

Oklahoma Oil and Natural Gas

Components and Long-Term Outlook

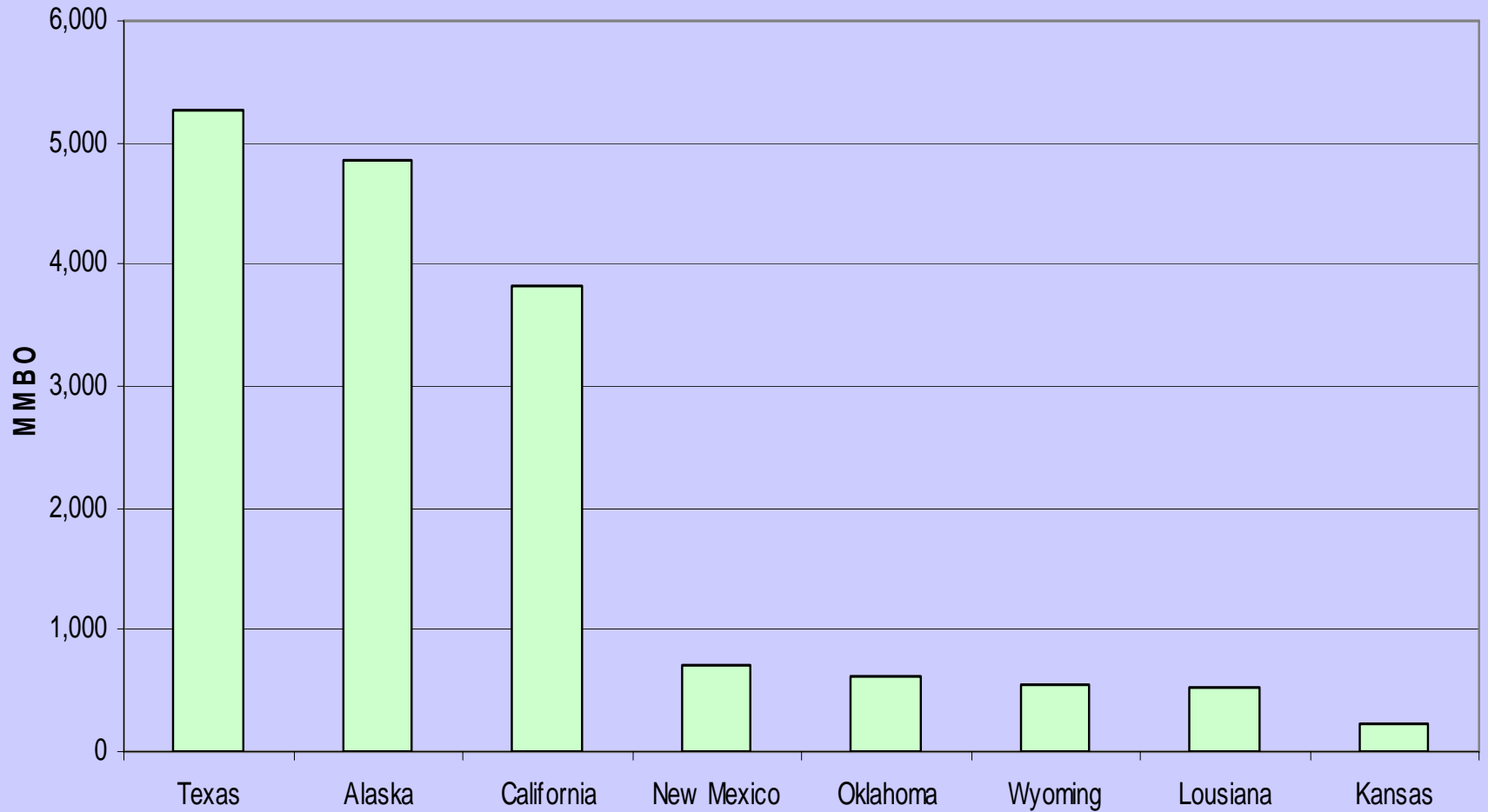
GEOL 4233 Lecture
January, 2008

Oklahoma Oil

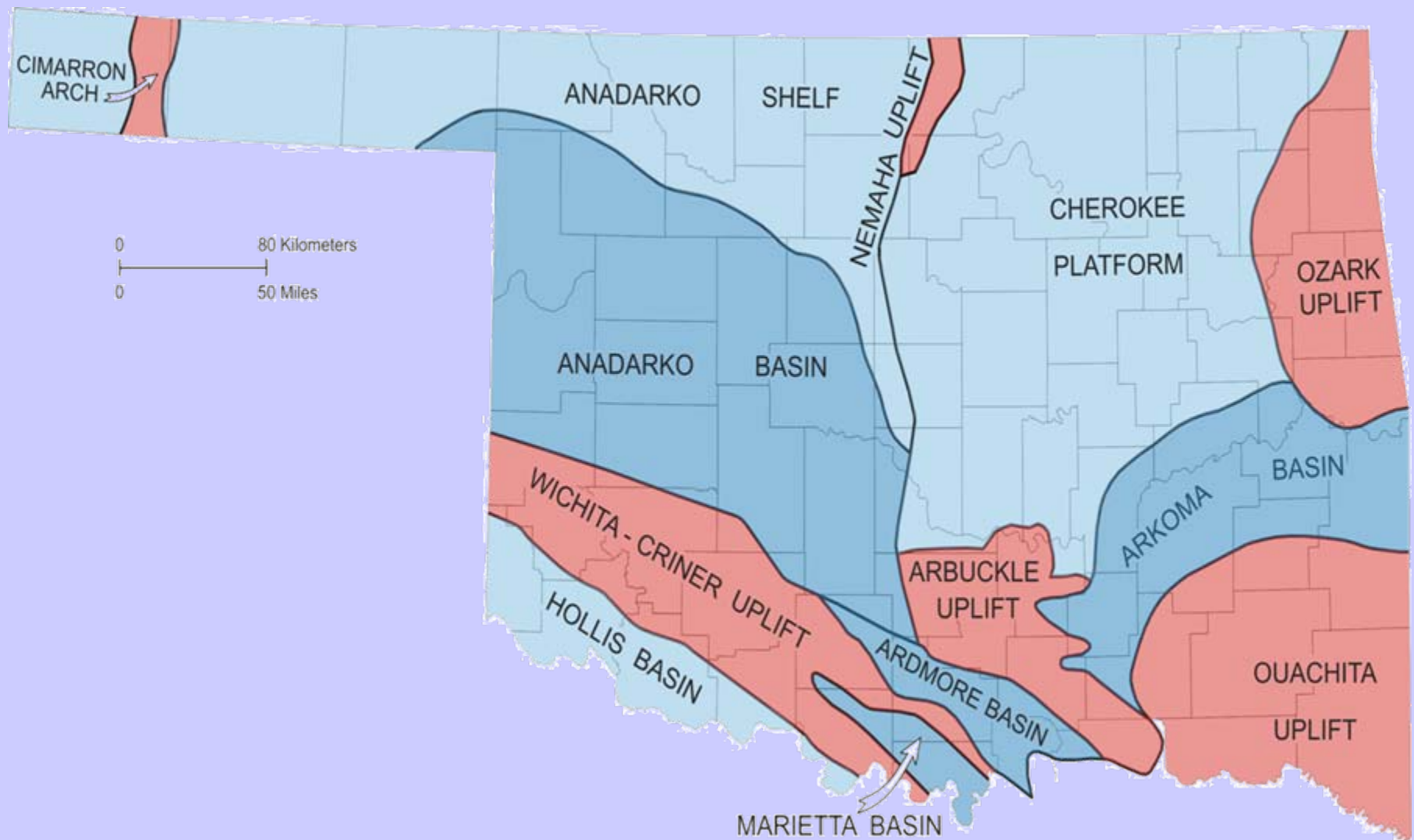


Crude Oil Reserves

(1-1- 2001)

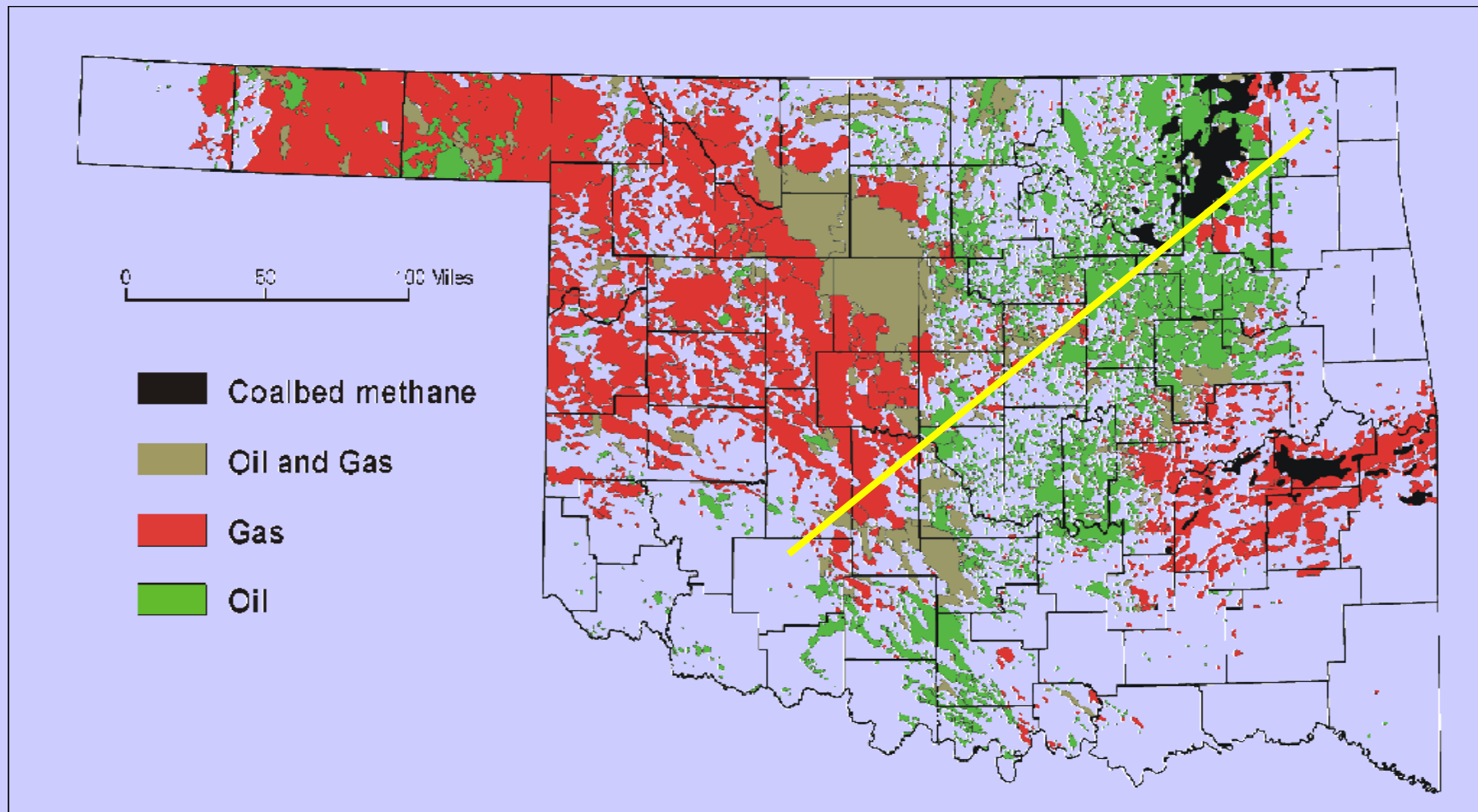


Data From World Oil



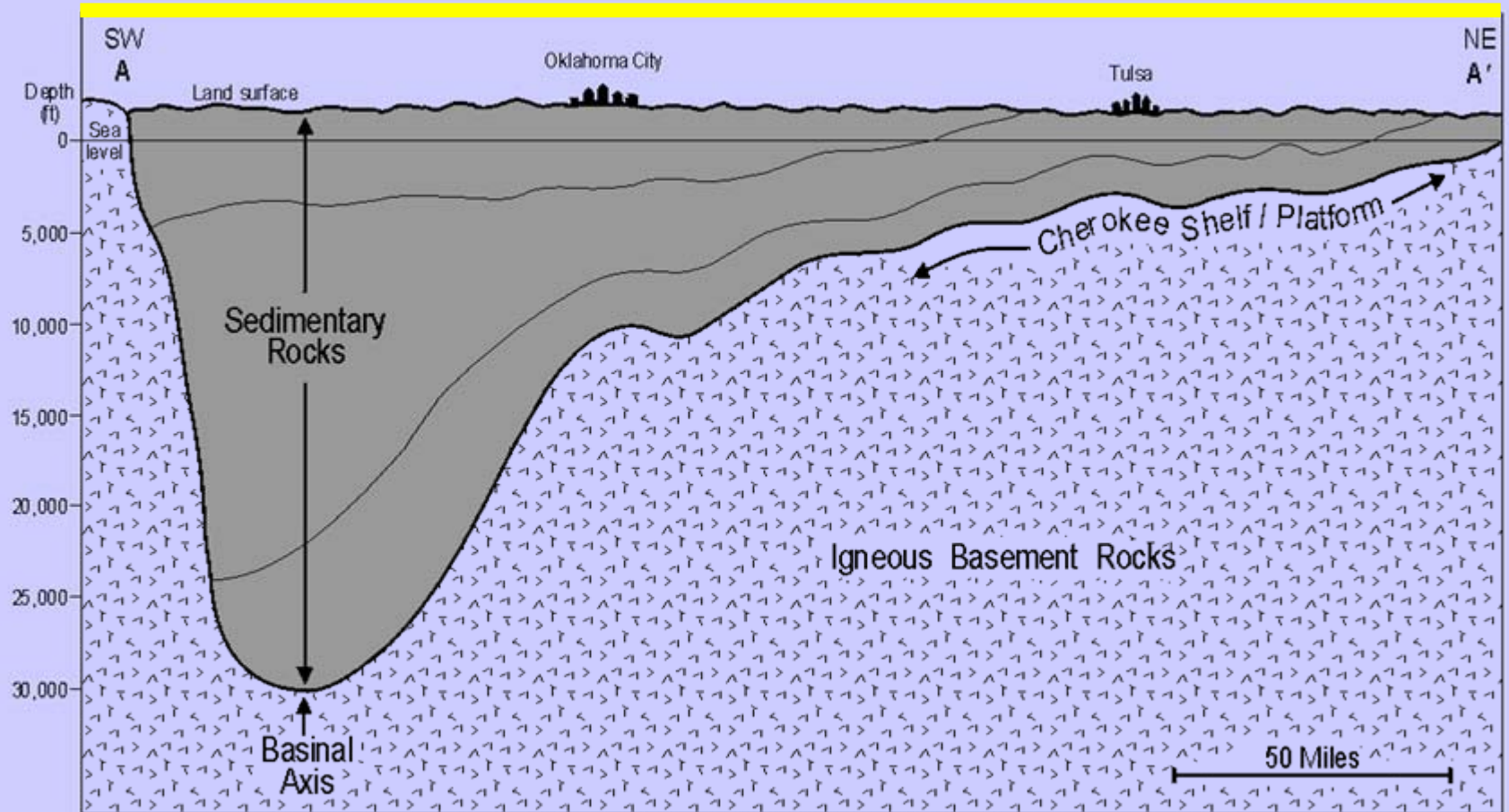
Geological Provinces of Oklahoma

Map of Oklahoma Oil and Gas Fields; Distinguished By GOR and Coalbed Methane Production. From Boyd (2002)
(GOR Cutoffs: Oil <5,000; Oil and Gas 5,000-20,000; Gas > 20,000)



Schematic Cross-section of the Anadarko Basin

Modified from Witt and others (1971).



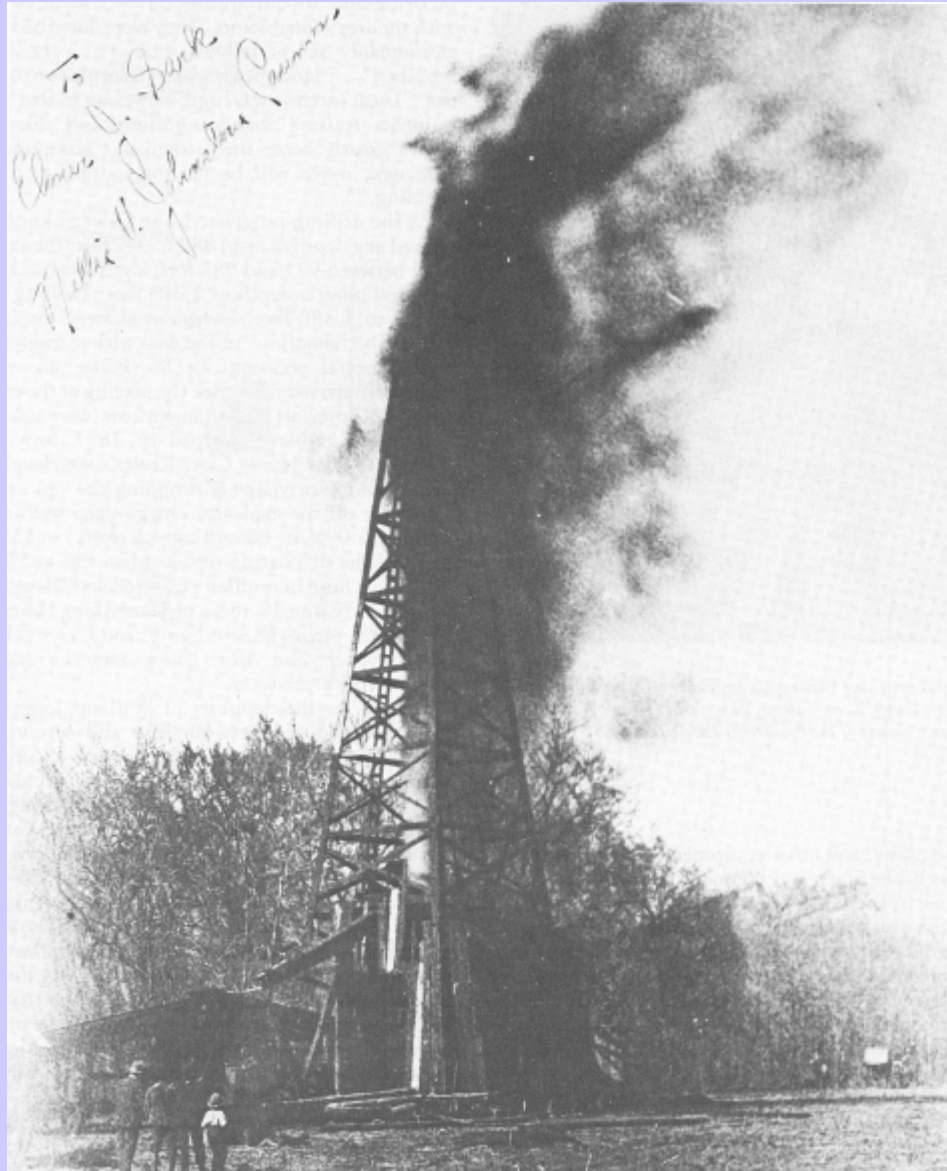
DIVISIONS OF GEOLOGIC TIME				Age (approx.) in millions of years	
Eon	Era	Period	Epoch		
Phanerozoic	Cenozoic	Quaternary	Holocene	0.010	
			Pleistocene	1.6	
		Tertiary	Pliocene	5	
			Miocene	23	
			Oligocene	35	
			Eocene	57	
			Paleocene	65	
			Mesozoic	Cretaceous	Late
		Early			146
		Jurassic		Late	157
	Middle			178	
	Early			208	
	Triassic	Late		235	
		Middle		241	
		Early		245	
	Paleozoic	Permian		Late	256
				Early	290
		Carboniferous	Pennsylvanian		303
					311
		Mississippian	Late	323	
			Early	345	
		Devonian	Devonian	Late	363
				Middle	377
				Early	386
			Silurian	Late	409
	Early			424	
	Ordovician		Late	439	
		Middle	464		
		Early	476		
	Cambrian	Late	510		
Middle		517			
Early		536			
				570	

Geologic Time Scale

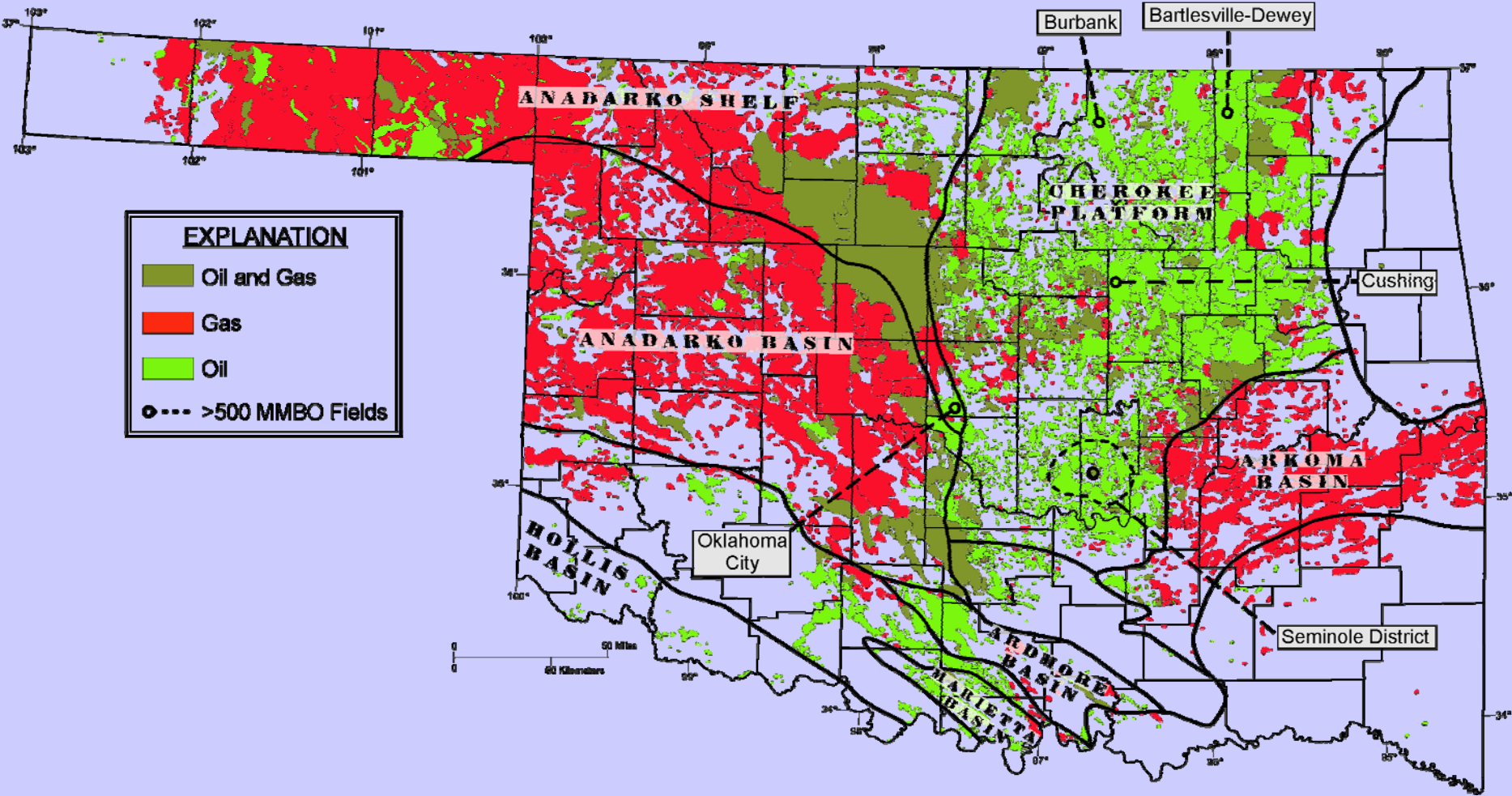
Modified From Harland (1990) and Hansen (1991).



Oil seep in Stanley Fm. (U.Miss) 20 miles south of McAlester. Photo by Jock Campbell.

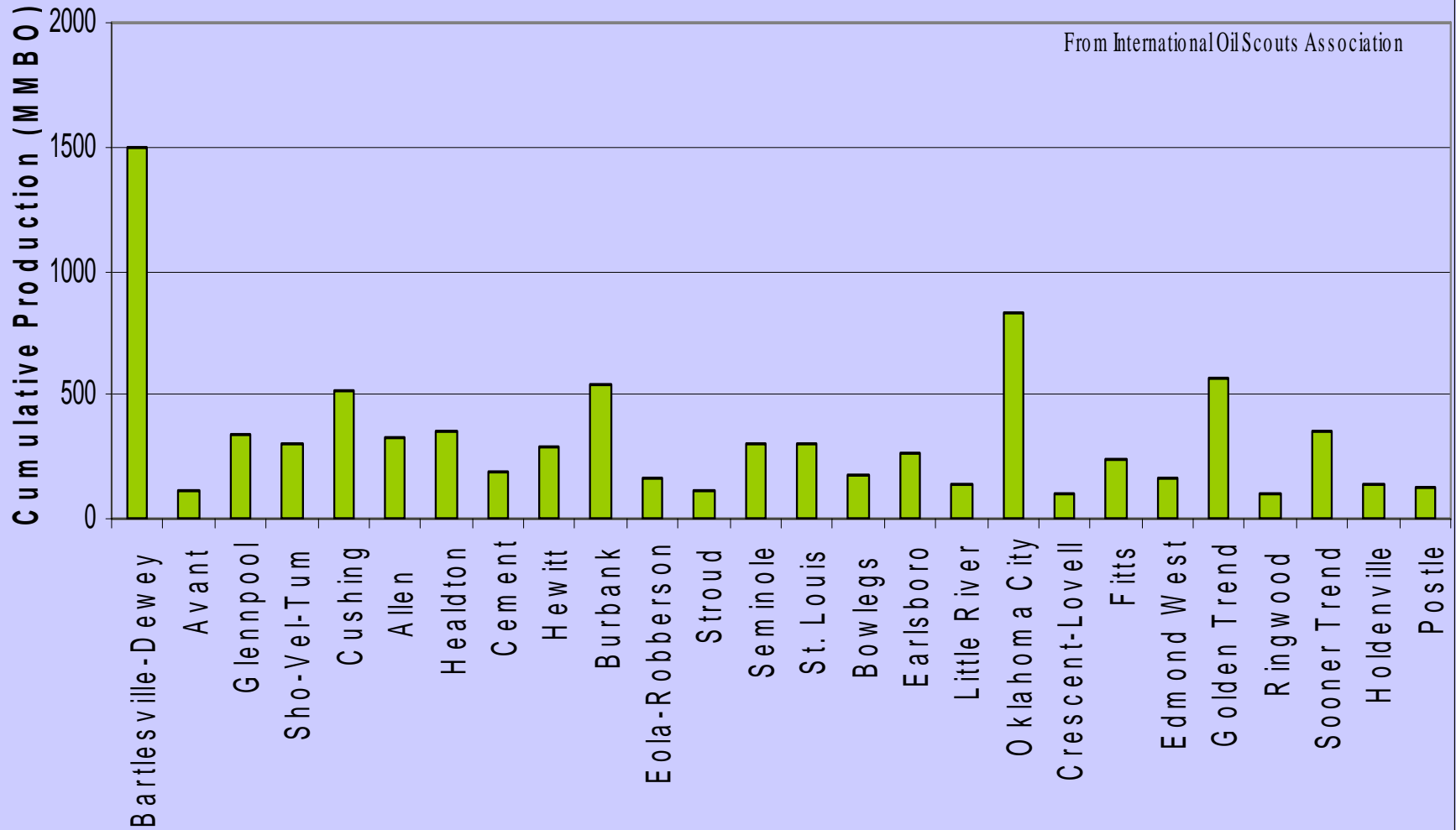


The Nellie Johnstone #1, drilled in 1897 just south of Bartlesville, established the first economic production in the State.
Photograph taken from Franks, 1980.

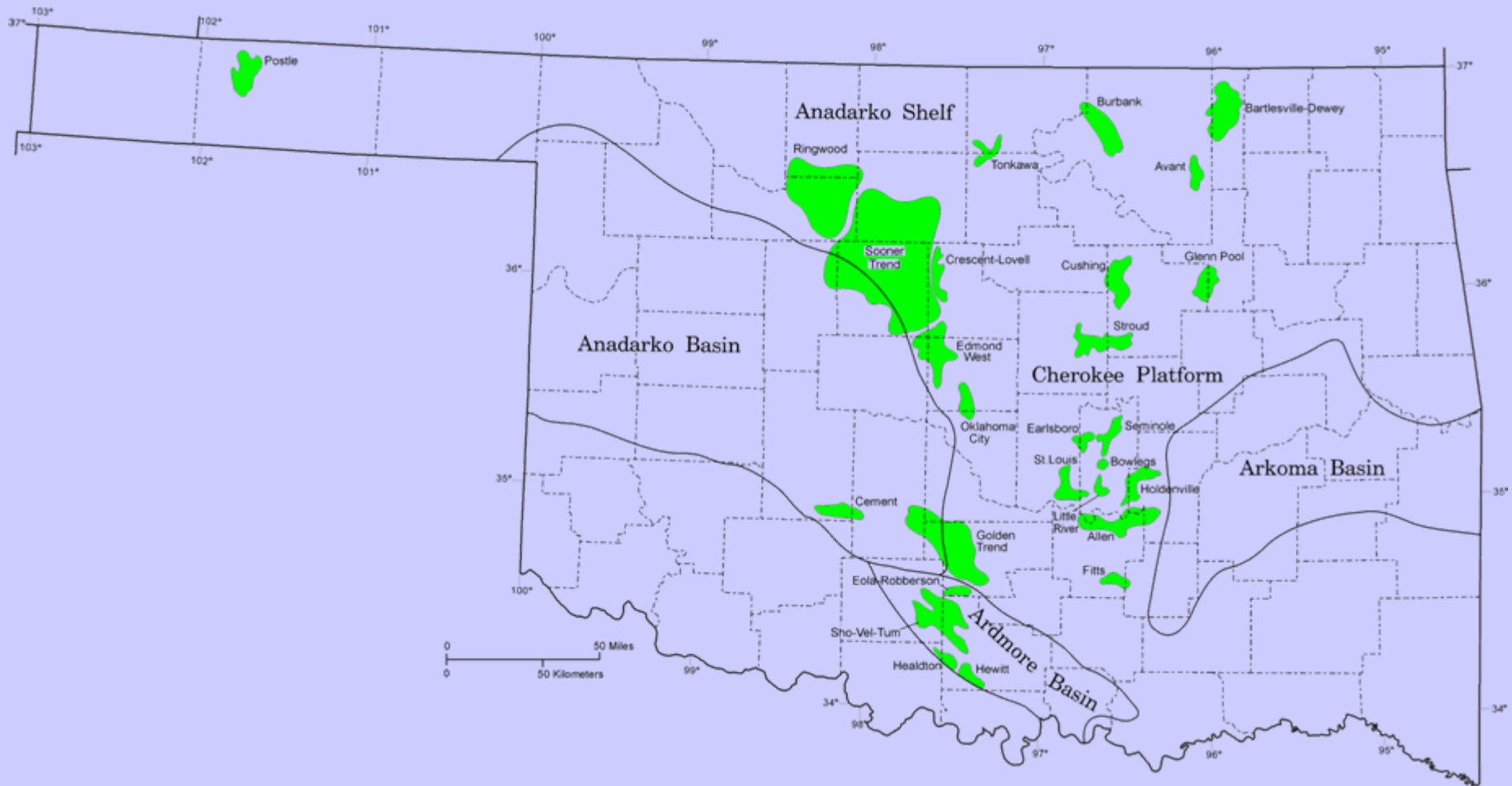


Major* Oil Fields in Oklahoma

* Cumulative production > 100 MMBO through 1/1/2000

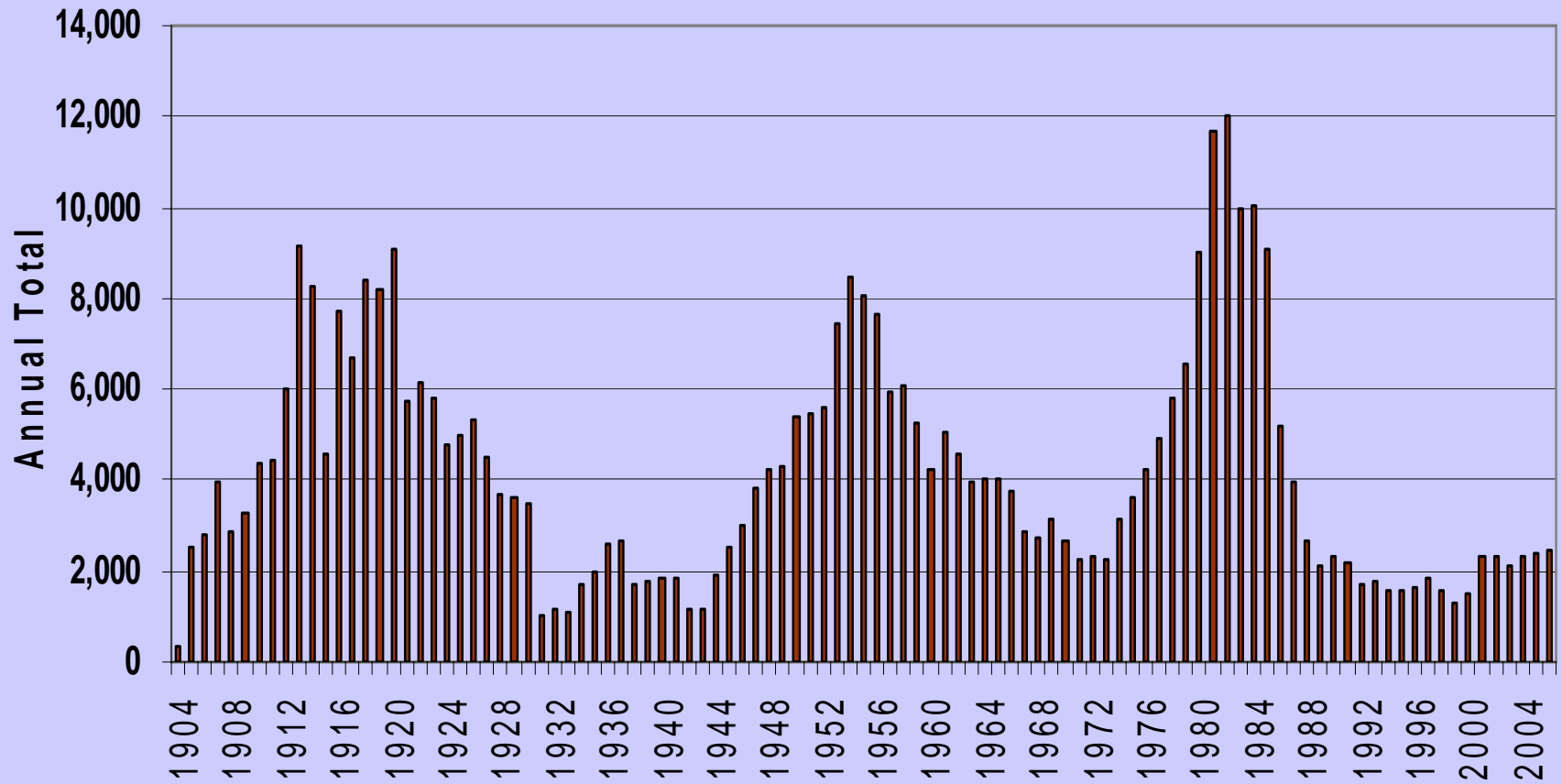


Major Oklahoma Oil Fields (> 100 MMBO Recovery)



Oklahoma Well Completion History

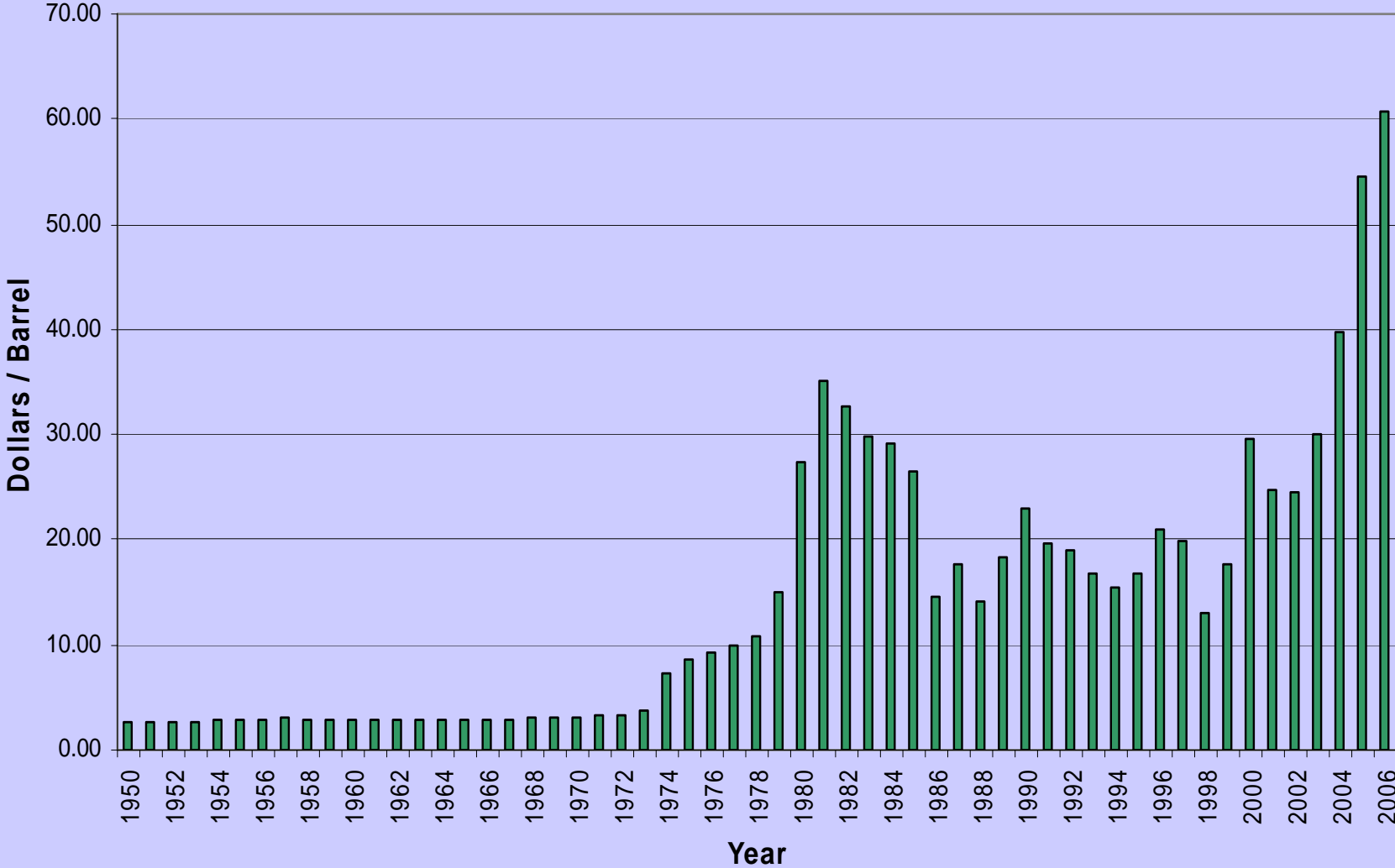
(All Wells)



Data From Oklahoma Corporation Commission

Average Oklahoma Crude Price

(Not Inflation Adjusted)

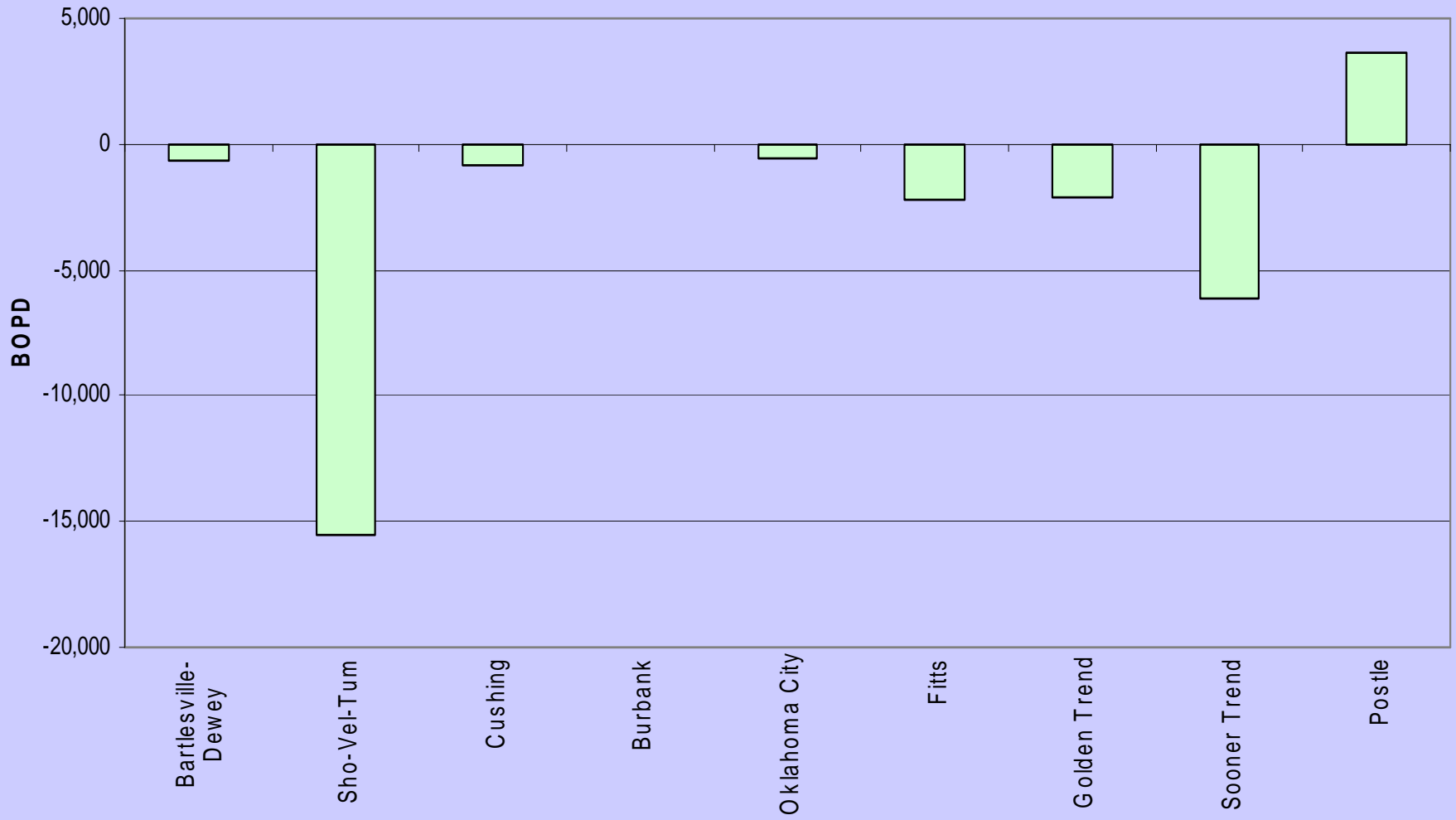


Data From Oklahoma Corporation Commission

Selected Oklahoma Oil Fields: Ten-Year Change in Production 1994-2003

(> 500 MMBO Recovery or 4,000 BOPD)

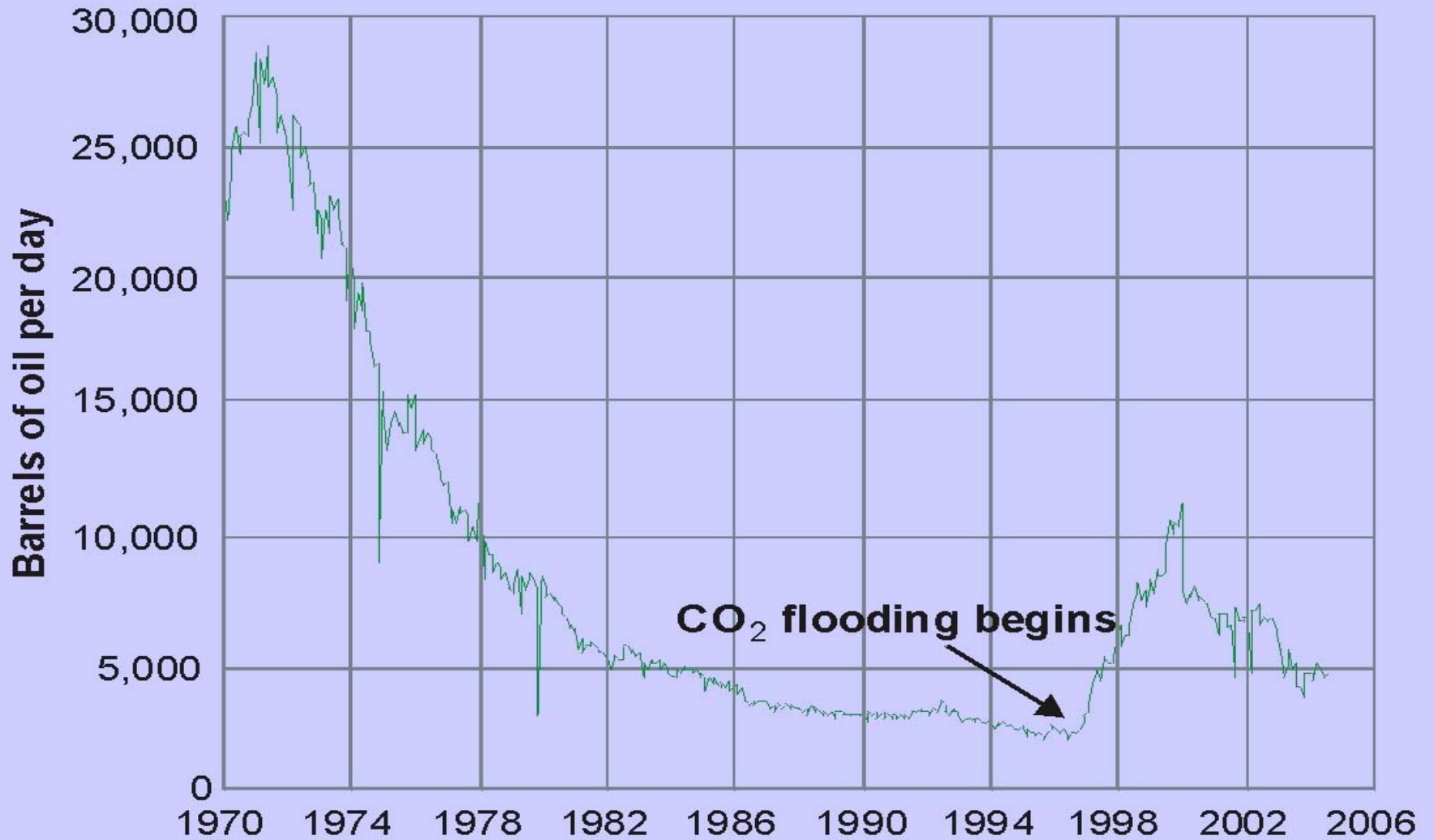
From IHS Energy, 2004



Sho-Vel-Tum Field Oil Production

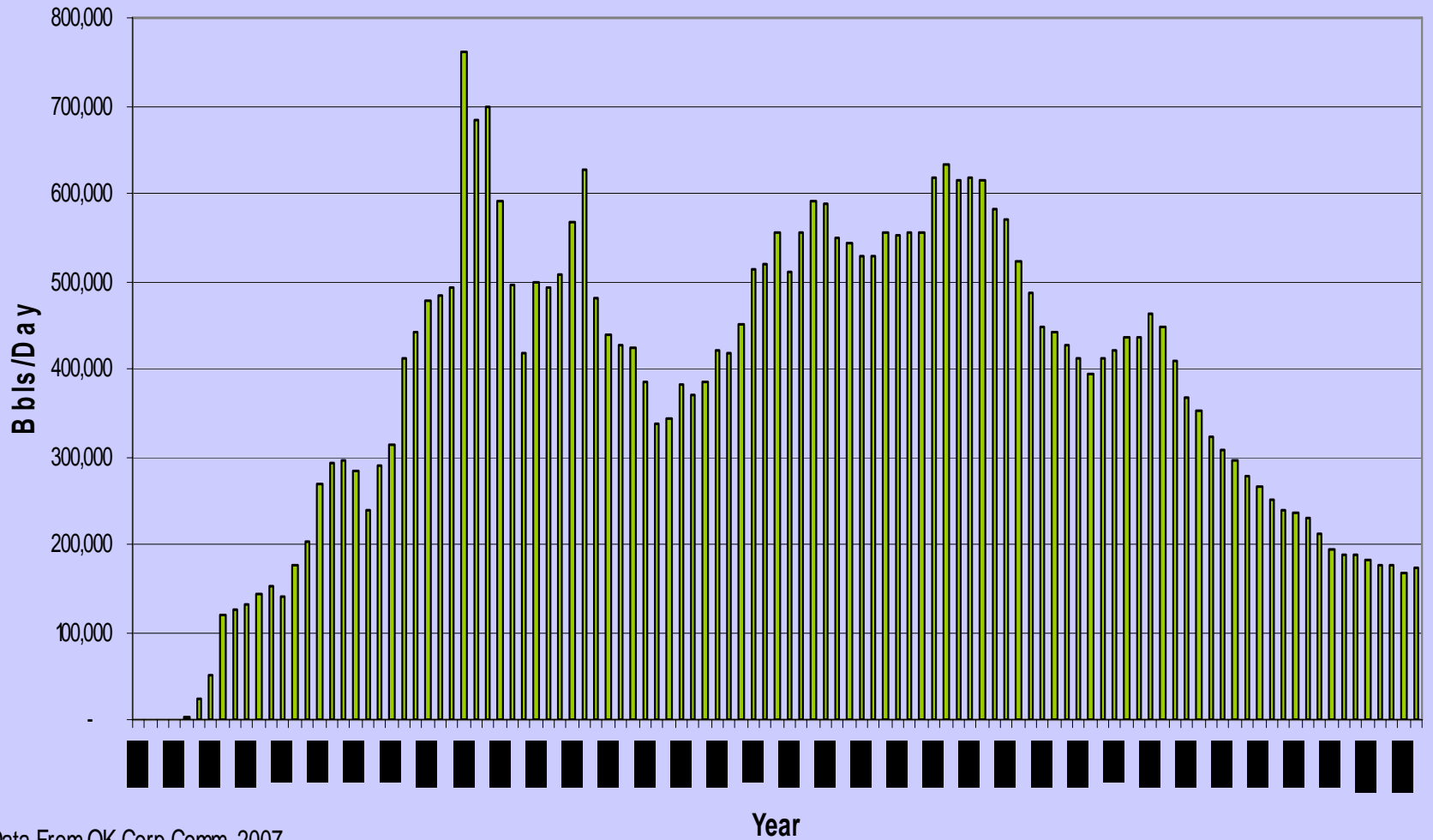


Postle Field Oil Production



Oklahoma Crude Oil Production

(Including Condensate)



Data From OK Corp Comm, 2007

Oklahoma's Major Reservoir Classes

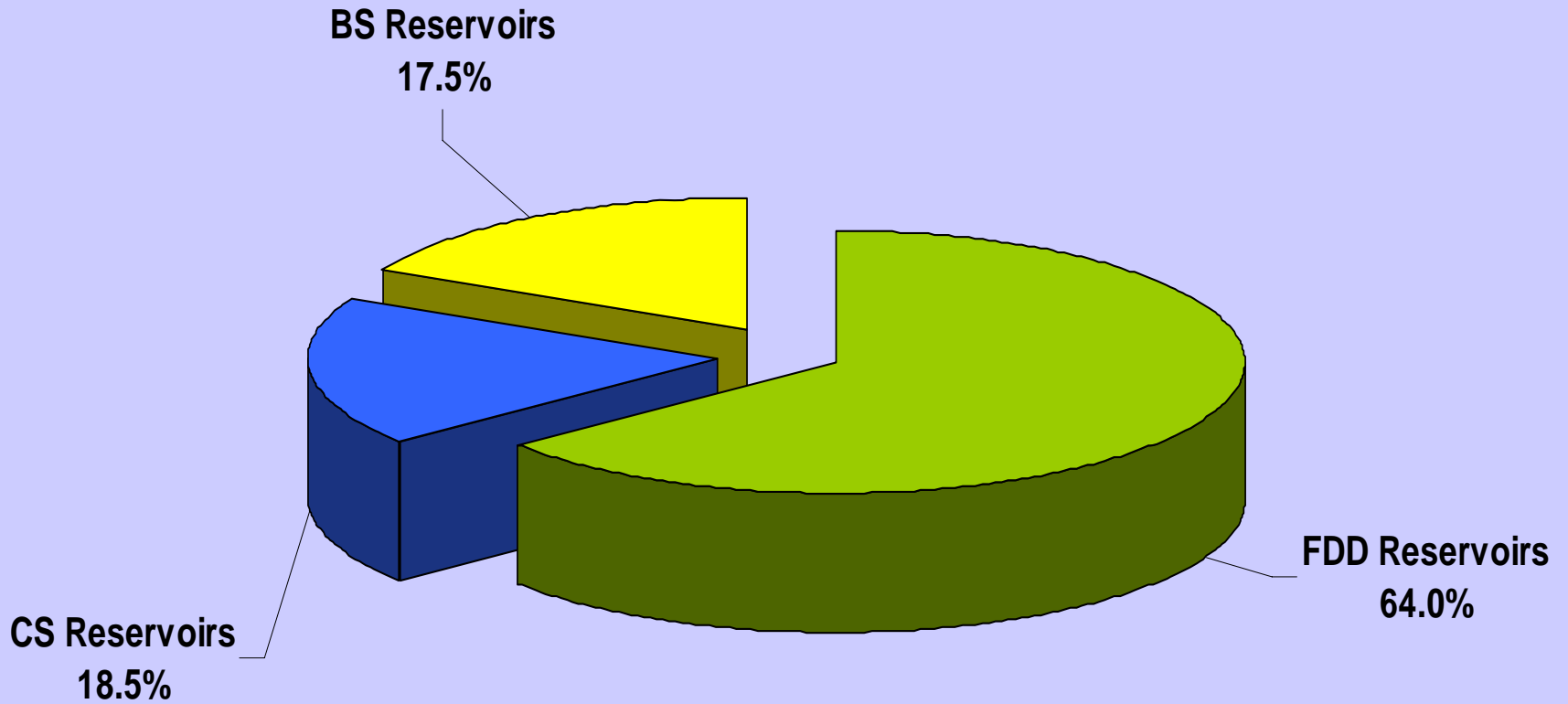
Blanket Sandstone (BS):

Carbonate Shelf (CS):

Fluvial-Dominated Deltaic (FDD):

Oklahoma Oil Production By Reservoir Class

Where reservoir recorded by operator



BS - Blanket Sandstone
CS - Carbonate Shelf
FDD - Fluvial-Dominated Deltaic Sandstone

**Blanket Sandstone (BS)
Oil Creek Sandstone**



SYSTEM	SERIES	GROUP	RESERVOIR CLASS		
			(BS) Blanket Sandstone	(CS) Carbonate Shelf	(FDD) Fluvial-Dominated Deltaic Sandstone
Permian	Leonardian	Sumner			Fortuna Wichita Noble-Olsen
	Wolfcampian	Chase			
		Council Grove			Wolfcamp Beasley
Pennsylvanian	Virgilian	Wabaunsee			
		Shawnee			
		Douglas			Tonkawa Swastika
	Missourian	Ochelata		Lansing	Healdton Osage-Layton Hoxbar
		Skiatook		Missouri Lime	Layton Wade Burns-Brundage Medrano Cleveland Marchand
	Desmoinesian	Marmaton		Oswego	Deese
		Cherokee			Prue Senora Skinner Gibson Dora Red Fork Hart Bartlesville Osborn Booch
	Atokan	Atoka			Gilcrease Muskogee
	Morrowan	Morrow		Union Valley	Morrow Keyes Cromwell Kelly
	Springeran	Springer			
Mississippian		Chester		Manning (Ark. Novaculite)	
		Meramec		Meramec Sycamore	
		Osage		Osage Miss. Chat	
Devonian			(Misener)		
Silurian		Hunton		Hunton	
Ordovician		Viola			Viola
		Simpson	Bromide Wilcox Tulip Creek McLish Oil Creek		
		Arbuckle			Arbuckle
Cambrian					
Pre-Cambrian					

**Carbonate Shelf (CS)
Hunton Limestone**



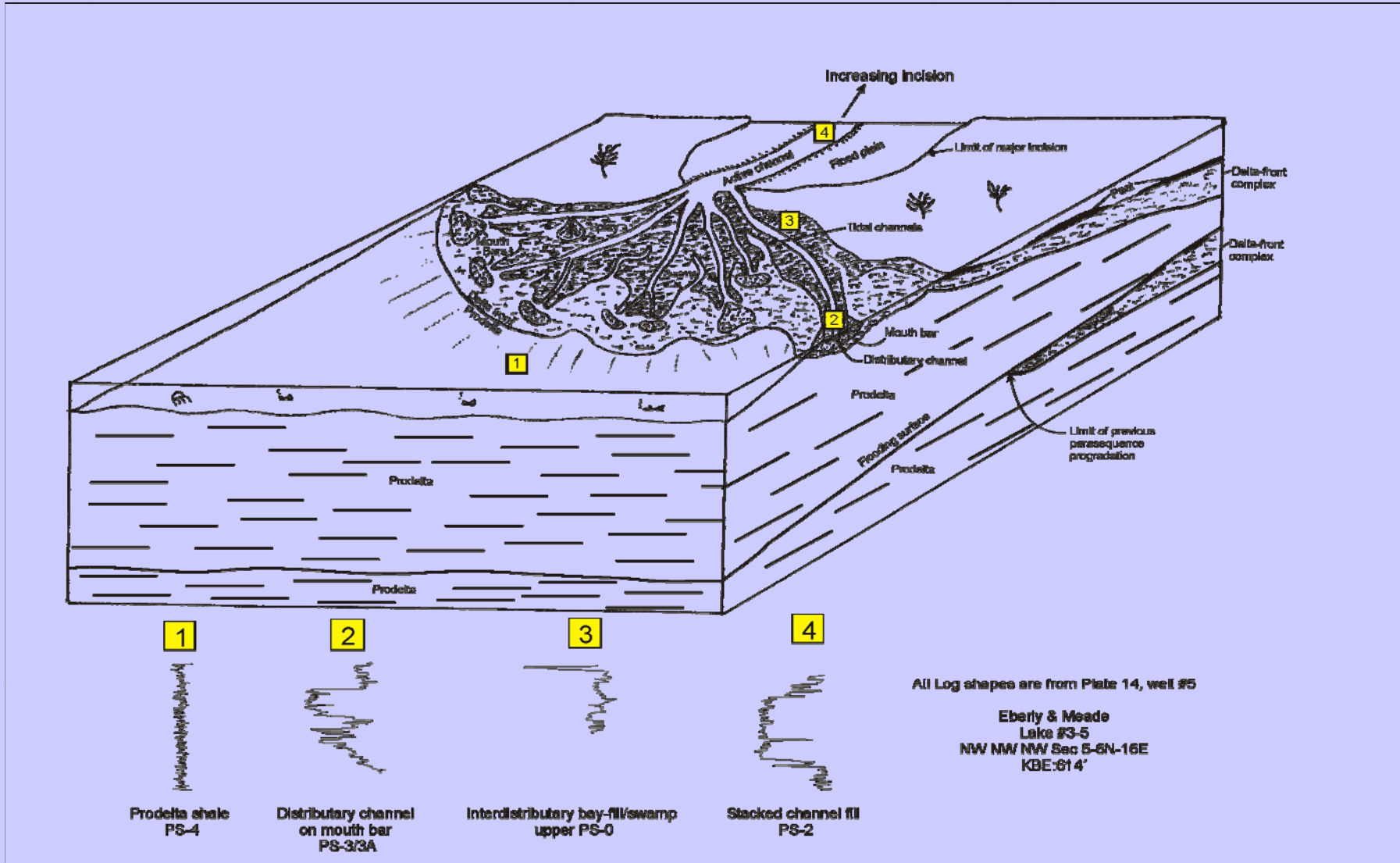
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	Wolfcampian	Chase			
		Council Grove			Wolfcamp Beasley
		Admire			
Pennsylvanian	Virgilian	Wabaunsee			
		Shawnee			
		Douglas			Tonkawa Swastika
	Missourian	Ochelata		Lansing	Healdton Osage-Layton Hoxbar
		Skiatook		Missouri Lime	Layton Wade Burns-Brundage Medrano Cleveland Marchand
	Desmoinesian	Marmaton		Oswego	Deese
		Cherokee			Prue Senora Skinner Gibson Dora Red Fork Hart Bartlesville Osborn Booch
	Atokan	Atoka			Gilcrease Muskogee
	Morrowan	Morrow		Union Valley	Morrow Keyes
	Springeran	Springer			Cromwell Kelly
Mississippian		Chester		Manning (Ark. Novaculite)	
		Meramec		Meramec Sycamore	
		Osage		Osage Miss. Chat	
			(Misener)		
Devonian		Hunton		Hunton	
Silurian					
Ordovician		Viola		Viola	
		Simpson	Bronide Wilcox Tulip Creek McLish Oil Creek		
		Arbuckle		Arbuckle	
Cambrian					
Pre-Cambrian					

**Fluvial Dominated Deltaic (FDD)
Hartshorne Sandstone**

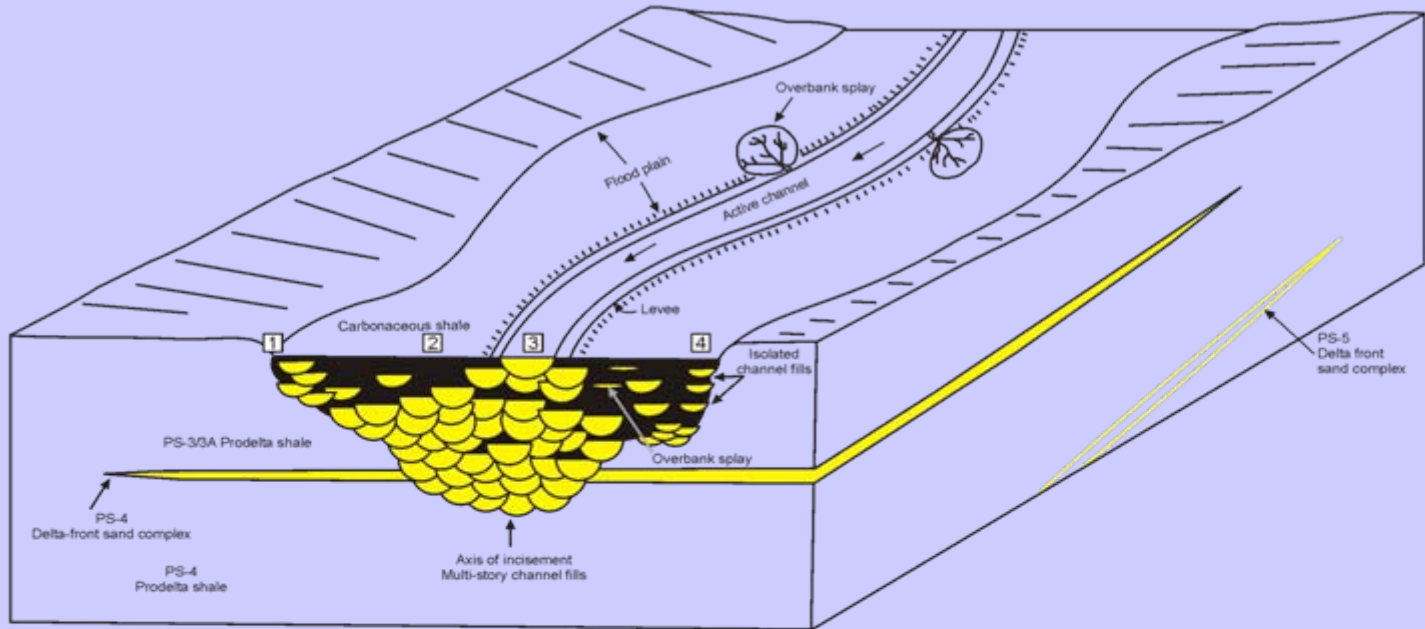


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	Wolfcampian	Chase			
		Council Grove			
Pennsylvanian	Virgilian	Wabaunsee			
		Shawnee			
		Douglas			Tonkawa Swastika
	Missourian	Ochelata		Lansing	Healdton Osage-Layton Hoxbar
		Skiatook		Missouri Lime	Layton Burns-Brundage Wade Cleveland Medrano Marchand
	Desmoinesian	Marmaton		Oswego	Deese
		Cherokee			Prue Senora Skinner Gibson Dora Red Fork Hart Bartlesville Osborn Booch Gilcrease Muskogee
	Atokan	Atoka			
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Mississippian		Chester		Manning (Ark. Novaculite) Meramec Sycamore Osage Miss. Chat	
		Meramec			
		Osage			
				(Misener)	
Devonian					
Silurian			Hunton		Hunton
Ordovician					
			Viola		Viola
			Simpson	Bromide Wilcox Tulip Creek McLish Oil Creek	
Cambrian			Arbuckle		Arbuckle
Pre-Cambrian					

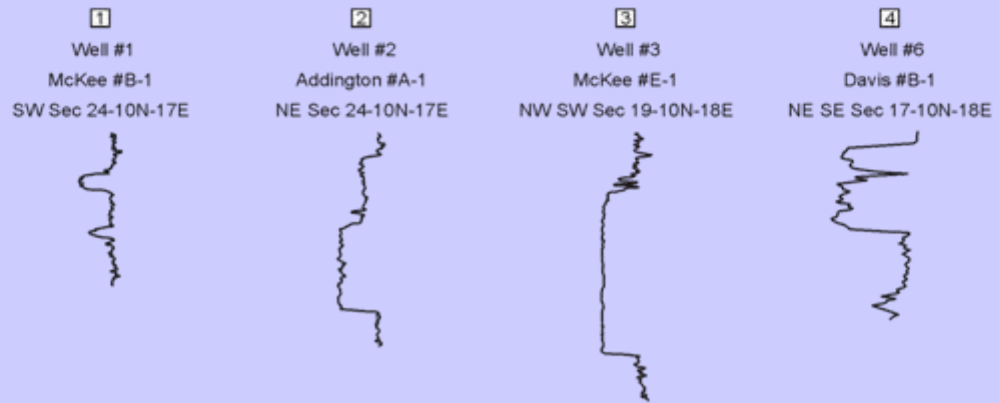
Depositional Environments In Idealized Tidal Delta



Idealized Incised Valley



Log signatures from cross section A-A' (Plate 10)



Major Factors Impacting Recovery

Reservoir Complexity

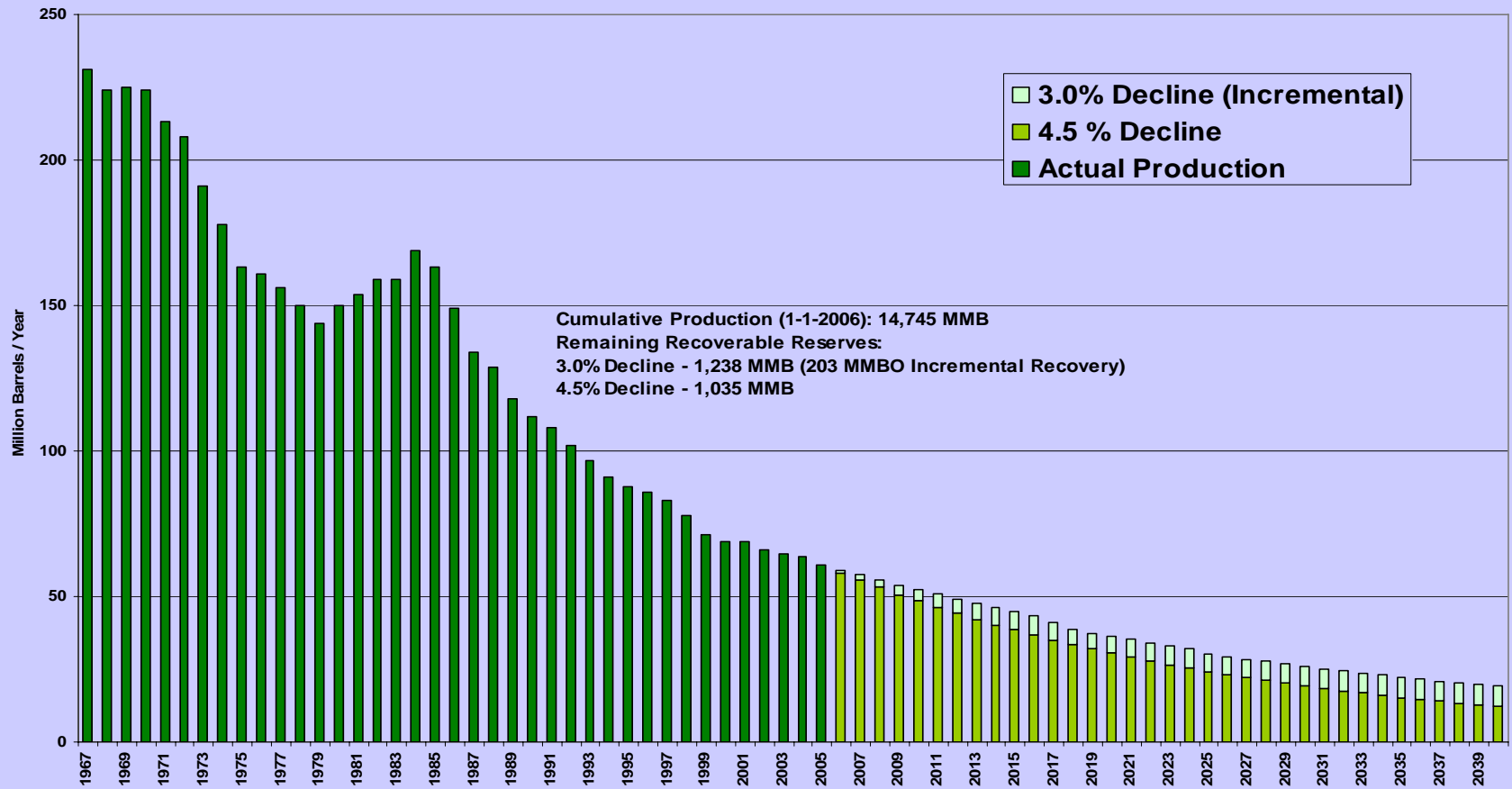
Poor Reservoir Management



Cushing Field Blowout
(circa 1914)

Two Possible Oil Futures

Projected Oklahoma Oil Production Decline (Through 2040)



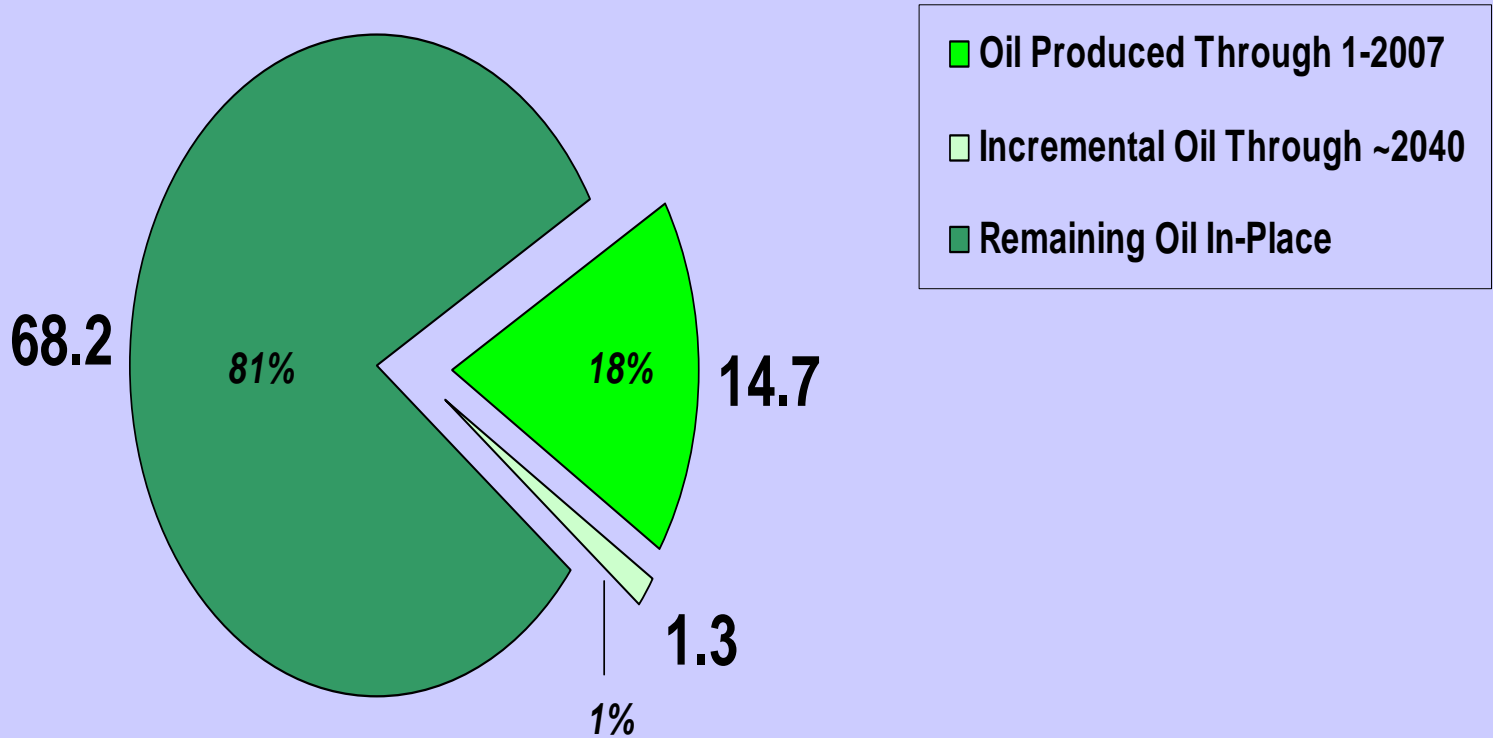
Oklahoma Original and Remaining Oil In-Place Volumes (MMBO) By Reservoir Class

<u>Reservoir Class</u>	<u>% of Cum Prod</u>	<u>E.U.R. (Max)</u>	<u>Average Recovery Factor</u>	<u>1/RF%</u>	<u>OOIP</u>	<u>Rem OIP</u>
BS	17.5%	2,806	44.1%	2.27	6,370	3,564
CS	18.5%	2,949	10.0%	10.00	29,490	26,541
FDD	64.0%	10,245	21.2%	4.72	48,356	38,111
Total	100.0%	16,000	<<<< Aggregate 19.0% >>>>		84,216	68,216

(1-1-2006 Cum = 14,745)

Oklahoma's Oil Endowment

(In Billions of Barrels)



Estimated Original Oil In-Place 84.2 BBO

Oklahoma Natural Gas

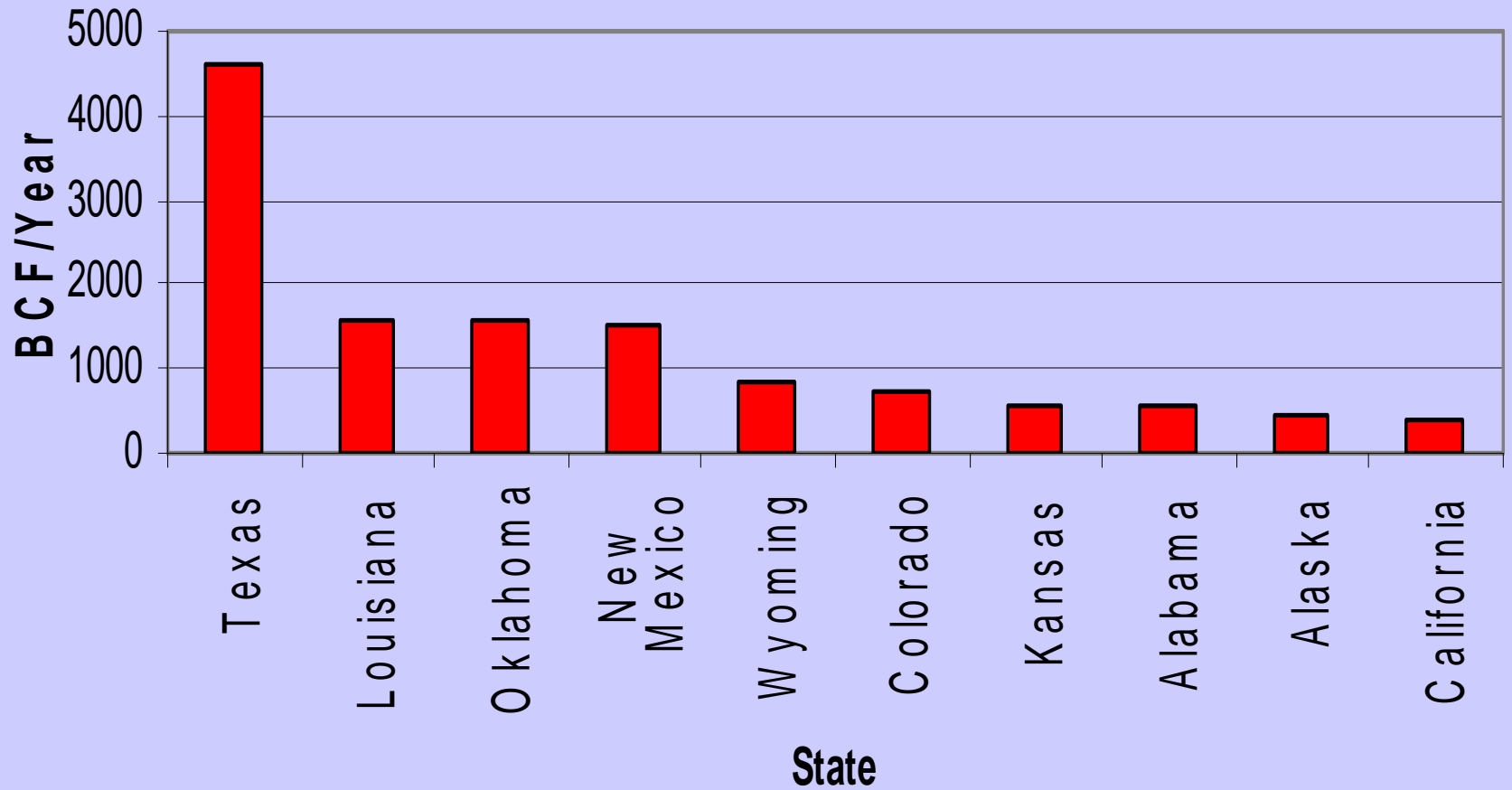


The Source of Oklahoma Coal



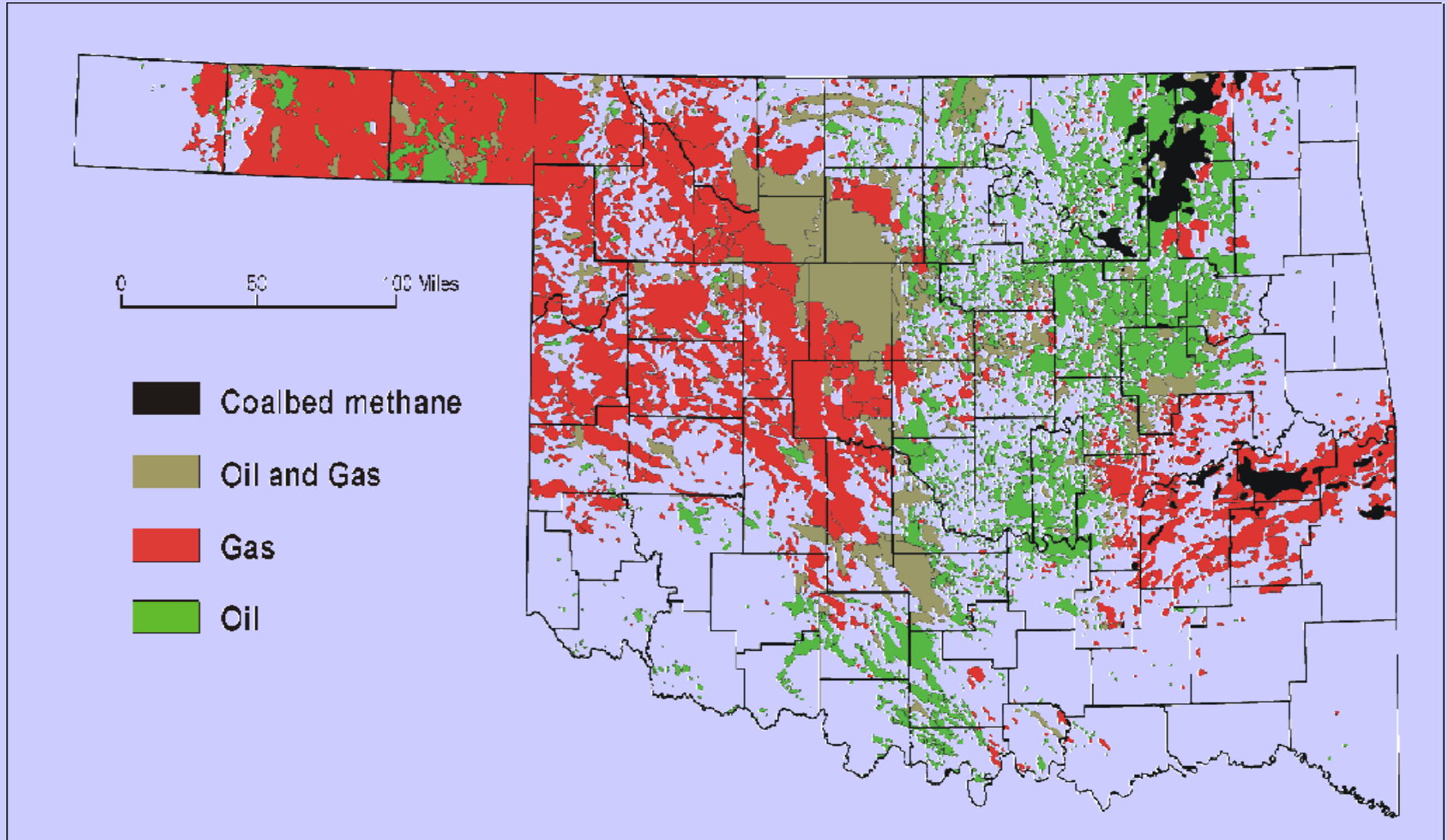
Wyoming

Natural Gas Production in 1999



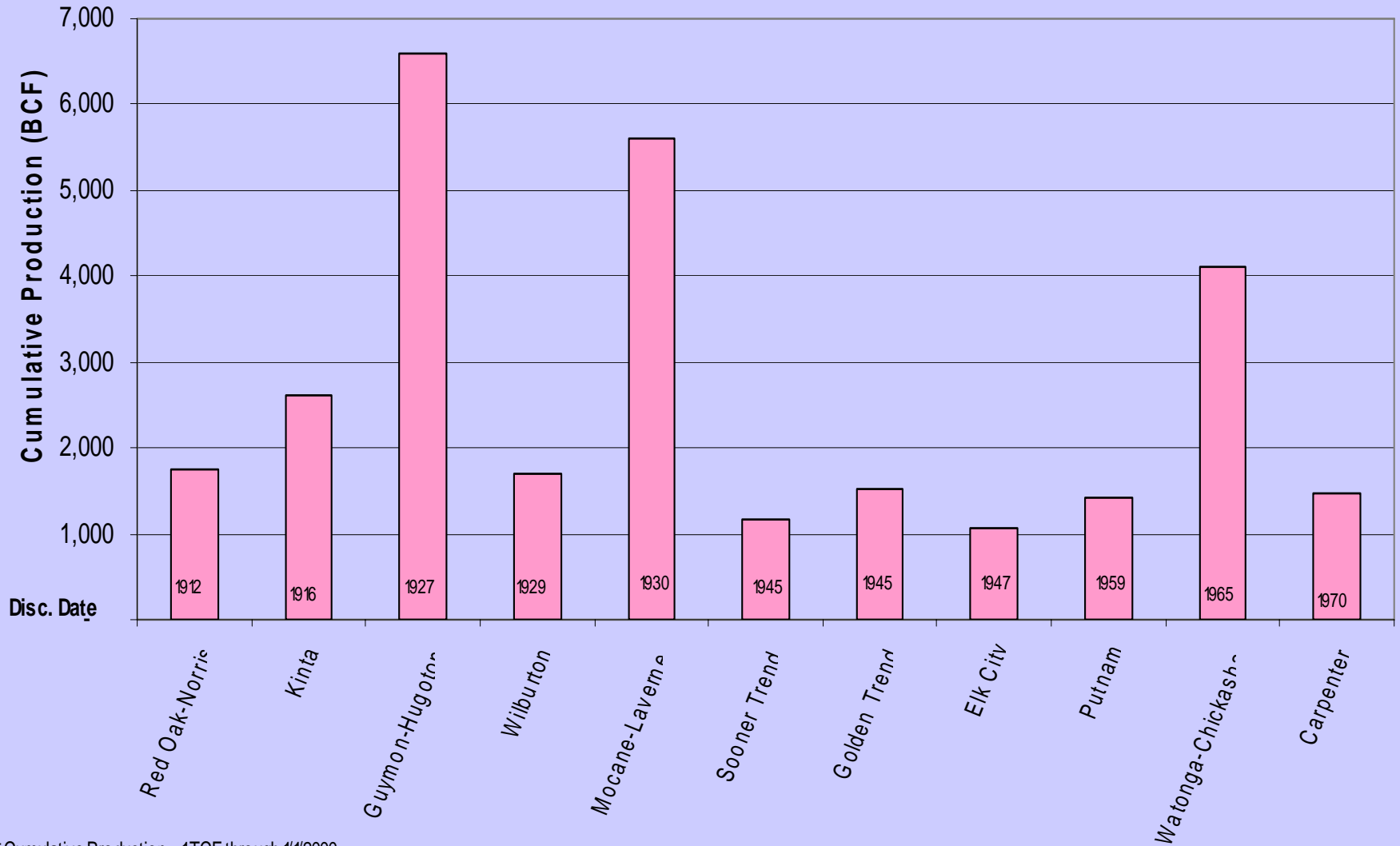
Excluding Federal OCS Gas

Map of Oklahoma Oil and Gas Fields; Distinguished By GOR and Coalbed Methane Production. From Boyd (2002)
(GOR Cutoffs: Oil <5,000; Oil and Gas 5,000-20,000; Gas > 20,000)



Major* Gas Fields of Oklahoma

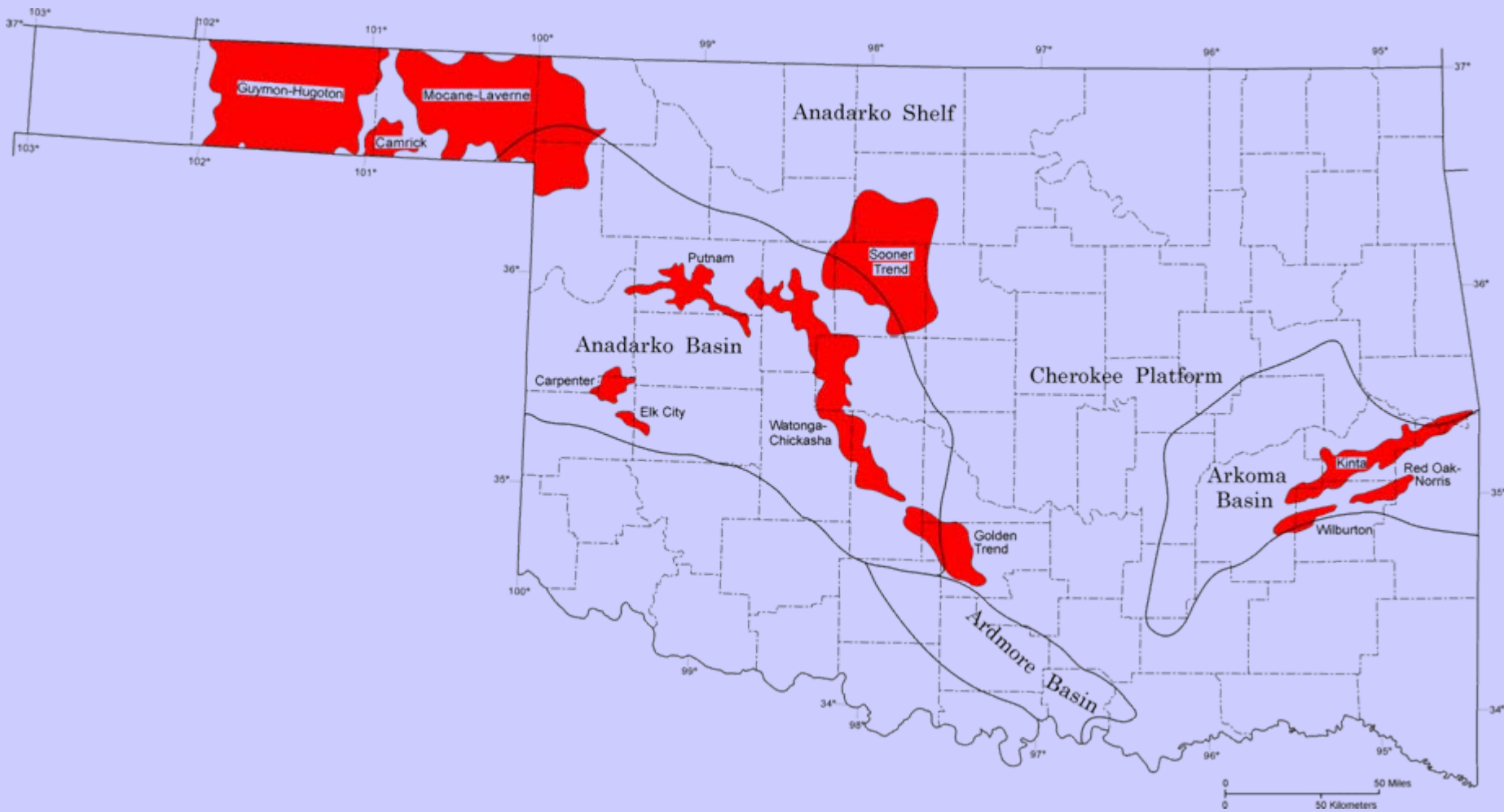
From International Oil Scouts Assoc.



* Cumulative Production > 1TCF through 11/2000

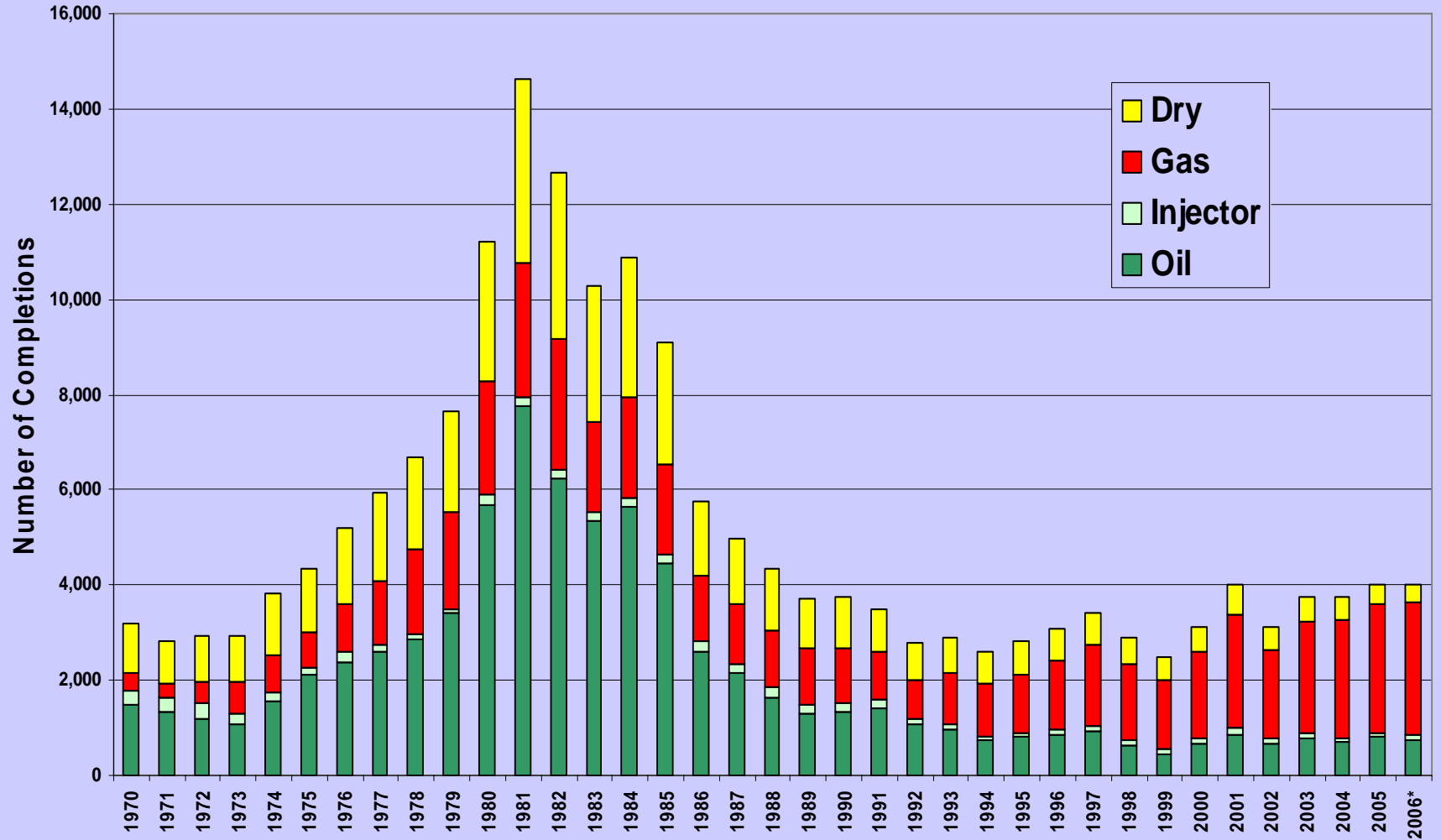
Major Oklahoma Gas Fields

(> 1 TCF Recovery)



Oklahoma Drilling Results 1970-2006

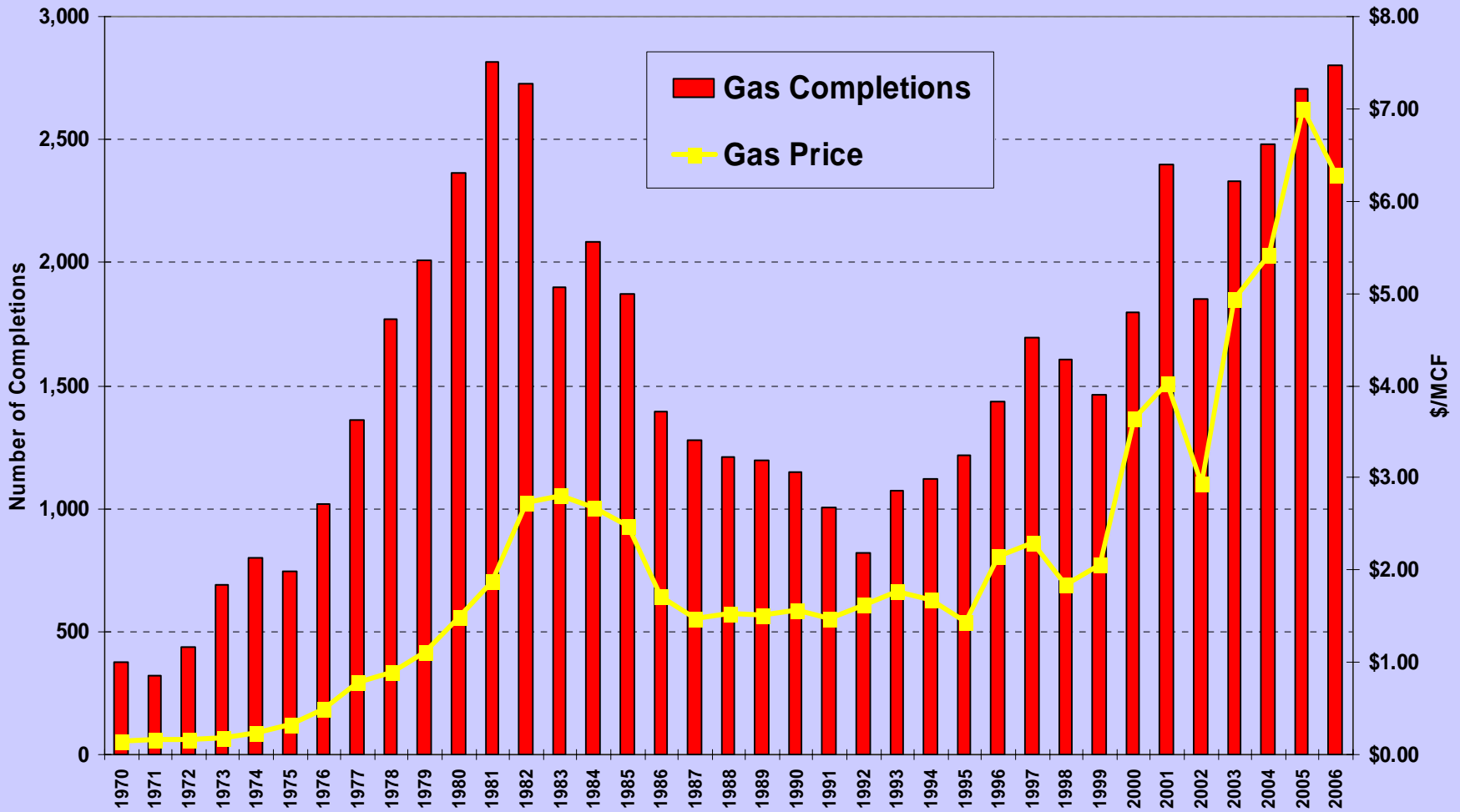
(Data from IHS Energy 4-2007)



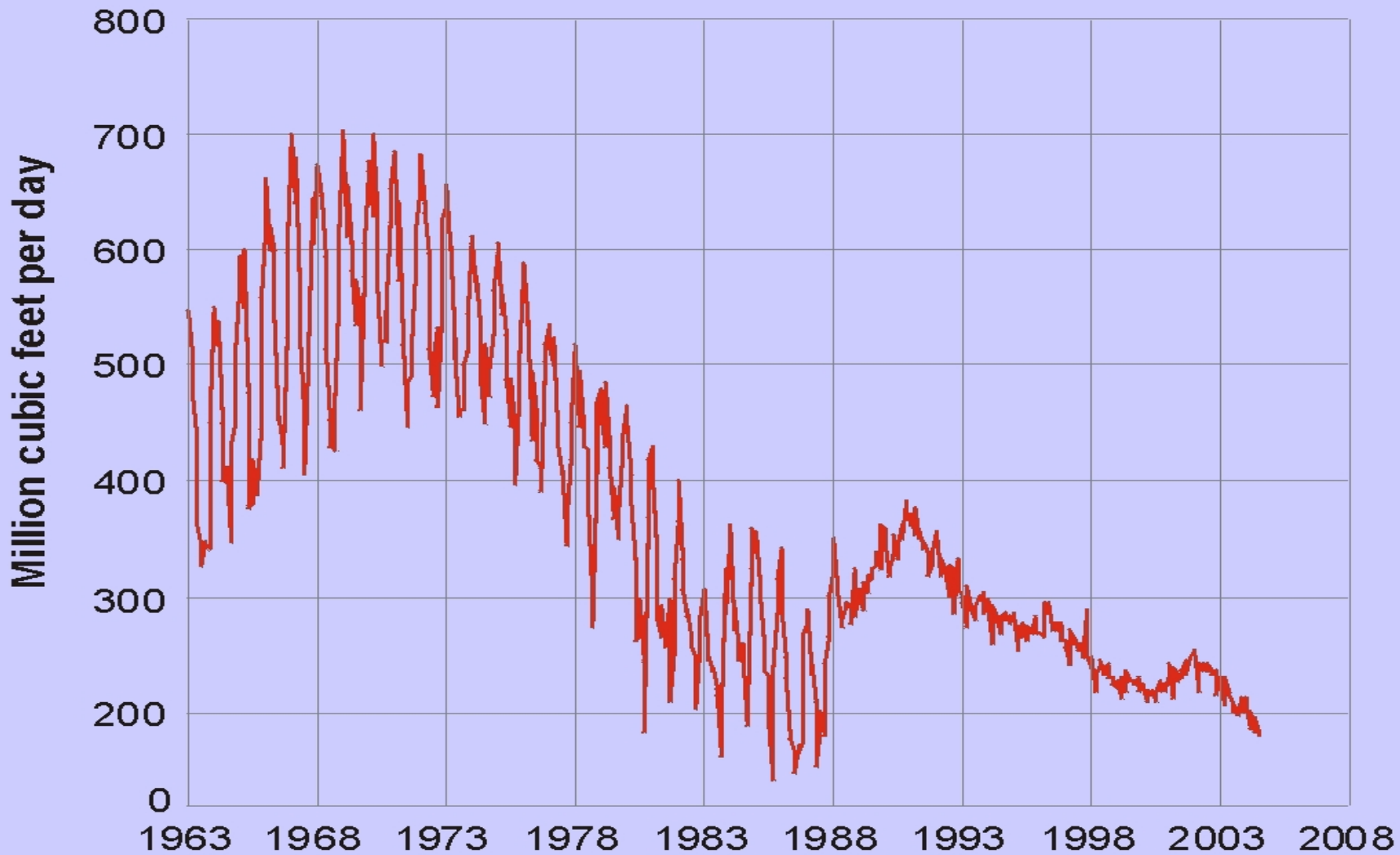
* - 2006 Estimated

Oklahoma Gas Drilling & Price Since 1970

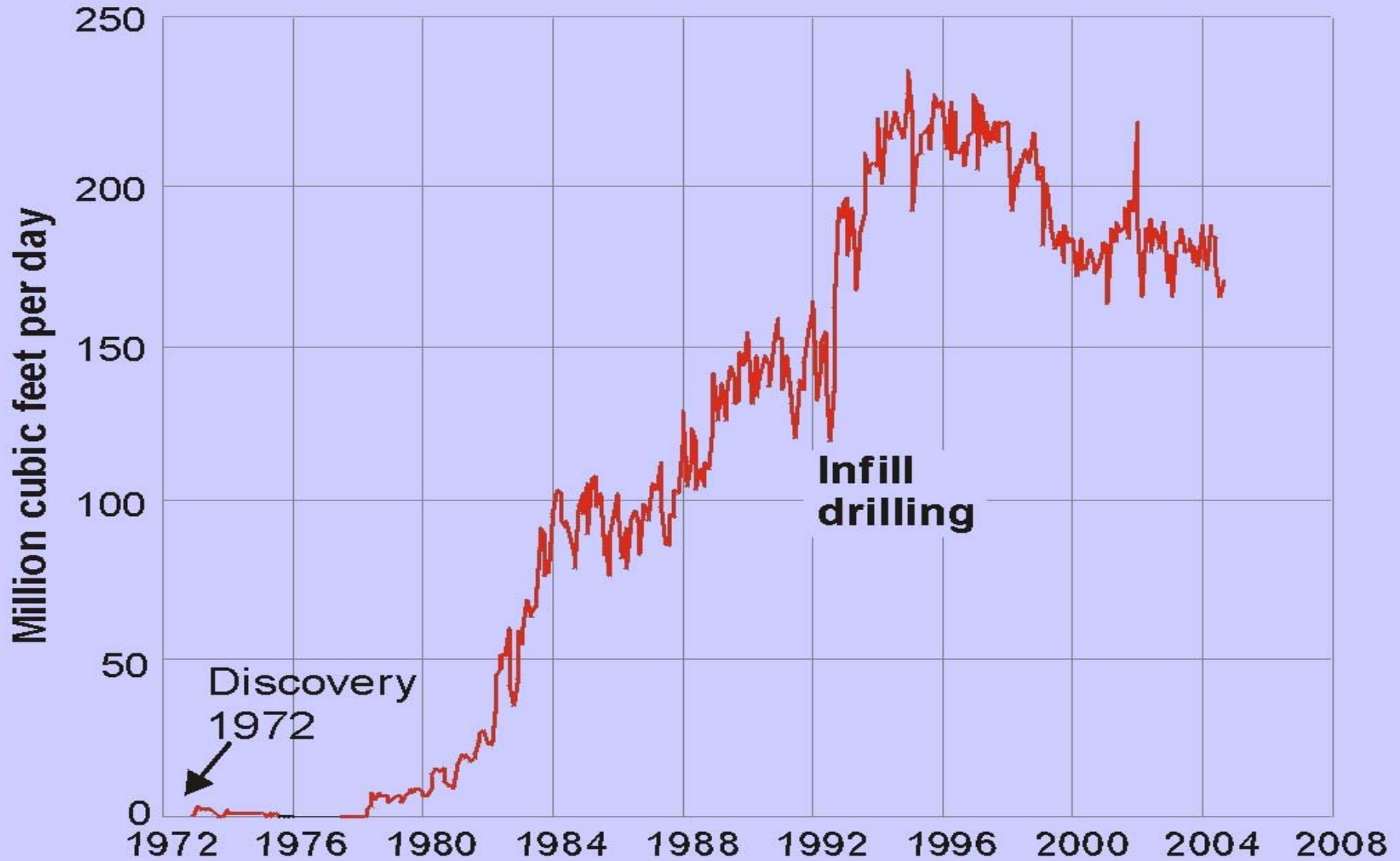
Drilling data from IHS Energy(4-2007) / Prices from O.C.C.



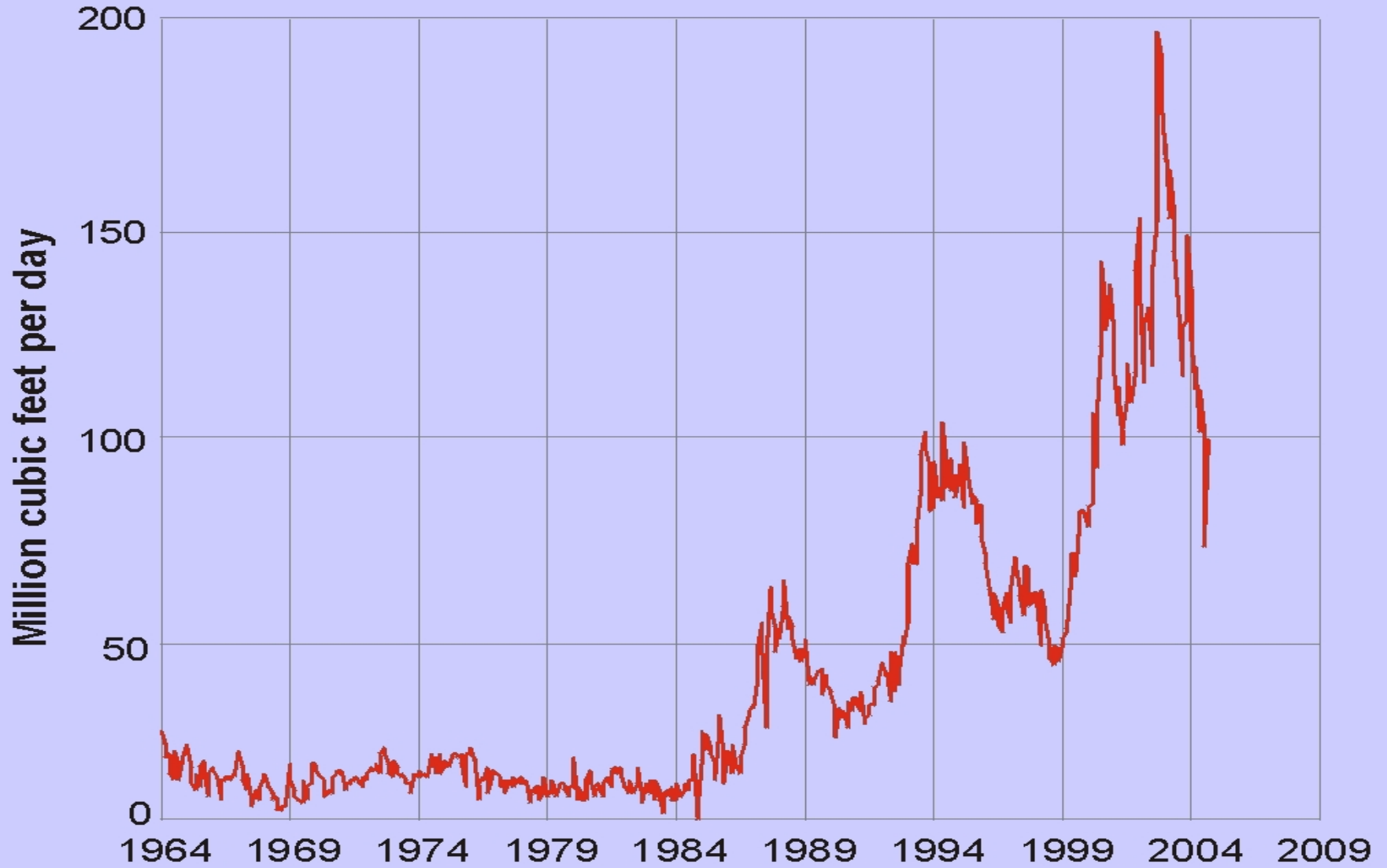
Mocane Laverne Field Gas Production



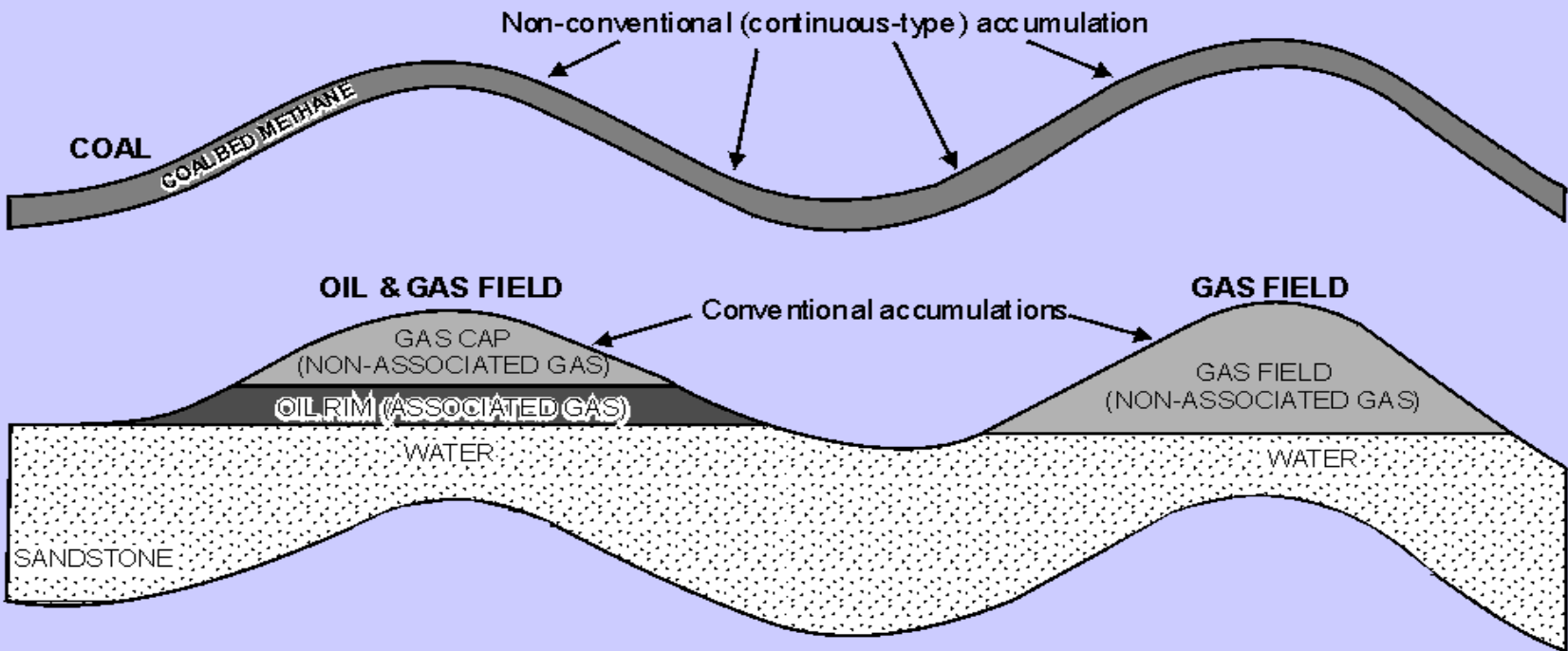
Strong City Field Gas Production



Cement Field Gas Production

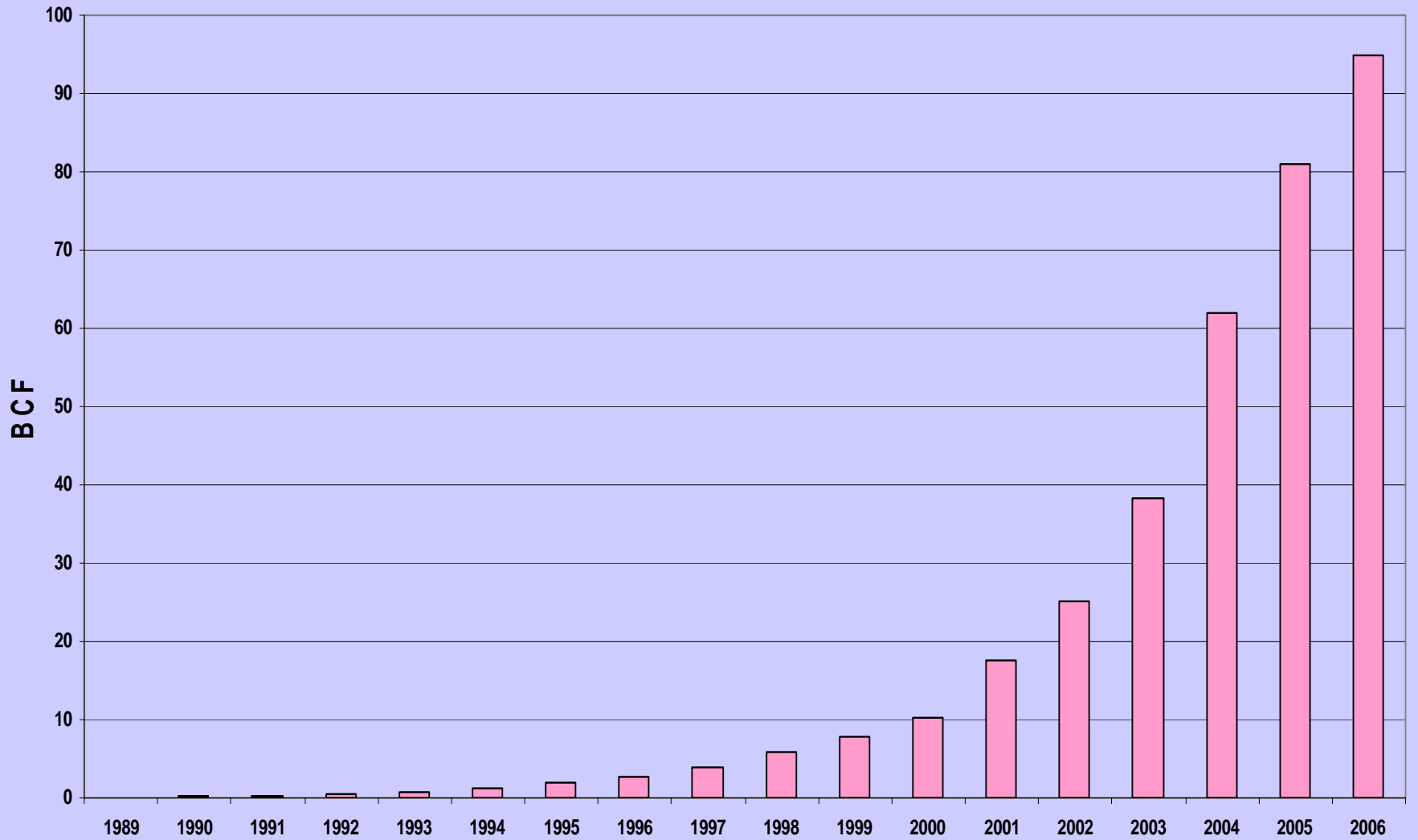


Some types of subsurface natural gas accumulations



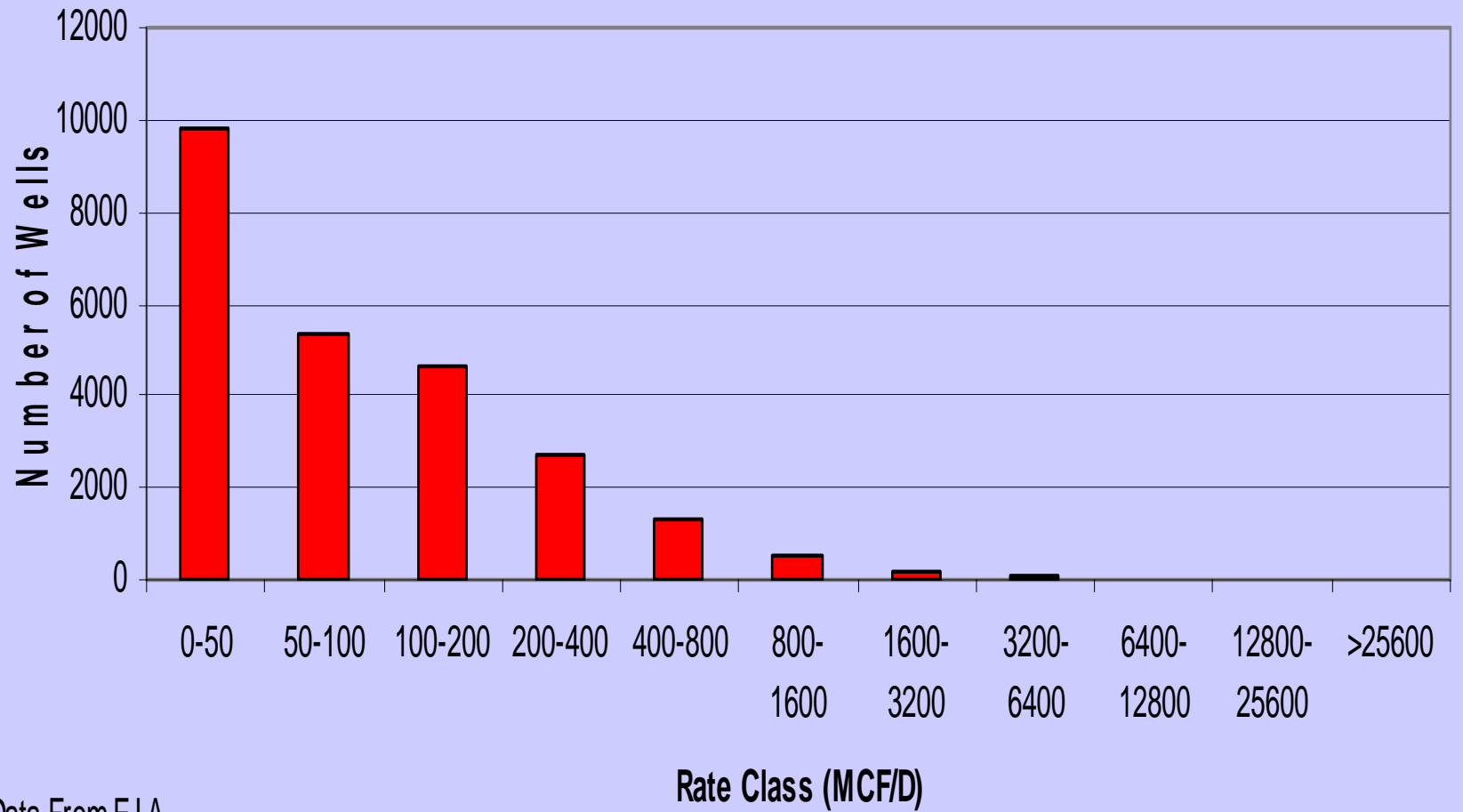
Oklahoma Coalbed Methane Production

(Estimates from Cardott, 2004 and IHS Energy)



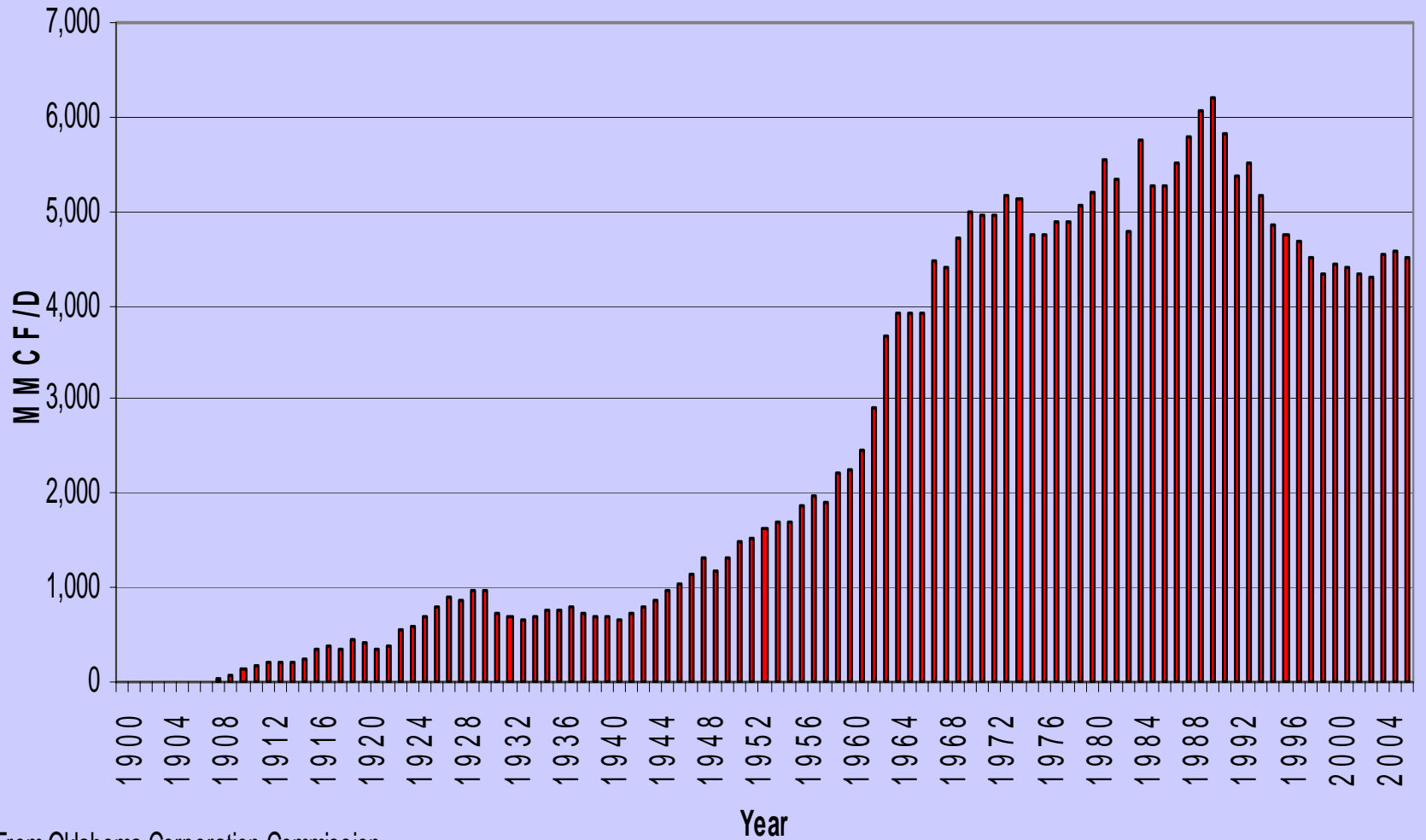
Oklahoma Gas Well Production Rates

(1999)



Data From E.I.A.

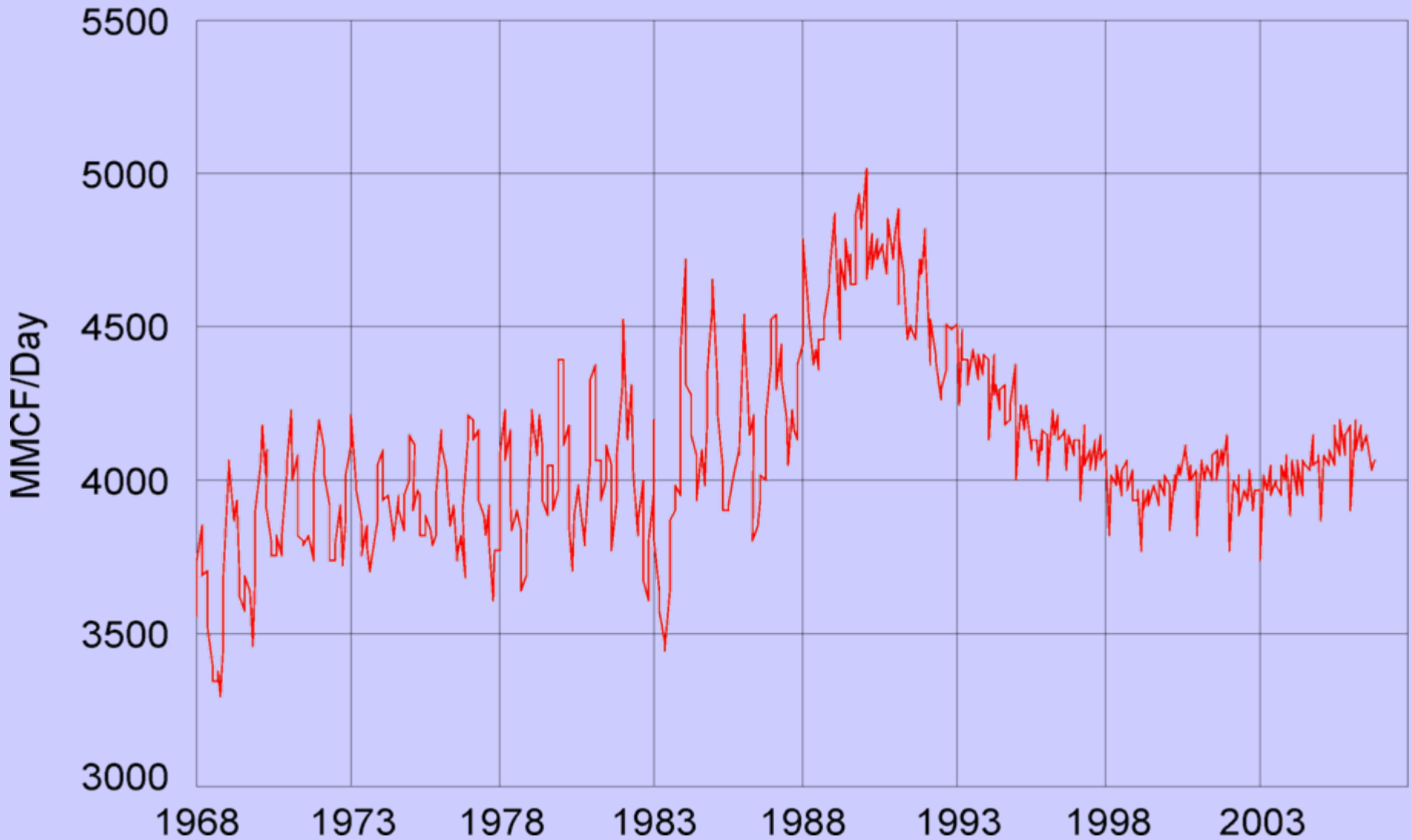
Oklahoma Natural Gas Production



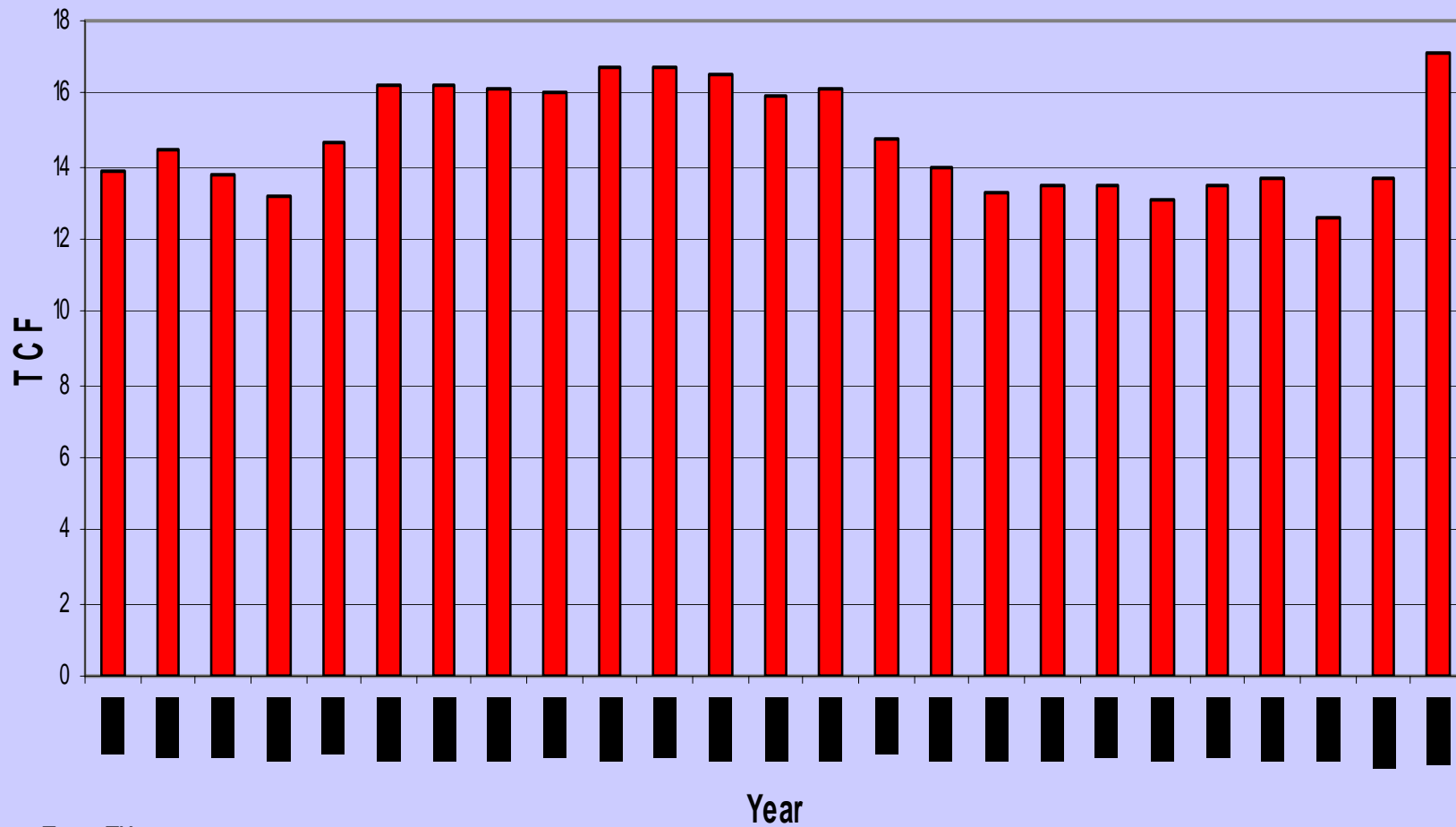
From Oklahoma Corporation Commission

Oklahoma Natural Gas Production

(From IHS Energy - Gas Wells Only)



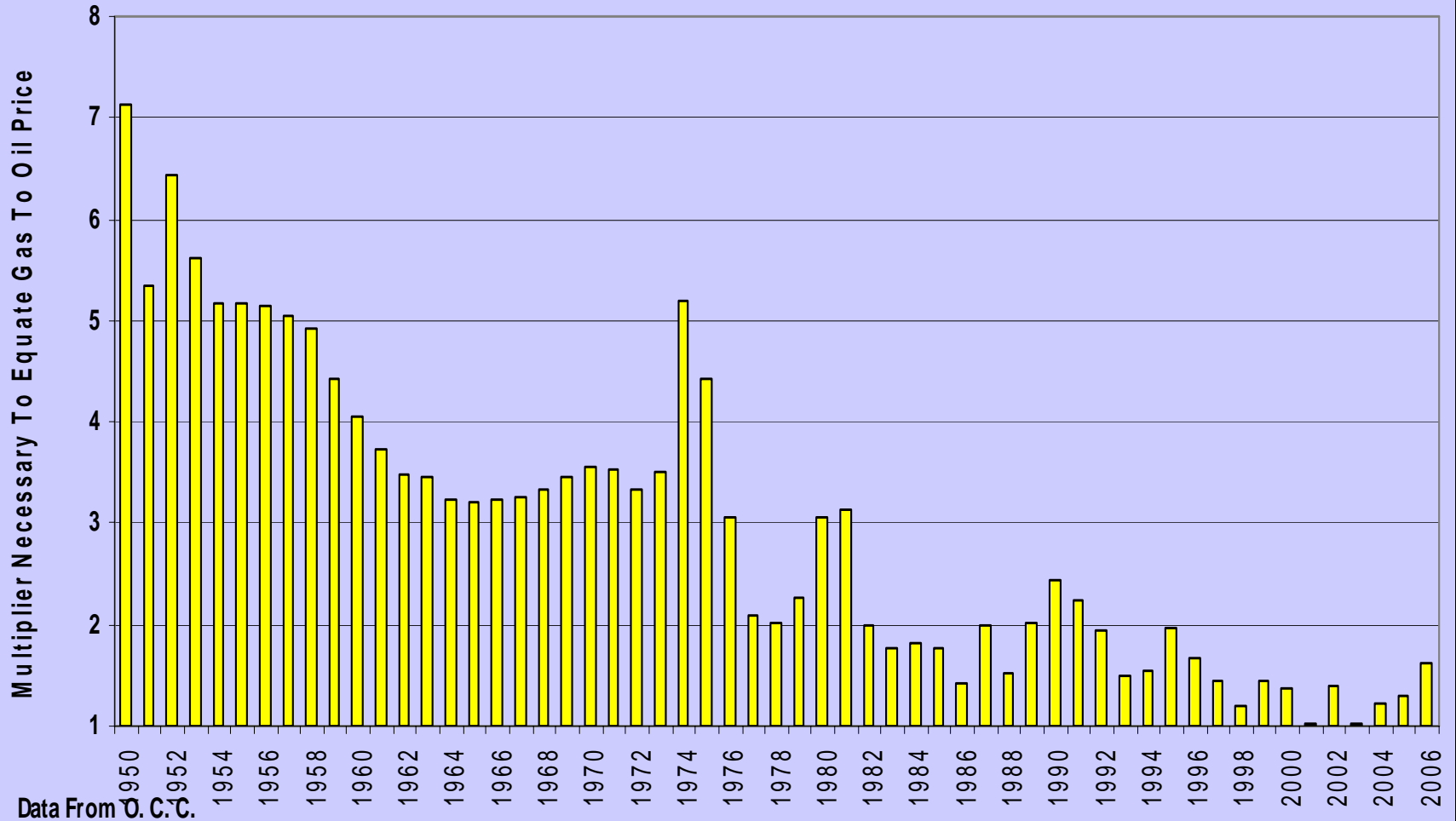
Oklahoma Proved Dry Gas Reserves



Data From EIA

Oklahoma Gas Price Undervaluation Relative To Oil

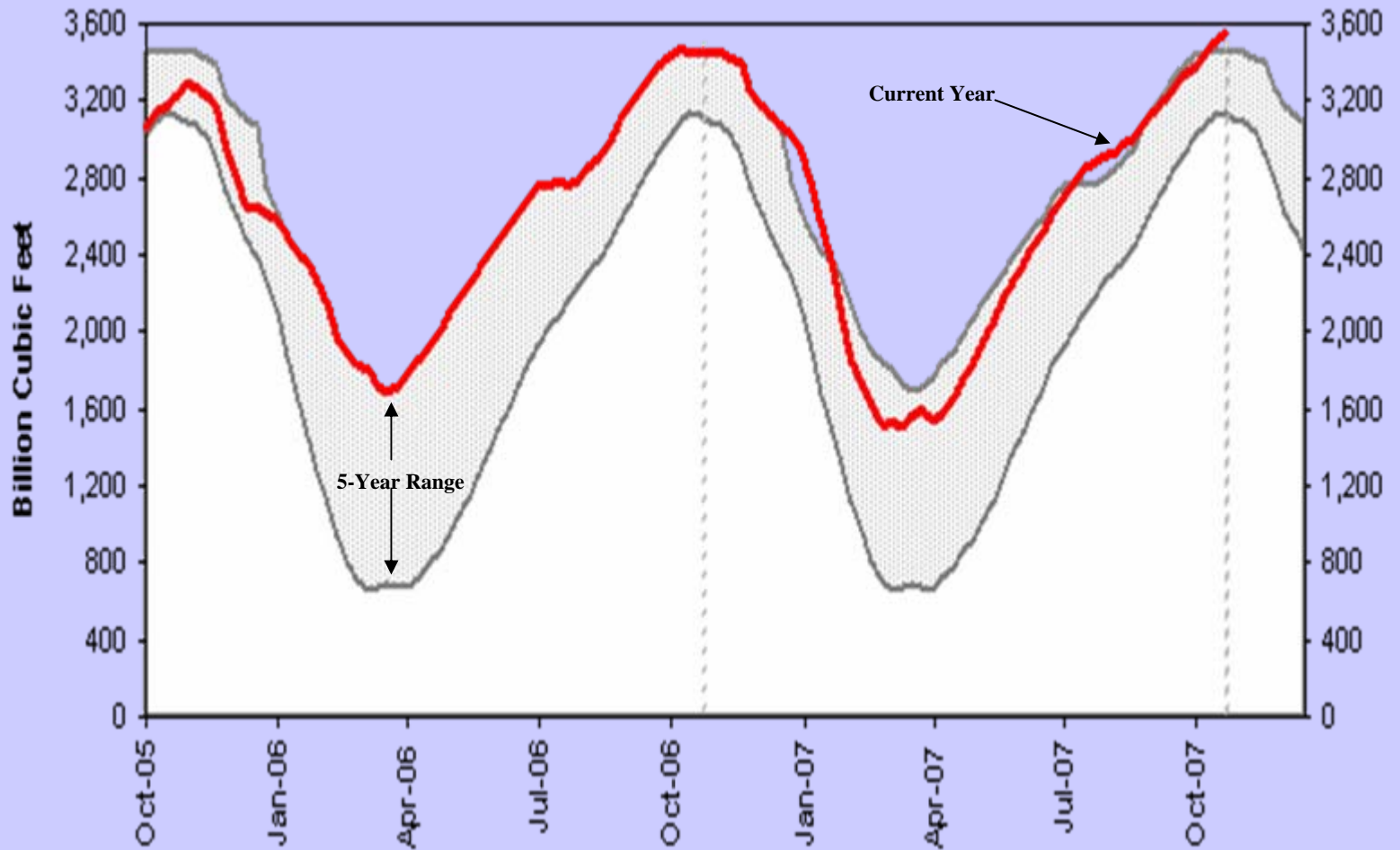
(6 MCF/ Barrel)



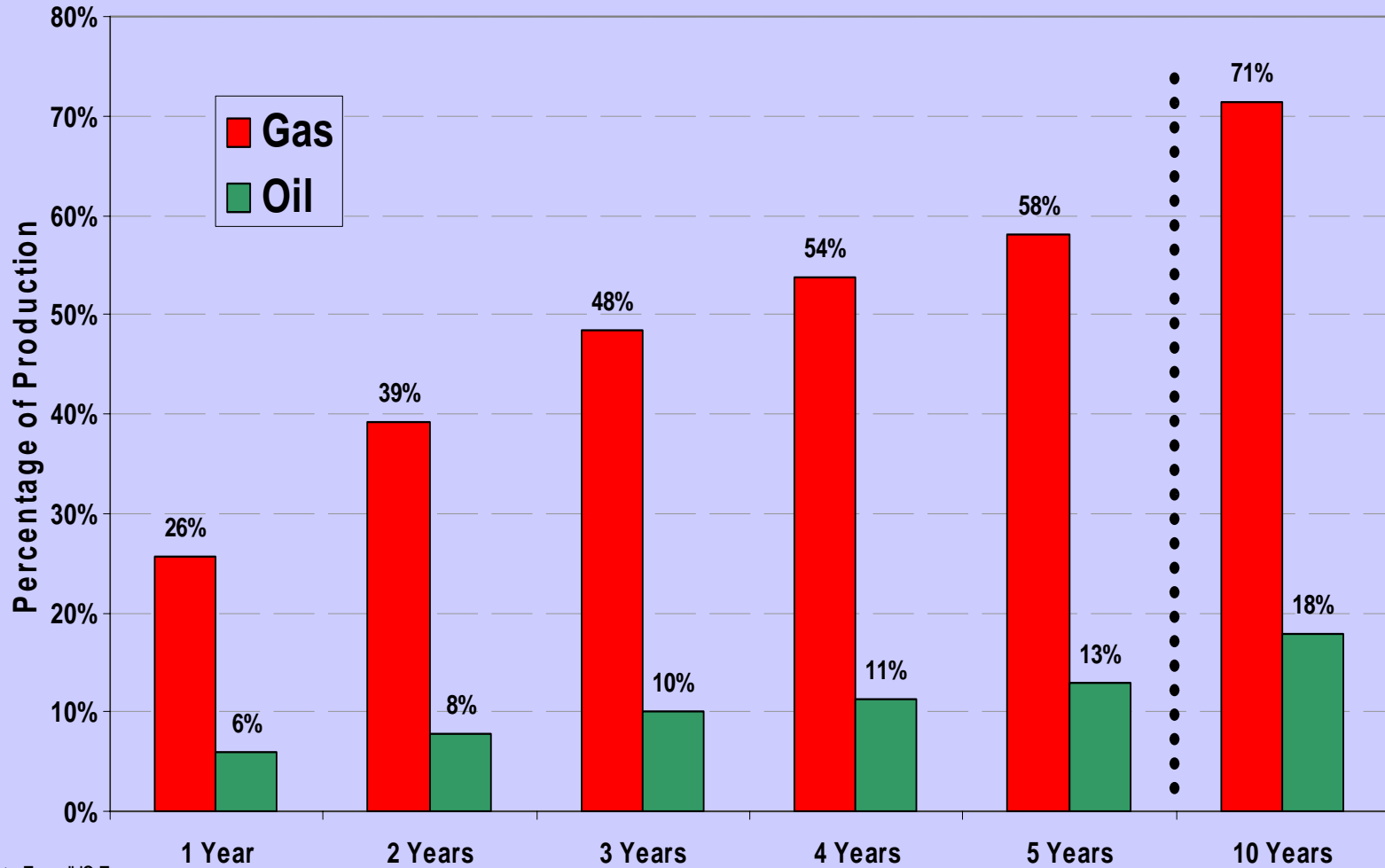
Data From O. C. C.

Working gas in underground storage compared with 5-year range

(From E.I.A.)

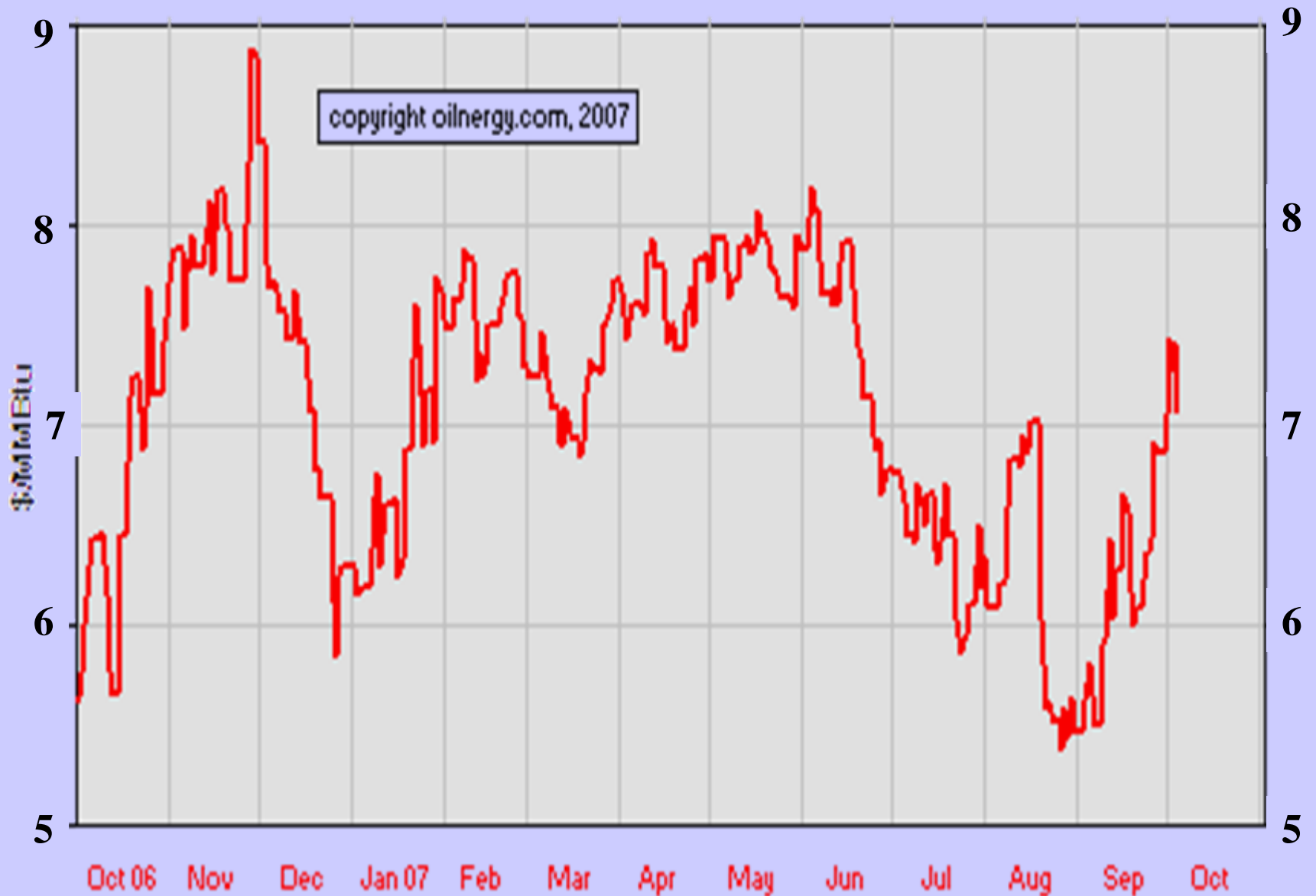


Contributions To Oklahoma Gas and Oil Production Based on Well Age (For January 2007)



Data From IHS Energy

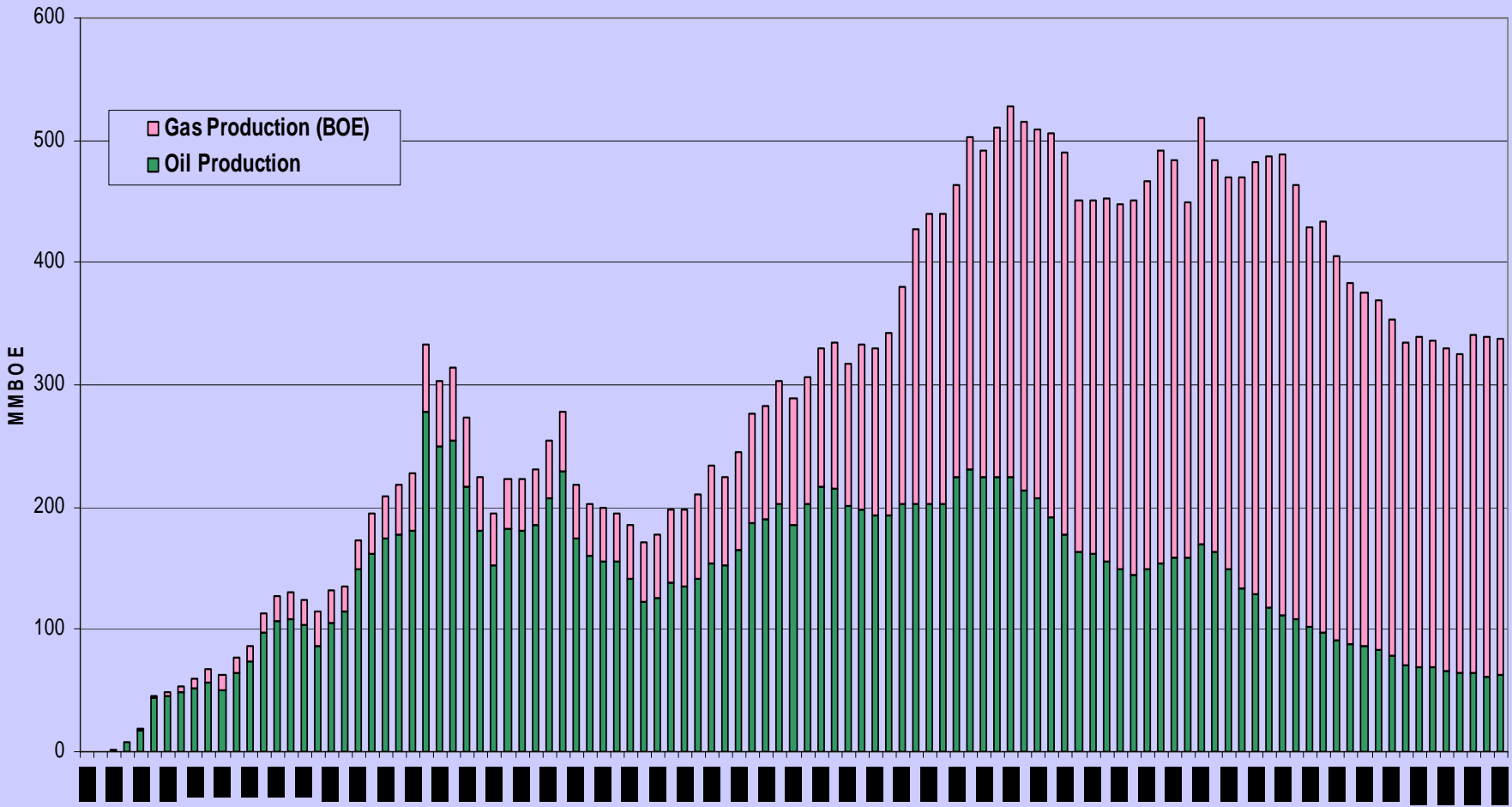
NYMEX Henry-Hub Natural Gas - 12 previous months



State Summary

Oklahoma Annual Hydrocarbon Production

(6 MCF / Bbl)



Data From Oklahoma Corporation Commission

Conclusions

OIL:

- 1) Undiscovered oil insignificant.
- 2) Improved recovery only source for significant new production.
- 3) Long-term prices should remain strong. (Global market)
- 4) Challenge is identifying enhancement opportunities.

GAS:

- 1) Will remain State's primary energy resource.
- 2) Many sources of new production.
- 3) Price tied to weather. (Local market)
- 4) Drilling activity key to maintaining production levels.

BOTH:

- 1) Price will determine volumes ultimately produced.
- 2) State/operator revenues dependent on price, not production rate.



Acknowledgements

IHS Energy Group

U.S. Department of Energy (E.I.A.)

Oklahoma Corporation Commission

Oklahoma Tax Commission

International Oil Scouts Association

Oil and Gas Journal