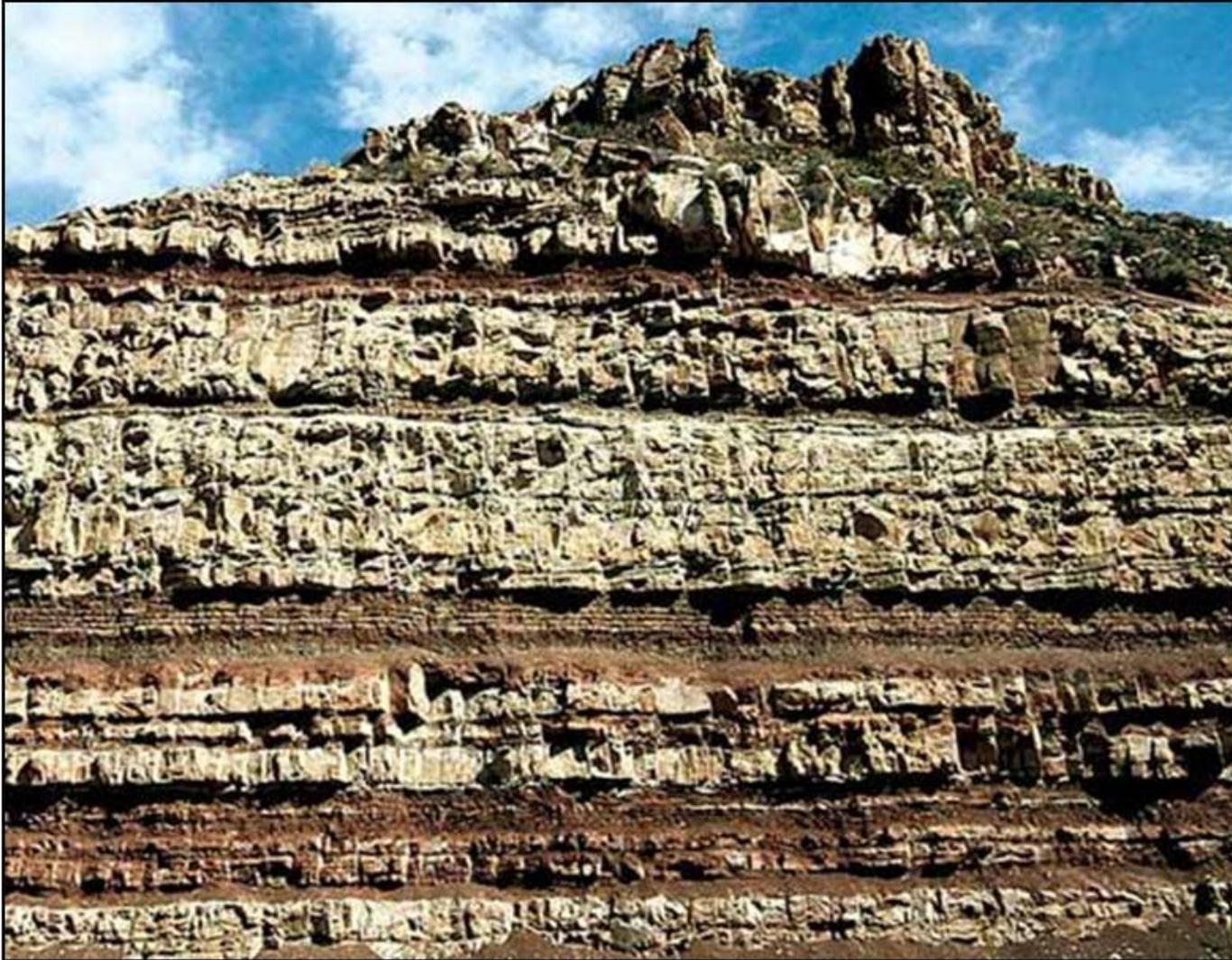


Commodity	Country	Production	Reserves
Oil		(Billions of barrels per year)	(Billions of barrels)
	Saudi Arabia	4.21	265.9
	Russia	3.94	93.0
	United States	3.65	44.2
Natural gas		(Billion cubic meters)	(Billions cubic meters)
	United States	687.6	930
	Russia	604.8	31,300
	Iran	166.6	33,800
Coal		(Millions of short tons)	(Millions of short tons)
	China	3,561	114,500
	United States	904	237,925
	India	613	60,600

Russia = 173 billion tons

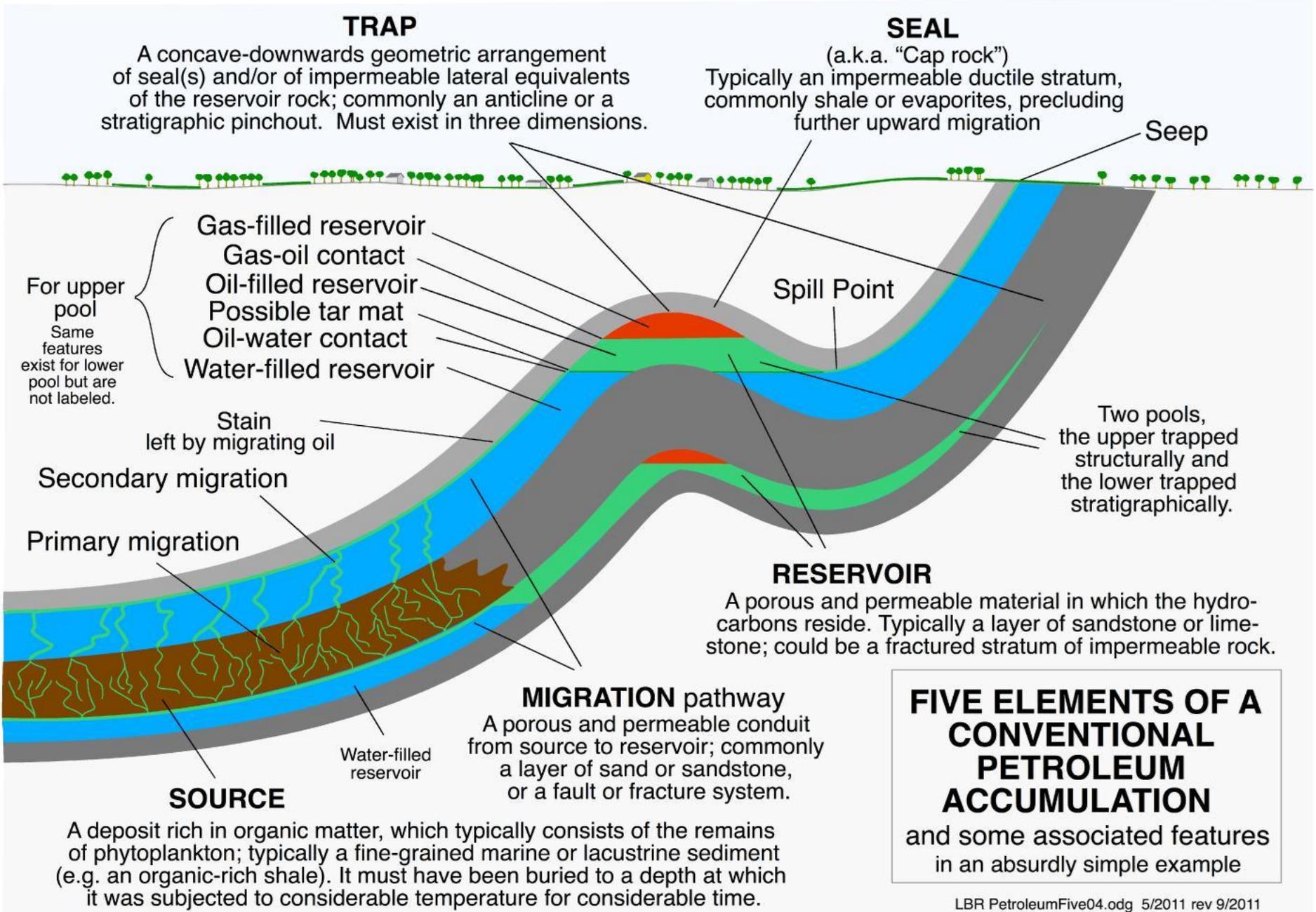
# Sedimentary Rocks are Layered (basin filling)



Youngest Strata



Oldest Strata

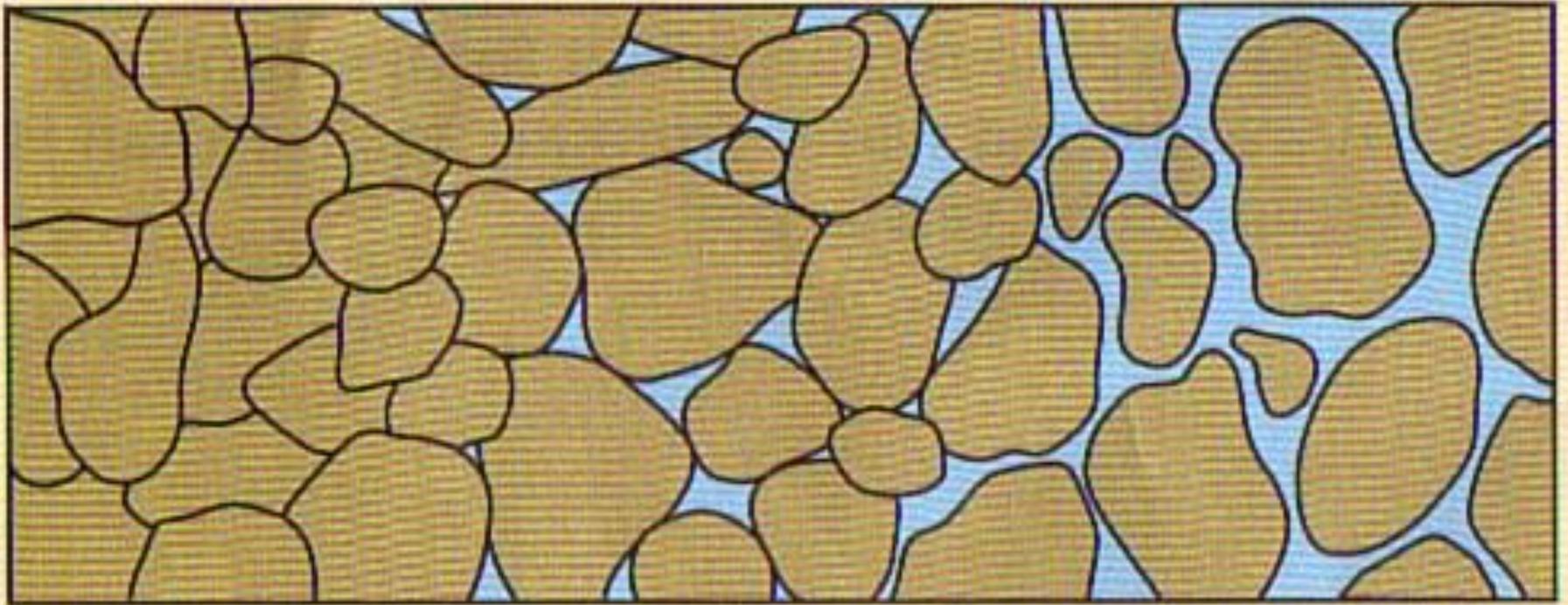


**FIVE ELEMENTS OF A CONVENTIONAL PETROLEUM ACCUMULATION**  
and some associated features in an absurdly simple example

no  
pore spaces

unconnected  
pore spaces

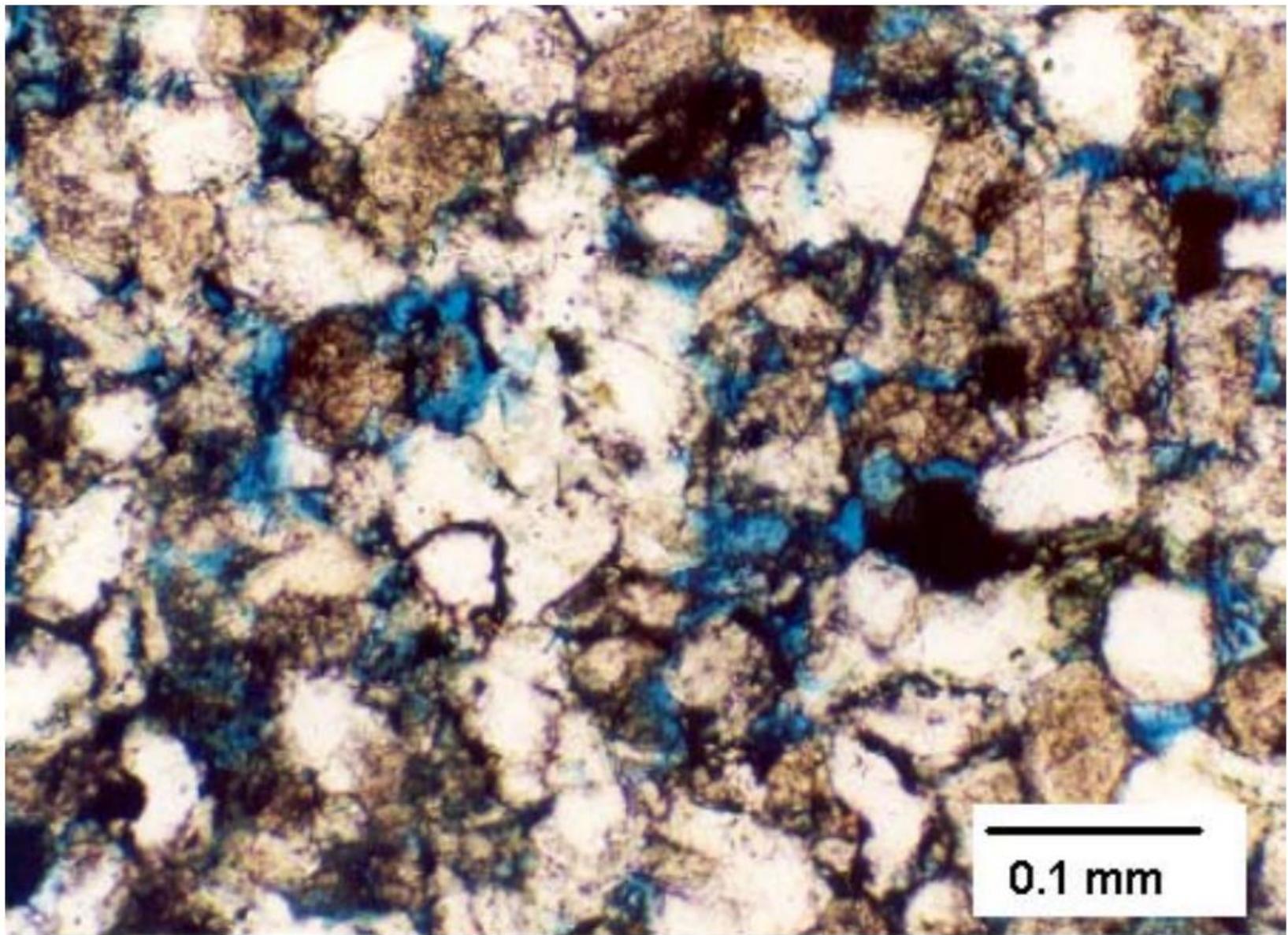
connected  
pore spaces



non-porous  
non-permeable

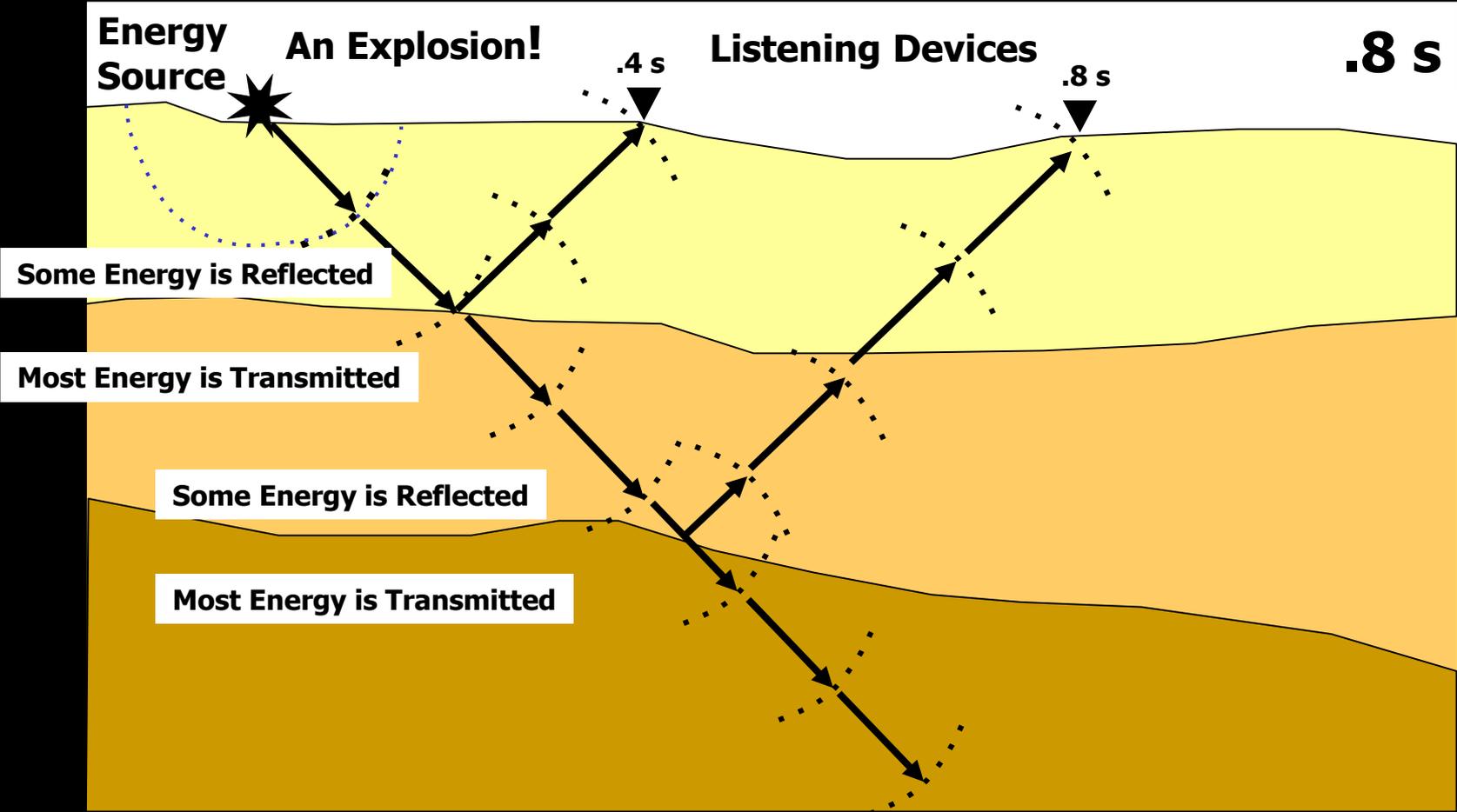
porous  
non-permeable

porous  
permeable



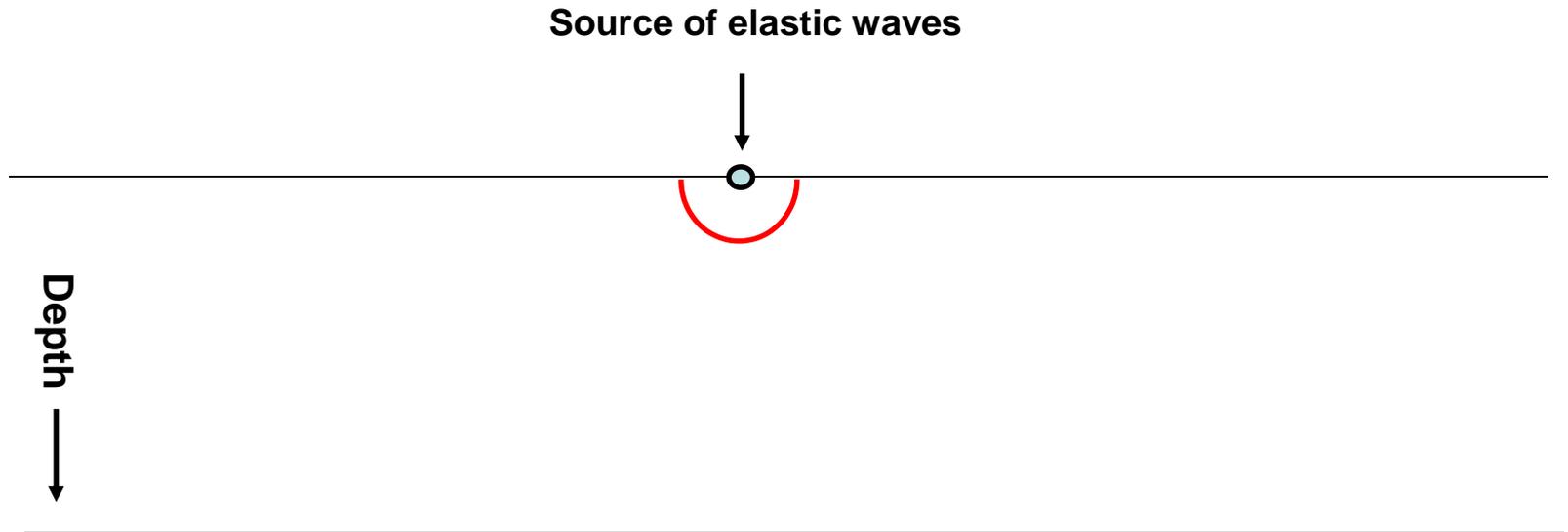
**Figure 3. Greatly magnified microscopic image of a sandstone reservoir rock. The pore spaces may be occupied by oil, gas, or water. This is from the gas-productive sandstone of Figure 4. From Broadhead<sup>1</sup>.**

# Seismic Data



# A. The nature of the seismic image

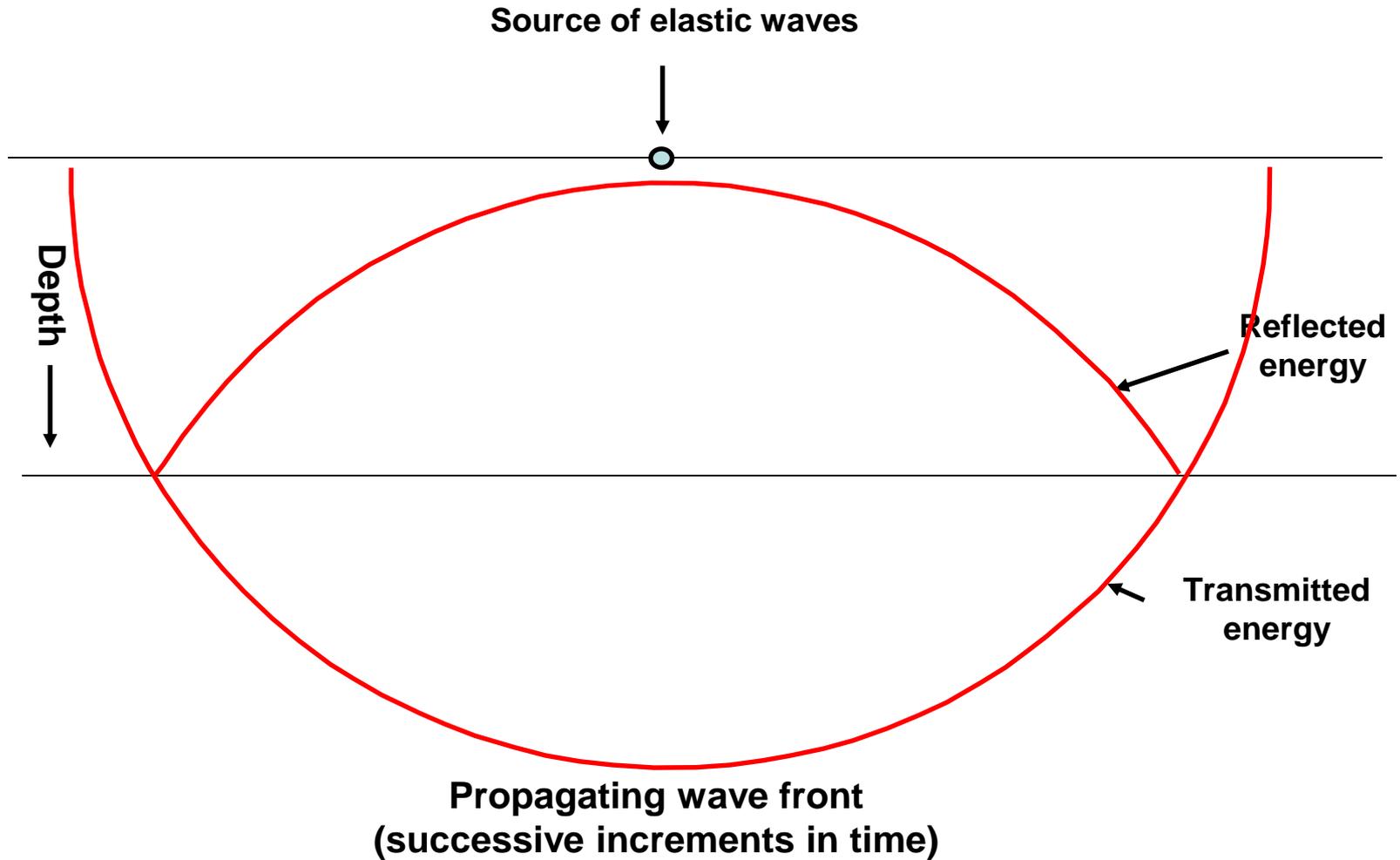
- Rays and Waves



Propagating wave front  
(successive increments in time)

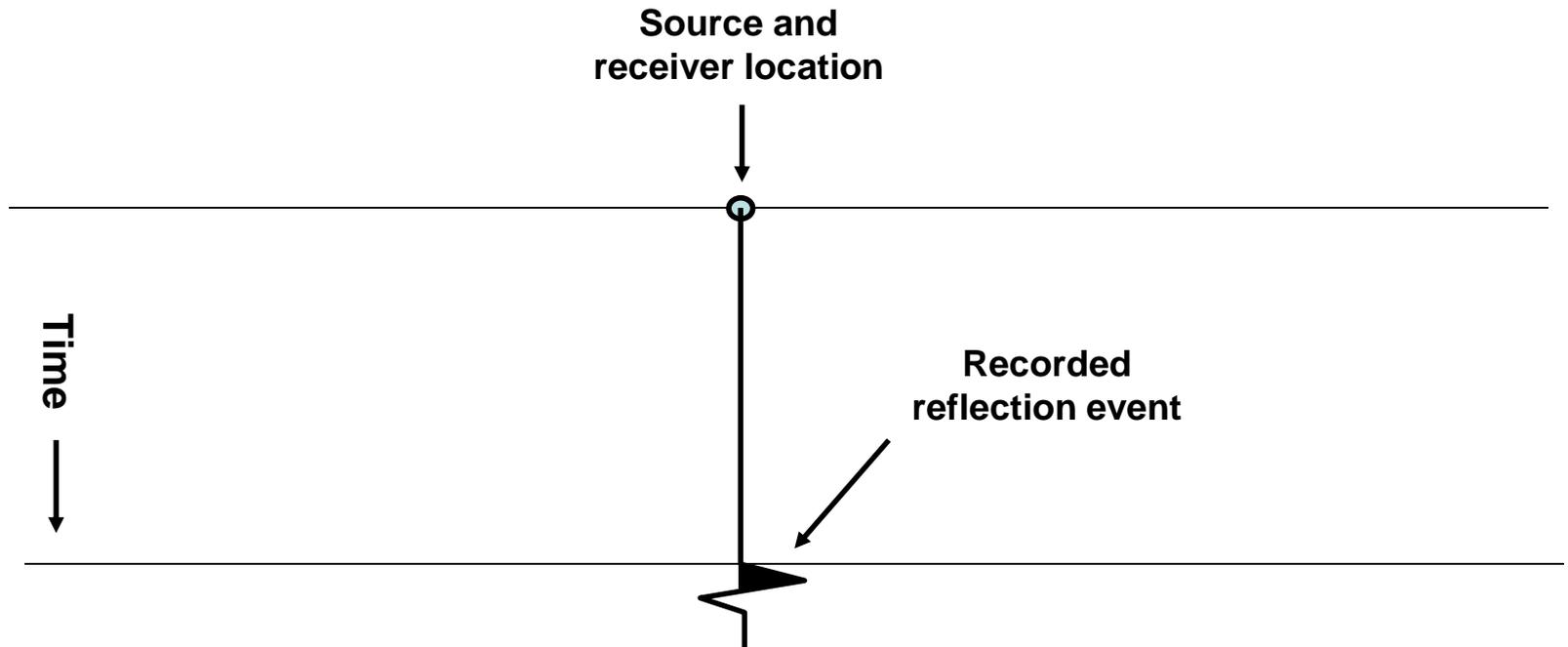
# A. The nature of the seismic image

- Rays and Waves



# A. The nature of the seismic image

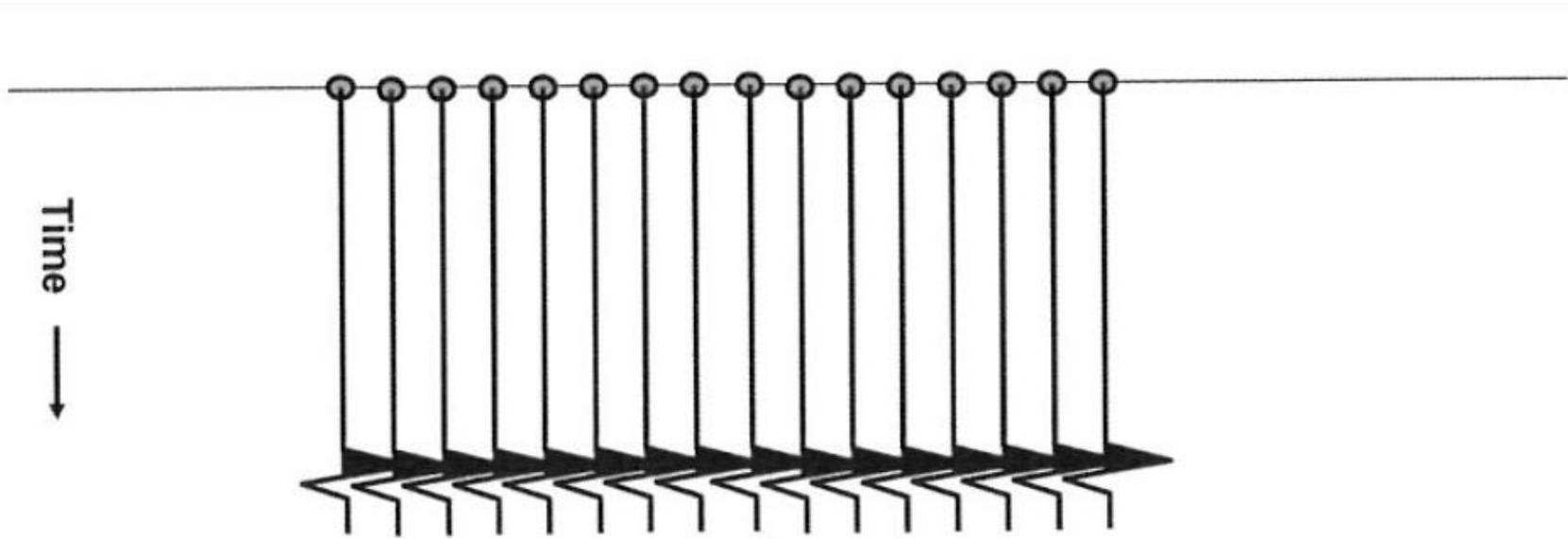
- Rays and Waves



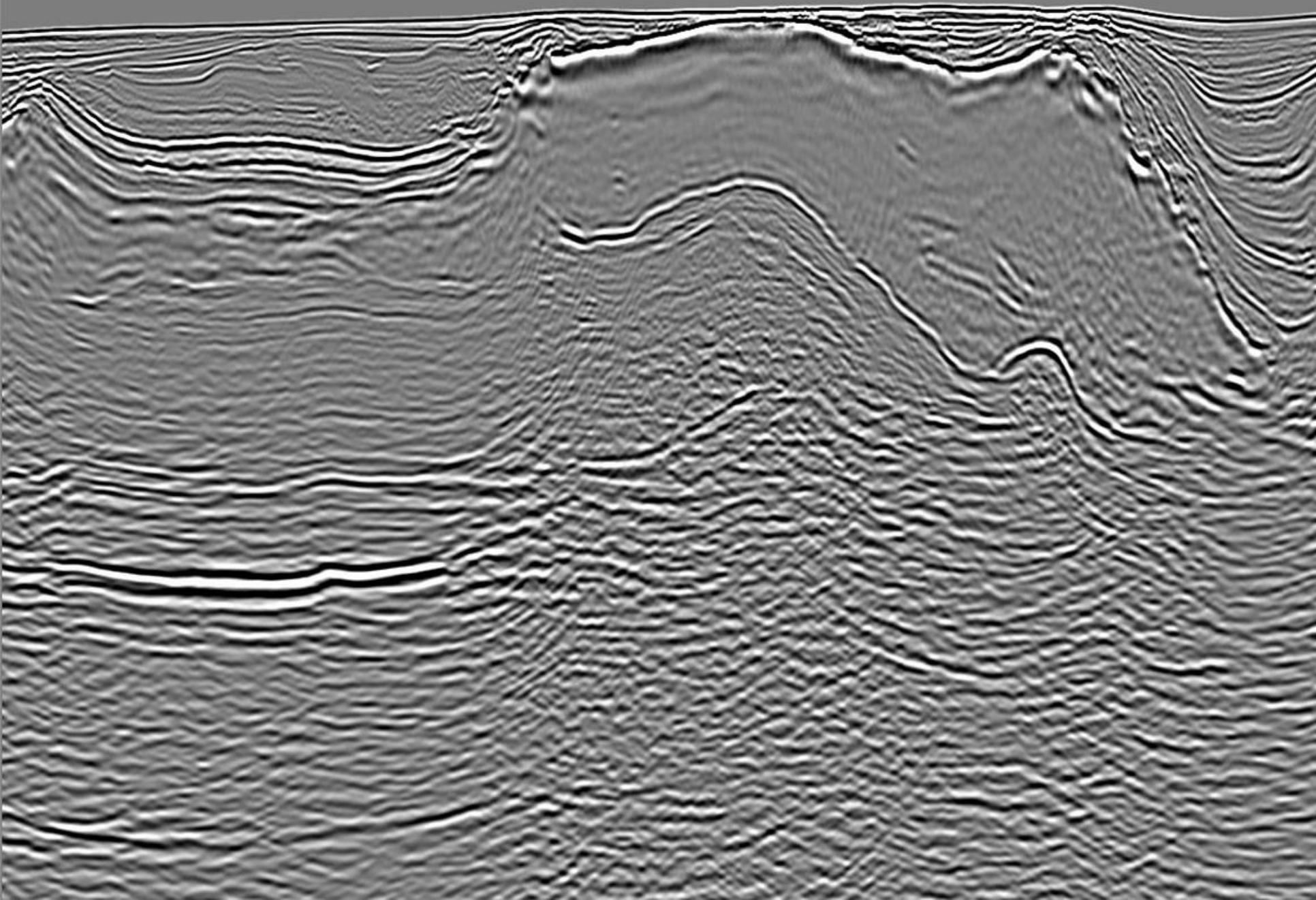
Seismic display in time

# A. The nature of the seismic image

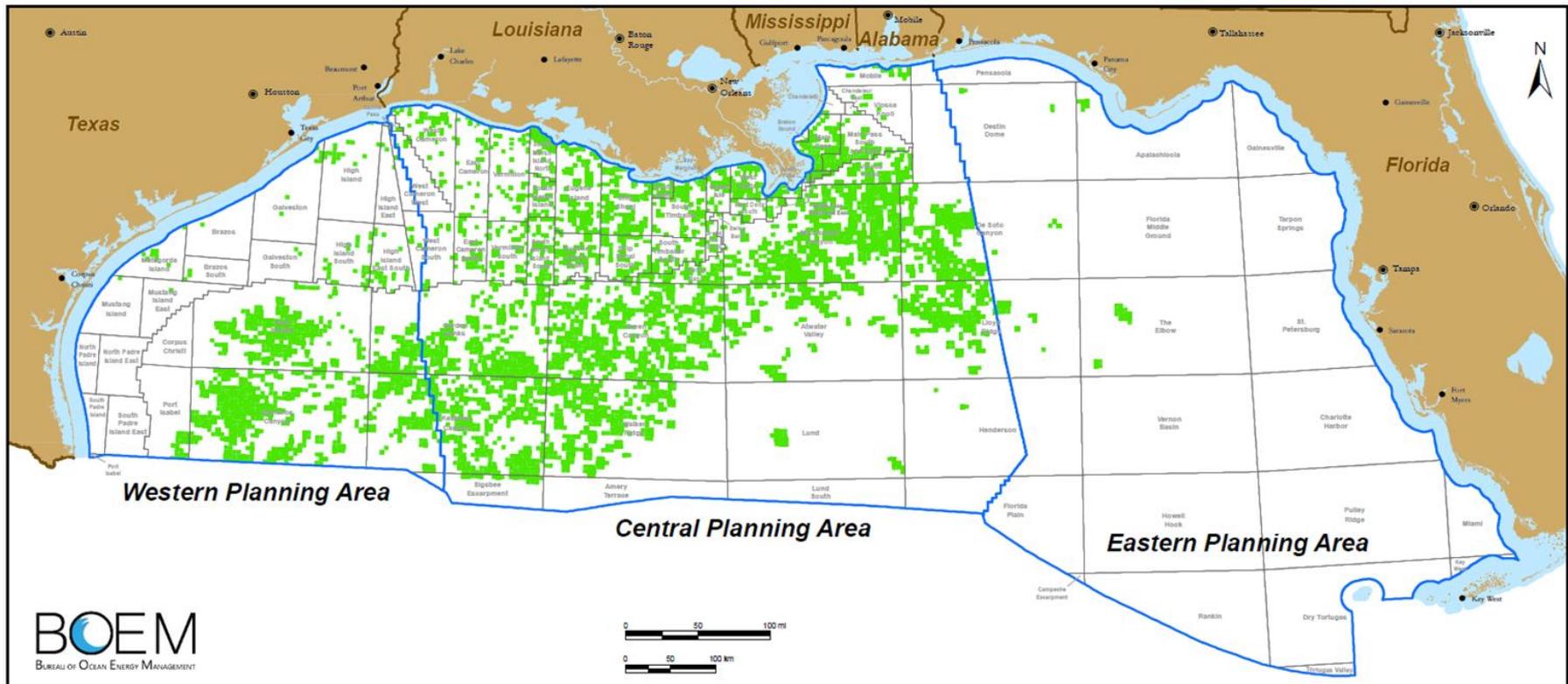
- Rays and Waves



Seismic display in time



# BOEM Gulf of Mexico OCS Region Blocks and Active Leases by Planning Area January 4, 2016



Planning Areas	Total Blocks	Total Acres	Number of Leases	Acres Leased
Western	5,240	28,576,813	907	5,143,073
Central	12,409	66,446,351	3,505	18,574,590
Eastern	11,537	64,357,859	48	264,030
Sub-Totals	29,186	159,381,023	4,460	23,981,693
CPA / EPA Shared Blocks*	(86)		(3)	
<b>Totals</b>	<b>29,100</b>	<b>159,381,023</b>	<b>4,457</b>	<b>23,981,693</b>

Active Leases

Planning Area Boundary

\* CPA and EPA contain 86 shared blocks of which 3 are leased. These blocks are given both a CPA and EPA designation in the data which accounts for a higher block total.

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF OCEAN ENERGY MANAGEMENT  
GULF OF MEXICO REGION

Sale Number : 254  
Sale Identifier : GULF OF MEXICO  
Sale Date : 18-MAR-2020

*Final Sale Summary by Bid System*

	12 1/2 Total	18 3/4 Total	Sale Total
1. Tracts Receiving Bids	6	65	71
2. Acres Receiving Bids	30,000.00	367,285.73	397,285.73
3. Sum of High Bids	\$901,339.00	\$92,182,114.00	\$93,083,453.00
4. Sum of All Bids	\$1,028,116.00	\$107,559,069.00	\$108,587,185.00
5. Total Number of Bids	7	77	84
6. Average Number of Bids	1.17	1.18	1.18
7. Companies Participating	3	20	22
8. (A) Highest Bid Per Tract	\$250,777.00	\$11,114,050.00	\$11,114,050.00
(B) Number of Bids	1	2	2
(C) OCS Number(s)	G36869	G36896	G36896
9. (A) Highest Bid per Acre	\$50.16	\$1,929.52	\$1,929.52
(B) Number of Bids	1	2	2
(C) OCS Number(s)	G36869	G36896	G36896
10. (A) Largest Number of Bids	2	2	2
(B) Number of OCS/Tracts	1	12	13
(C) OCS Number(s)	G36872	G36874 G36878 G36880 G36894 G36895 G36896 G36900 G36901 G36902 G36906 G36907 G36909	G36872 G36874 G36878 G36880 G36894 G36895 G36896 G36900 G36901 G36902 G36906 G36907 G36909

Lease Block Auction Video

Company's Bid Summary

## Onshore

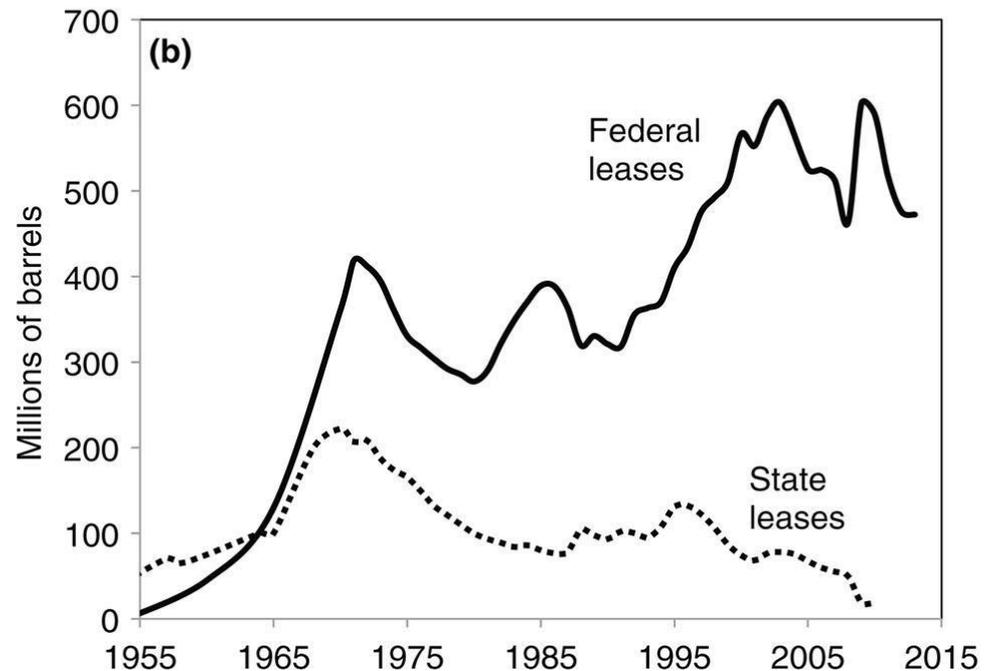
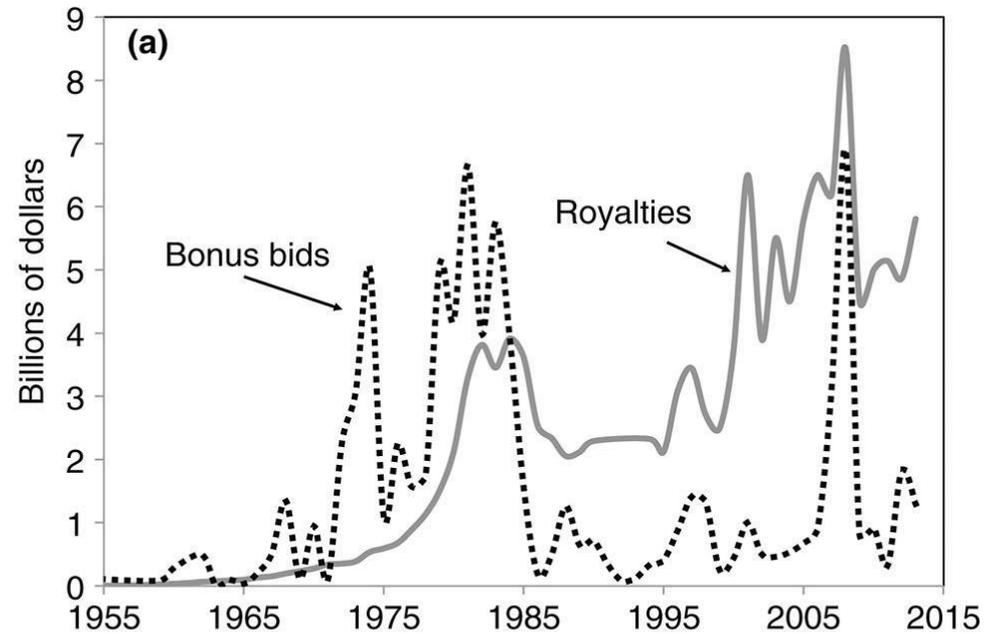
- Rentals: \$1.5-2.0 / acre
- Royalty: 12.5%
- Much is regulated by BLM (Bureau of Land Management)

## Offshore

- Rentals: \$7-11 / acre
- Royalty: 18.75%
- Bonus: \$100k - \$20 million
- Regulated by BOEM (Bureau of Ocean Energy Management)

## Tahiti Field

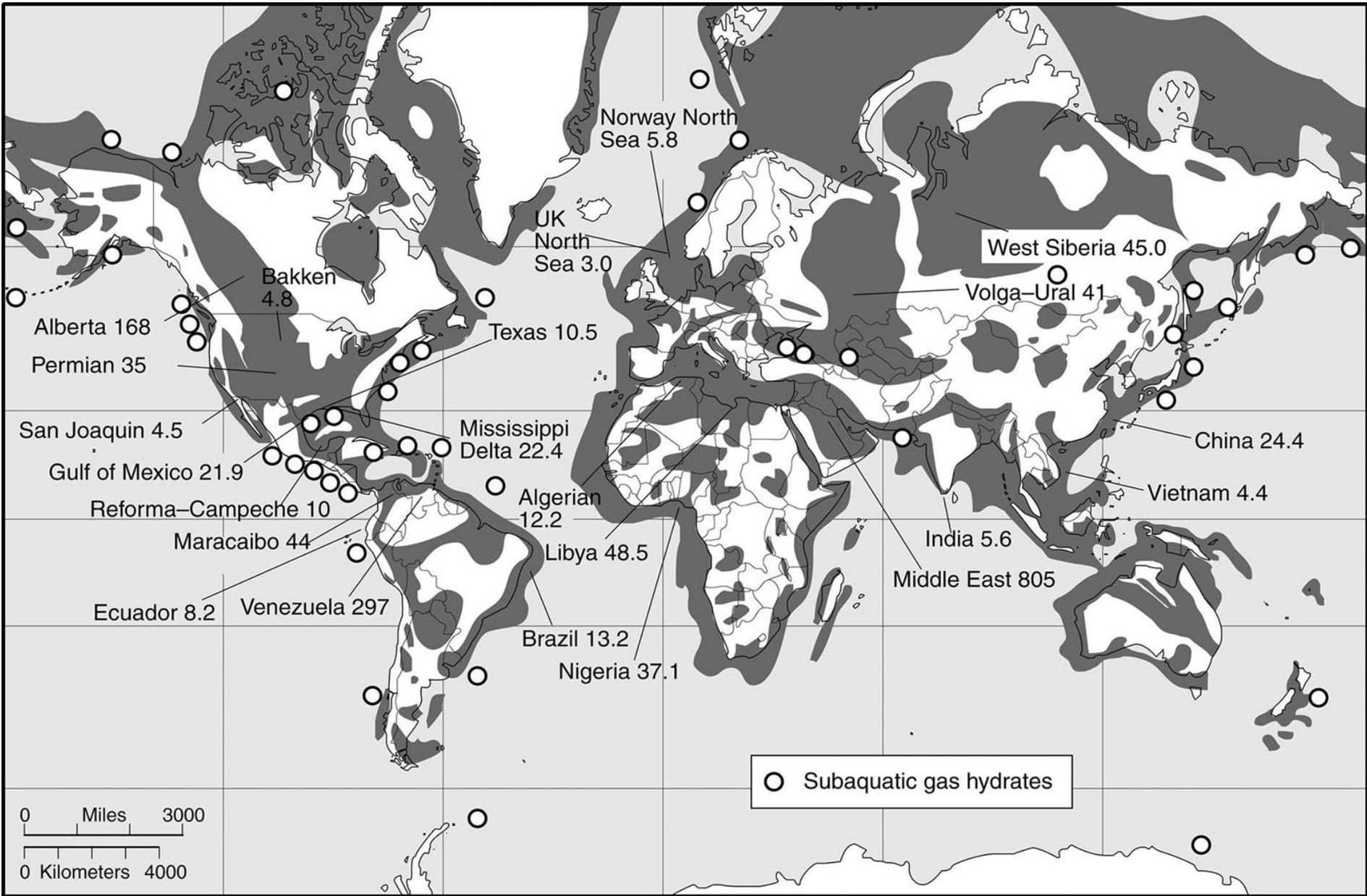
- ~125,000 bpd oil at \$100 / barrel
  - \$12.5 million / day
- 70mmscf/d gas
  - \$350,000 / day
- Total Royalties
  - \$2.8 million / day



## Where does government revenue from oil / gas / mineral production go?

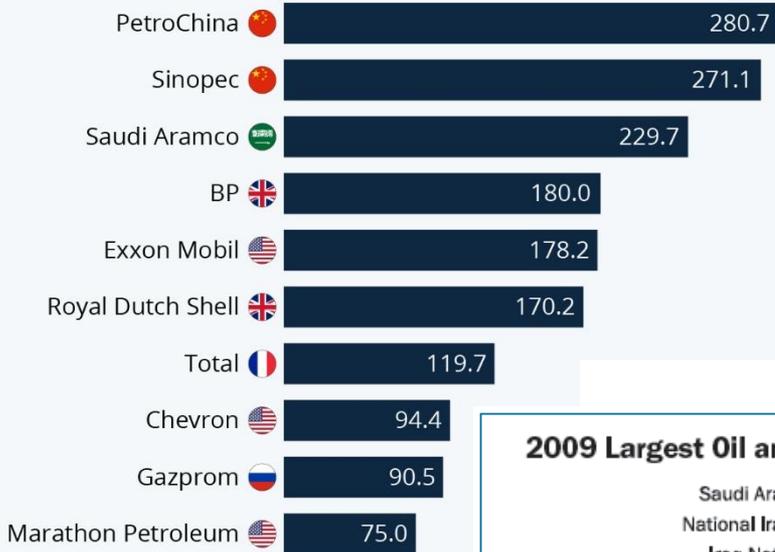
Fund	Amount
American Indian tribes	\$932,956,397.19
Historic Preservation Fund	\$150,000,000.00
Land and Water Conservation Fund	\$895,580,482.27
Reclamation Fund	\$1,592,181,337.45
State share: offshore	\$40,939,426.68
State share: onshore	\$1,964,029,388.52
US Treasury	\$8,648,688,422.06
<b>Total</b>	<b>\$14,224,375,454.17</b>

*Federal mineral royalty revenue for 2013. Data from US Office Natural Resources Review.*



# The Biggest Oil and Gas Companies in the World

Revenue of the world's largest oil and gas companies in 2020 (in billion U.S. dollars)

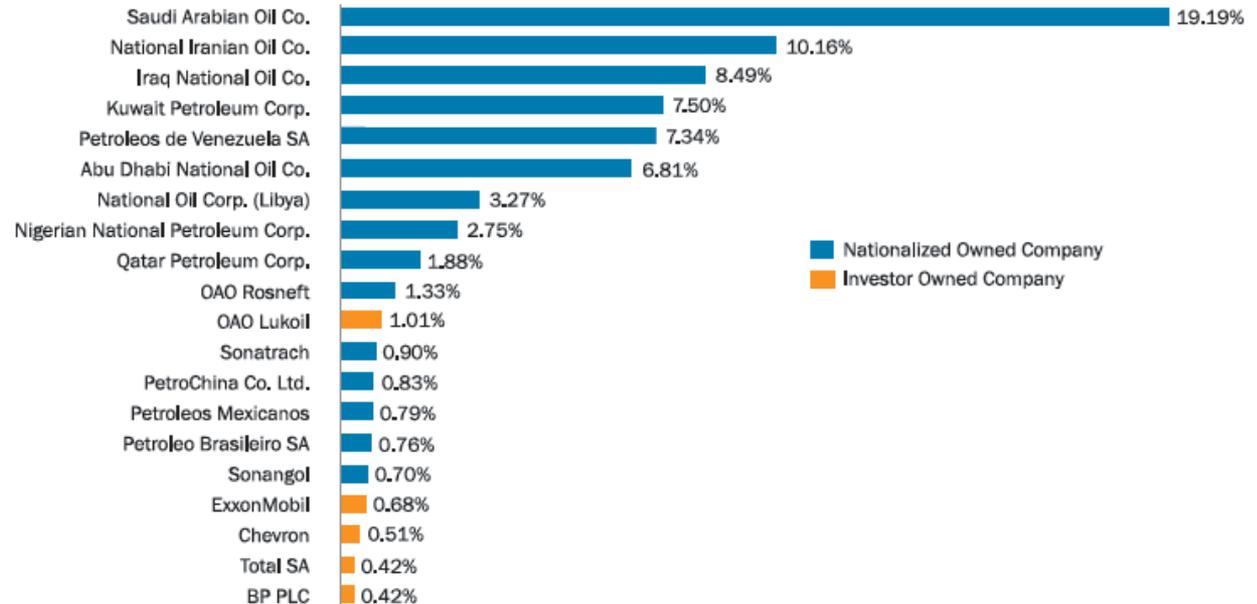


Source: Forbes Global 2000



What companies have the largest Oil / Gas reserves and which companies make the most money off hydrocarbons?

## 2009 Largest Oil and Gas Companies (percent of worldwide reserves)



Source: Calculated from World Reserves of 1.3 trillion barrels as of January 1, 2010 according to *Oil & Gas Journal*, December 6, 2010 and leading companies according to: *Oil & Gas Journal*, September 6, 2010.

# A Fully-Integrated Oil Company

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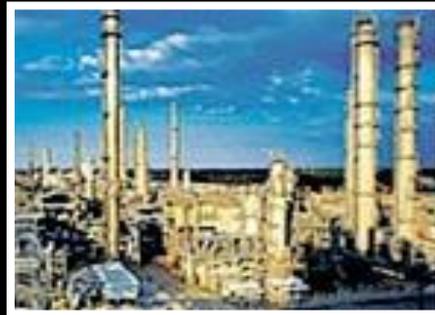


[http://www.npl.co.uk/upload/img\\_400/oilrig.gif](http://www.npl.co.uk/upload/img_400/oilrig.gif)

**Getting Raw  
Oil & Gas to  
the Refinery**

**UPSTREAM**

**Refinery**



**Getting Refined  
Products to  
the Consumers**

**DOWNSTREAM**

Rank	Field name	Country	Year discovered	Oil (Bbbl)	Gas (Tcf)
<i>Largest conventional fields in the world</i>					
1	South Pars*	Iran and Qatar	1971	50.000	1,800.00
2	Ghawar	Saudia Arabia	1948	140.000	186.00
3	Burgan	Kuwait	1938	75.000	72.50
4	Urengoy	Russia	1966	0.000	350.00
5	Safaniya	Saudia Arabia	1951	50.000	0.00
6	Upper Zakum	Abu Dhabi	1963	50.000	0.00
7	Yamburg	Russia	1969	0.000	289.60
8	Urgenoy	Russia	1975	0.002	285.59
9	Kashagan	Kazakhstan	2000	38.000	35.00
10	Bolivar Coastal	Venezuela	1917	44.00	0.00
<i>Largest producing conventional fields in United States</i>					
	Prudhoe Bay	Alaska	1968	20.00	35.00
	Panhandle-Hugoton	Kansas	1922	1.5	75.00

# What can you make from one barrel of oil?

Researchers broke down a typical barrel of domestic crude oil into what could be produced from it. The average domestic crude oil has a gravity of **32 degrees** and weighs **7.21 pounds per gallon**. Here's what just one barrel of crude oil can produce:

Wax for  
**170**  
birthday candles or  
**27**  
crayons.



Distillate fuel to drive a large truck  
(five miles per gallon) for almost

**40 miles**

If jet fuel fraction is included,  
that same truck can run nearly

**50 miles**



Asphalt to make about  
**one gallon**

of tar for patching roofs or streets.



Lubricants to make about  
**one quart**  
of motor oil.



About  
**four pounds**  
of charcoal briquettes.



Gasoline to drive a medium-sized car  
(17 miles per gallon) for more than

**280 miles**



Nearly  
**70 kilowatt-hours**  
of electricity at a power plant  
generated by residual fuel.



Liquefied gases,  
such as propane, to fill  
**12**  
small (14.1-ounce) cylinders for home,  
camping or workshop use.

There would be enough petrochemicals left in that same barrel to also provide the base for:



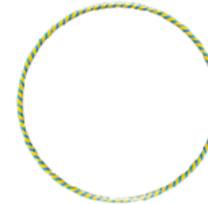
**540**  
toothbrushes



**750**  
pocket combs



**39**  
polyester shirts



**23**  
hula hoops



**135**  
four-inch rubber balls



**65**  
plastic drinking cups



**11**  
plastic telephone housings



**65**  
plastic dustpans



**195**  
one-cup measuring cups

The lighter materials in a barrel are used mainly for paint thinners and dry-cleaning solvents, and they can make nearly a quart of one of these products. The miscellaneous fraction of what is left still contains enough byproducts to be used in medicinal oils, still gas, road oil and plant condensates.

# Saudi Arabia Oil & Gas Fields

- Legend**
- Saudi Arabia
  - Oil Fields
  - Gas Fields
  - Natural Gas Pipelines
  - Oil Pipelines
  - Oil Export Terminals
  - Refineries





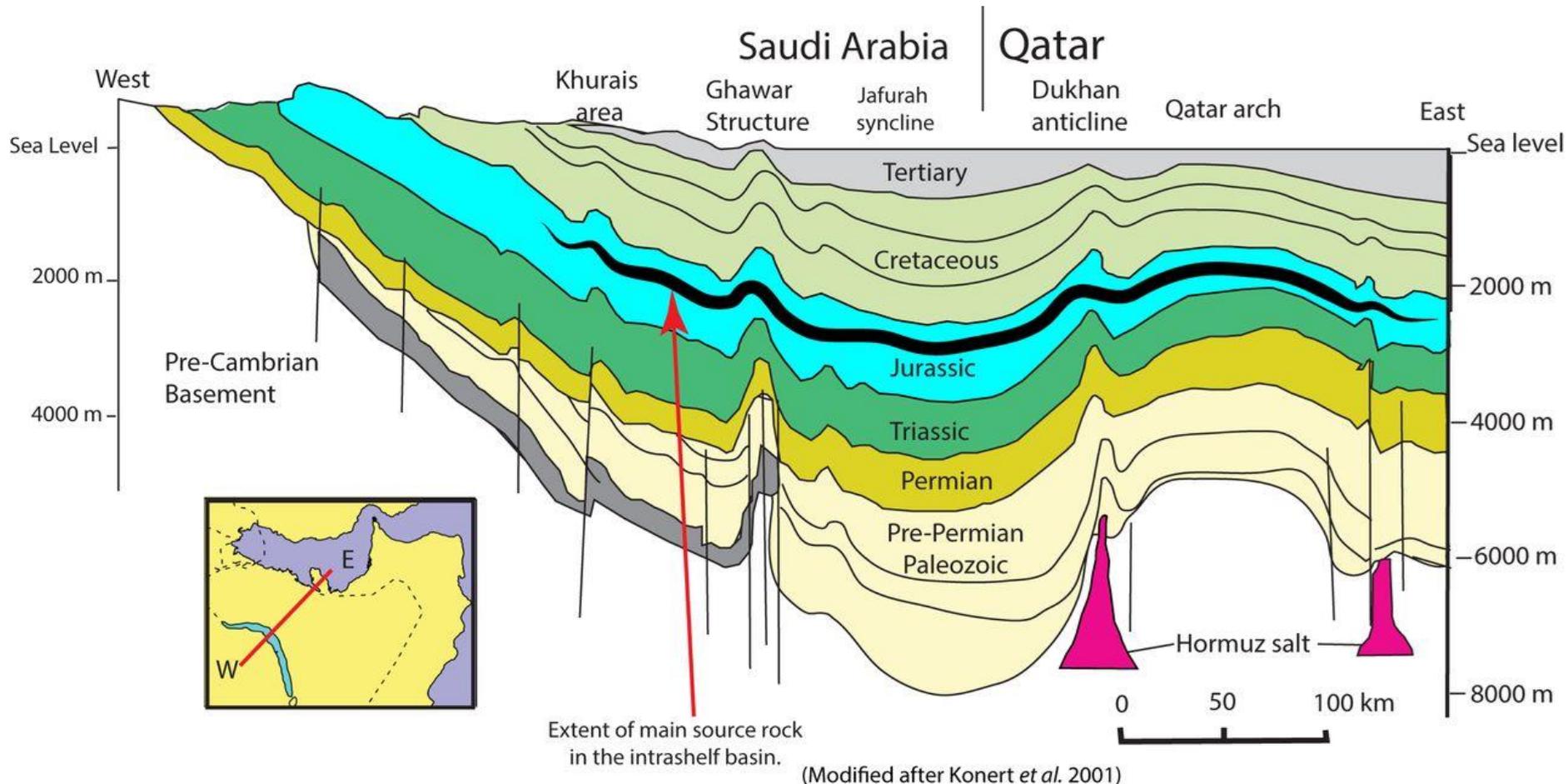
# Gawar Oil Field, Saudi Arabia: Largest conventional oil field in the world!

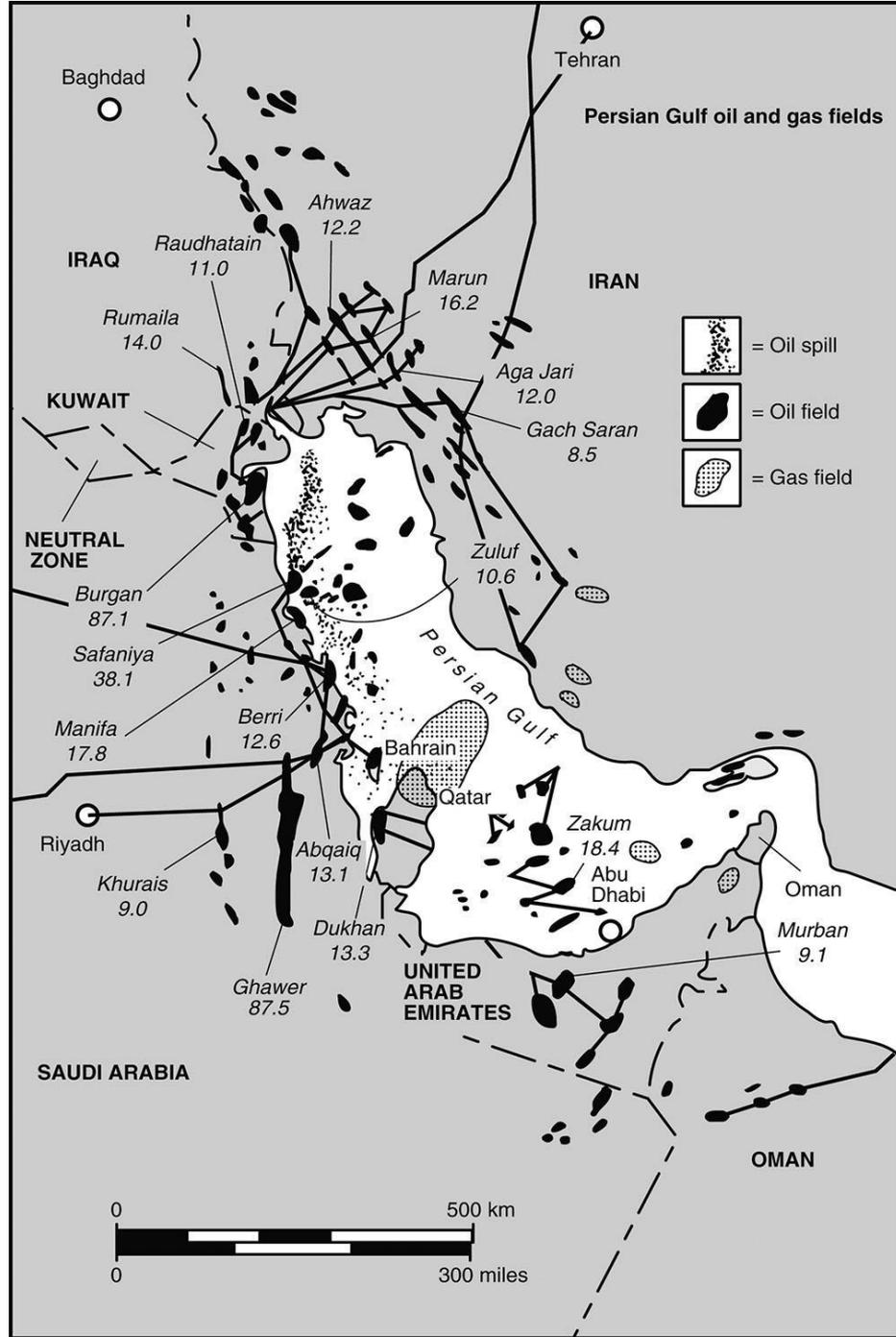
TRAP: a structural fold (anticline)

RESERVOIR: Jurassic limestone with high porosity (up to 35%) about 280 ft thick, 6,000-7,000 feet beneath the surface

SOURCE: marine shelf mudstone (marl) with as up to 5% organic material (TOC)

SEAL: is salt (anhydrite)





# Persian Gulf War Impacts:

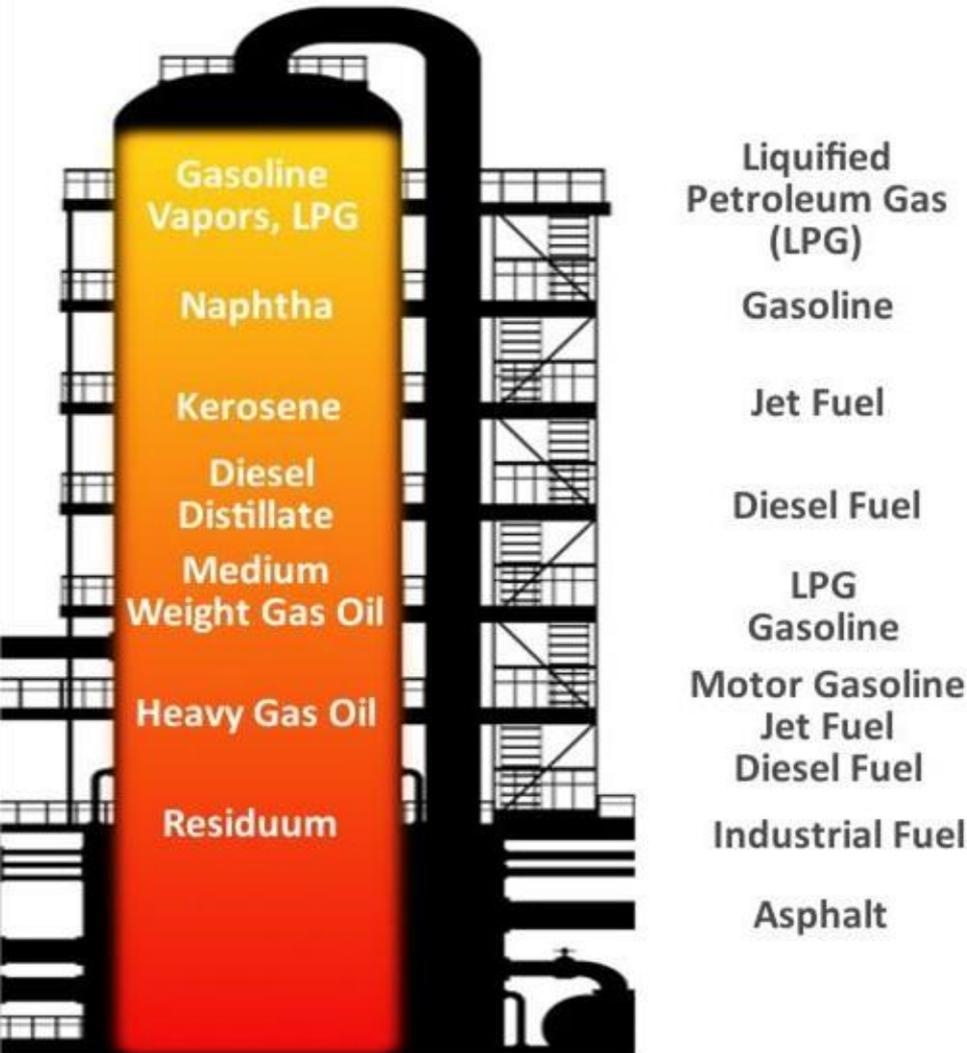
It was revealed that in a last-ditch attempt to prevent U.S. forces from landing on the beaches of Kuwait, Iraqi forces intentionally dumped oil into the Persian Gulf. They released oil from eight oil tankers, a refinery, two terminals, and a tank field. Since the Iraqis anticipated an amphibious invasion, they also dug long trenches down the coastline and filled them with oil. This act of “environmental terrorism” released a total of 11 million barrels of crude oil into the Persian Gulf, resulting in the largest oil spill in history. For the next three months, oil continued to spill into the Gulf at a rate of up to 6,000 barrels a day. Furthermore, while the Iraqis were retreating they set ablaze a reported 732 oil wells. When the Kuwait Oil Company first announced this in May of 1991, they calculated the oil wells were burning as many as 6 million barrels a day.







# Refining a Barrel of Oil (Crude)



\*Source U.S. Energy Information Administration

1. Heat the crude oil to a high temperature of ~1112 F / 600C.
2. The mixture boils, forming vapor (gases); most substances go into the vapor phase.
3. The vapor enters the bottom of a long column (**fractional distillation column**) that is filled with trays or plates. These help to collect liquids that form at various heights in the column. There is a temperature difference across the column (hot at the bottom, cool at the top).
4. The **vapor rises** in the column.
5. As the vapor rises through the trays in the column, it cools.
6. When a substance in the vapor reaches a height where the temperature of the column is equal to that substance's boiling point, it will condense to form a liquid. (The substance with the lowest boiling point will condense at the highest point in the column; substances with higher boiling points will condense lower in the column.).
7. The trays collect the various liquid fractions.
8. The collected liquid fractions may pass to condensers, which cool them further, and then go to storage tanks, or they may go to other areas for further chemical processing