

# ***Fossil Fuel Resources***

Exam next Tuesday

February 14

Bring Scantron and Review Questions

# Sedimentary rocks

About 75% of all rock outcrops on the continents

Important to reconstruct much of Earth's history

Sediment is derived from weathering

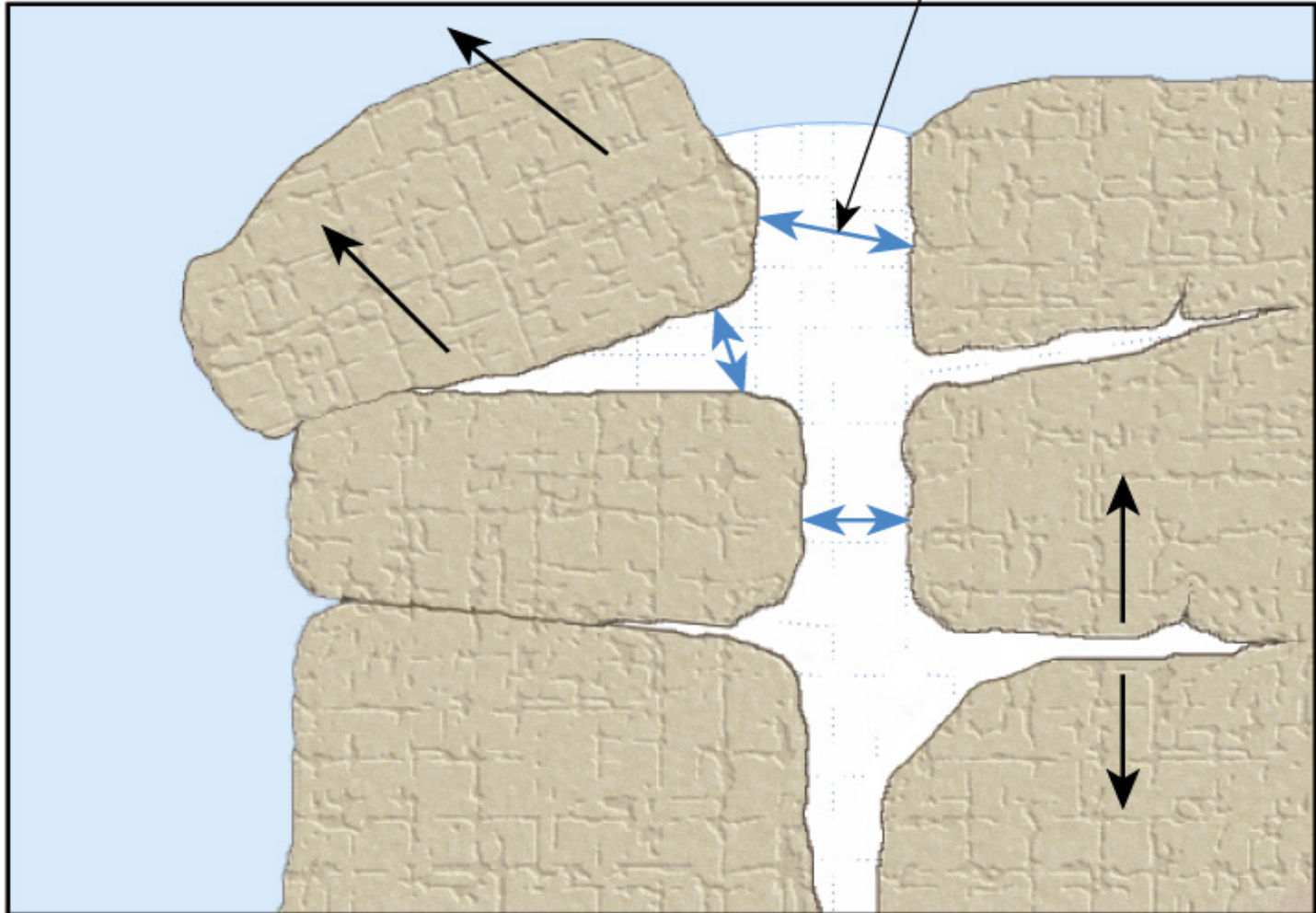
# Weathering

Two kinds of weathering

- Mechanical
- Chemical

# Mechanical Weathering

Frost wedging



# Chemical weathering

- Chemical changes of minerals
- Removing or adding elements
- Most important agent is water

# **Rates of weathering**

Important factors

- Rock characteristics
- Climate

# Sedimentary Rocks

## Two main types

- Clastic (or detrital) —Deposition of particles
- Chemical—Precipitation from water (includes rocks formed by organisms)

# Types of Clastic Rocks

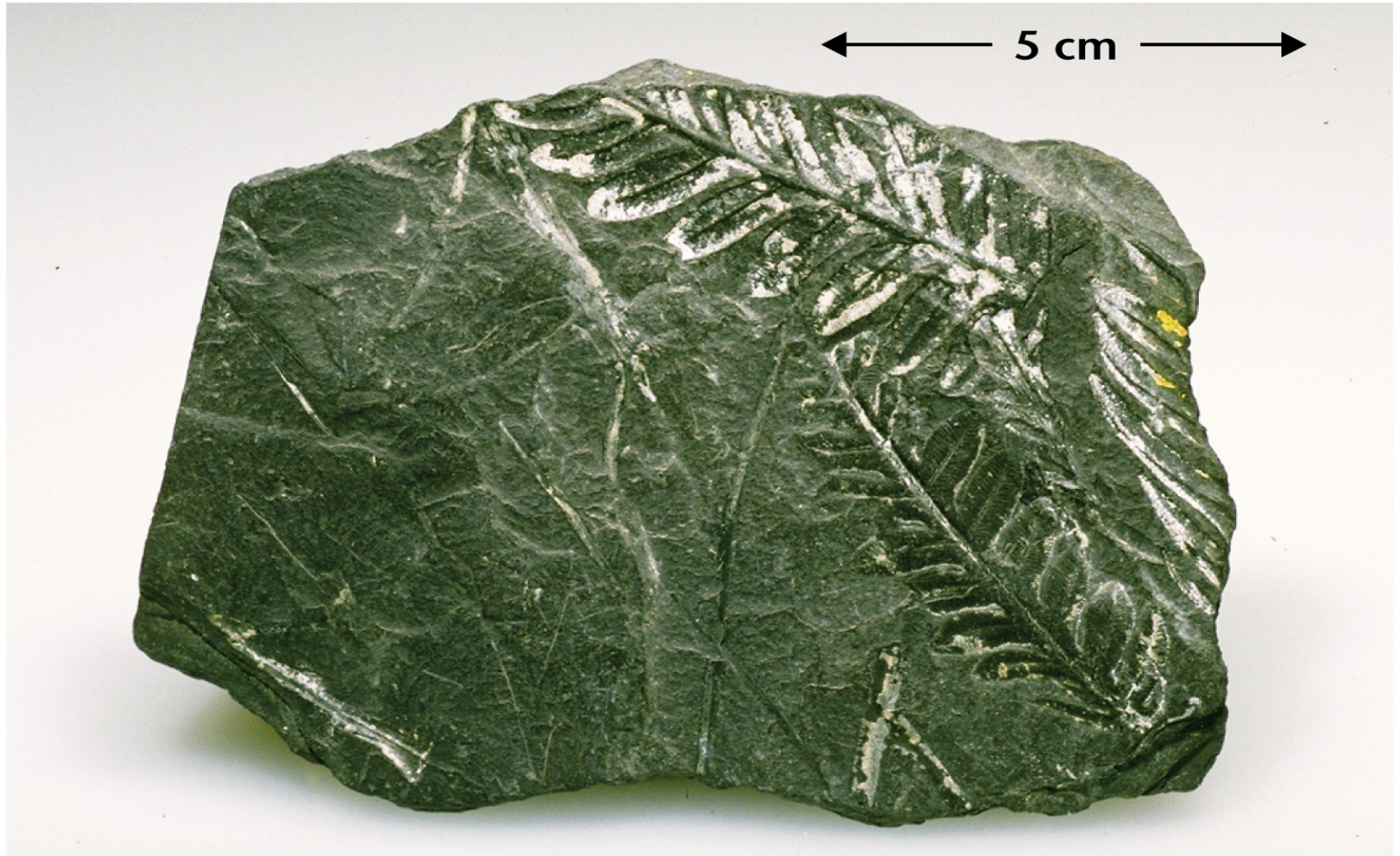
- Shale (most abundant)
- Sandstone
- Conglomerate



# Shale

- Most common type of clastic rock
- Very fine grained sediment
- Usually gray
- Tendency to split along planes (fissile)

# *Shale with plant fossils*



**D**

# Sandstone

- Composed of sand-size particles
- Environments include
  - Beach
  - River
  - Shallow sea
  - Dunes

# ***Sandstone***



C

# Conglomerate

- Particles larger than 2 mm
- Usually rock fragments

# ***Conglomerate***



**A**

# Chemical rocks

Dissolved material precipitates to form sedimentary rock

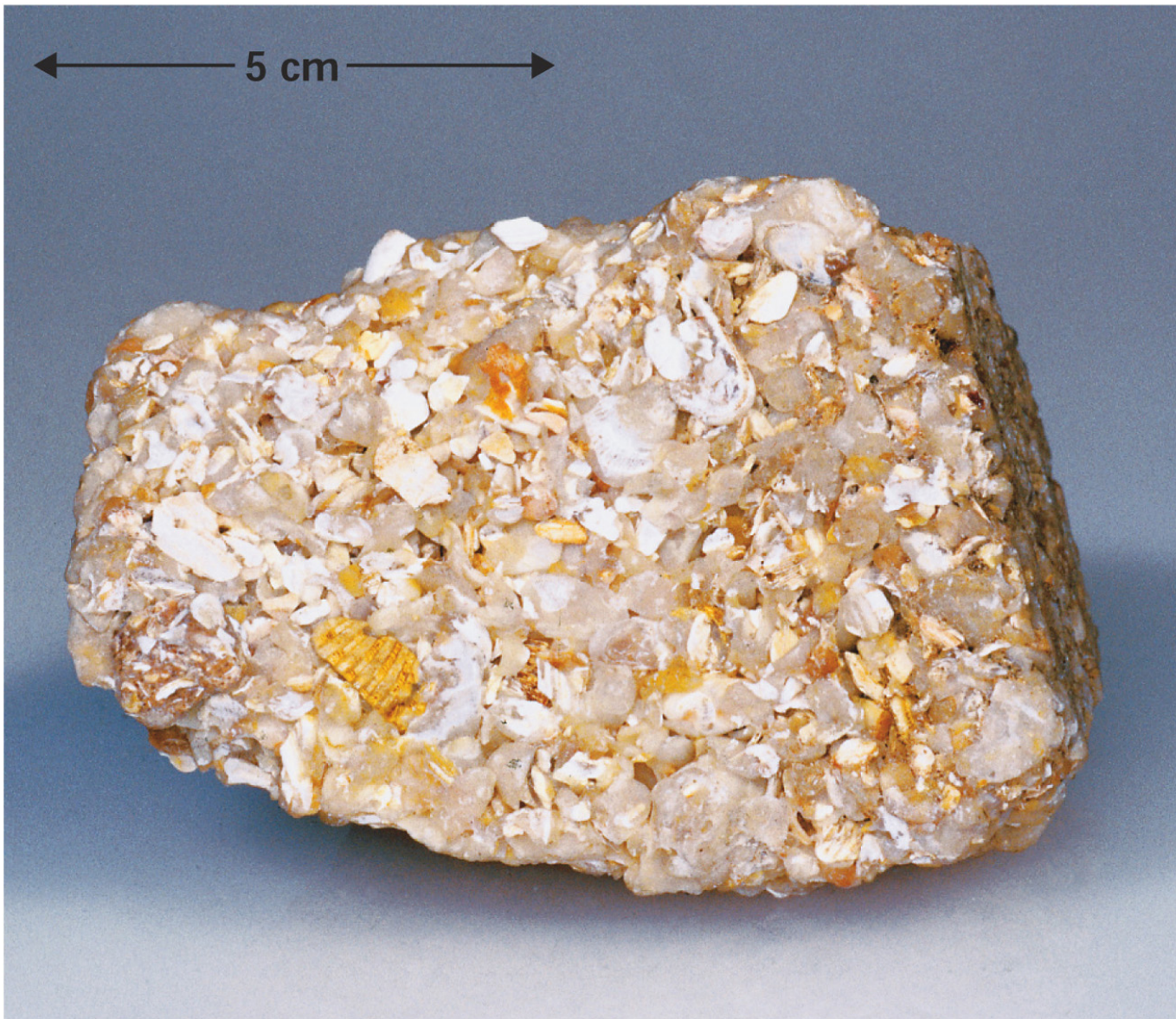
- Physical processes
- Life processes (biochemical origin)

# Chemical rocks

- Limestone
  - calcium carbonate
  - 90% precipitated by organisms
- Most common type of chemical rock



# *Coquina*



**Close up**



Copyright © 2006 Pearson Prentice Hall, Inc.

# Fossiliferous limestone





Copyright © 2006 Pearson Prentice Hall, Inc.

# ***Chemical rocks***

Direct precipitation from water

- Chert, flint, jasper, opal or agate
- Evaporites—Salt, Gypsum
- Hotspring deposits

# Rock salt



# Features of sedimentary rocks

- Bedding and bedding planes
- Size, shape and distribution of grain sizes
- Fossils
  
- Porosity
- Permeability

# **Economic importance**

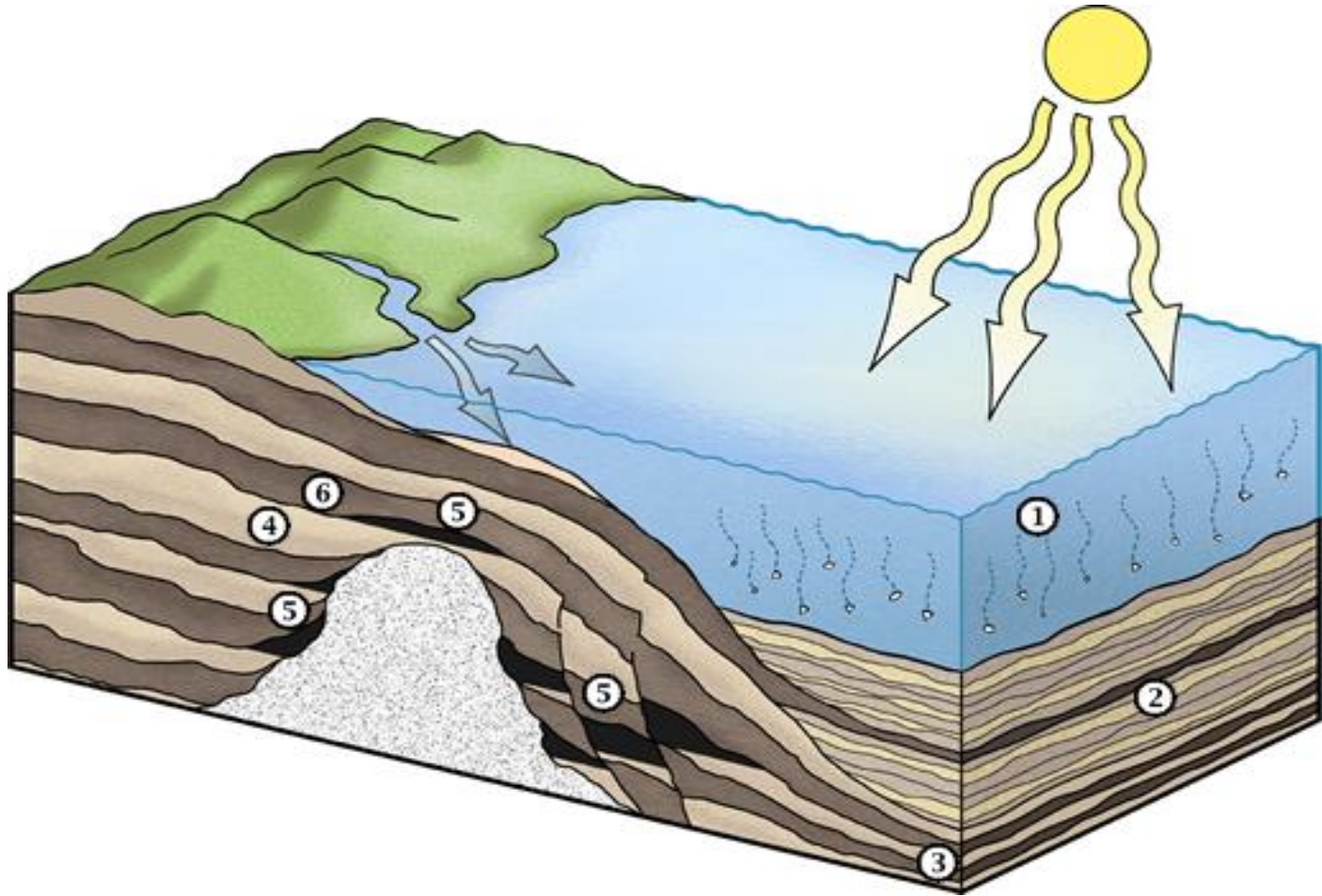
- Coal
- Petroleum and natural gas
- Sources of iron and aluminum



# Petroleum Requirements

- Source
- Cooking
- Reservoir
- Trap

# Hydrocarbon System



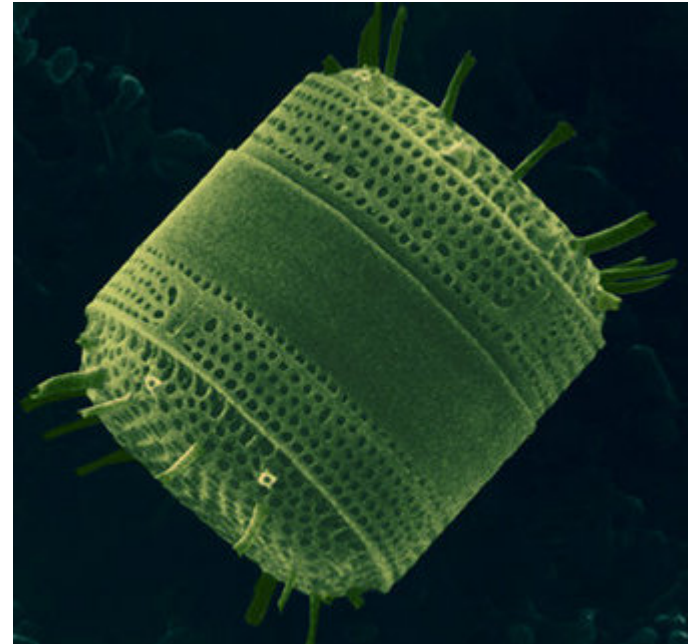
- [http://www.priweb.org/ed/pgws/systems/systems\\_home.html](http://www.priweb.org/ed/pgws/systems/systems_home.html)

# SOURCES

- Shale with organic material
- Gooney sludge on ocean floor

# Diatoms

- Planktonic organisms
- Probable source of petroleum



[http://www.priweb.org/ed/pgws/systems/energy\\_capture/capture.html](http://www.priweb.org/ed/pgws/systems/energy_capture/capture.html)

<http://www.priweb.org/ed/pgws/systems/source/source.html>

# COOKING

- Just right temperature
- Just right pressure
- Just right time

# RESERVOIR

- Permeable
- Porous
- Usually a sedimentary rock

# PERMEABLE

- Permits fluid throughflow
- Nylon scrubbie

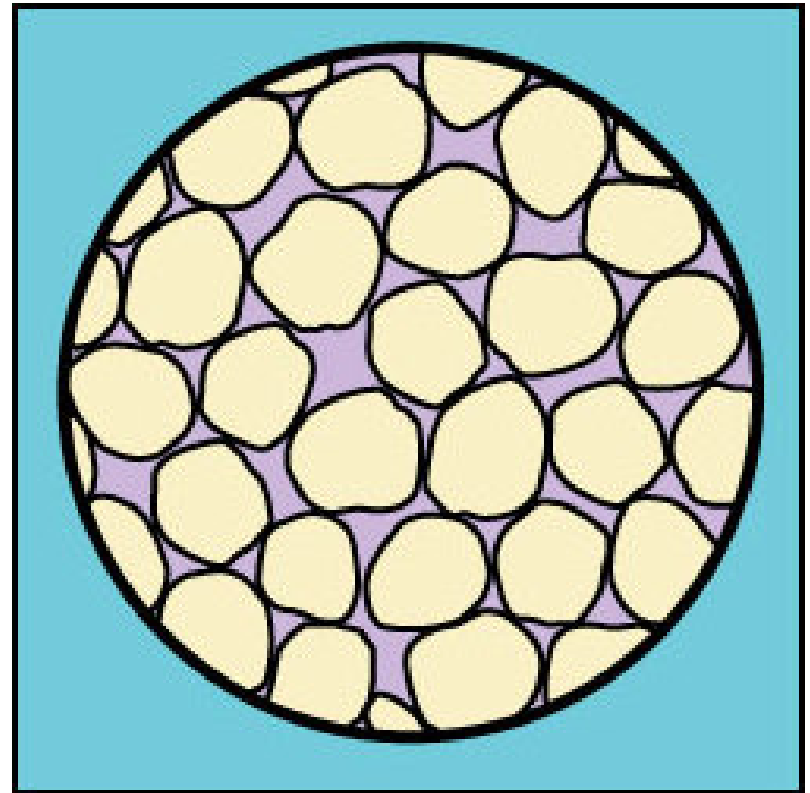
# POROUS

- Has open space
- Sponge



# RESERVOIR

- Permeable
- and Porous

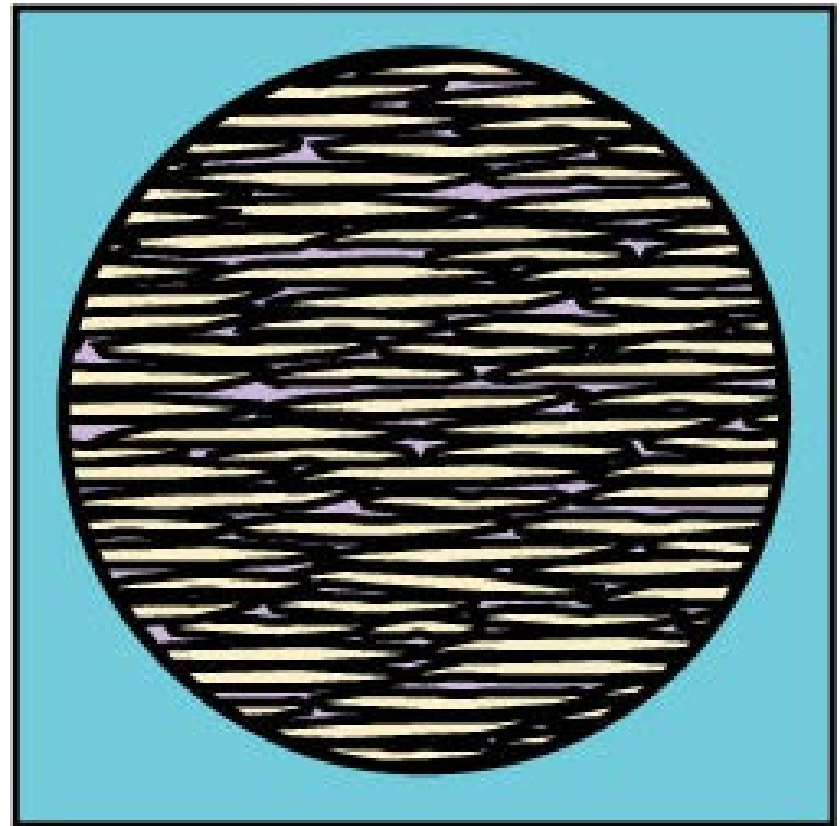


# TRAP

- Impermeable
- Shale, commonly
- (Usually not source shale)

# Trap

Almost no  
permeability or  
pore space



# STYLES OF TRAPS

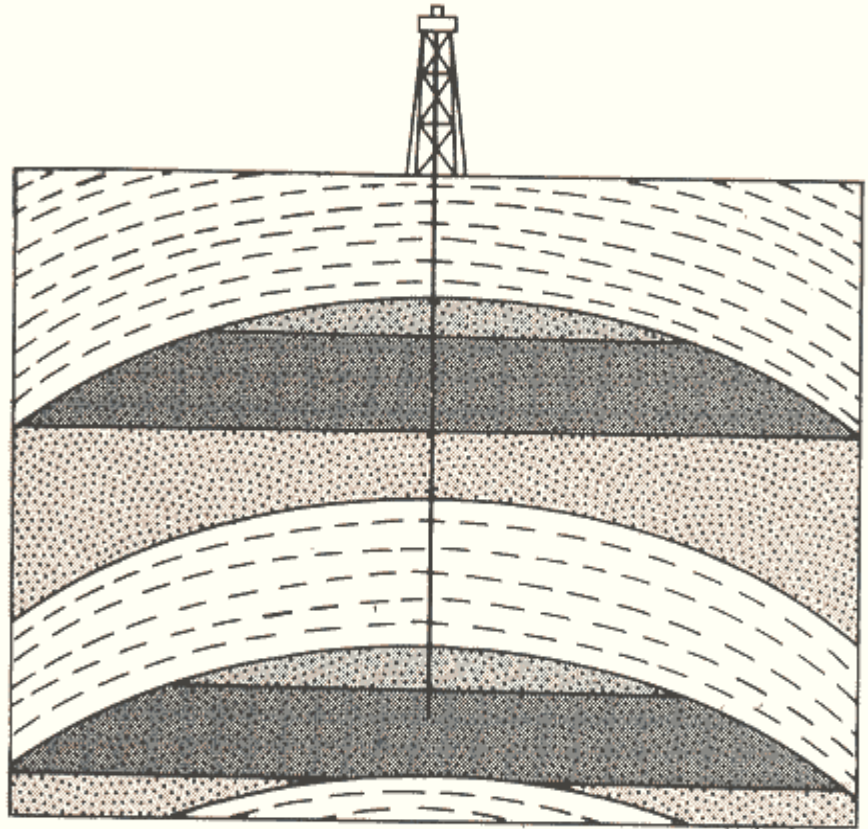
- Structural
- Stratigraphic

# STRUCTURAL TRAPS

- Anticline
- Fault
- Overthrust
- Salt Dome

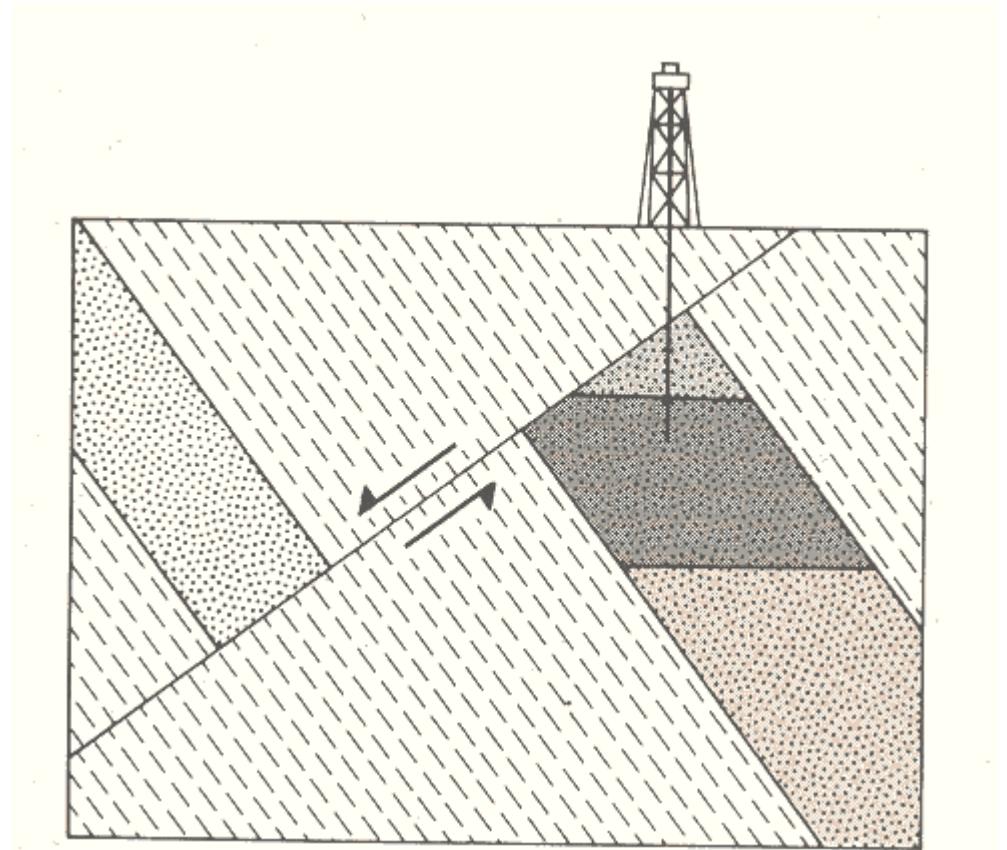
# ANTICLINE TRAP

- Reservoir sand
- Capping shale
- Arched fold



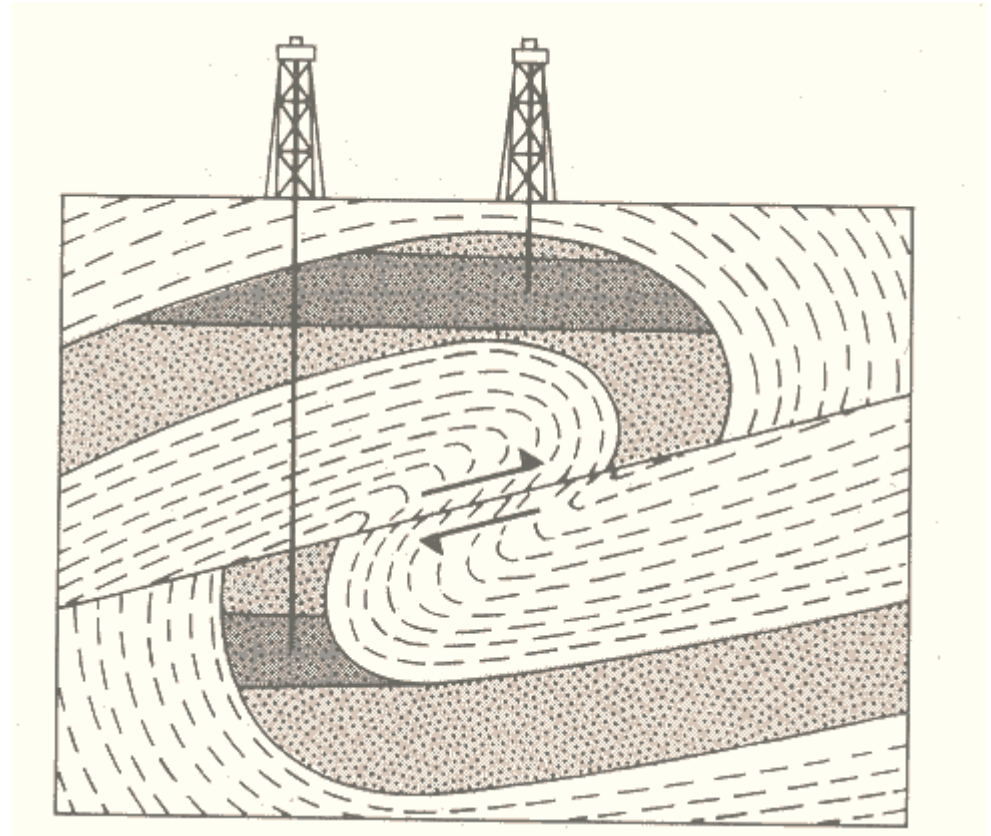
# FAULT TRAP

- Reservoir exists
- Fault creates trap



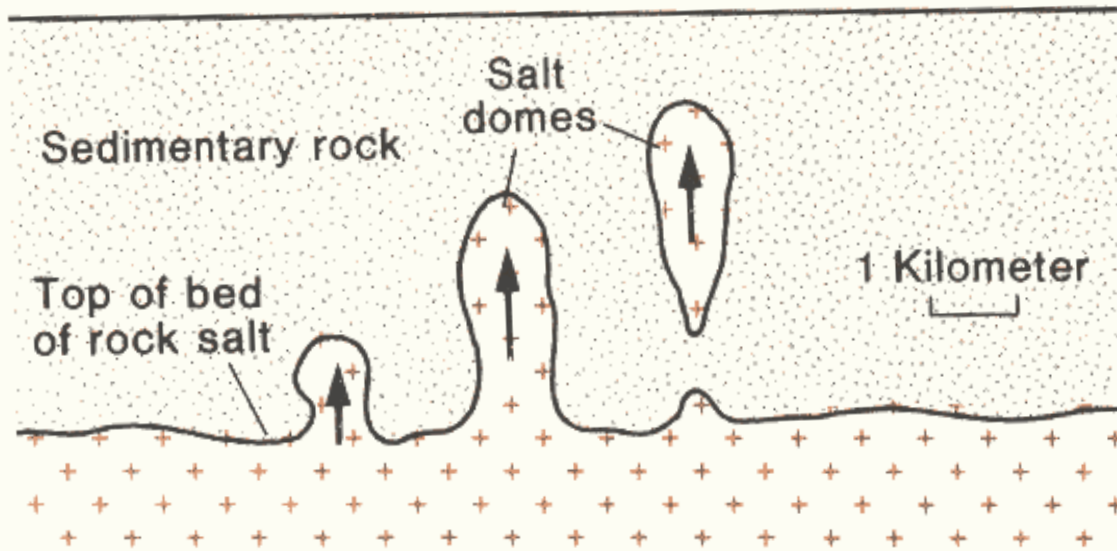
# OVERTHRUST TRAP

- Reverse fault
- Both fold and fault traps





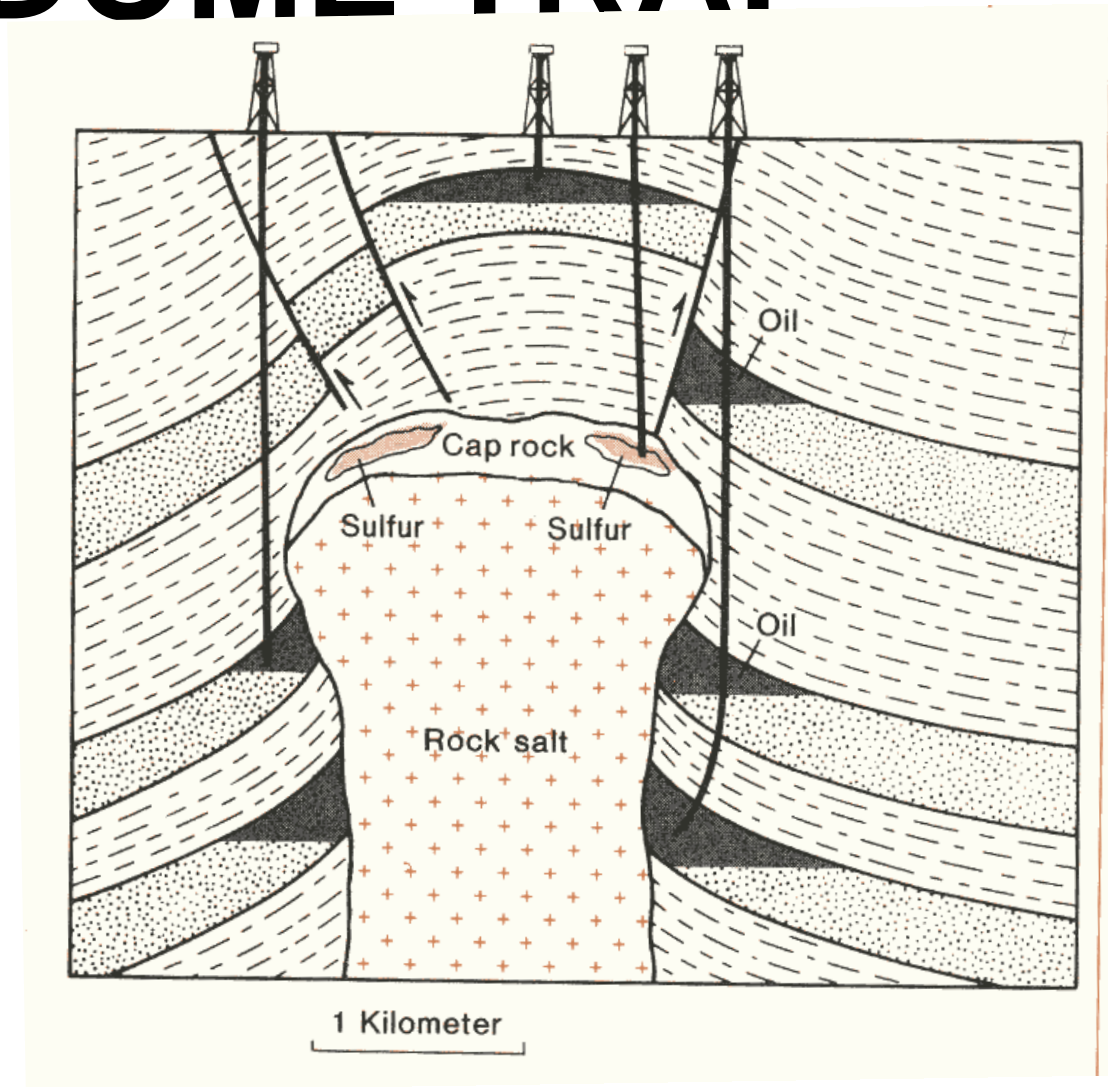
# SALT DOME TRAP



**Figure 21.4** Salt domes rise from a thick layer of buried rock salt and move upward through overlying sedimentary rock.

# SALT DOME TRAP

- Rising dome deforms beds
- Salt and shale impermeable

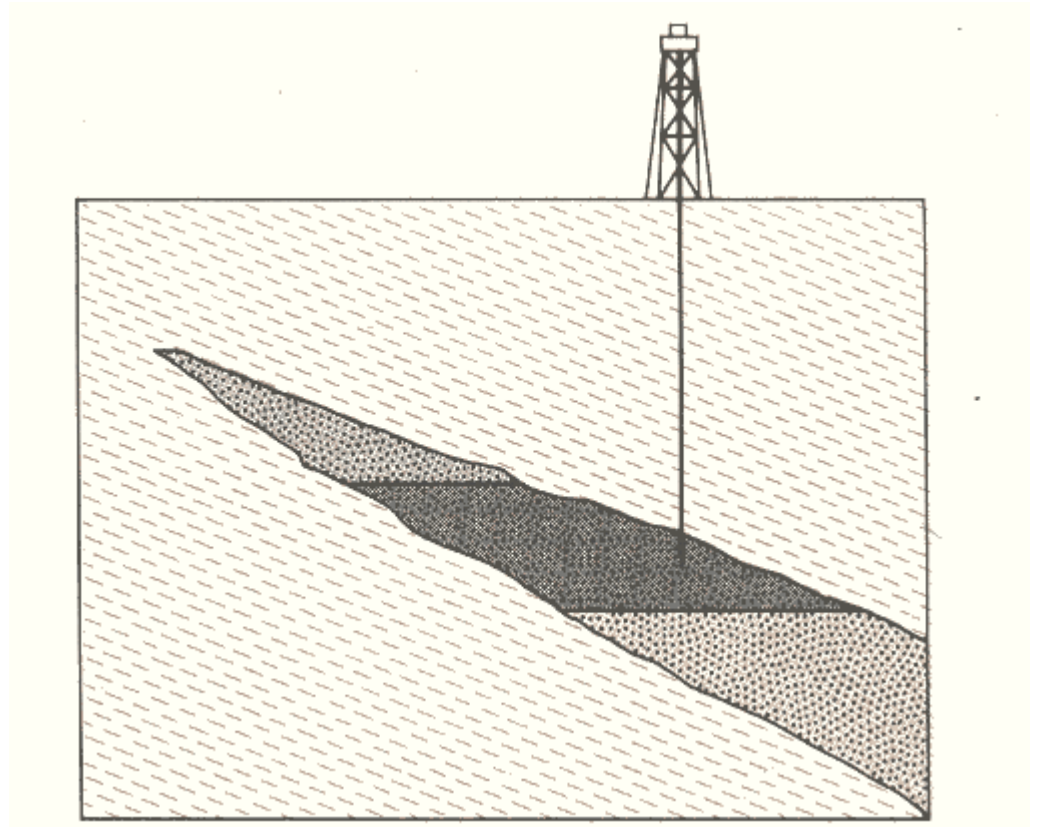


# STRATIGRAPHIC TRAPS

- Sand pinch
- Lens
- Unconformity
- Reef

# SAND PINCH TRAP

- Deposition of sand
- Shale deposited above sand
  - Deltas
  - Invading seas



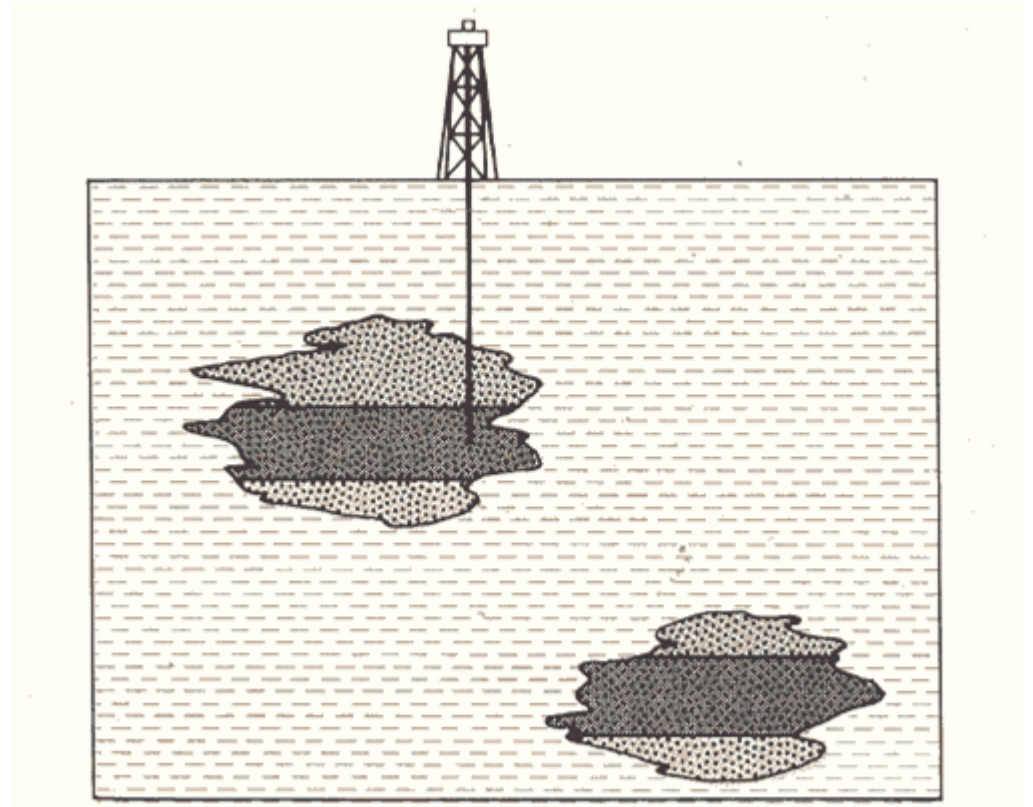
# ***Ganges Delta***



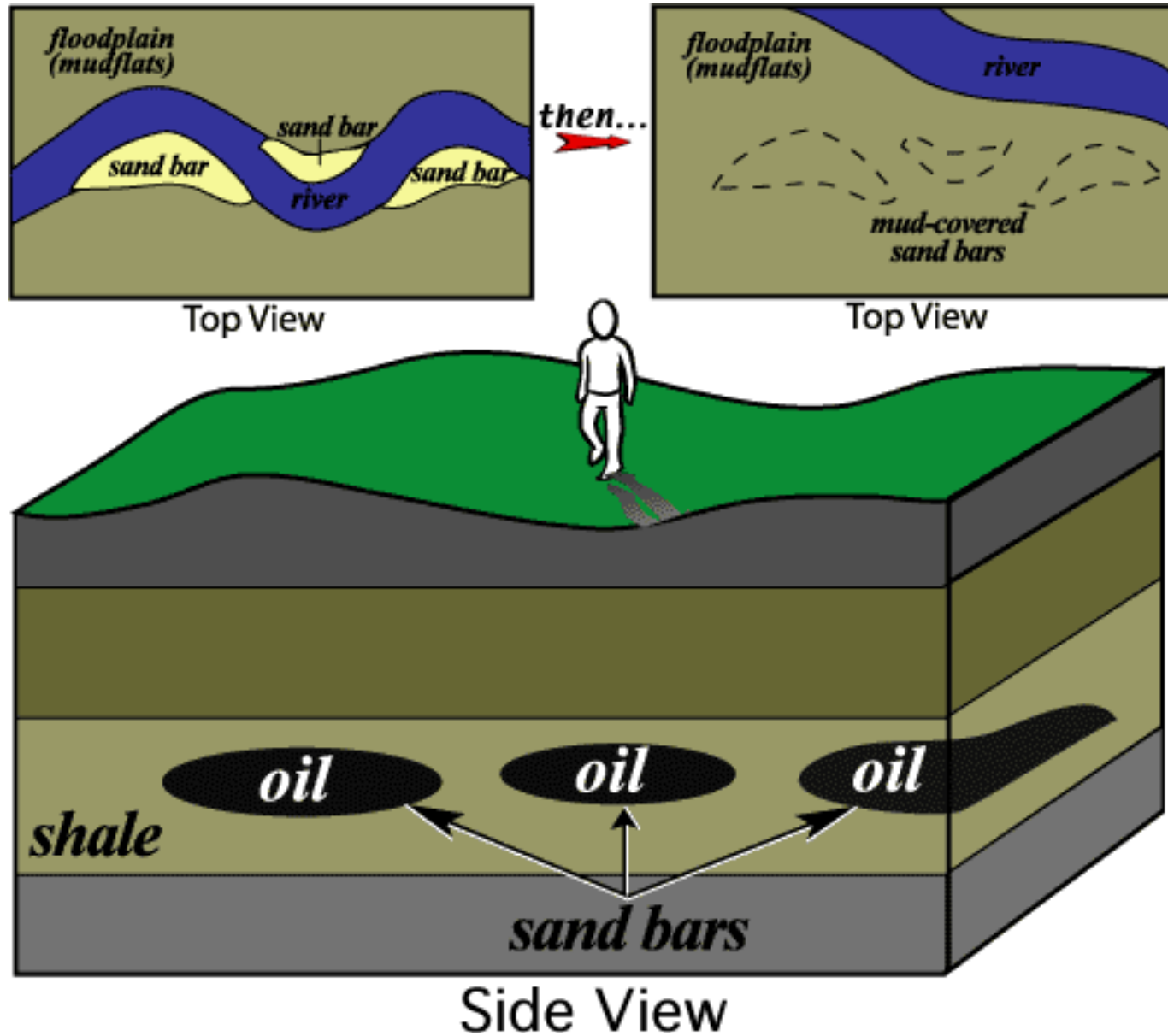
<http://eol.jsc.nasa.gov/debrief/STS066/rep2.htm>

# SAND LENS TRAP

- Channel sand
- Shifting channel of river
- Shale above

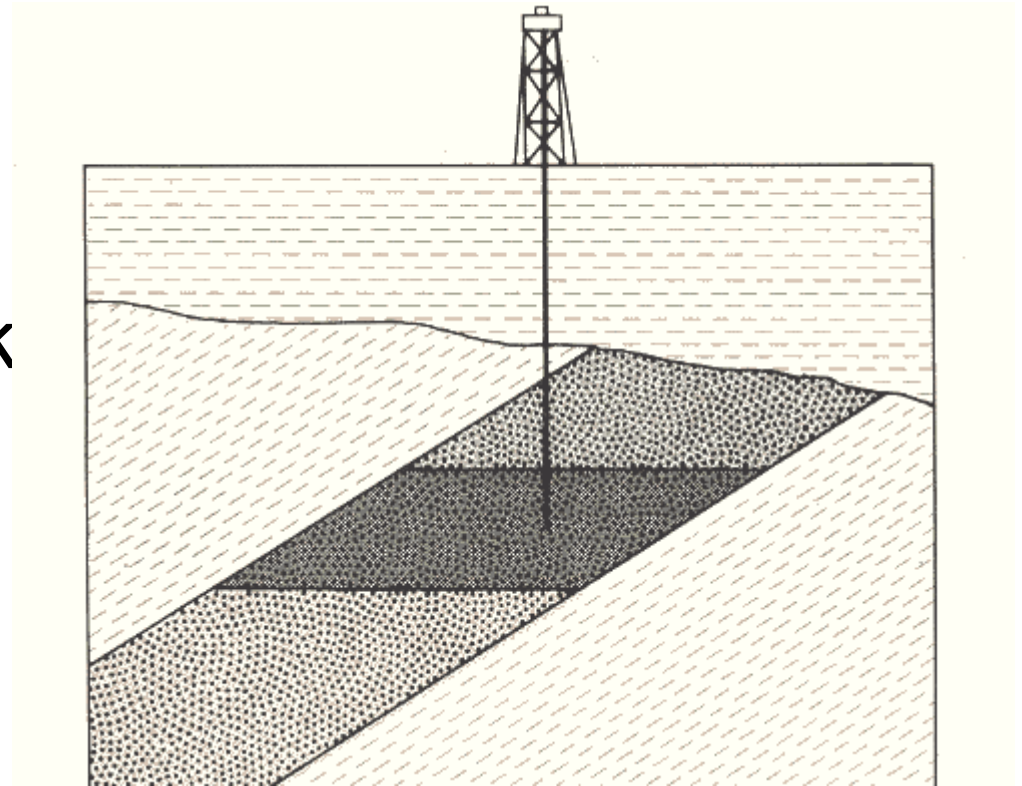


# Sand lens Traps from meandering streams



# UNCONFORMITY TRAP

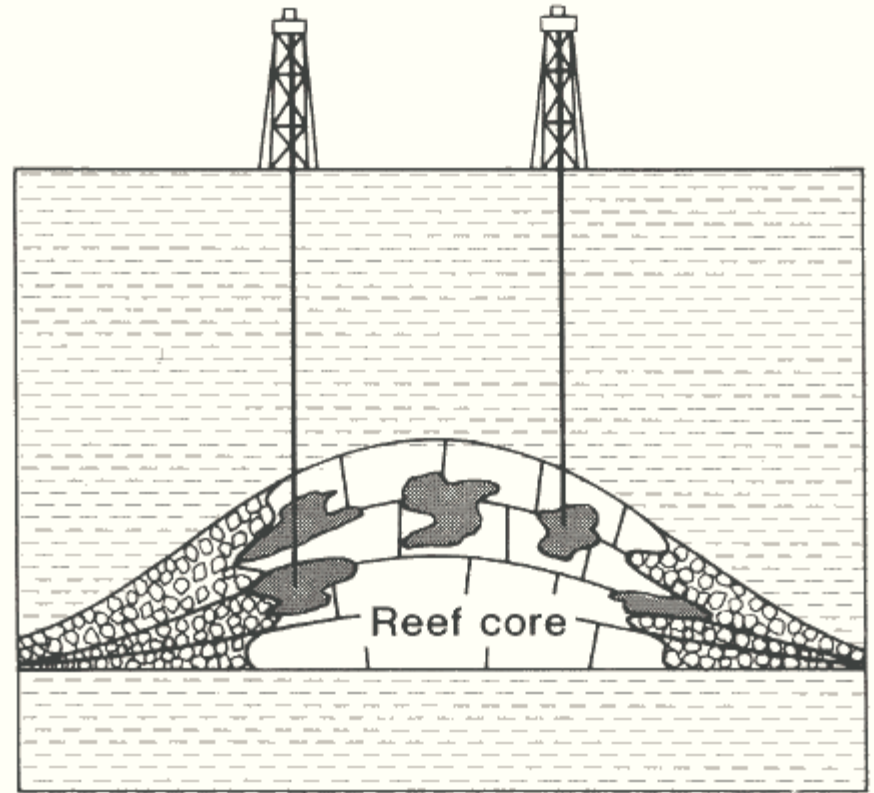
- Reservoir rock tilted and eroded
- Impermeable rock deposited above erosion surface

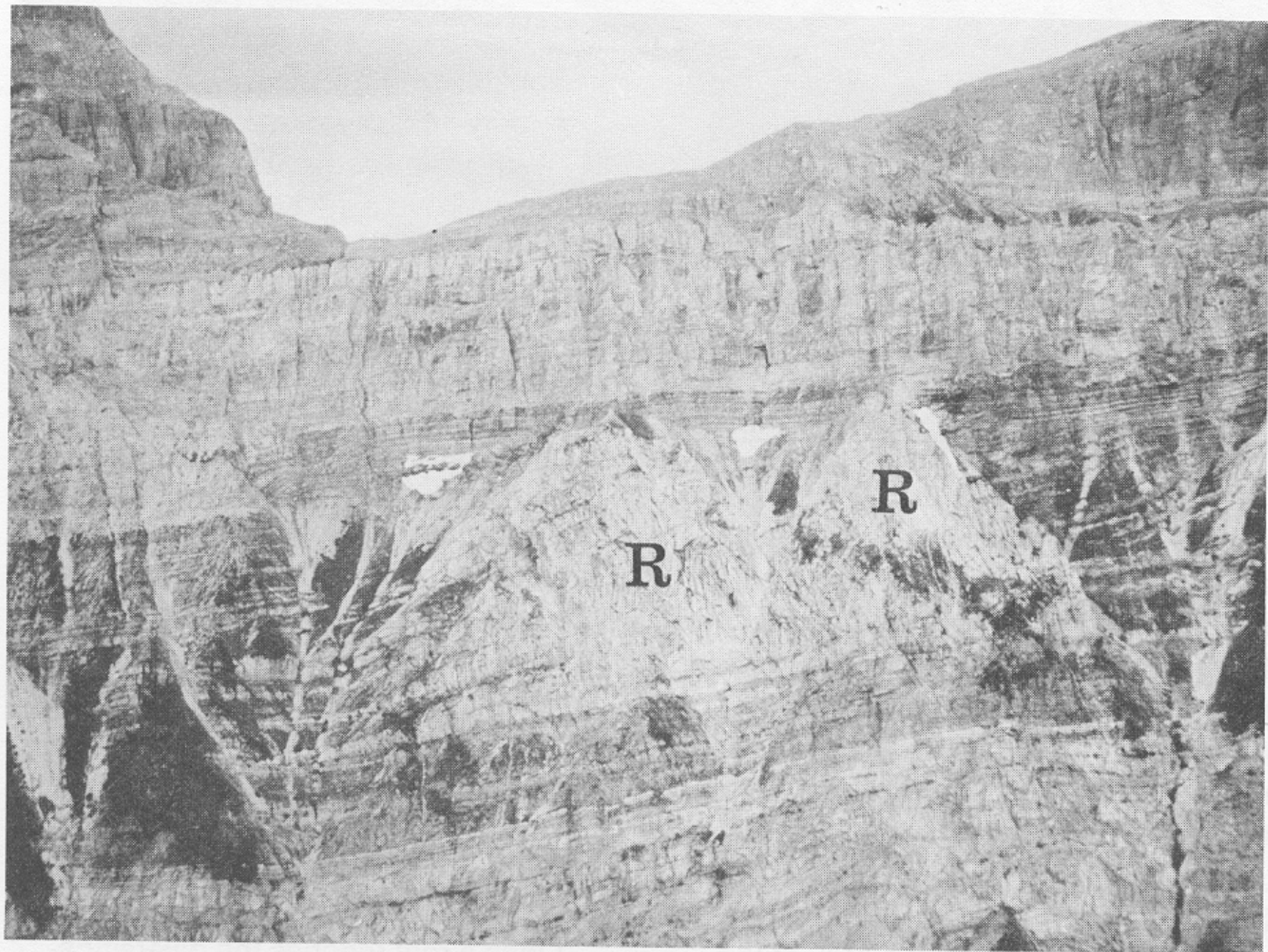




# REEF TRAP

- Porous reef core
- Flanks also porous
- Impermeable shale cap

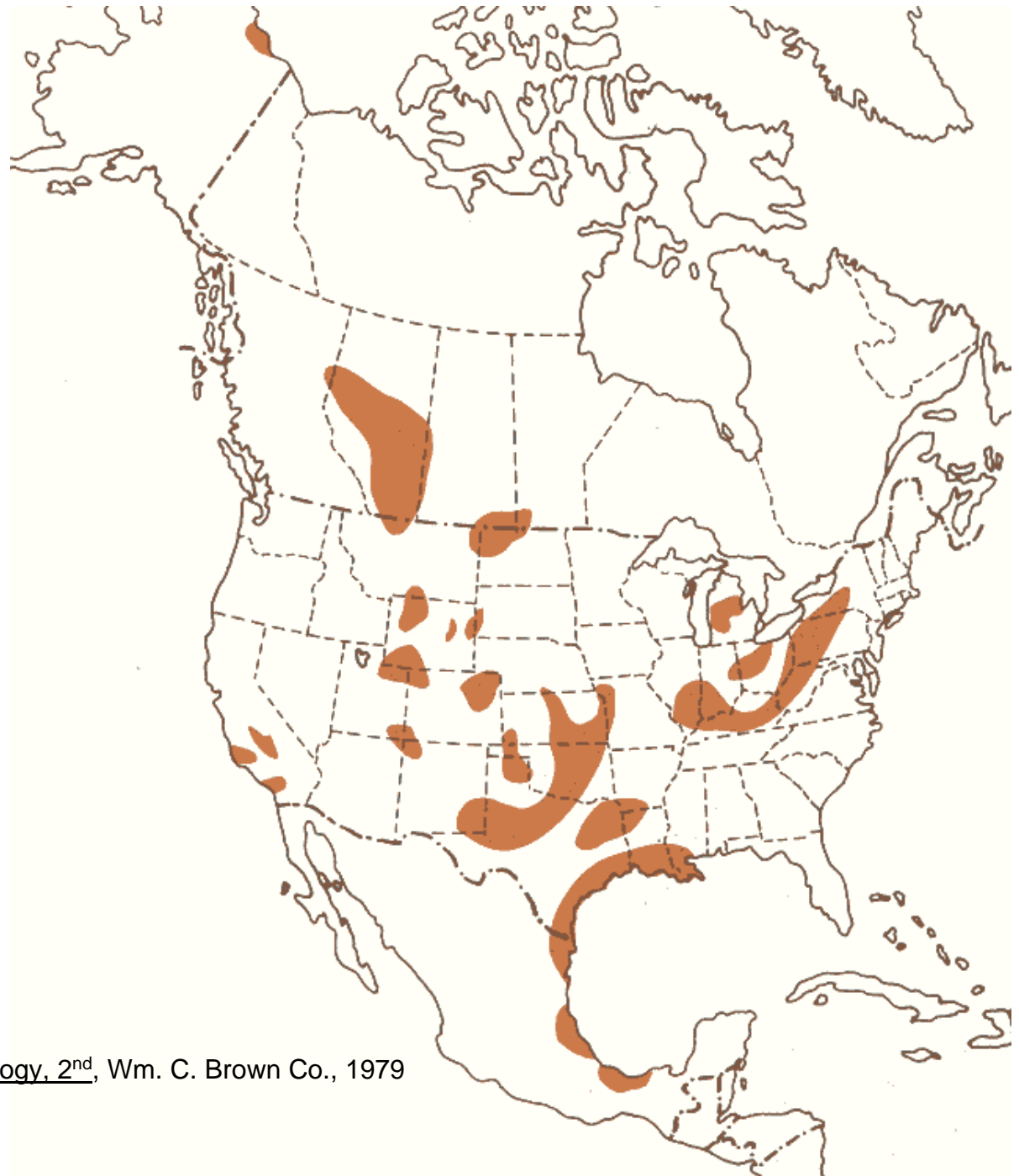




# LOCATIONS OF FUELS

- Middle East
- North America

# MAJOR OIL FIELDS IN NORTH AMERICA



Plummer, McGeary Physical Geology, 2<sup>nd</sup>, Wm. C. Brown Co., 1979

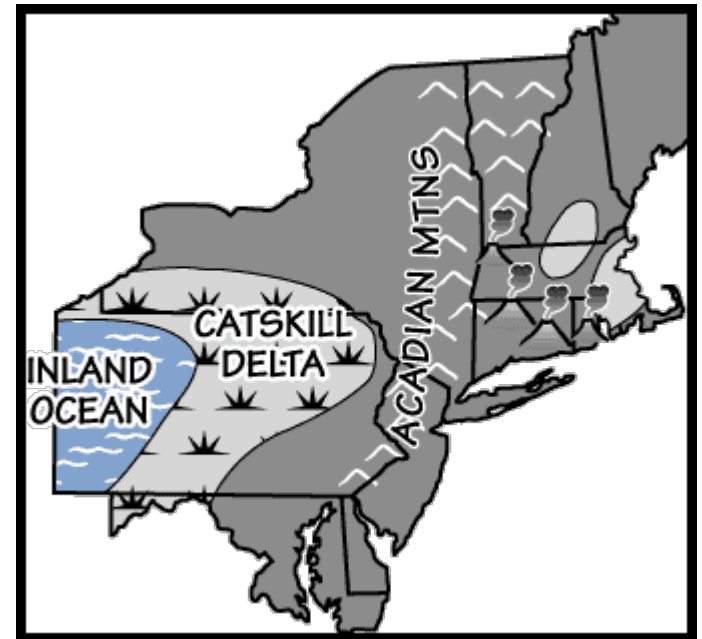
# TITUSVILLE, PA

- Oil Creek Valley in the 1860s
- Phillips well (rt) 4000 bbl/day
- Woodford well (lt) 1500 bbl/day



# Origin of Pennsylvania Oil

- Delta deposits of gooky mud with organics
- Overlain by river sand
- Sea invades and covers all with shale
- Pennsylvanian Period



# Texas Oil

- Lucas Gusher, 1901
- Initial production 100,000 bbl/day
- Salt dome traps



<http://www.priweb.org/ed/pgws/history/spindletop/spindletop.html>

# Boiler Avenue

On Spindletop  
salt dome at  
Beaumont,  
Texas



<http://www.priweb.org/ed/pgws/history/spindletop/spindletop.html>



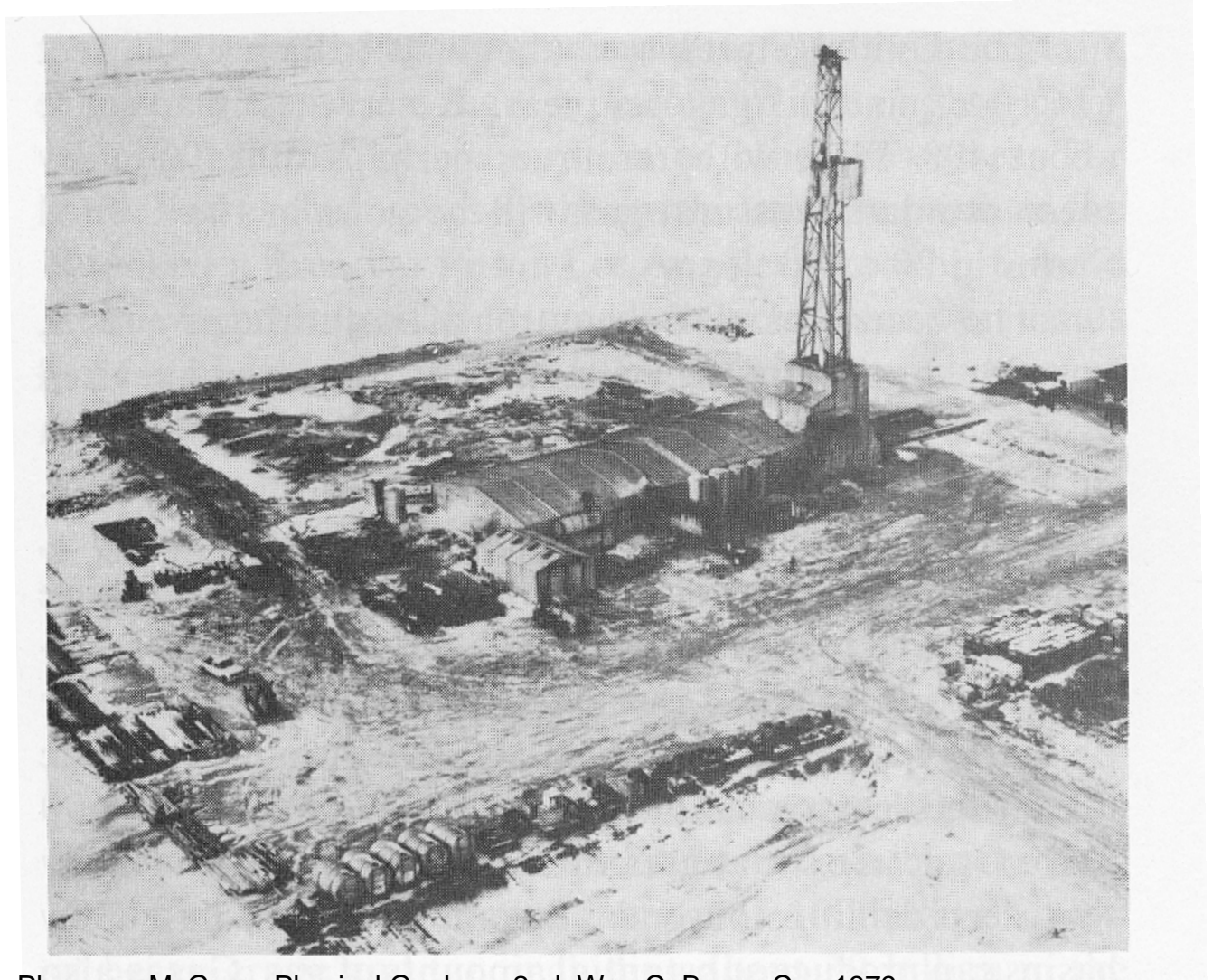
# Signal Hill, Long Beach, CA

1932



[http://www.priweb.org/ed/pgws/history/signal\\_hill/signal\\_hill2.html](http://www.priweb.org/ed/pgws/history/signal_hill/signal_hill2.html)

# Drilling on the North Slope



Plummer, McGeary Physical Geology, 2nd, Wm. C. Brown Co., 1979

# Drilling in the North Sea



Rocks and Fossils, Busbey, Doenraads, Willis and Roots, Fog City Press, 1997

# Top 10 Countries— Oil Statistics

- Reserves
- [http://www.nationmaster.com/graph-T/ene\\_oil\\_res&int=10](http://www.nationmaster.com/graph-T/ene_oil_res&int=10)
- Consumption
- [http://www.nationmaster.com/graph-T/ene\\_oil\\_con&int=10](http://www.nationmaster.com/graph-T/ene_oil_con&int=10)