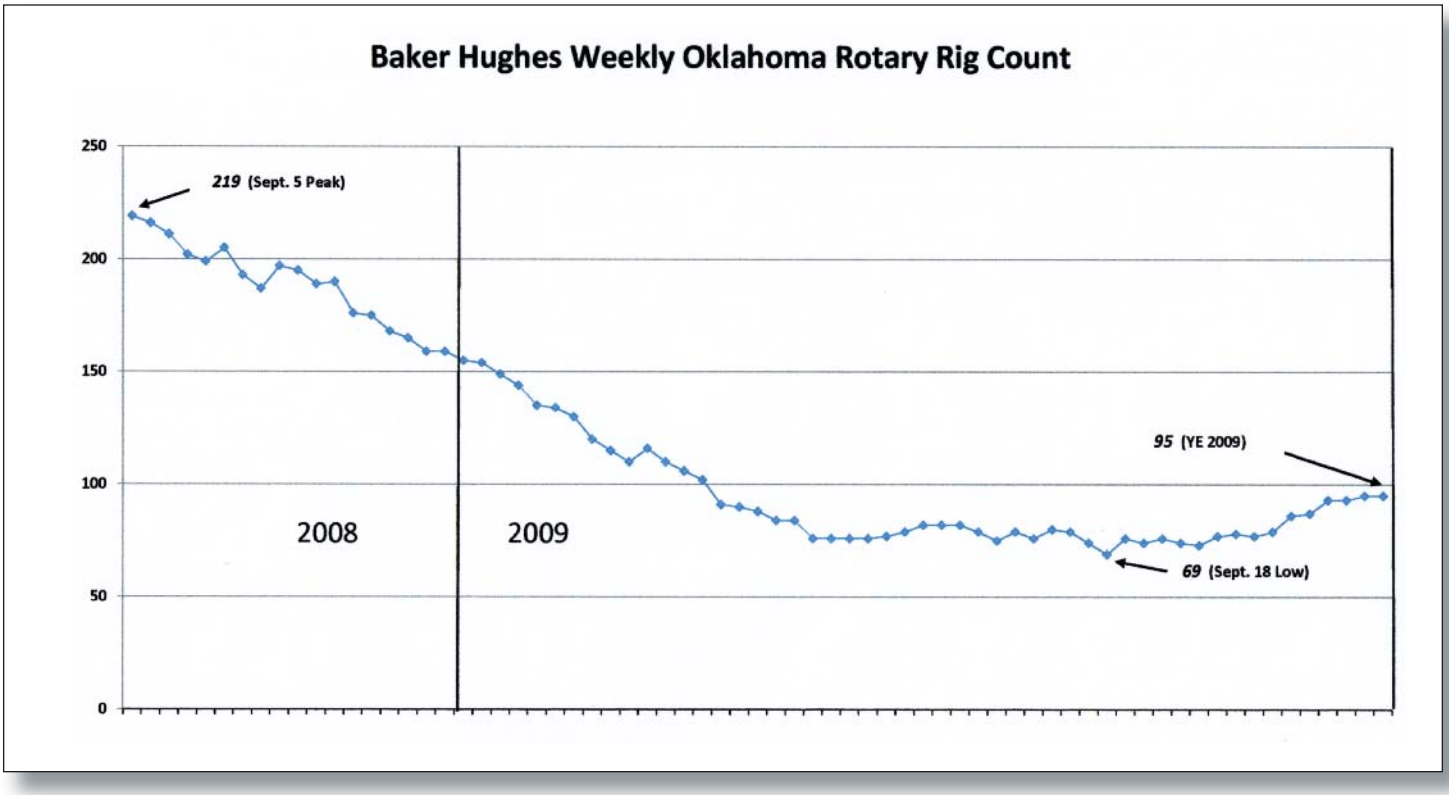


Figure 1. Oklahoma Weekly Rotary Rig Count, from peak activity (Sept., 2008) through year-end 2009. Data from Baker Hughes (2010).

number of working rigs below 100 in both of those years. The rise in prices in the intervening years saw Oklahoma drilling activity rise to levels not seen since the drilling boom of the early 1980s.

The average 2009 wellhead natural gas price in Oklahoma is projected to be approximately $3.27 per thousand cubic feet (MCFG) (Soltani, 2009). This is less than half last year's average price, which, at $7.32 per MCFG, was an all-time record (Figure 3). Although at this writing, prices have increased modestly due to unusually cold winter weather; the long-term course of natural gas prices and future drilling activity is as impossible to predict as winter weather and the

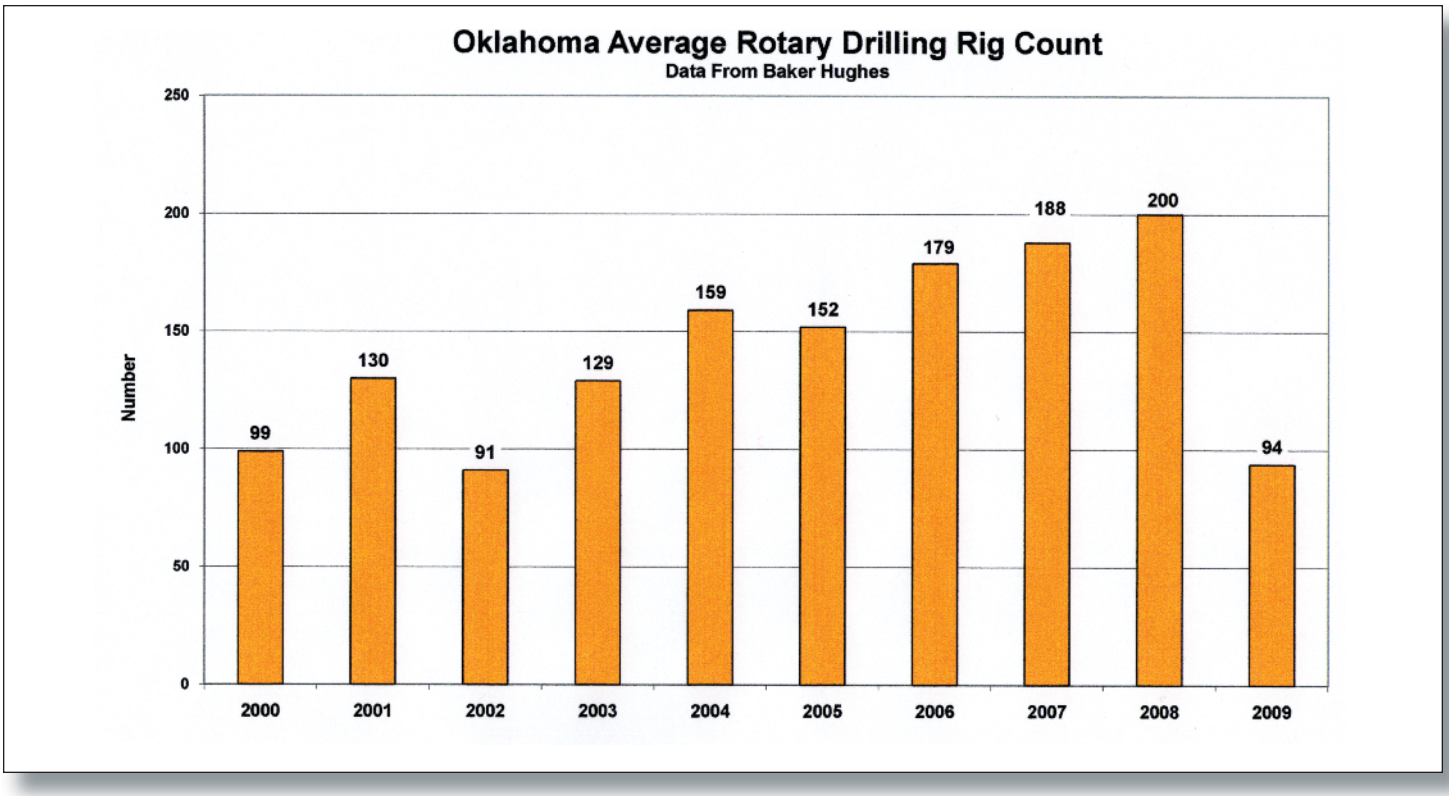


Figure 2. Oklahoma Annual Average Rotary Drilling Rig Count, from 2000 through 2009. Data from Baker Hughes (2010).

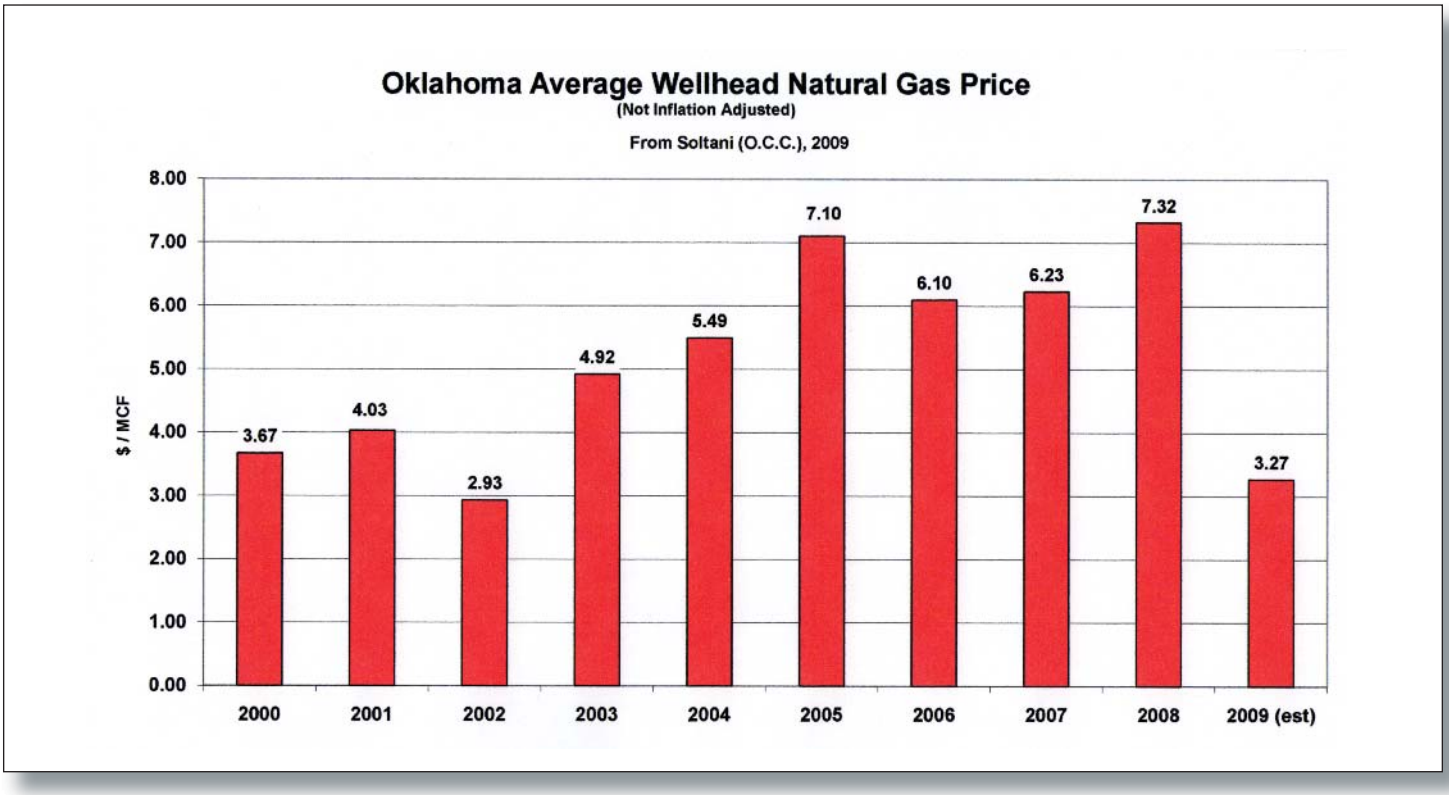


Figure 3. Oklahoma Average Wellhead Natural Gas Price from 2000 through 2009 (not inflation adjusted). Data from Soltani (2009).

speed at which the U.S. economy will recover. Of greater concern than the number of active rigs at any given moment is the fact that more than one quarter of the State's gas production comes from wells that are less than a year old (Boyd, 2005). Reporting lags make it difficult to determine precisely, but the sharp fall in drilling activity in 2009 looks like it will precipitate a reduction in State gas production of between five and ten percent. Thus, as well as making each cubic foot less valuable, low natural gas prices also rapidly reduce the volume that can be delivered. This reduces not only operator income, but because gas represents 82% of BOE (barrel of oil equivalent) production, it is the key factor in lower gross production tax revenue and State budget shortfalls.

Total completions in 2009 were 53% gas and 35% oil (Figure 4). The larger proportion of oil completions over previous years is due to the fact that in the 2009 oil drilling declined about a third while gas dropped by over half.

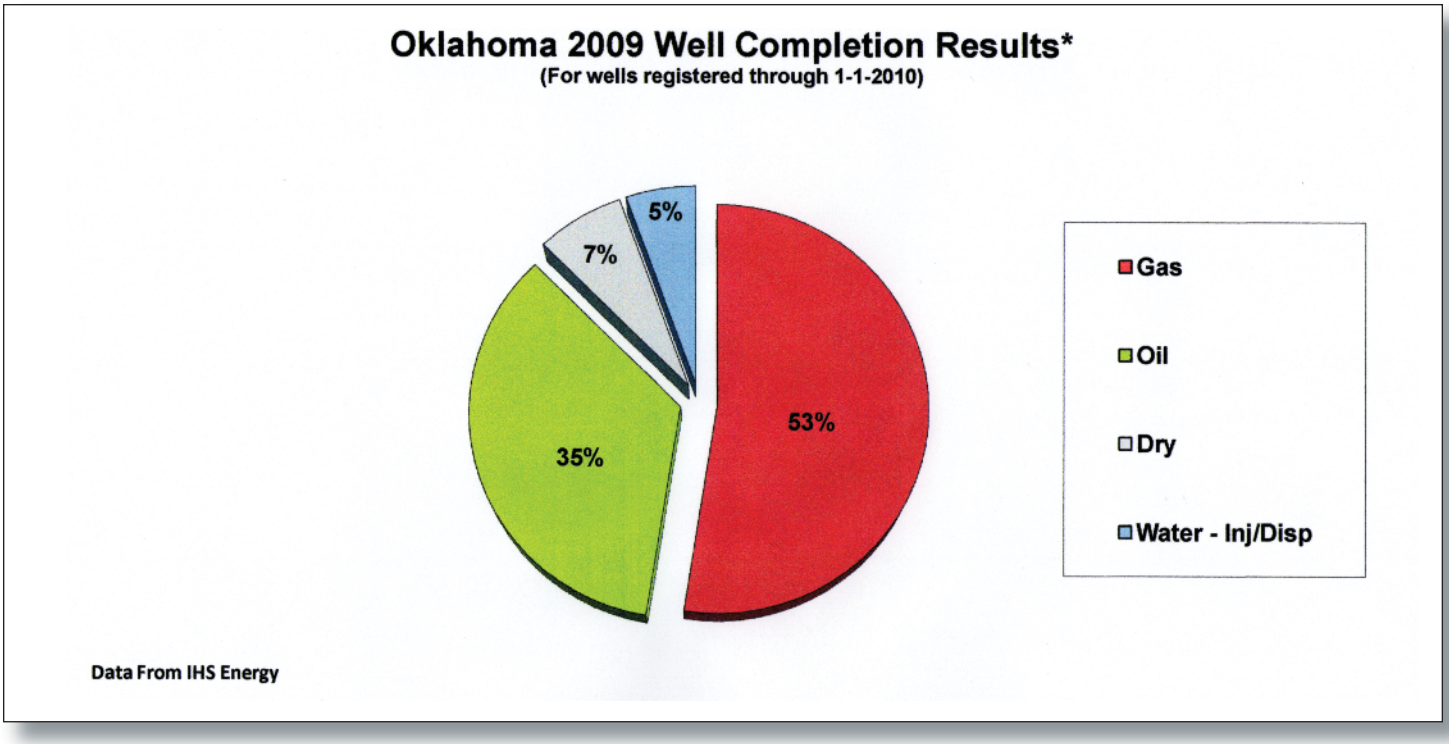


Figure 4. Oklahoma 2009 Well Completion Results (for wells reported through January 1, 2010). Data from IHS Energy (2010).

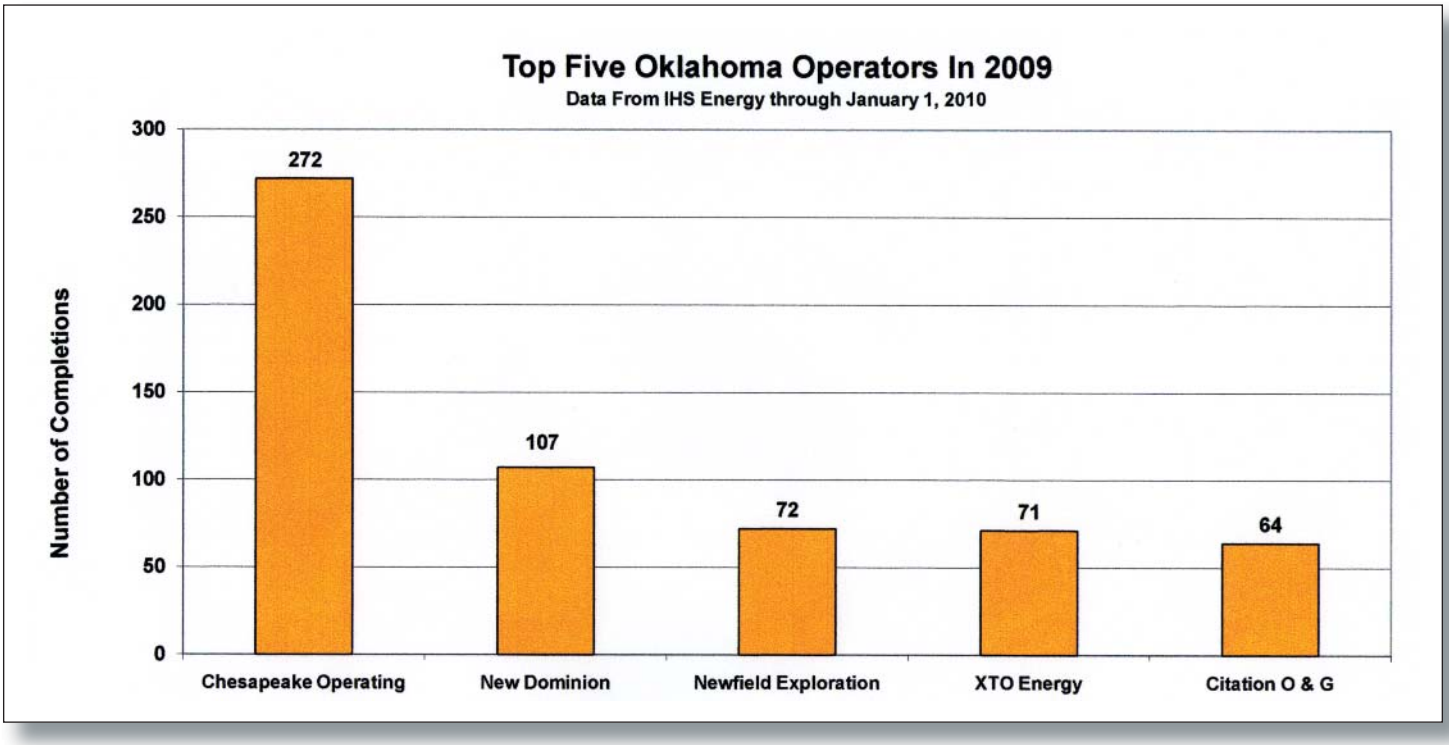


Figure 5. Top Five operators in Oklahoma in 2009, based on the number of completions registered through January 1, 2010. Data from IHS Energy (2010).

Water-injection and disposal wells represent about 5% of 2009 drilling with dry holes accounting for only 7% of the total. This overall 93% success rate is comparable to previous years and shows that drilling for both oil and gas in Oklahoma continues to be overwhelmingly developmental. Reporting delays increased the number of 2008 registered completions from last year's report by 33%. If this delay remains constant through the coming year, it is estimated that the total number of 2009 completions will be roughly 2,800, reflecting a 40% decrease over 2008's total of about 4,800 completions.

Hundreds of companies drilled wells in 2009, but Chesapeake Operating continues to be by far the most active operator (Figure 5). The 272 completions registered through January 1st are half the 545 completions that were assigned to them in last year's report. However, these still represent more than one in eight of all wells drilled in Oklahoma in 2009. Chesapeake drilled wells in almost every area of the State, but favorite targets were the Chester and Mississippian on the Anadarko Shelf and the Des Moines Granite Wash in the deep Anadarko Basin.

In order of number of wells completed, other major operators in 2009 include New Dominion, whose activity rose substantially from 2008. Their drilling is associated almost exclusively with dewatering projects, and these are concentrated in the Misener-Hunton in the central part of the State and the Arbuckle in the Oklahoma City Field. Newfield Exploration's activity was restricted to horizontal Woodford development in the main Woodford fairway located the western Arkoma Basin. XTO Energy's activity was divided mostly between horizontal Woodford development wells in the same area and gas development in a variety of reservoirs on the Anadarko Shelf. Citation Oil and Gas concentrated their activity in oil development in southern Oklahoma, mostly in the Healdton, Fitts, and Sho-Vel-Tum Fields (Figure 5).

**Horizontal Drilling**

Oklahoma has abundant conventional and unconventional low-permeability reservoirs. This has helped make horizontal drilling by far the most important drilling/completion technique to be recently applied in the State. Horizontal-drilling technology has made formerly unproductive areas and reservoirs profitable and revitalized reservoirs that have been producing for decades. Its share of drilling continues to grow with horizontal wells now representing 27% of all State drilling.

In addition to increased wellbore exposure to low-permeability reservoirs, horizontal drilling is useful in dewatering dual-porosity oil reservoirs. Dewatering is the process by which reservoir pressure is reduced in fields with natural water support through aggressive water production. This production triggers associated gas expansion in poorer (unswept) parts of the reservoir, forcing oil into the natural- and/or induced-fracture system and ultimately into the wellbore. Most of the notable wells listed in this report are horizontal completions.

Almost every significant productive reservoir in the State has been drilled horizontally somewhere, but some have been systematically exploited in well-defined area(s) which can be thought of as geologic plays. Using an arbitrary 50-well cutoff, there are three horizontal plays that, while still producing, are largely inactive in terms of drilling. Chesapeake utilized horizontal-drilling technology in the mid- to late-1990's to pursue mostly oil in the Sycamore carbonate in southern Oklahoma. Most of these wells are located in Sho-Vel-Tum Field and the Golden Trend. EOG Resources in western Texas County made another largely inactive horizontal play. Here they drilled about 70 horizontal gas wells between 2000 and 2003 in the Council Grove, mostly in Unity SW and Guymon-Hugoton Fields (Figure 6).

A much more scattered and diverse horizontal play is targeting the Mississippi Lime and Chat. The Mississippi Lime is a regional carbonate that is found across most of the State. Reservoir quality tends to be poor, but it is often fractured, and horizontal drilling affords the opportunity to encounter more of these fractures. This strategy seems to be behind gas drilling in McIntosh County in the northern Arkoma Basin as well as oil-targeted drilling along the northern shelf of the Anadarko Basin. Of particular interest in horizontal Mississippi Lime development is Chesapeake's drilling in northeastern Woods County. Here they have had some success (see Well #4) with multi-stage fracture stimulations on horizontal Mississippi Lime wells, 11 of which were completed in 2009 (Figures 6 and 7).

A related horizontal play, which because of inconsistent reservoir naming is here combined with the Mississippi Lime, is the Mississippi Chat. The Chat, a thin, siliceous zone of variable reservoir quality that intermittently develops on top of the Mississippi Lime, can be identified seismically. Horizontal wells located and oriented based on seismic anomalies have allowed operators to maximize reservoir exposure to the Chat. This play has been largely restricted to western Osage and Kay Counties on the Cherokee Platform (Figure 7).

In an aggressive dewatering project that utilizes horizontal drilling, New Dominion has targeted the Arbuckle in the Oklahoma City Field (Figure 6). Here they have drilled 51 horizontal laterals from 17 surface locations since 2004, with seven registered thus far as 2009 completions. Cumulative production stands at about 1.4 MMBO and 10.0 BCFG, with latest daily rates of about 1,000 BO and 13 MMCFG. New Dominion is now disposing over 145,000 BWPD, which is going back into the Arbuckle via horizontal wells drilled on the downthrown side of the field's trapping fault.

The most active horizontal plays and their drilling activity over the last five years are shown in Figure 8. The 2009

totals for each of the six categories listed have been increased by 33% in an attempt to account for the reporting delays described previously. This gives a more accurate year-to-year comparison and hopefully shows the direction that activity in these plays is taking.

The Woodford horizontal play appeared to remain nearly as active as it was in 2008. That this could happen in a year in which natural gas prices fell by over half (Figure 3) is probably due to the fact that a large number of expensive leases are nearing expiration. Most of the horizontal Woodford drilling in 2009 was concentrated within or close to established fairways. The largest of these lies in the western Arkoma Basin in a broad trend extending from north-central Pittsburg and Hughes through Coal and western Atoka Counties. In 2009 this fairway expanded eastward, becoming more contiguous with satellite areas located in Pittsburg County. Many operators were active in this area, but Newfield Exploration continues to be the dominant player (see Well #11).

The smaller fairway located in the Anadarko Basin in western Canadian County saw 46 horizontal Woodford wells completed in the last 12 months. Most were located within the established productive area, but others will enlarge the play west and south into Blaine and Caddo Counties (Figure 6). Overall, Devon Energy and Cimarex Energy were the most active operators in 2009 in this area (see Well #8).

The last area of major horizontal Woodford drilling is located on the northern flank of the Ardmore Basin. After more than two-dozen completions in 2009, disconnected groups of wells will merge into a more contiguous trend extending from northeastern Marshall into north-central Carter County (Figure 7). This area tends to produce more liquids than the western Arkoma or Anadarko Basin parts of the play (see Well #9).

Since 2005, about 1,100 horizontal Woodford wells have been drilled, about a third (363) of which will be completed in 2009. There are now 919 horizontal producing wells and these have brought production in four years to over 880 MMCFGPD. Cumulative horizontal Woodford production now stands at about 493 BCFG. This yields an average per-well cumulative volume of just over one half BCFG and an average rate of about 960 MCFGPD (IHS Energy, 2010). Al-

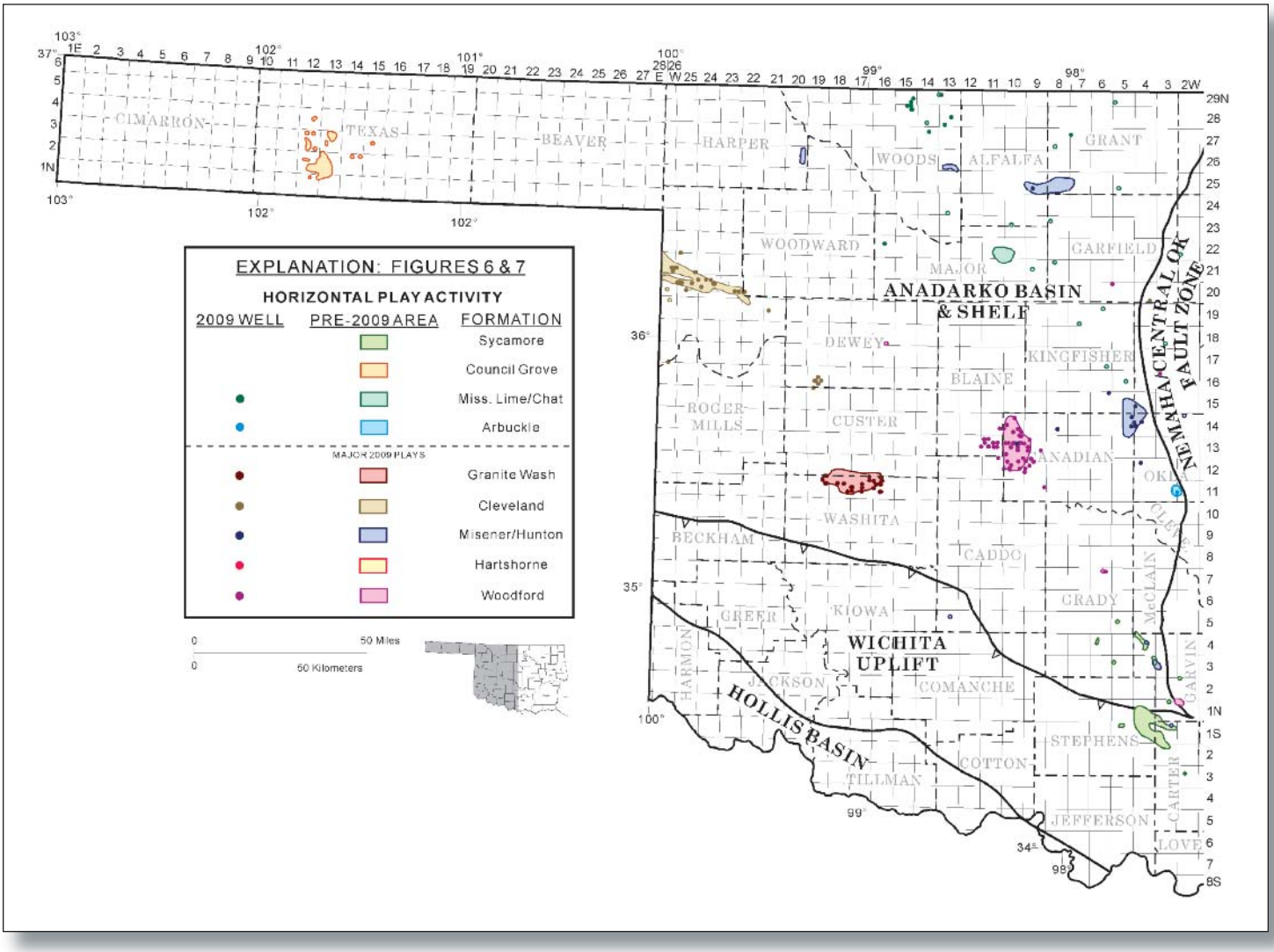


Figure 6. Map of major (> 50 completions) western Oklahoma horizontal drilling plays. Outlines show productive areas before 2009 with dots showing 2009 completions. Areas and activity are from IHS Energy (2010). Geologic province boundaries are modified from Northcutt and Campbell (1995).

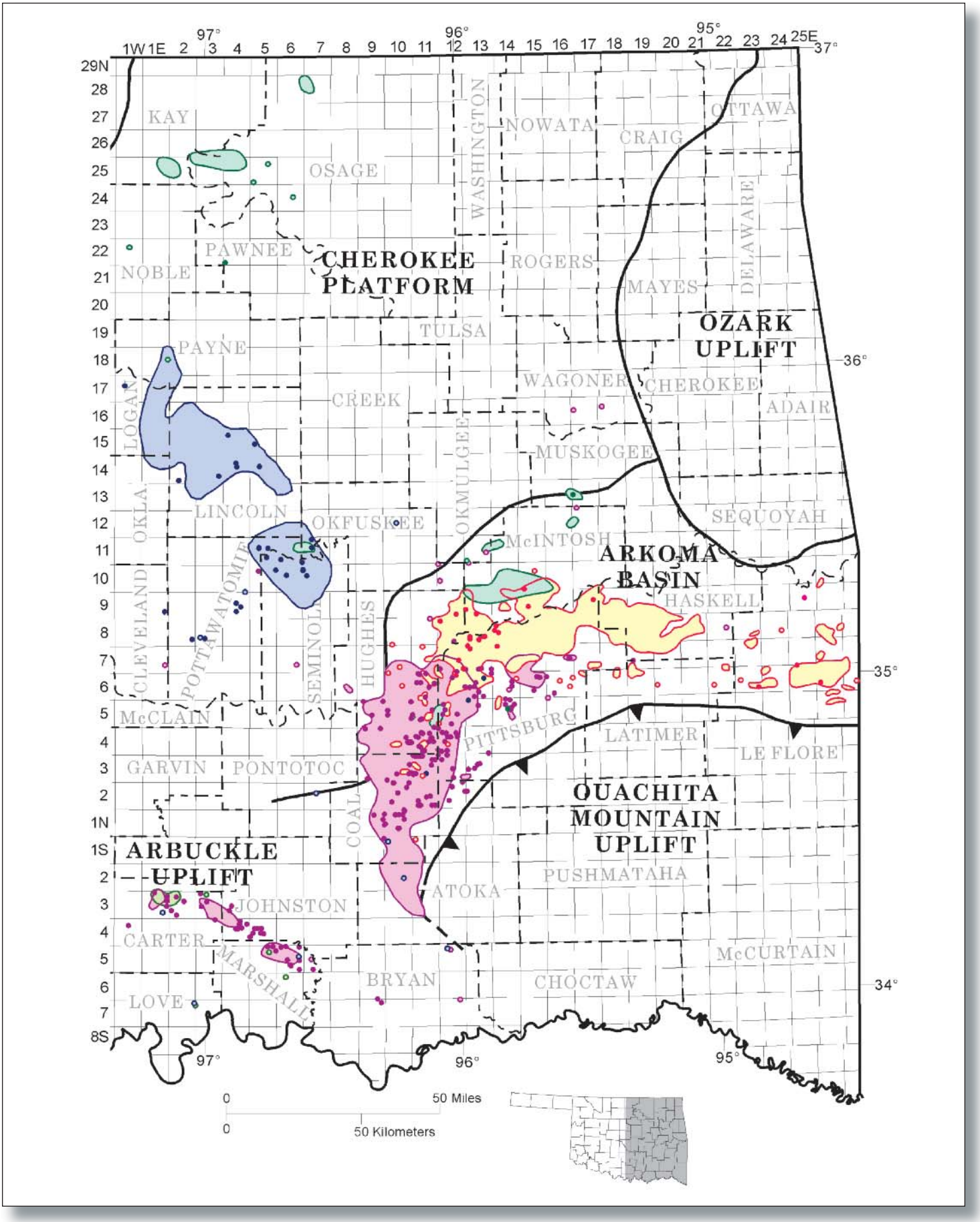


Figure 7. Map of major (> 50 completions) eastern Oklahoma horizontal drilling plays. Outlines show productive areas before 2009 with dots showing 2009 completions. Areas and activity are from IHS Energy (2010). Geologic province boundaries are modified from Northcutt and Campbell (1995).

though true of all plays, but especially so because of its high initial declines, the direction that Woodford production takes from here will be entirely dependent on drilling activity, which in turn is dependent on the price of natural gas.

Hartshorne coalbed methane has been exploited in the Arkoma Basin with horizontal wells for more than a decade. During this time over 1,550 wells have been drilled. However, the fall in natural gas prices has reduced horizontal Hartshorne drilling activity by about 85%, giving it the largest decline in activity for any major horizontal play in 2009 (Figure 7). Before being eclipsed by the Woodford in 2007, the Hartshorne coalbed play was by far the most active horizontal play in the State. Cumulative horizontal Hartshorne coalbed methane production now stands at 336 BCFG with a current daily rate of 142 MMCFGPD. Cumulative production for the average well now stands at 214 MMCFG at a current rate of about 150 MCFGPD.

Dewatering has found its greatest application in the Hunton (Misener/Hunton) reservoir where nearly 1,000 wells have been drilled in the last seven years. This method of production has been pursued in a number of areas but is mostly concentrated in central Oklahoma in and around Lincoln and Seminole Counties. Like the Woodford, this play remained strong in 2009, largely due to the efforts of New Dominion, who accounted for over half of the 2009 Misener/Hunton horizontal drilling in Oklahoma. Most of this drilling has stayed within previously established fairways (Figure 7).

Horizontal drilling activity targeting the Cleveland sandstone fell by about a third in 2009, presumably because the most prospective acreage in the established trend has been drilled. Horizontal Cleveland activity had been restricted to central Ellis County (and the Texas Panhandle), but in the past year a number of outliers have been drilled, the most notable being six new wells mostly in southwestern Dewey County (see Well # 2). This new area is 30 miles from the main fairway and is characterized by high initial gas rates with varying volumes of condensate with gravities up to 48º API. Similar production characteristics are seen in the main fairway in Ellis County, but it is not yet known if horizontal Cleveland production in these two areas will eventually be linked into a single large trend (Figure 6).

The Des Moines Granite Wash horizontal play (see Well #5) is located in the deep Anadarko Basin in Washita County (Figure 6). Vertical wells have produced from this formation since the mid-1980s, but horizontal production only began in April 2007. In slightly more than two and a half years this play has produced about 50 BCFG and 2.8 MMBC at a rate of 120 MMCFG and 11 MBC per day (IHS, 2010). Despite the fact that most of the 72 producing wells have been on line for under a year, this yields an average per well recovery thus far of about 700 MMCFG + 40 MBC. In the Des Moines Granite Wash play Chesapeake operates 66 of the 76 horizontal wells, which they call their Colony Wash Play. The play has increased in activity every year and this is ex-

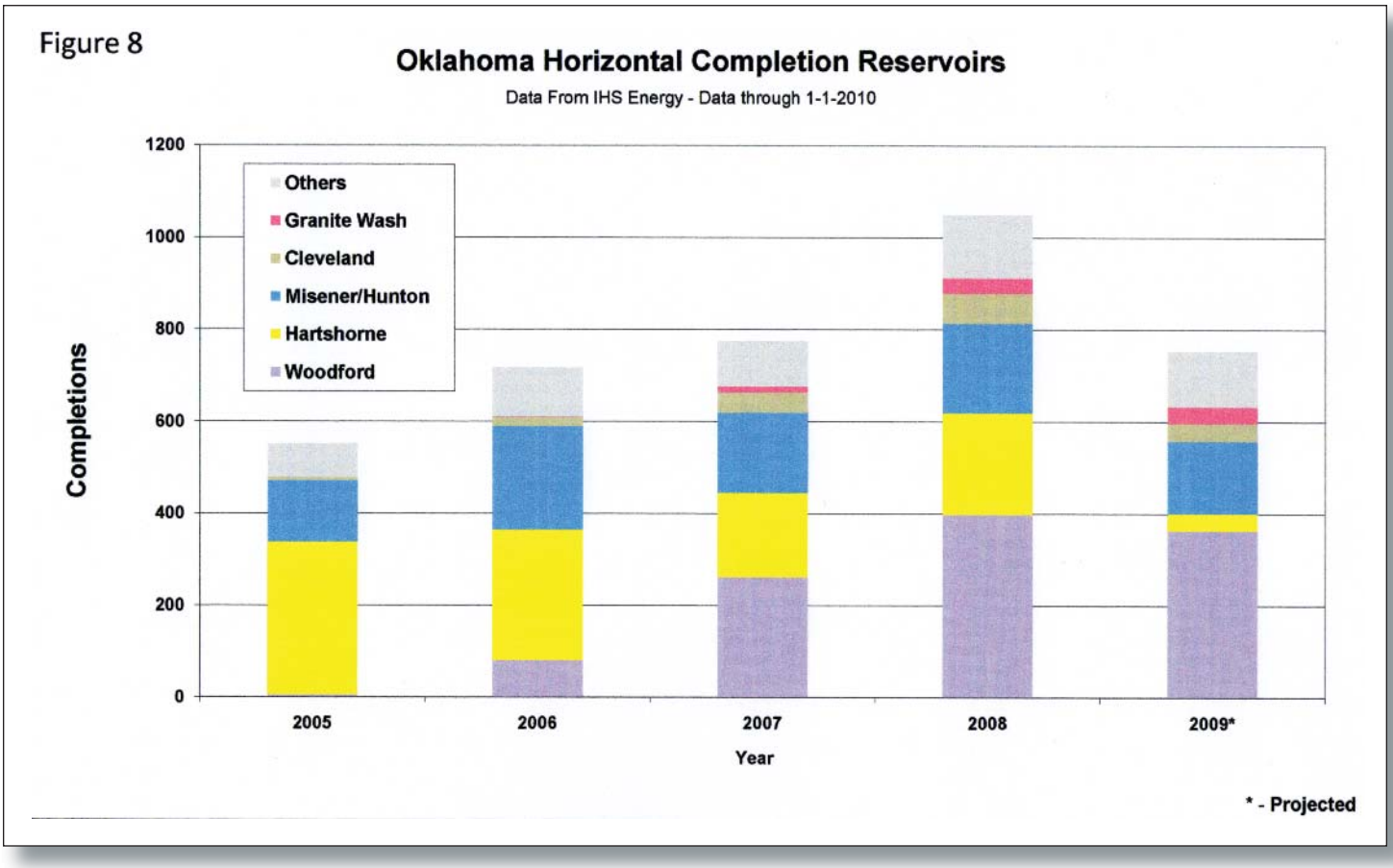


Figure 8. Oklahoma horizontally completed reservoirs from 2005 through 2009. Completions for 2009 have been increased to account for anticipated reporting delays. Data from IHS Energy (2010).

pected to continue as Chesapeake indicates that it will drill 40 net wells in 2010 using the seven rigs that it has now dedicated to this play (Chesapeake Energy, 2009). Numerous staked locations and uncompleted wells suggest that this play will expand both east and west from its current 'sweet spot' in north-central Washita County.

The Oklahoma oil and gas industry is applying horizontal-drilling technology to a variety of other reservoirs across the State. Many wells are clearly sub-economic, but others are showing promise. These wells are classified as 'Other' in Figure 8. Reservoirs that are being more actively pursued include the Tonkawa, Sylvan, and Viola, each of which has 15 to 20 completions registered for 2009. These or others may eventually develop into larger horizontal-drilling plays. With Oklahoma's myriad reservoirs exhibiting low-permeability, dual-porosity systems, thick transition zones, or compartmentalization, it is virtually certain that other plays will emerge in the future.

**Significant Wells in 2009**

The following is a list of what are, or may become, significant wells for 2009 in Oklahoma. It is based on a weekly review of wells described in the IHS Energy *EnergyNews on Demand* Mid-Continent activity reports that were released online throughout the year. An initial list of 138 possibilities compiled from this publication was distilled to a total of 13. Such a list is necessarily subjective and may miss wells that could eventually become noteworthy. Due to confidentiality issues, wells that may be notable for technical reasons will probably be missed. For instance, those that confirm some new type of trapping style or proved the benefit of a new completion technique will be difficult to identify until information is disseminated years later.

The wells shown here are of two general classes - those that establish significant production more than one mile from existing production in the same reservoir, which is the stan-

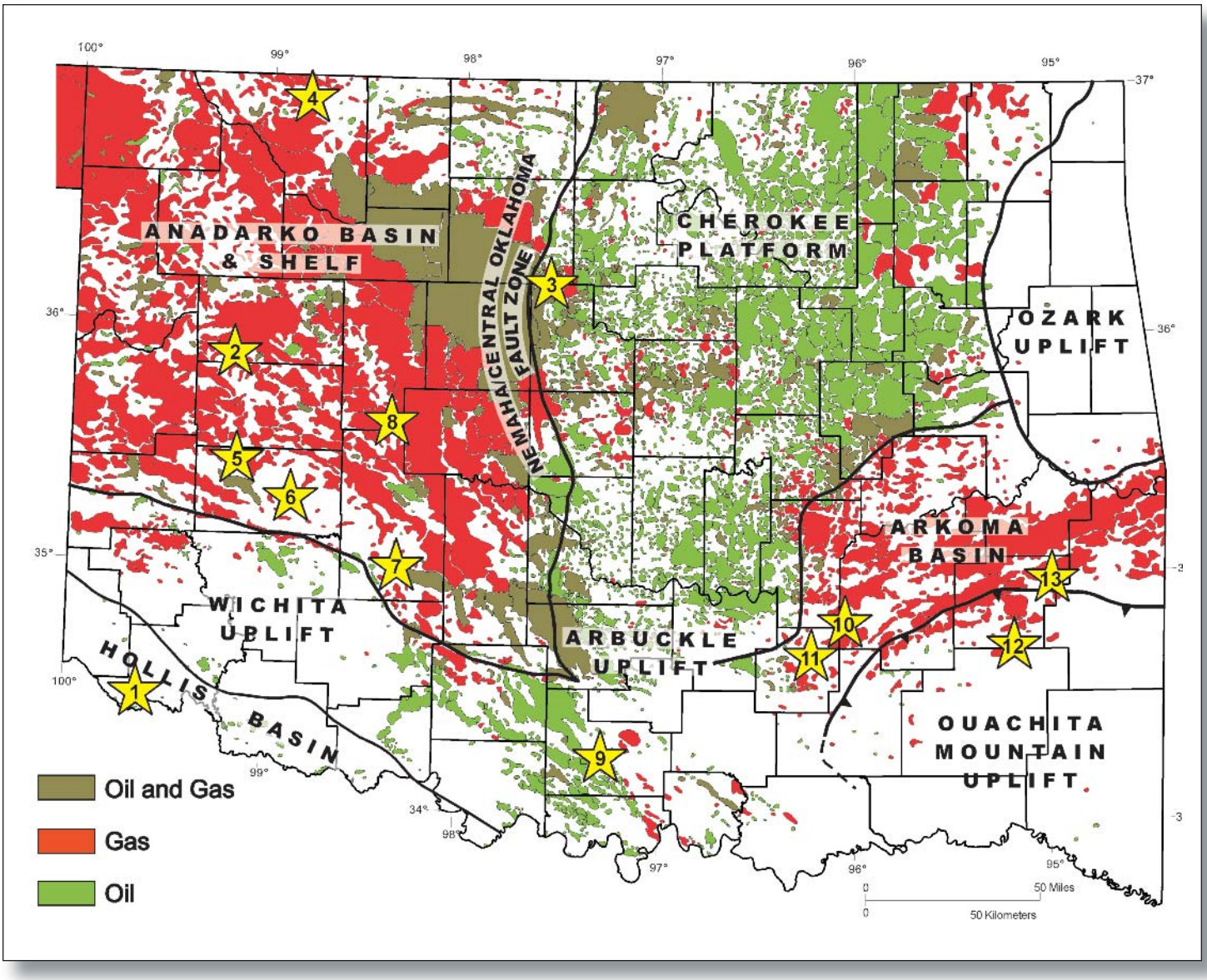


Figure 9. Map of Oklahoma oil and gas fields, distinguished by GOR, showing location of significant wells reported for 2009. Modified from Boyd (2002). Geologic province boundaries modified from Northcutt and Campbell (1995).

dard to be considered a discovery, and those that are notable for other reasons. The latter include rank wildcats, major play expansions, or wells that prove the benefit of new production and/or completion techniques. The following are wells reported as completed in 2009 that are considered significant (Figure 9).

**1)** Sec. 29-1S-23W (Jackson County): GLB Exploration is in the process of testing the State's first horizontal Barnett Shale well – the 1-29 Hatch. Located in far southwestern Oklahoma in the Hollis Basin, the well is three miles from the Texas border. At last report the well had reached its pre-drill projected depths: measured depth (MD) of 12,481' and a true vertical depth (TVD) of 8,400'. The Barnett Shale in the Fort Worth Basin was the first major shale gas reservoir to be exploited in the world. The horizontal drilling and completion techniques that were pioneered there laid the groundwork for all future shale gas plays. Success or encouragement with the Hatch well will likely set off additional drilling and potentially initiate a new play for the State.

**2)** Sec. 28-16N-19W (Dewey County): An area with two isolated horizontal Cleveland wells in western Dewey and Custer Counties received a boost in 2009 with the drilling of five additional wells. The best of these was the JMA Energy Chester Owens #1-28H. This well had an initial potential of 6.9 MMCFGPD + 379 BCPD (45º API) from an open-hole completion in the last 400' of a 4,300' lateral. This interval (TVD 9,768') was fracture stimulated in a single stage with about 850,000 pounds of sand. In four months of production the Owens made 681 MMCFG + 18 MBC with a rate in its last month of 5.8 MMCFGPD. This area is about 30 miles southeast of the main Cleveland horizontal fairway located in Ellis County and indicates that the productive limits of this reservoir are far from defined (Figure 6).

**3)** Sec. 35-20N-4W (Garfield County): Underscoring this statement, Kirkpatrick Oil drilled a horizontal Cleveland well over 100 miles northeast of the JMA Energy well (Figure 6). Completed in a 2,500' lateral (TVD 5,180') that was fracture stimulated in a single stage with 400,000 pounds of sand, the LaDonna #1-35H had an initial flowing potential of 103 BO + 485 MCFG + 445 BWPD. In its first six months online the well produced a relatively modest 10 MBO with a rate in its last month of 60 BOPD. History shows that horizontal recoveries can improve dramatically as drilling/completion practices are refined and integrated with geology. Time will tell if this area will become a focus of horizontal Cleveland Sandstone production.

**4)** Sec. 3-28N-15W (Woods County): Widely scattered horizontal Mississippi Lime production (Figure 6) found at least a temporary focal point with the drilling of the Chesapeake Serenity 1-3H. Completed in January 2009, this well had an initial flowing potential of 1,250 BO + 1,064 MCFG + 1,392 BW per day with a MD of 9,212' and a TVD of 5,071'. The well was perforated from 5,480' to 9,156' and acid-fracture stimulated in seven stages with about 125,000 pounds of sand per stage. Several follow-up wells have been drilled around the Serenity, each fracture stimulated in a single large (800,000-900,000 pound) stage. In its first ten months online the Serenity has produced about 61 MBO and 82 MMCFG. Chesapeake's four follow-up wells had initial potentials between 48 and 271 BOPD, but none in three to five months has produced more than 2 MBO and 8 MMCFG. Time will tell if elaborate acid-fracture stimulations are economically justified in the Mississippi Lime.

**5)** Sec. 13-11N-19W (Washita County): A well for which economics are not in question is the Chesapeake Huls USA #1-13H. Completed in February, this well was drilled in the Des Moines Granite Wash with a MD of 16,851' and TVD of 12,527'. Its initial potential was, for this play, a modest 5.734 MMCFGPD. However, in its first eight months of production it has made 1.994 BCFG and 32 MB of 55º API condensate. Even more impressive than cumulative production is the fact that in its last month of production the Huls USA was making 15 MMCFGPD. This well produces from a 4,156' lateral that was fracture stimulated in a single stage with about 2.1 million pounds of sand. Located on the western edge of the current play fairway (Figure 6), future drilling will certainly expand this play in the coming year.

**6)** Sec. 16-9N-16W (Washita County): Chesapeake has established excellent production in an almost unproductive township in the deep Anadarko Basin. Their South Fork #1-16 was completed in late 2008, but did not register until this year. It was drilled southwest of the only productive well in the township (10-9N-16W), which is the GHK Garst #1-10. A 22,850' well drilled in 1981; it produced 1.1 BCFG from the Morrow. Chesapeake perforated the Springer in their new well from 21,536-544' and fracture stimulated it in two stages with about 200,000 pounds of sand. Although the South Fork's initial potential was 6.6 MMCFGPD, in its last month online it was producing 8.2 MMCFGPD, and has cumulative production in 12 months of 3.1 BCFG. Chesapeake has offset the South Fork with a well (Merkey #1-15) in Section 15. This well has no listed initial potential, but produced an average of 5.2 MMCFGPD in its first month. Chesapeake has permitted two additional wells in Sections 10 and 20 of the same township.

**7)** Sec. 10-6N-11W (Caddo County): Continuing on the success of their Norma Jo well (Sec. 6-6N-11W) that appeared in the 2007 drilling highlights report (Boyd, 2008), St. Mary Land & Exploration drilled two excellent development wells and a 2.5-mile step-out to their production in Broxton North Field. This step-out, the #1-10 Wilt, had an initial potential of 6.2 MMCFGPD in the Springer from perforations from 19,982-20,002'. In its first 11 months online this well has produced about 1.8 BCFG and continues to produce at an average rate of 4.1 MMCFGPD. This is the 6th deep Springer well to be drilled by St. Mary in this area in the last two years. In the last reported month these wells

were producing a combined 50 MMCFGPD and had a cumulative production of about 23.5 BCFG.

**8)** Sec. 21-13N-11W (Blaine County): Although not the best horizontal Woodford well drilled in the Anadarko Basin in 2009, the Marathon Hicks BIA #1-21H was the best step-out from the established producing trend. Highlighting the pitfalls in judging wells based only on their initial potentials, this well initially tested at only 1.3 MMCFG + 1200 BWPD. However, in its first seven months of production it has made 706 MMCFG with a rate in the last month of about 3.0 MMCFGPD. The well produces from a 3,800' lateral (TVD 14,170') that was fracture stimulated with a total of about 1.3 million pounds of sand introduced over an 8-stage treatment.

**9)** Sec. 15-4S-1W (Carter County): In a major step-out, XTO Energy completed a horizontal Woodford oil well 7.5 miles southwest of the nearest Woodford production in the established producing trend in the Ardmore Basin. The Prairie Valley #1-15H had an initial potential of 310 BO + 2,154 MCFG + 1,946 BWPD from a 3,780' lateral with a TVD of 10,834'. The well was fracture stimulated in a single stage with 100,000 pounds of sand, which is very modest by Woodford standards. The well has not yet been put on production, but any encouragement has the potential to dramatically increase the prospective area for horizontal Woodford in the southern Oklahoma.

**10)** Sec. 29-4N-12E (Pittsburg County): Based on cumulative production, the best horizontal Woodford well drilled in 2009 in the main area in the western Arkoma Basin was BP America's IGOU #1-29H. Cumulative production for this well is 1,309 MMCFG in nine months on line. Of note is the fact that in its last month it was still producing at a rate of about 3.5 MMCFGPD, which is just below its initial potential of 3.65 MMCFGPD. This well produces from a 3,500' lateral (TVD 8,583') that was fracture stimulated with 1.5 million pounds of sand in a one-stage treatment.

**11)** Sec. 22-2N-10E (Coal County): In a demonstration that there is more to drill horizontally in the western Arkoma Basin than just the Woodford, Newfield Exploration has five laterals planned from a single surface location. Their Cunningham well has three Viola laterals planned (3H, 4H, and 5H), one Woodford lateral that is already producing (1H), and a Cromwell lateral (2H) that was recently completed. The Cromwell completion was made in a 4,900' lateral at a TVD of about 7,600'. This well underwent a 10-stage fracture stimulation with about 300,000 pounds of sand per stage. The initial potential was 6.5 MMCFG + 1,010 BWPD. Two Woodford laterals from another surface location are already producing in this section, each with a cumulative production of about 900 MMCFG and a current rate of about 1.3 MMCFGPD.

**12)** Sec. 34-3N-20E (Latimer County): Although it was completed as a dry hole, GHK set a benchmark in 2009 by drilling the deepest well in the Arkoma Basin. Drilled to 26,100', the #2-34RE Mary well was the reentry of a deep (20,628') Jackfork producer in the Potato Hills Field. This well produced about 475 MMCFG through perforations from 18,235-18,347'. The reentry tested subthrusted Oil Creek and Arbuckle from 25,170-25,422'. This interval was treated with about 300,000 pounds of bauxite, but tested gas a rate that was too small to measure.

**13)** Sec. 20-6N-22E (Latimer County): The Atokan Red Oak sandstone has produced gas for decades across a broad swath of the Arkoma Basin through Pittsburg, Latimer and Le Flore Counties. Since 2007 BP America has drilled and completed 15 horizontal Red Oak producers in part of this trend within the Red Oak Field. In an average producing life of about one year these wells have produced a combined 12.5 BCFG and continue at a rate of about 28 MMCFGPD; this despite the fact that they lie in a sea (~ 40-acre spaced) of vertical Red Oak producers. The BP Martin Unit #C-12 was completed in June and in its first month made 227 MMCFG. This average rate of 7.5 MMCFGPD was 3 times its initial potential of 2,579 MCFGPD. The C-12 well was completed in a 3,600' lateral (TVD 8,024') and fracture stimulated in one stage with about four million pounds of sand. Time will tell how much gas can be recovered from the less permeable parts of the Red Oak reservoir that the vertical wells have been unable to access, but if this technique can be applied throughout the play, the potential is enormous.


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Dan Boyd is a petroleum geologist with the Oklahoma Geological Survey, where he has been employed since 2001. Dan received his Master of Science degree in geology from the University of Arizona in 1978. He spent the first 22 years of his career as an exploration and development geologist in the petroleum industry. From 1978 through 1991 he worked on a variety of areas in the United States from Houston, Dallas, and Oklahoma City for Mobil Oil and Union Texas Petroleum. In 1991 he moved overseas, working in Karachi Pakistan for four years and Jakarta Indonesia for the following four. He returned with his family to the U.S. in 1999 with Arco (the successor to Union Texas) where, until Arco's sale to BP, he worked the offshore Philippines from Plano, Texas.

Since joining the OGS staff Dan has presented and published several reports on the history, status, and future outlook of the oil and gas industry in Oklahoma. He chaired the 2002 Symposium on Cherokee Reservoirs in the Southern Midcontinent (OGS Circular 108), and prepared and presented a workshop on the Booch gas play in southeastern Oklahoma (Special Publication 2005-1). His most recent study of oil reservoirs and recovery efficiencies (Shale Shaker May/June, 2008) demonstrates that large volumes of producible oil remain in the ground and that a major barrier to finding and producing this oil is shortcomings in State oil and gas data. Dan serves on the board of Energy Libraries Online (ELO) from a conviction that the long term success of the Oklahoma industry depends on improving both the completeness and accessibility of State oil and gas data.

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