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# The Tight Oil Renaissance: Delivering on the Promise

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# Situation Summary

## The Playing Field

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- Oil market turbulence - geo-political & economic uncertainty
  - U.S. & OECD oil demand reaches a plateau
  - Supply anxiety with high oil prices & low U.S. gas prices
  - Rebalance diverse new supplies to markets
  - Western hemisphere moving toward energy independence
- The Crush of Above Ground Uncertainty
  - Picking the winners - Keystone XL, Renewables
  - Concerns for the environment – climate change
    - Fear of fracking - water management - “Mismeasuring Methane”
  - Increased public expectations for corporate responsibilities
- Challenging business conditions
  - Increasing costs
  - Competition for capital, equipment & HR
  - Technology imperative

# Introduction: The Market Environment

## *What has changed since January 2011?*



- Multi-speed global recovery
- 2011 U.S. GDP 1.7%



- U.S. moderate expansion
- 2012 U.S. GDP ~ 2.2%



- 2011 (January) Henry Hub at \$4.52 per Mcf
- Storage = 2,353 bcf



- 2012 (April) Henry Hub at \$1.92 per Mcf
- Storage = 2,478 bcf (+54%)



- WTI oil price at \$86.16 / bbl



- WTI oil (April) at \$99.89 / bbl



- Rigs: Oil Gas Horiz %  
793 909 968 56%



- Rigs: Oil Gas Horiz %  
1328 613 1139 58%

# U.S. Unconventional Gas Future



- Low-cost natural gas resources deliver major competitive advantages for the U.S. economy
  - Jobs: 2010 = 600,000; 2035 = 1,600,000
  - GDP: 2010 = \$76 billion; 2035 = \$231 billion
  - Taxes 2010-2035 = \$ 933 billion
  - Facilitates transformation to clean energy w/o subsidies
- E&P is rebalancing to a lower natural gas price scenario
  - 2012 average ~ \$2.26; recovery in 2013
  - Correction in dry gas drilling under way as operators focus on liquids-rich plays
  - Production curtailments and delayed connections
  - Be as creative finding gas markets as in finding the gas!

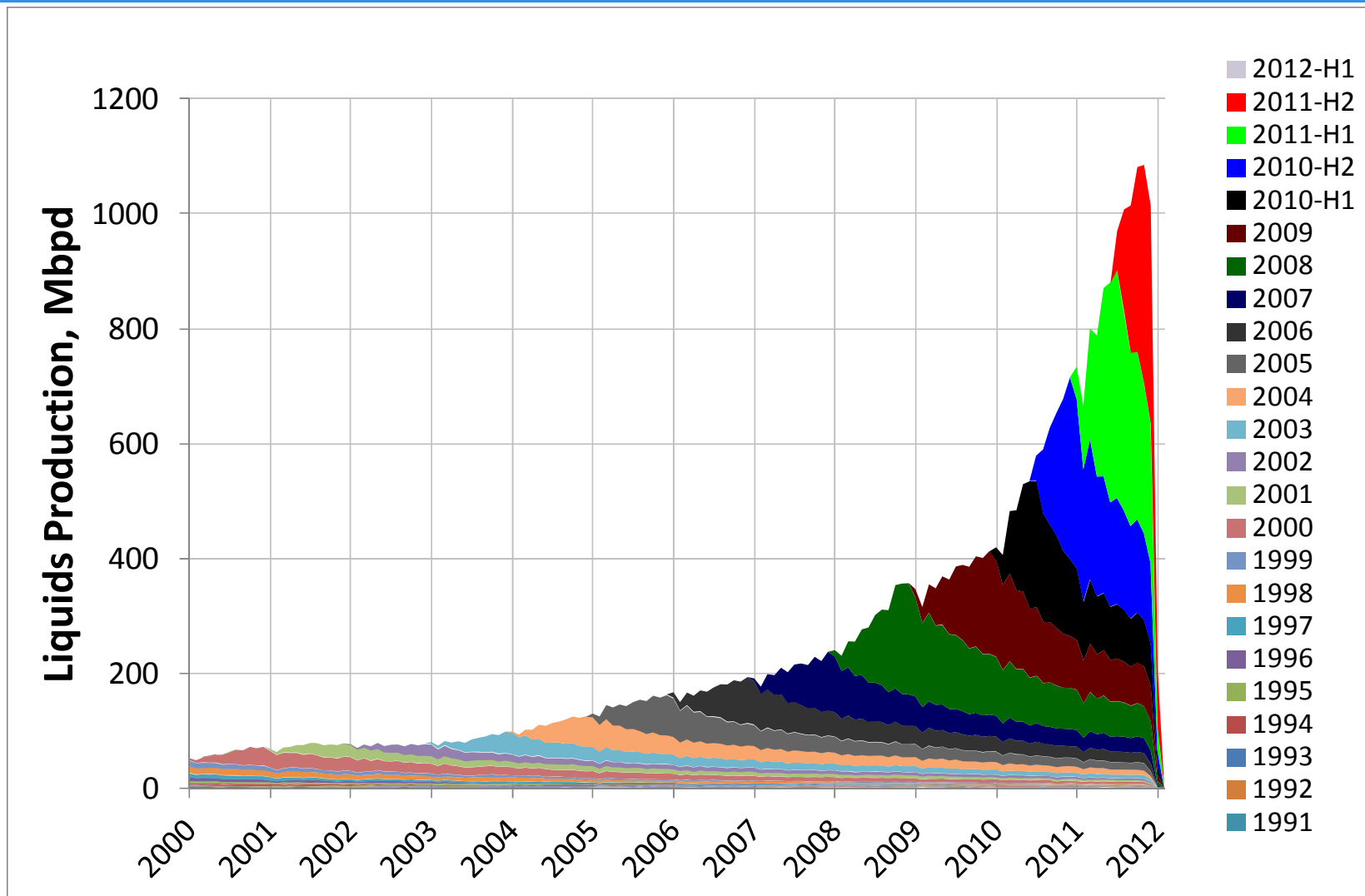
# Tight Oil – “The Great Revival”

## Established and Emerging Plays

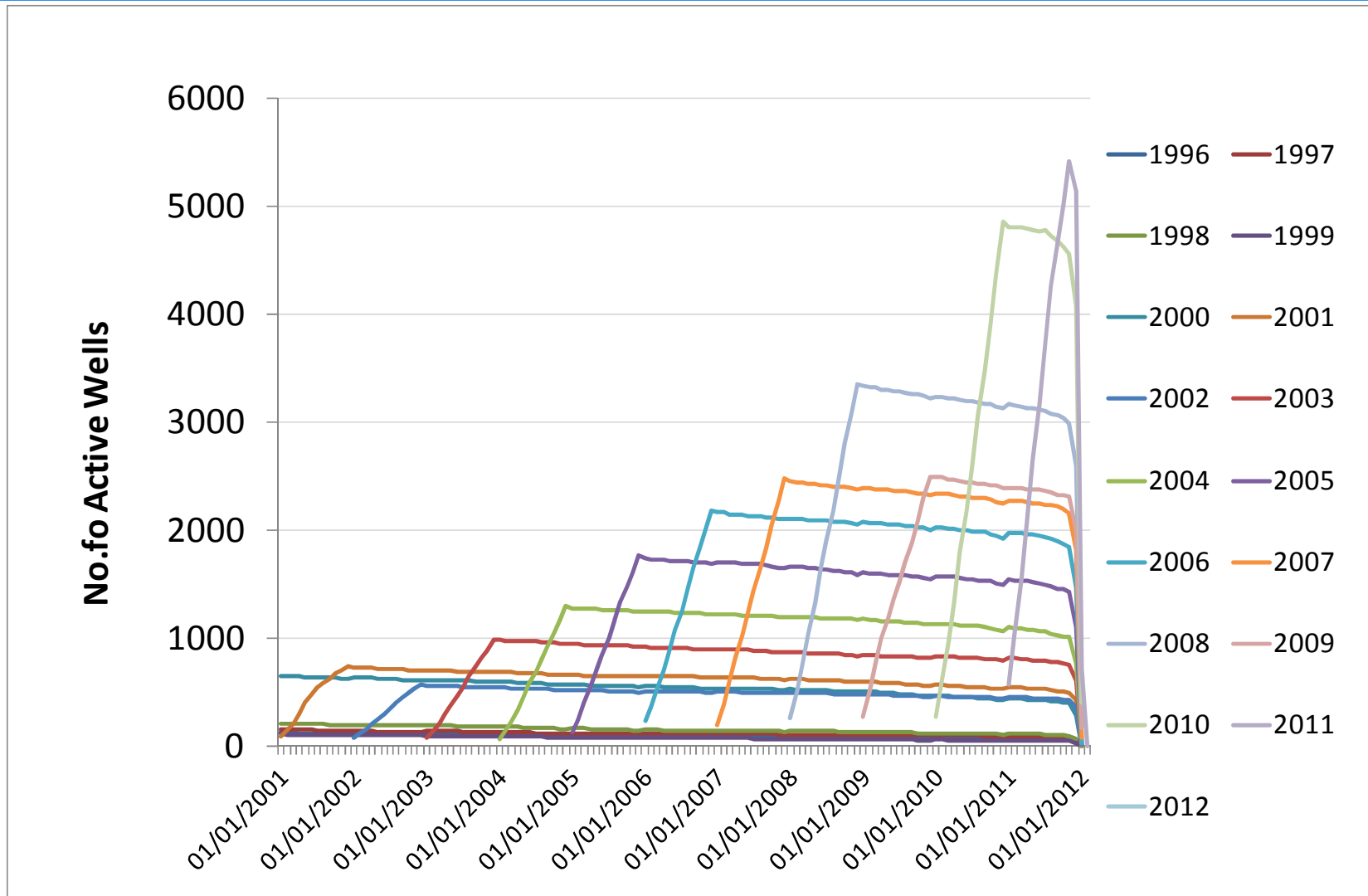


# U.S. Tight Oil Production > 1 MMb/d

## 2011 U.S. Onshore Oil Production + 586 Mb/d



# U.S. Tight Oil Activity Soaring > 5,000 Wells Drilled in 2011

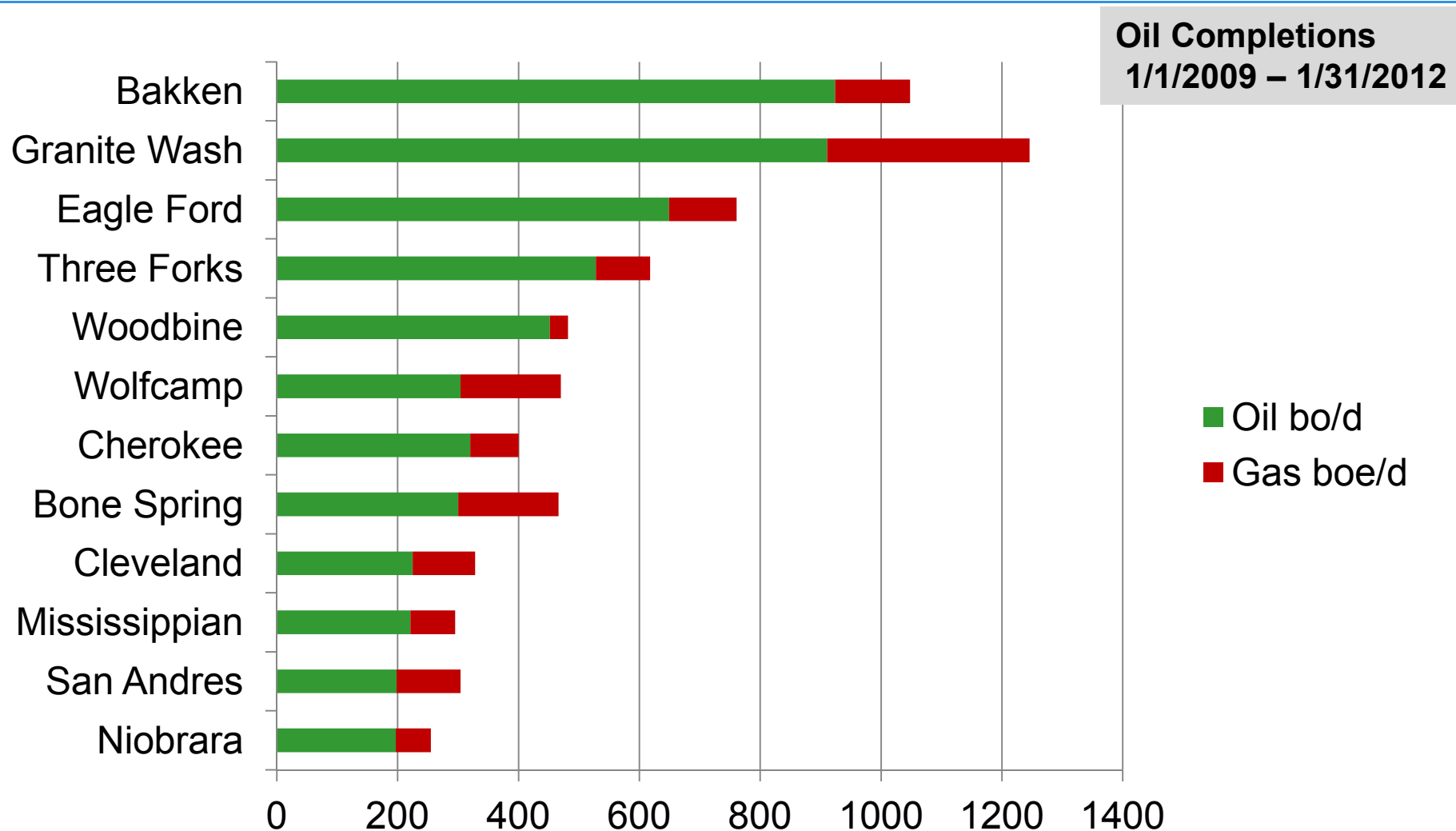




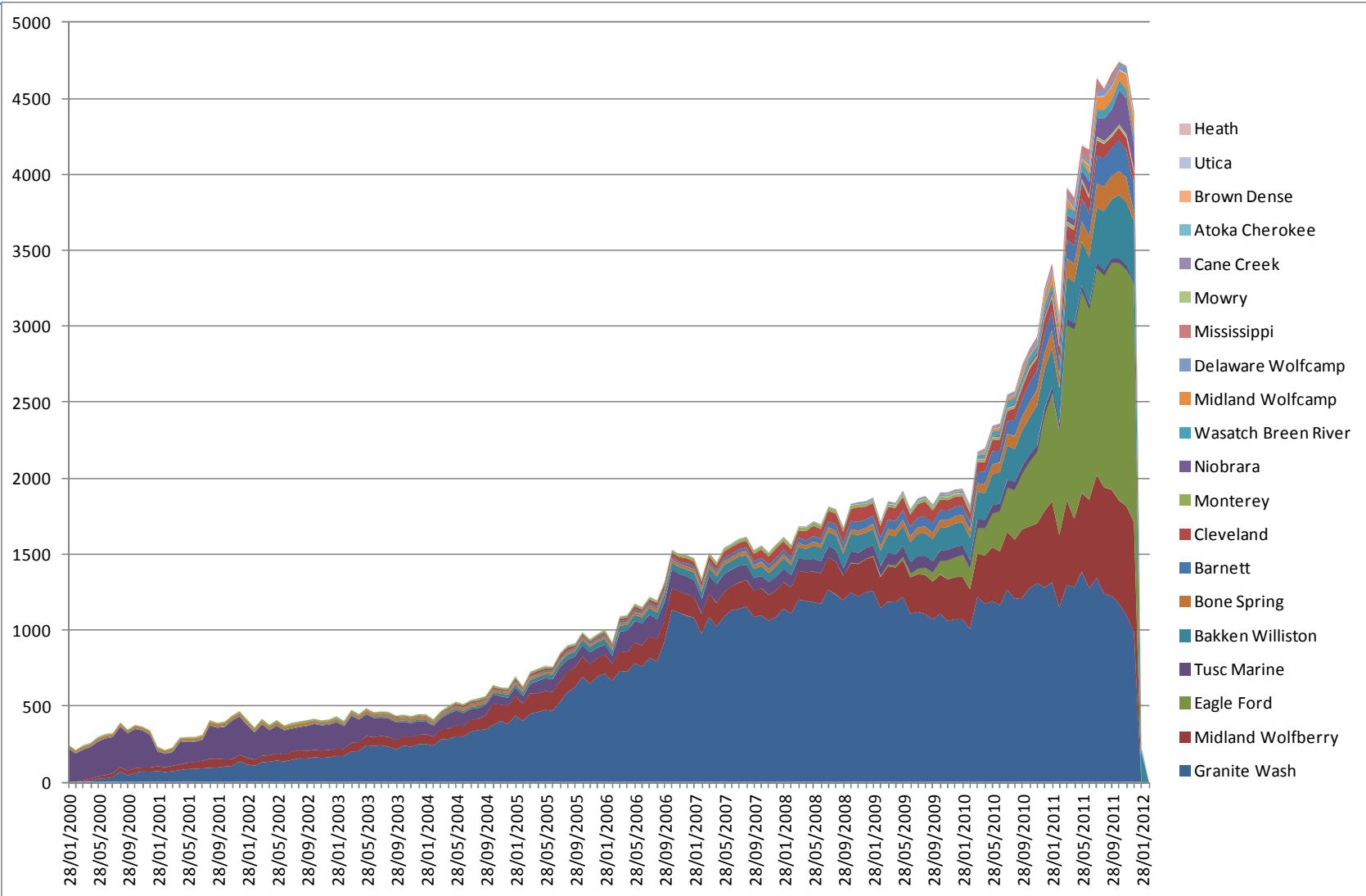


# Leading U.S. Tight Oil Plays

## Horizontal Well Average Oil + Gas IP (boe/d)



# Tight Oil Plays Drive Gas Production + 1.8 Bcf/d Since 1/1/2010



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Tight Oil Revival May 2012

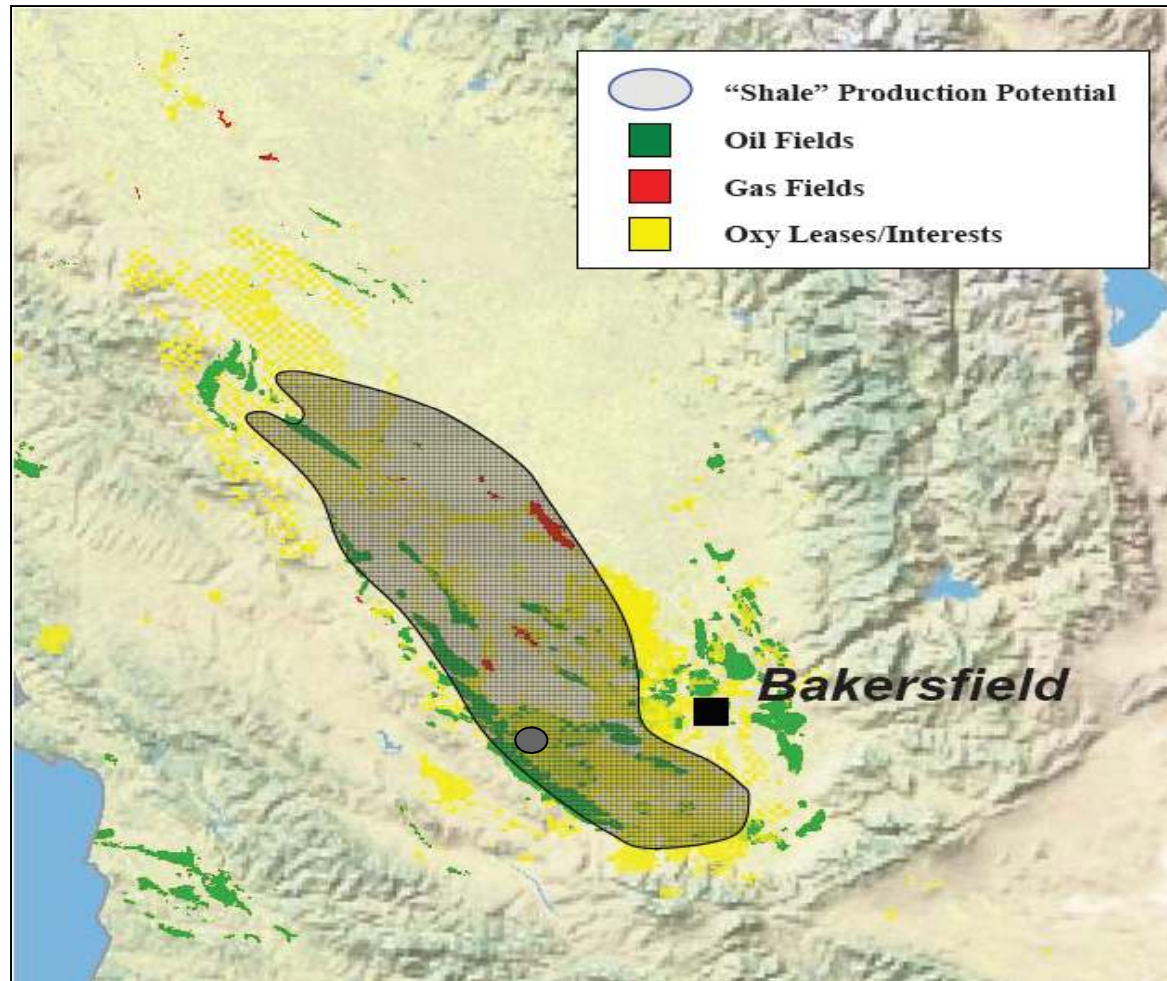


# Monterey Formation – The Great Facies Mix

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- Background: The Monterey Formation consists of several unique, largely conventional plays and reservoirs located in the San Joaquin Basin and the Los Angeles Basin
- Estimates of 300 Bbo in place and 1.5 – 2.0 Trillion cubic feet of gas
- The formation is young and hot—peak oil generating window
- **Production: Annual San Joaquin Basin production from 2007-2010 while prolific has been declining from 460,000 bopd in 2007 to 410,000 bopd in 2010 to 399,989 in 2011**
- Drilling: The play has historically been characterized by Vertical Oil wells, but horizontal drilling reached maximum levels in the early 2000s, but has now reverted back to vertical drilling
- Top Operators: Occidental Petroleum, Chevron, EOG, Venoco and AERA Energy have the greatest presence, followed by a few small private O&G companies.
- Regulatory: Recent revelations about fracturing, previously unknown to residents has caused some controversy and led to an initial finding that county level land use permits were violated.

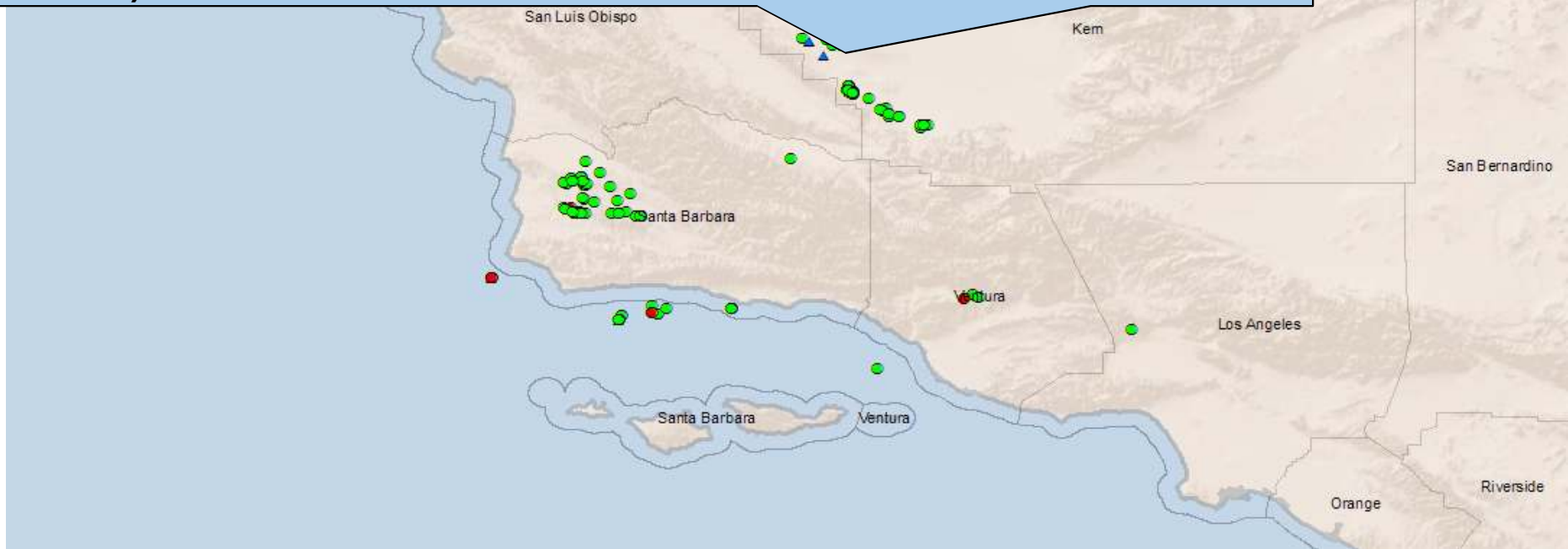
# A number of prolific fields have produced over 50 billion barrels of oil in the last century from the San Joaquin Basin



# Monterey



- Conventional sandstones have produced a majority of the historical oil
- Fracture porosity in less permeable zones
- Diatomites (Belridge Fields) AERA Energy
- Tight sandstones and siltstones which have been horizontally drilled
- Opalized porosity (McClure Shale)
- Horizontal and vertical drilling in the Antelope Shale (Elk Hills Field)

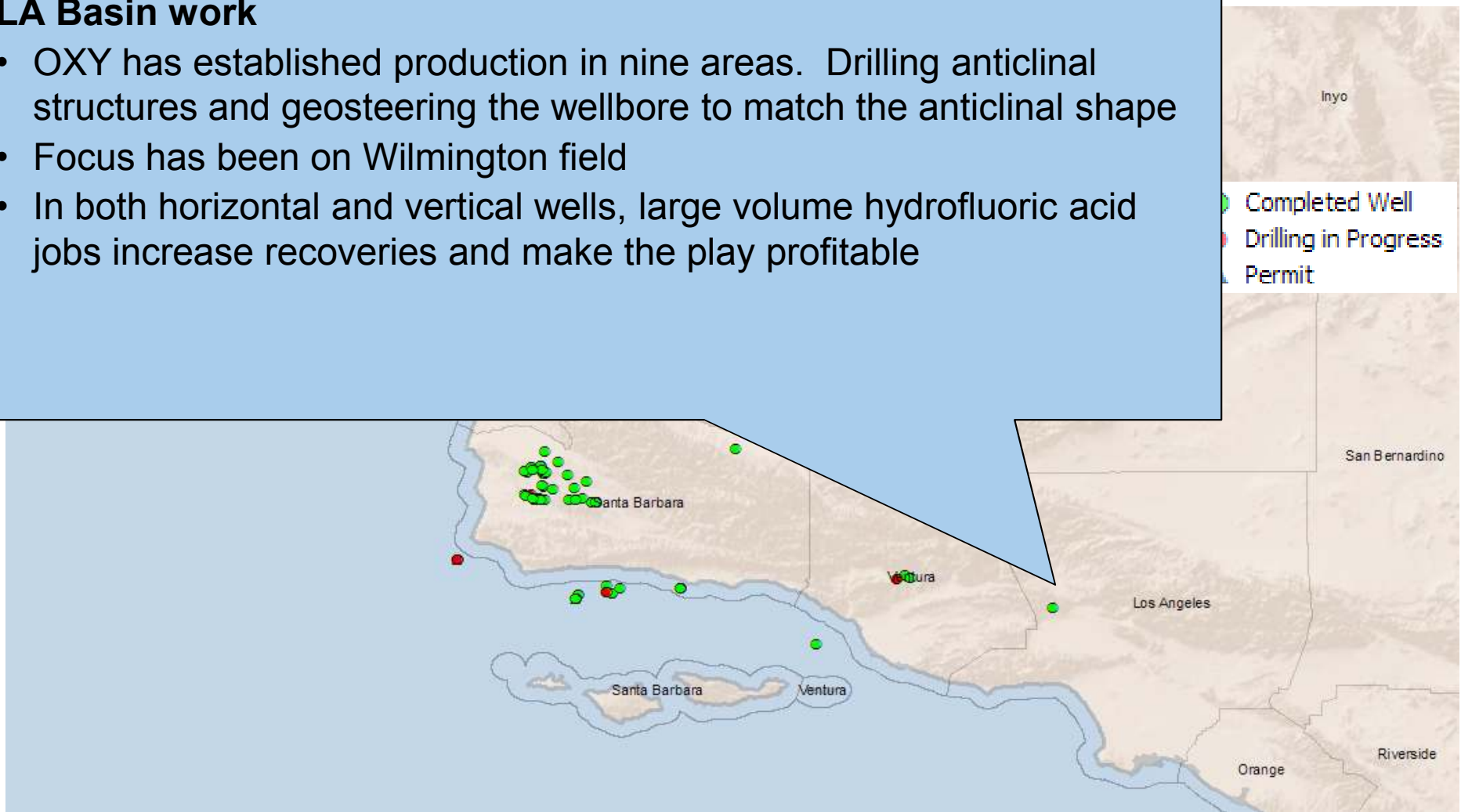


# Monterey Activity Developments



## LA Basin work

- OXY has established production in nine areas. Drilling anticlinal structures and geosteering the wellbore to match the anticlinal shape
- Focus has been on Wilmington field
- In both horizontal and vertical wells, large volume hydrofluoric acid jobs increase recoveries and make the play profitable

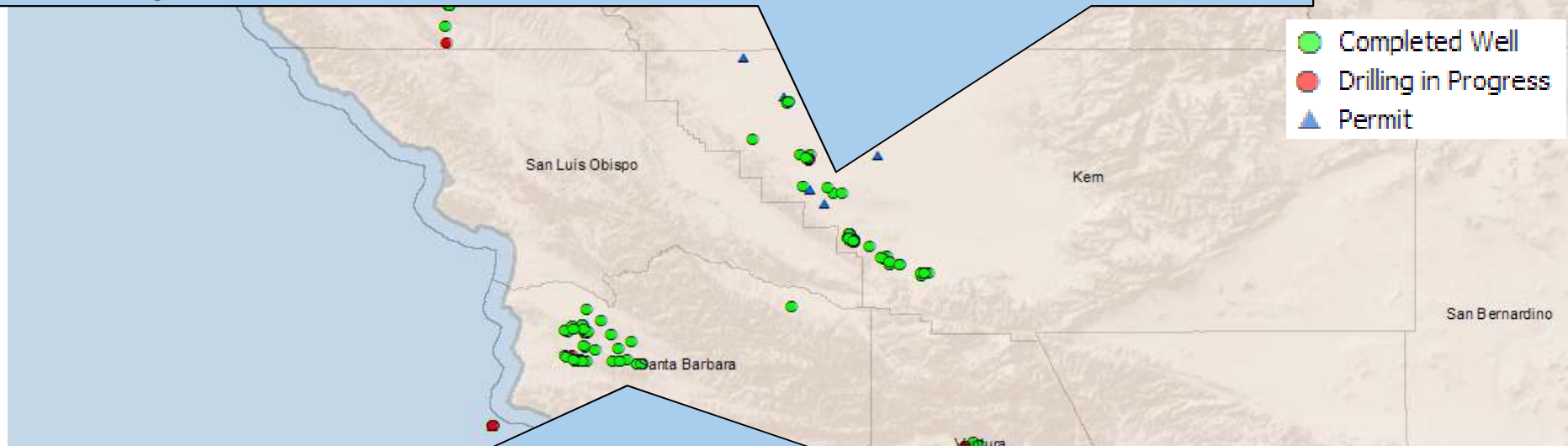


# Monterey



## Venoco western Kern Cty

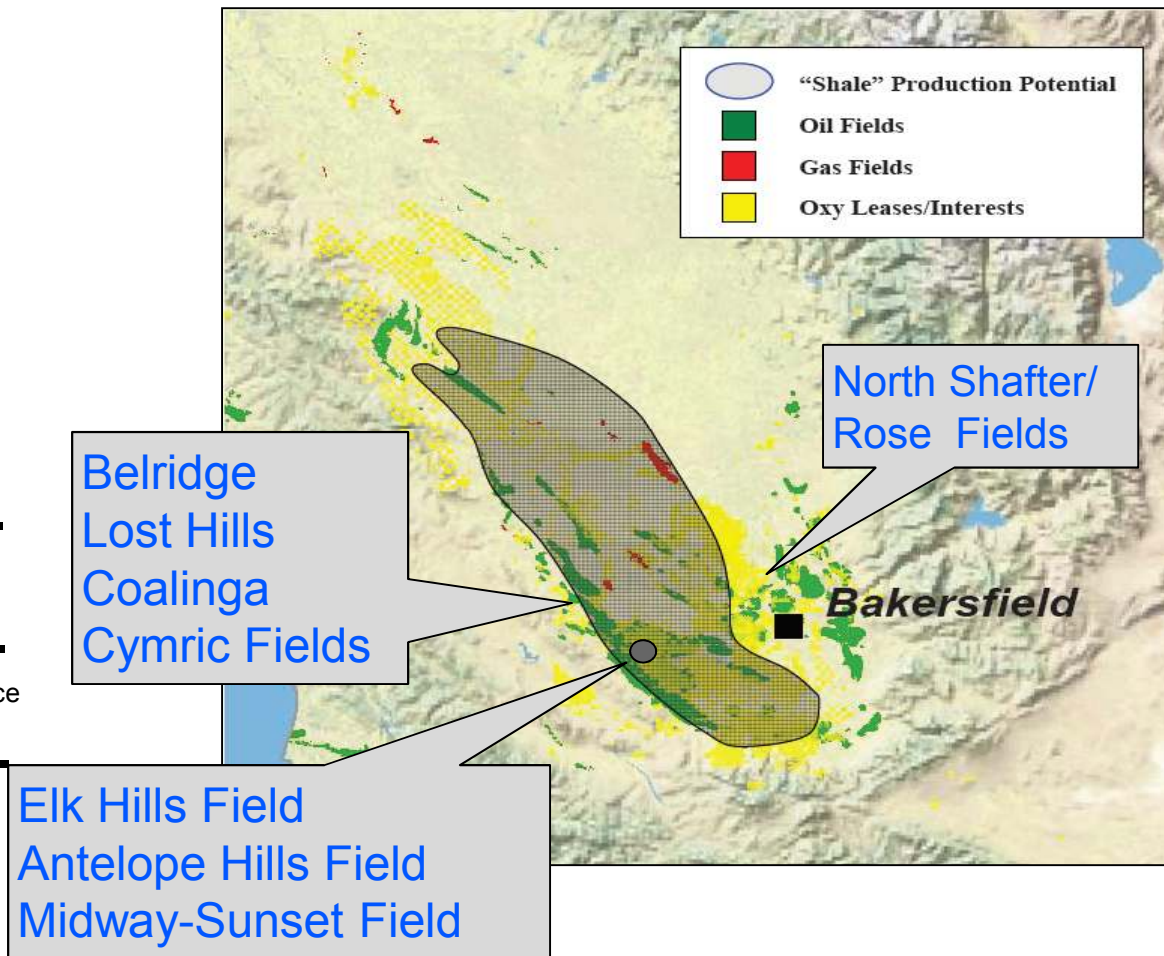
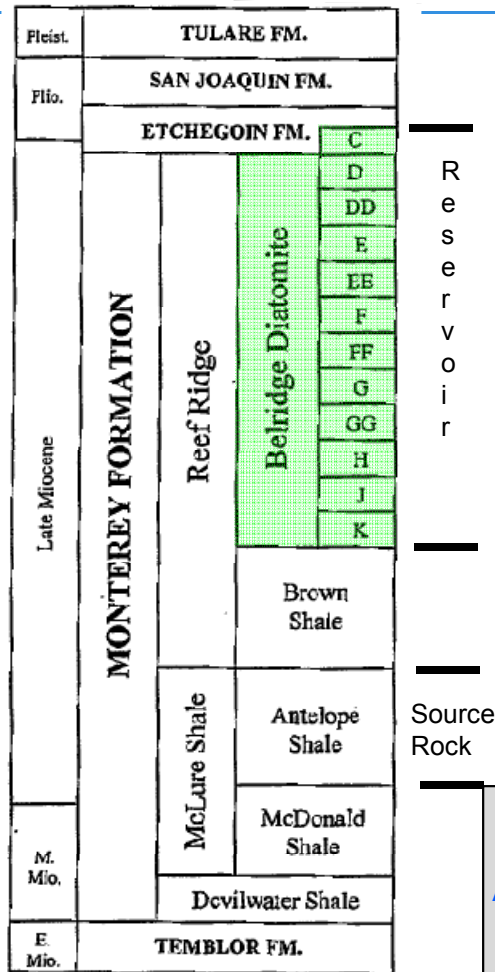
- Well results 221 boe/d with stabilized 7-day rate of 190 boe/d dropping to 134 boe/d over the 1<sup>st</sup> month
- Operator looking at multiple zones
- Other reported rates ranging between 10 and 25 bopd
- Testing continues in Devilwater and Gould zones



## Underground Energy Corp Santa Barbara Cty Zaca Field

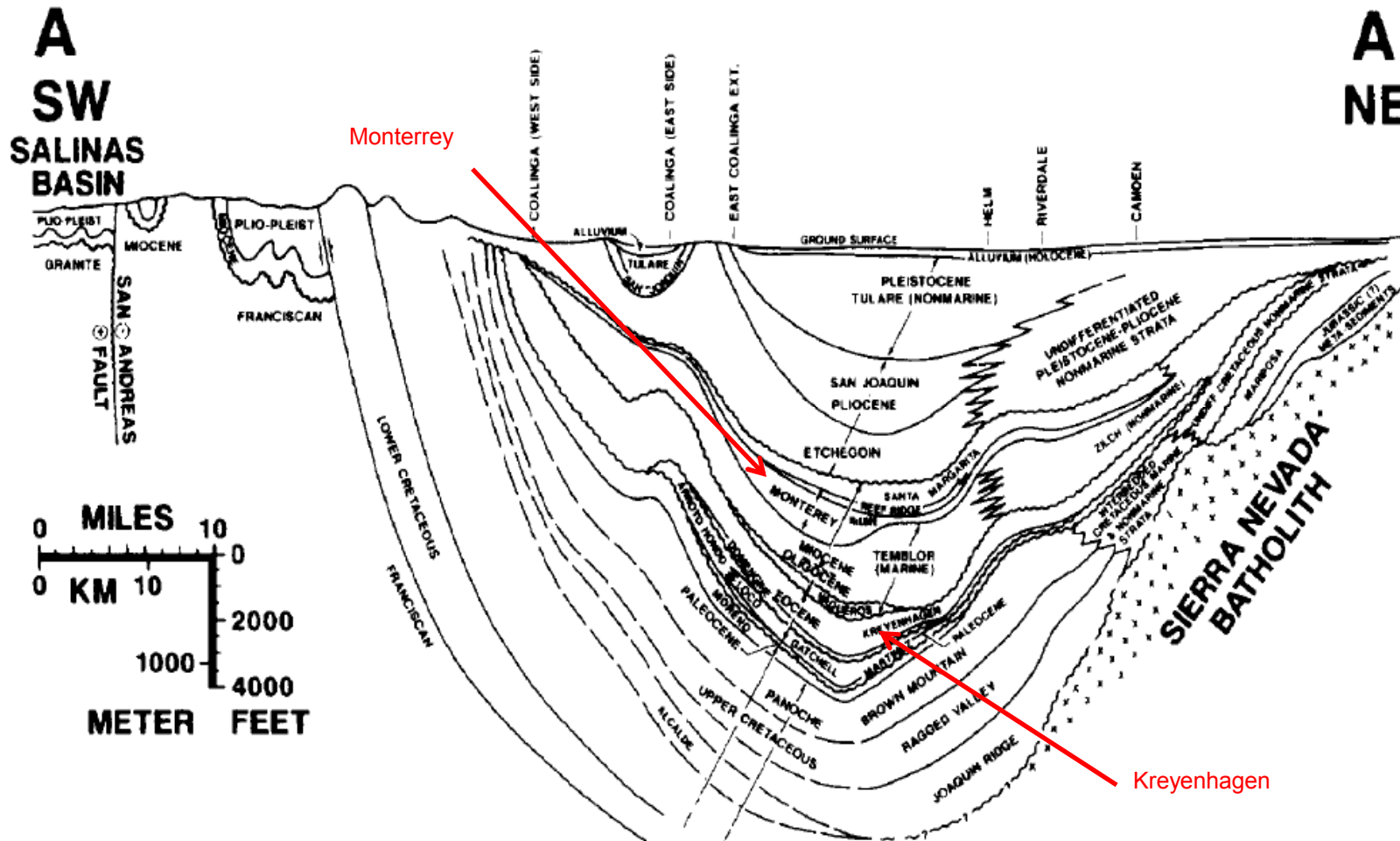
- Chamberlain 3-2 well field extension
- 7,685 ft TD Well cost \$2.4 million
- 1,700 ft pay zone in offset well, 1,200 ft of Monterey oil zone
- Typical pay in Zaca area is 1,100 ft
- Zaca average IPs 200 bopd EURs > 540,000 bbls

# Large fields have historically produced from the Monterey Formation – but are structurally controlled



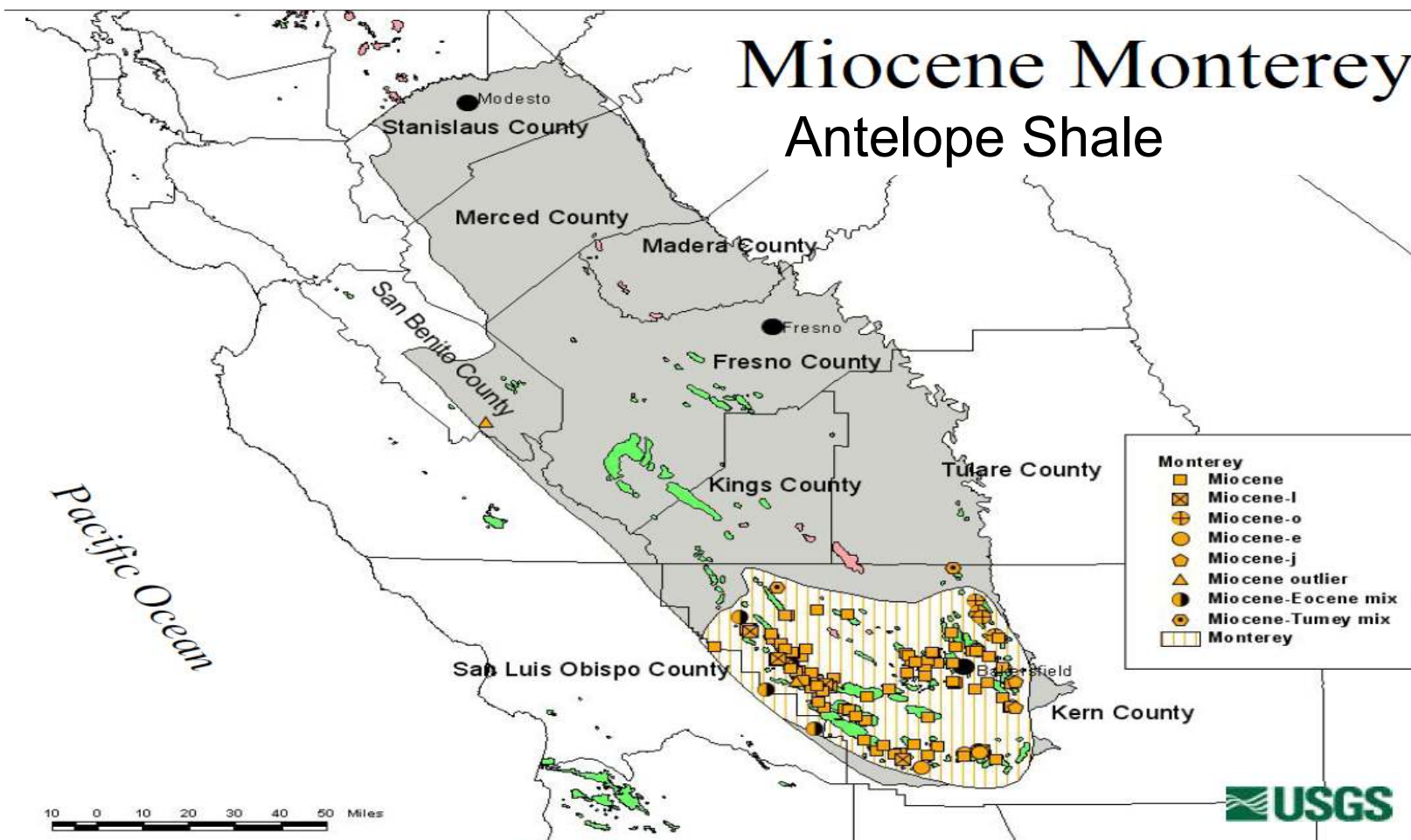


Cenezoic deposition has occurred on a leading continental edge – multiple zones produce both heavy and light oil



SOURCE: *Identification of Petroleum Systems adjacent to the San Andrea Fault California USA*, K.E Peters, T.D Elam, M.H Pytte, P.Sundaraman, Chevron, APPG

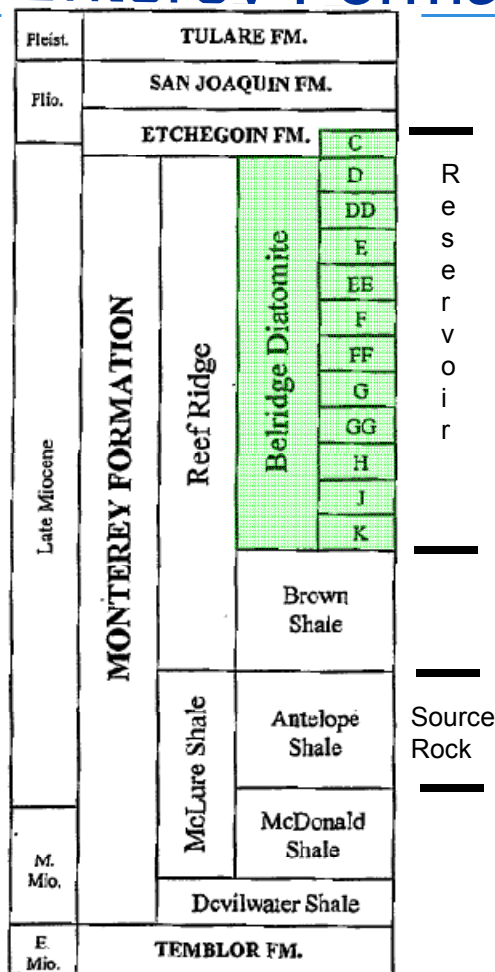
# The Antelope Shale member of the Monterey Formation is the primary source rock in the southern San Joaquin Basin



Lillis & Magoon, 2004, Oil-oil correlations to establish a basis for mapping petroleum systems, San Joaquin Basin, California, USGS Open-File Report 2004-1037



# A variety of play types have emerged in the Monterey Formation which are unique



- Conventional sandstones have produced a majority of the historical oil
- Fracture porosity in less permeable zones
- Diatomites (Belridge Fields)
- Tight sandstones and siltstones which have been horizontally drilled
- Opalized porosity (McClure Shale)
- Horizontal and vertical drilling in the Antelope Shale (Elk Hills Field)

# Shales of the San Joaquin Basin have received attention

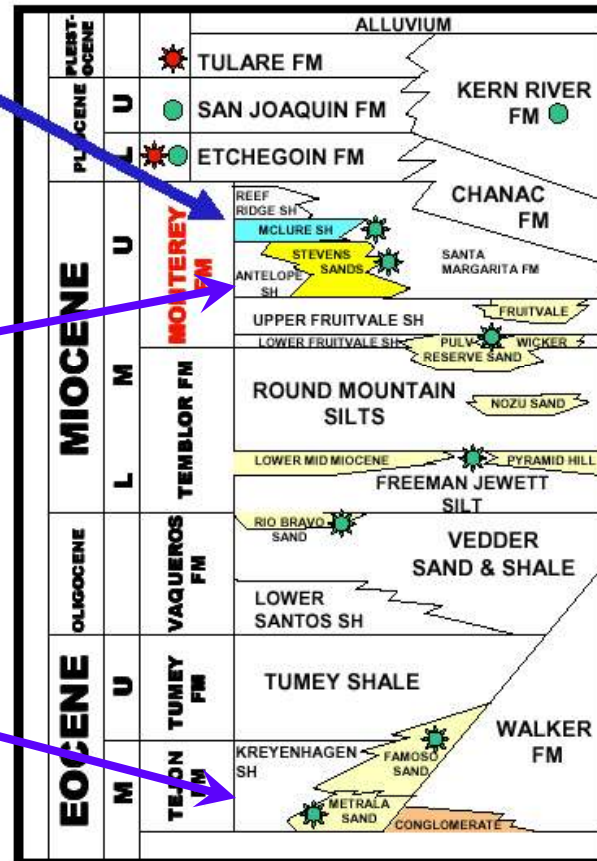


*McLure Shale Member of the Monterey*

*Horizontal & Vertical drilling In the Antelope Hills*

*Recent testing in The Kreyenheagen Shale*

## STRATIGRAPHIC COLUMN SOUTHERN SAN JOAQUIN BASIN



- Shales are
  - Silica rich
  - Often fractured
  - Contain interbedded layers of sandstone and silt
  - May include some minor carbonate layers

SOURCE: *Success! Using Seismic Attributes and Horizontal Drilling to Delineate and Exploit a Diagenetic Trap, Monterey Shale, San Joaquin Valley, CA*, Anne Grau, Robert Sterling, Robert Kidney EOG Resources, Denver, CO.

# Tight Oil Type Play

## Bakken Shale Williston Basin



Oil Wells 1/1/2009 – Feb. 7, 2012

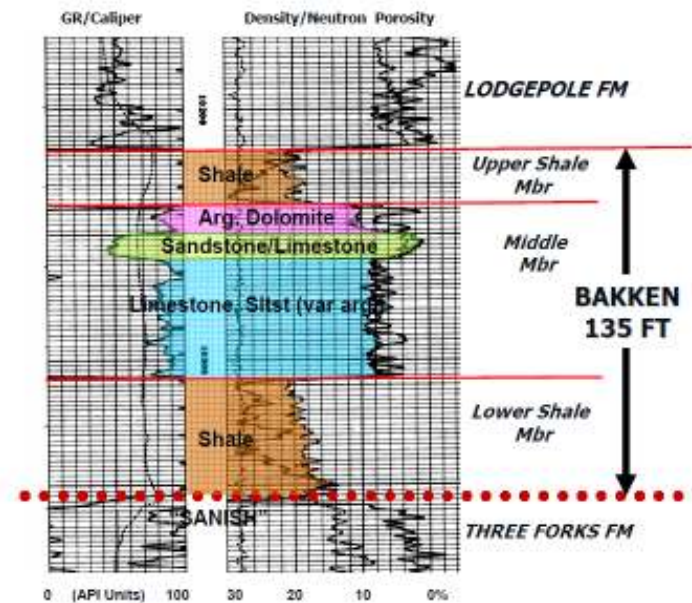
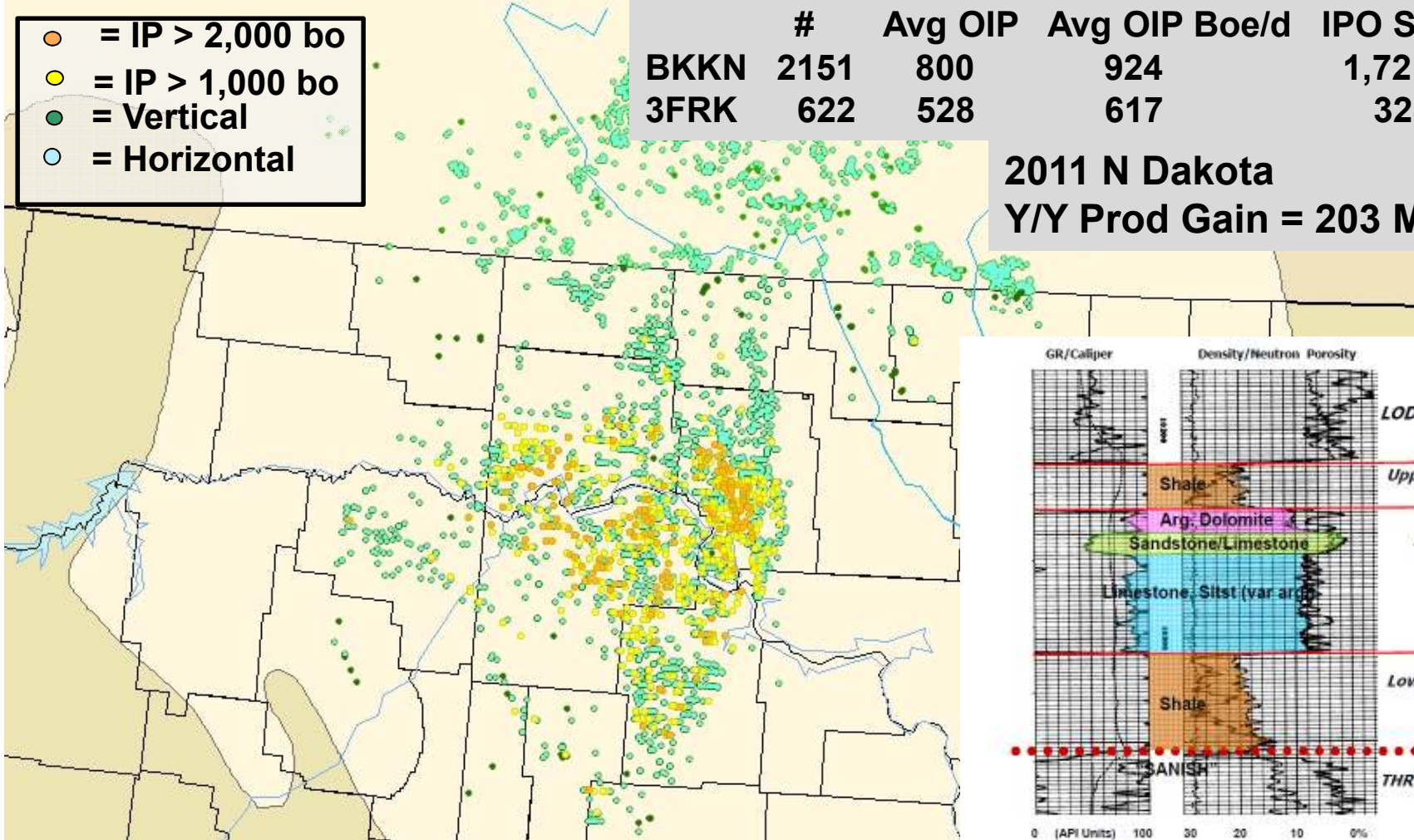
U.S. Horizontal Oil Wells

- = IP > 2,000 bo
- = IP > 1,000 bo
- = Vertical
- = Horizontal

	#	Avg OIP	Avg OIP Boe/d	IPO Sum b/d
BKKN	2151	800	924	1,721,483
3FRK	622	528	617	328,237

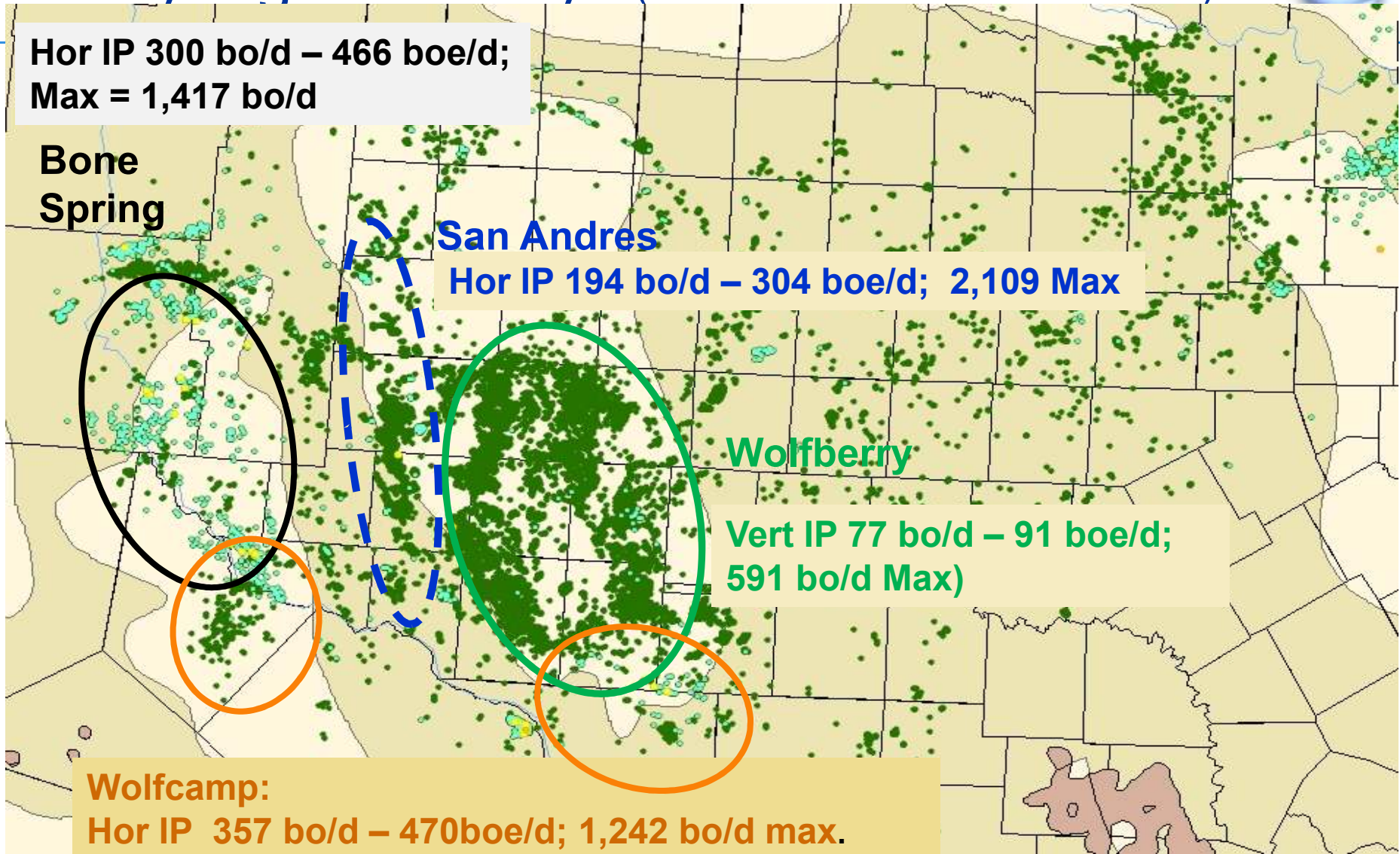
2011 N Dakota

Y/Y Prod Gain = 203 Mb/d



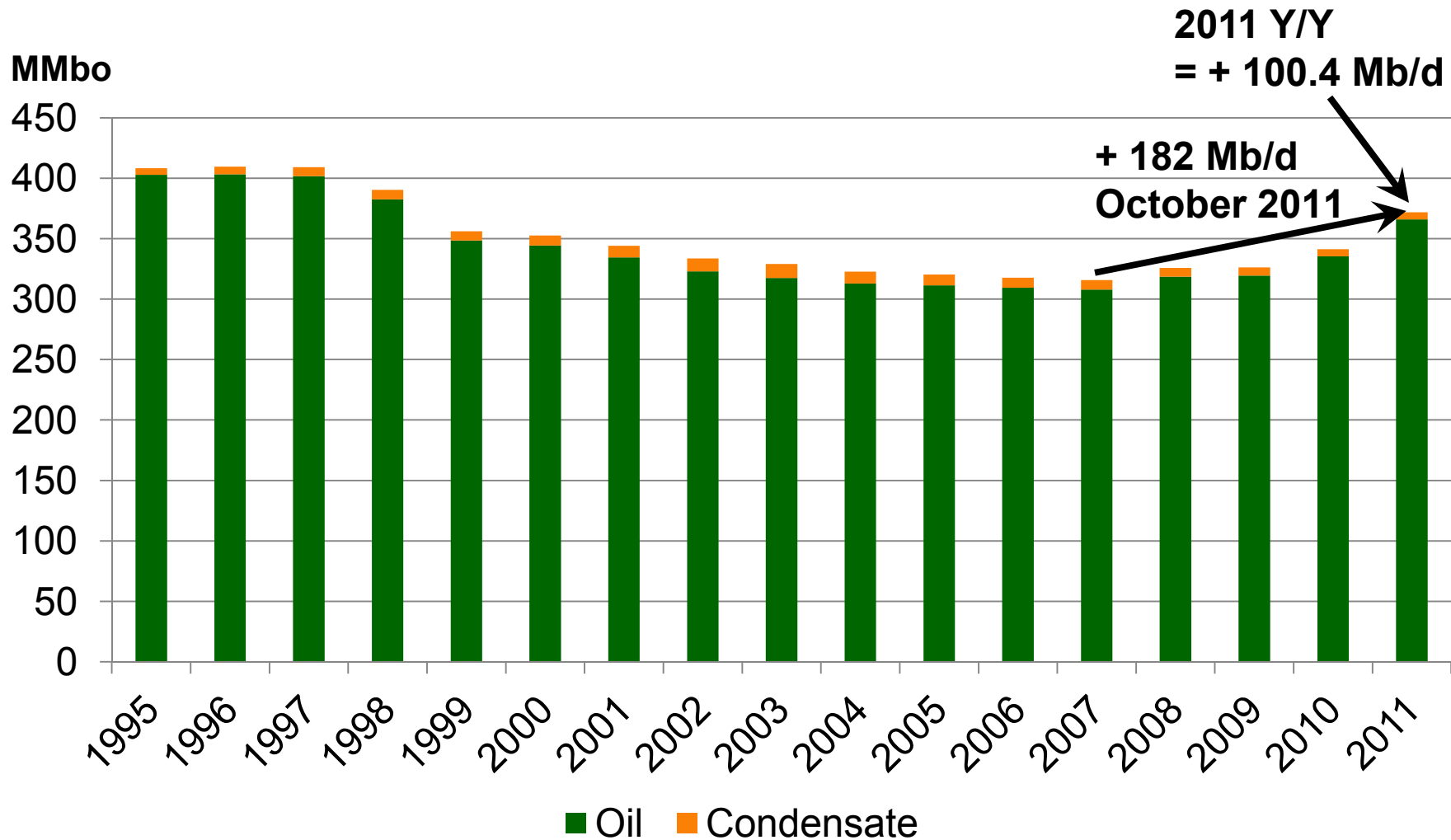
# Permian Basin

## Key Tight Oil Plays (Oil Wells 1/1/2009 - 2/07/2012)



# Permian Basin

## Annual Liquids Production 1995 – 2011 MMbo



# Modern Maturity!!



## TXL South Unit



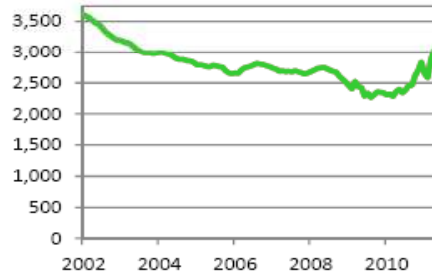
Active Clearfork Waterflood  
(10,200 acres, 77.0% WI, 70.5% NRI)



## North McElroy Unit



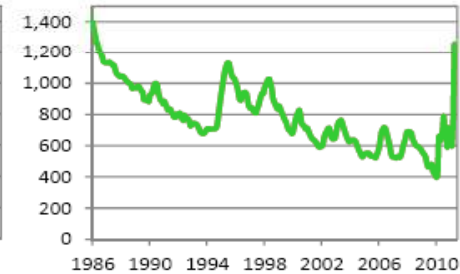
Active Grayburg Waterflood  
(11,400 acres, 97.6% WI, 85.0% NRI)



## Shafter Lake Unit



Active SanAndres Waterflood  
(13,000 acres, 81.4% WI, 68.7% NRI)



## BO/D

## Horizontals

- Producing
- Locations (20s)
- Targets
- TVD
- Laterals
- IP (BO/D)

5  
50+  
Stacked: U.Clearfork,  
Tubb, L.Clearfork  
5,800-6,300'  
5,000'  
200-500

10  
60+  
Grayburg  
3,000'  
5,000'  
200-300

5  
20+  
San Andres  
4,500'  
5,000'  
200-400





# The Tight Oil Renaissance Scorecard



- **Size of the prize:**
  - Potential tight oil resource ~ 50 Bboe  
(21% of the US discovered oil resource base in 5 years)
  - U.S. 2011 tight liquids production Y/Y = 456,212 b/d
  - Average rig count 1300 in 2012 could result in +750,000b/d
  - High case supply potential ~ 3-5 MMboe/d by 2020
- **What does this mean to U.S. economy? (10 years)**
  - 1.3 MM jobs
  - ~ \$988 B contribution to GDP & offset balance of payments
  - ~ \$ 97 B taxes and royalties to government

## **A Game Changer for U.S. oil!!**



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