

Introduction to Petroleum Geology

(Non-Technical)

- **Industry History**
 - **Technology**
 - **Discoveries**
 - **Companies**

- **Career Reflections** (so you want to be a petroleum geologist)

A History of Petroleum

- Ancient:**
- Egypt: oil to preserve mummies
 - China: natural gas for fuel
 - Babylonia: oil to seal walls and pave streets
 - America: tar to seal canoes

First Drilling: • America: using cable tool: to 70' in 1859

First Product: • Kerosene for lamps (Gasoline an unwanted by-product)

- Demand:**
- Industrial Revolution
 - Internal Combustion Engine (1885)
 - Global Economic Growth

Natural Oil Spills

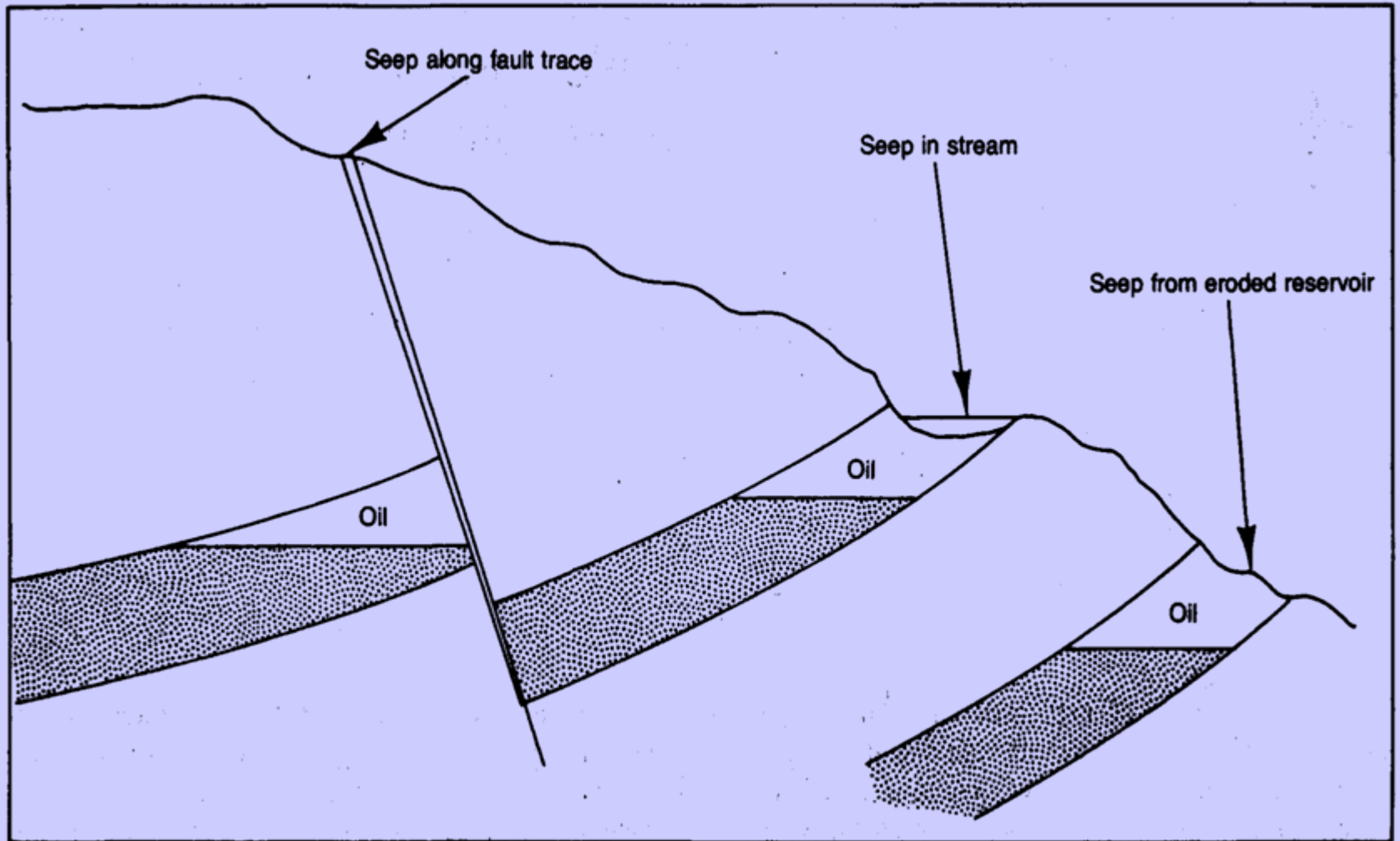


Fig. 442. Oil seeps

Tar sand near Redden Oklahoma (Atoka County)

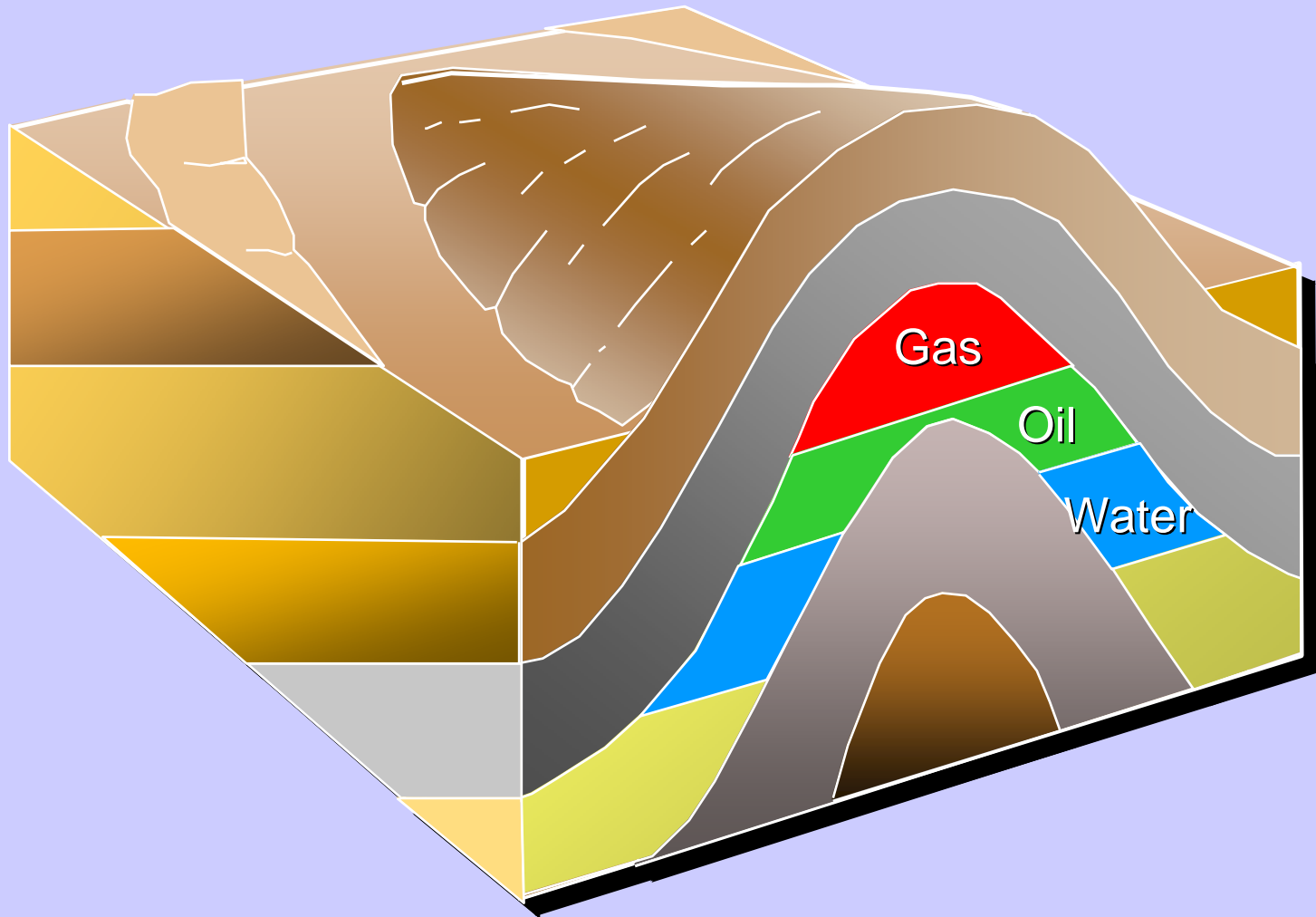


Industry 'Technological' Milestones

1883: Anticlinal theory (where to drill)

Anticlinal Theory

Petroleum Accumulates in Structural Closure



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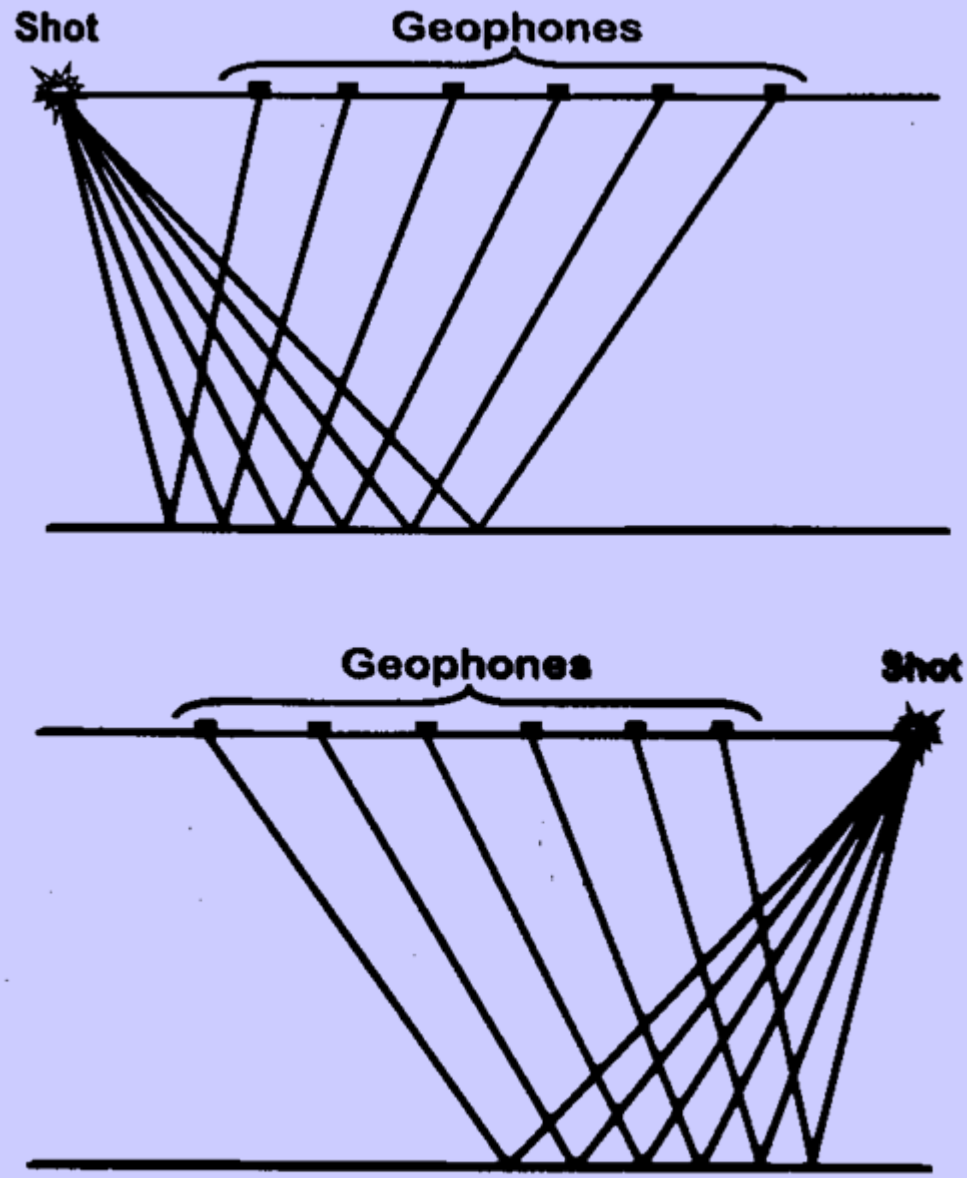


Figure 18. Cross sections illustrating single-ended spread shooting.



2D Seismic Line Gulf of Mexico (offshore)

Figure 5-19 Seismic line B. Profile shows gently dipping reflectors cut by a small growth fault. (Seismic data published by permission of TGS/GECO.)

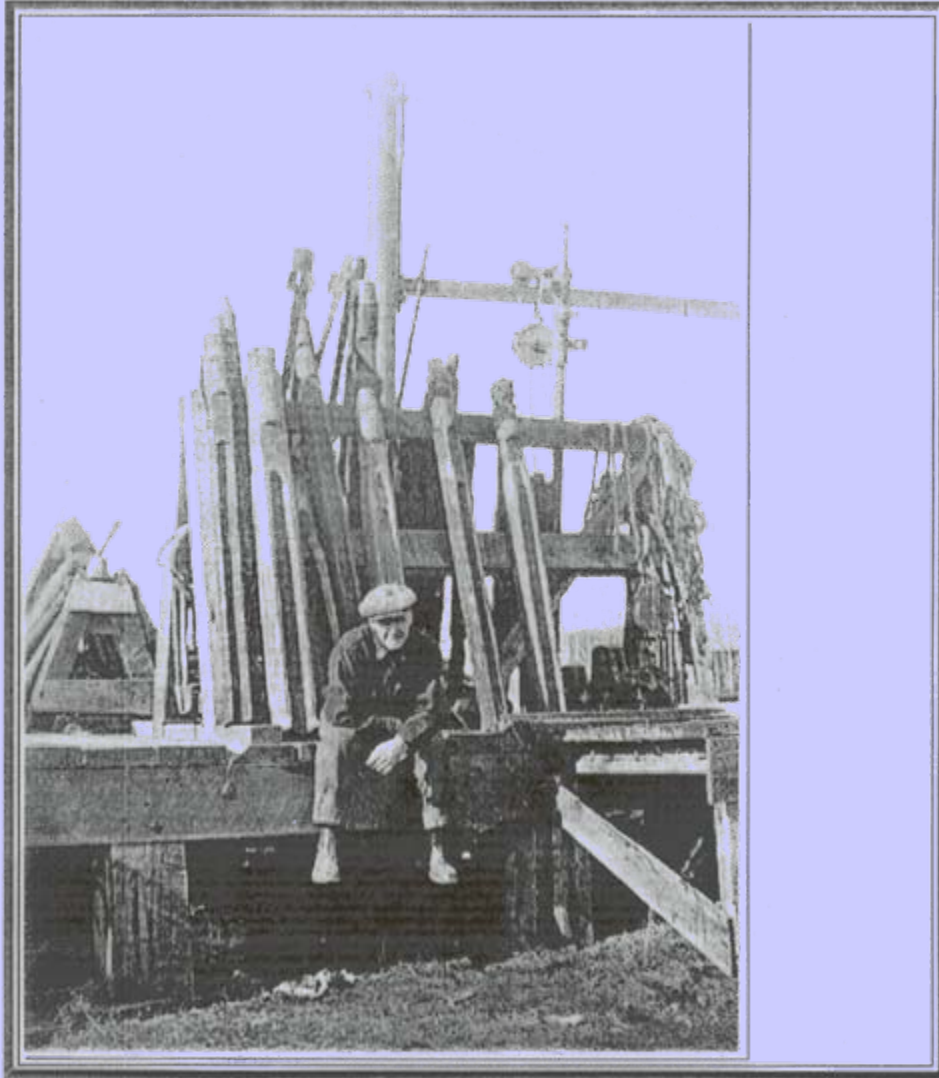
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A platform on which there are several
cable tool bits



Cushing Field Blowout
(circa 1914)

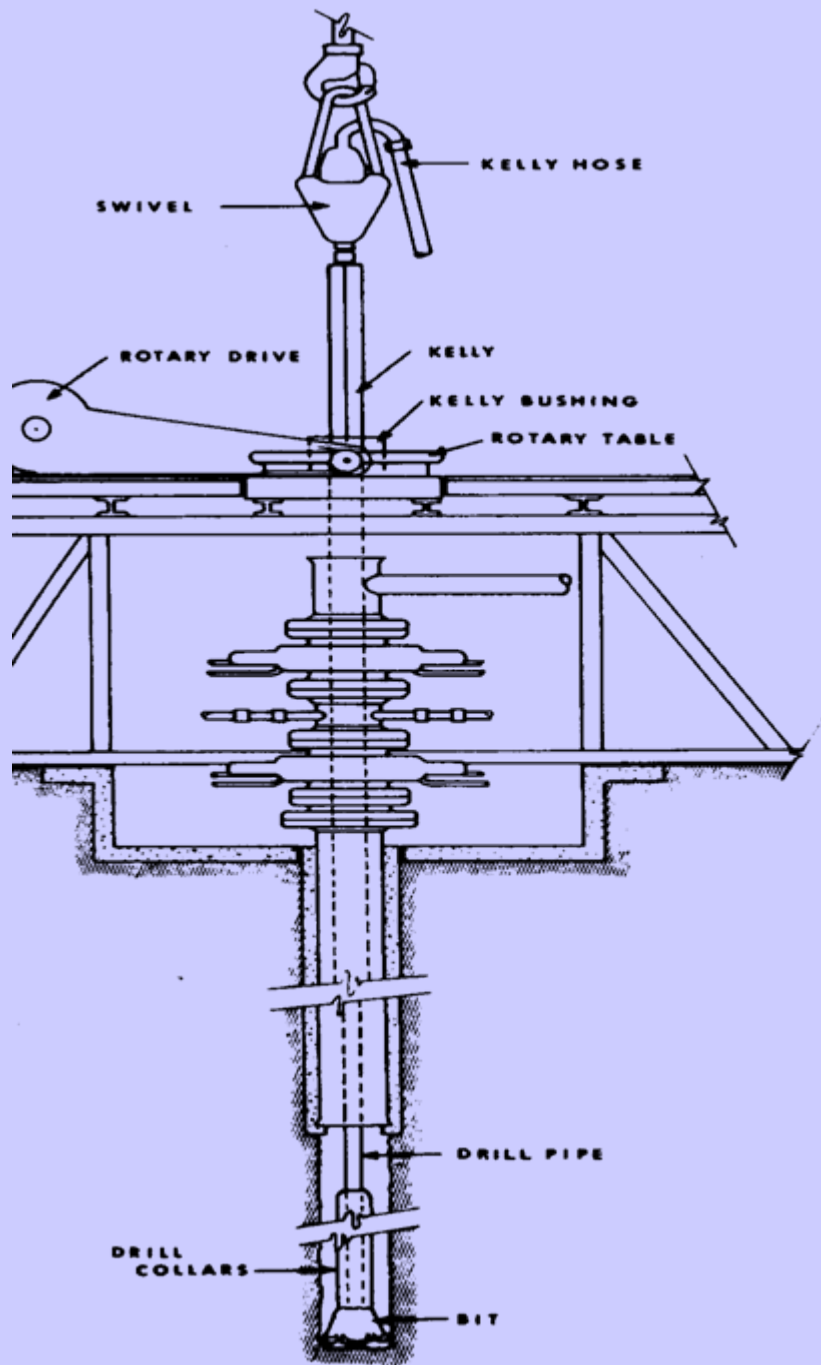
The outcome of a successful
cable-tool well.





Large Land Drilling Rig

Loving County, Texas
20,000' PTD Ellenberger test

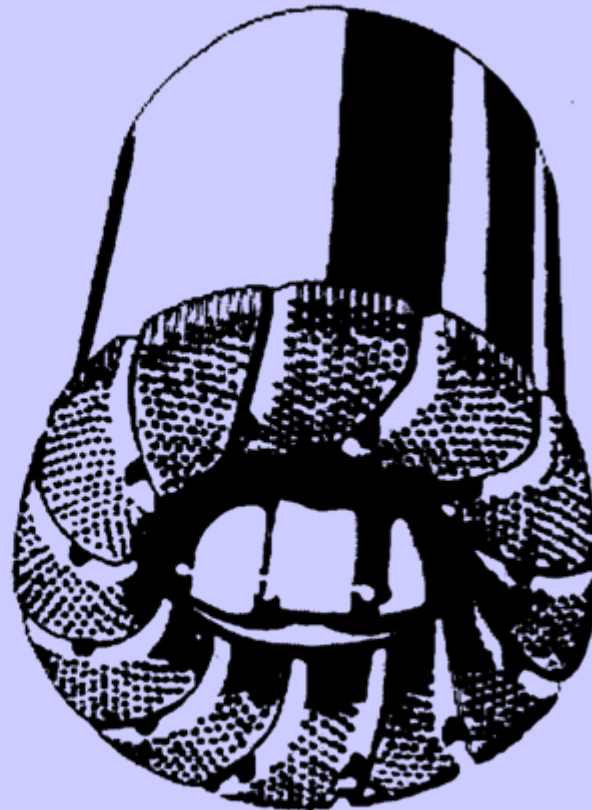


Rotary Drilling Rig Schematic

Tri-Cone Rotary Bit



Coring Bit





Nothing is Foolproof

2005 blowout in West Texas

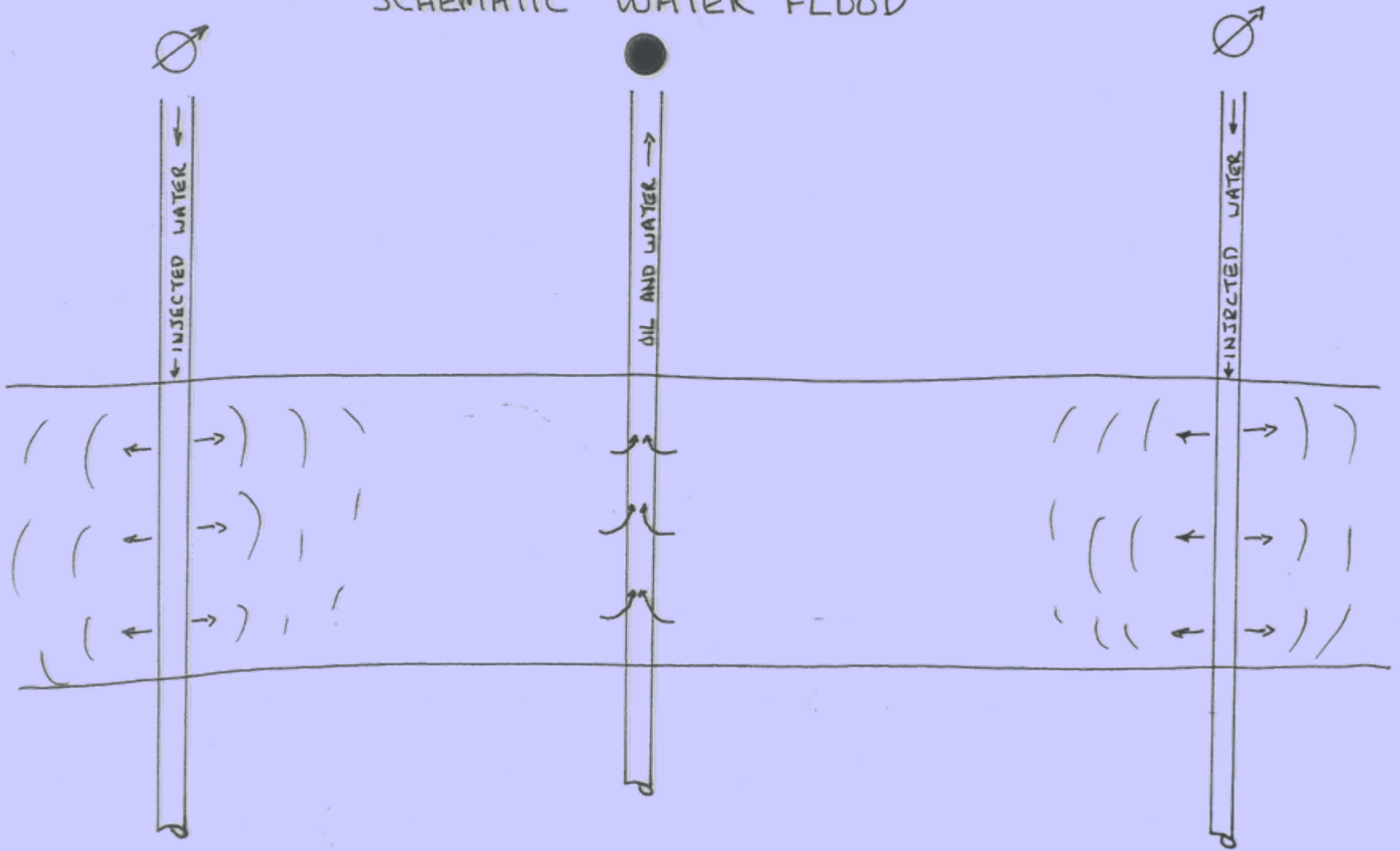
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Start of waterflooding (improved recovery)

SCHEMATIC WATER FLOOD



CROSS-SECTIONAL VIEW

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1930s: Offshore drilling (access to prospective areas)

Jack-Up Drilling Rig (Texas Federal Waters ~150' water depth)



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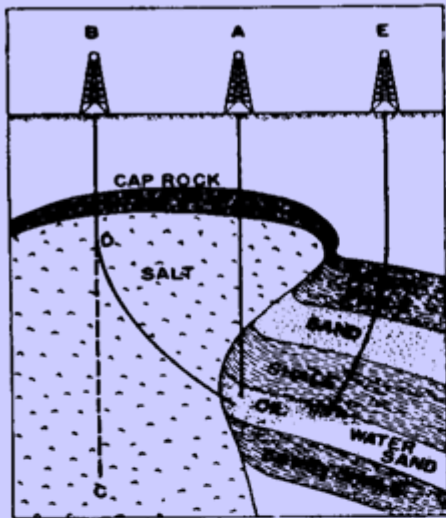
1930s: Offshore drilling (access to prospective areas)

1960s: Digital computers (data manipulation)

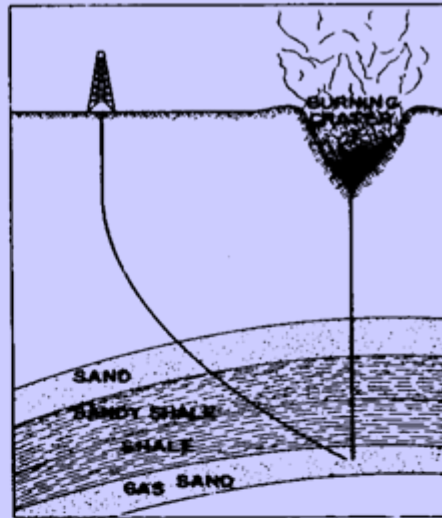
1970s: Directional drilling

1980s: 3D seismic (enhanced imaging)

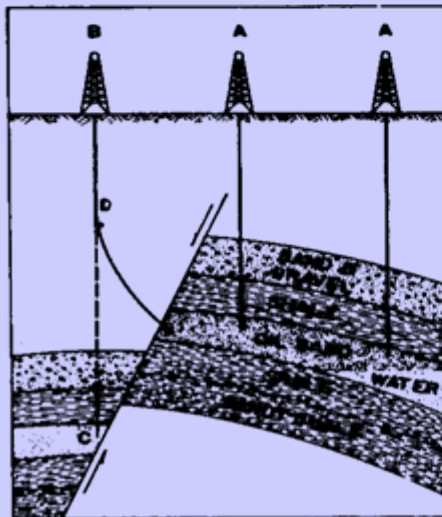
SALT DOME CONTROL



RELIEF WELL CONTROL



FAULT PLANE CONTROL



PROPERTY LINE CONTROL

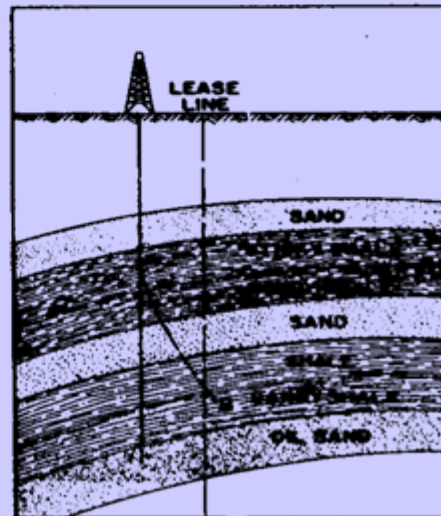


Figure 22.—Applications of directional drilling.

Oklahoma Industry Milestones

Nellie Johnstone – OK 1897 (1st deliberate discovery)

ONG installs first compressor on natural gas pipeline – 1910

First dual completion in Wacey Field – 1913

AAPG founded – 1918

First field tests of reflection seismograph conducted in OKC suburb – 1921

Introduction of rotary drilling to OK – 1924

Phillips Petroleum invents fractionation process to remove condensate from natural gas – 1925

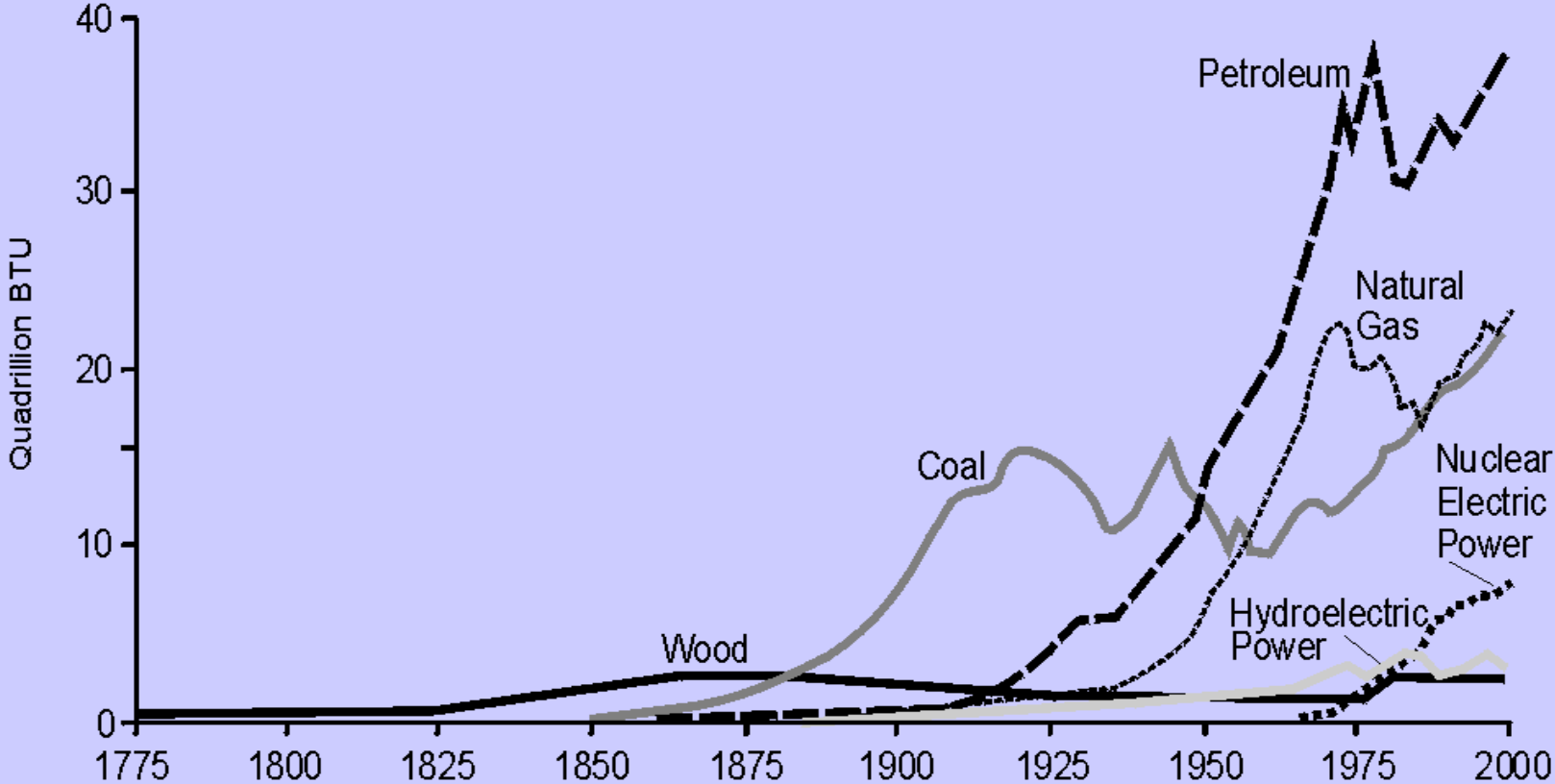
First waterflood operation started in Rogers County - 1931

Early U.S. Discoveries

Drilling on hills and near seeps (+ serendipity)

- **PA (1859) late 1800s**
- **CA (1865) 1920s**
- **TX (1880s significant discs) Spindletop: 1901**
- **OK (1897) Glenn Pool: 1905**

United States Energy Consumption By Source, 1775-2000. From E.I.A., (2003).





The Phillips well, on the right, and the Woodford well, on the left. Located in the middle of Oil Creek Valley (note the river at the right of the photograph), these two wells showed the early promise of the Oil Regions. The Phillips well was the most productive ever drilled to date, flowing initially at 4,000 barrels per day in October 1861. The Woodford well came in at 1,500 barrels per day in July, 1862. Note the wooden tank collecting the oil in the foreground, as well as the many different sized barrels in the background. At this time, barrel size was not yet standardized, which made terms like "Oil is selling at \$5 per barrel" very confusing.

Signal Hill Oil Field

Discovered 1921



A view of Signal Hill, just north of Long Beach, California, in 1930. The "forest" of oil derricks were drilled in the 1920's.
photo courtesy of the Los Angeles Public Library



**1901 Spindletop Field discovery
#1 Lucas**

Blowout @ 1,020' IP: ~100,000 BOPD



**Glenn Pool Oil Field:
#1 Ida E. Glenn Discovery – November 1905
Sec 10-17N-12E
Tulsa County, Oklahoma**

Companies

- Oklahoma
- Standard Oil Trust & Successors
- Seven Sisters
- Mergers & Super-Majors
- State-Owned Companies

Oklahoma Companies

- 1905 Glenn Pool Field discovered – Owned largely by Henry Ford Sinclair. It is central in the formation of **Sinclair** Oil Company in 1916 (Tulsa).
- 1910 E. W. Marland founds Marland Oil Company, which forms core of **Conoco** Oil Company in 1929 (Ponca City)
- 1912 Henry Doherty starts what will become **Cities Service** Company (Bartlesville)
- 1914 Discovery of Garber Field gives Herbert Champlin financial start for **Champlin** Oil Company (Enid)
- 1917 **Phillips** Petroleum Company founded by Frank and L. E. Phillips (Bartlesville)
- 1920 Erle Halliburton founds **Halliburton** Oil Well Cementing Company (Duncan)
- 1921 Lloyd Noble starts **Noble Drilling** Company (Ardmore)
- 1929 James Anderson and Robert Kerr form drilling company that in 1946 becomes **Kerr-McGee** Oil Industries (Ada)

Standard Oil Company

John D. Rockefeller

1870-1911 (cartel)

1880 controlled 95% of US refining

Broken apart in 1891 (Teddy Roosevelt)

Standard Oil Break-Up

(33 companies, including.....)

Standard of:

- New Jersey – Exxon
- New York – Mobil
- Indiana – Amoco
- California – Chevron

Other Major Spin-Offs

- Atlantic Richfield (ARCO)
- Pennzoil

The Original Seven Sisters (now 4)

- Exxon
- Shell (Royal Dutch)
- BP (Anglo-Persian)
- Mobil
- Chevron
- Gulf Oil
- Texaco

Major Mergers

Occidental buys Cities Service – 1982

Chevron with Gulf Oil – 1985 (Now Chevron)

BP with Amoco – 1998 (Now BP)

Exxon with Mobil – 1999

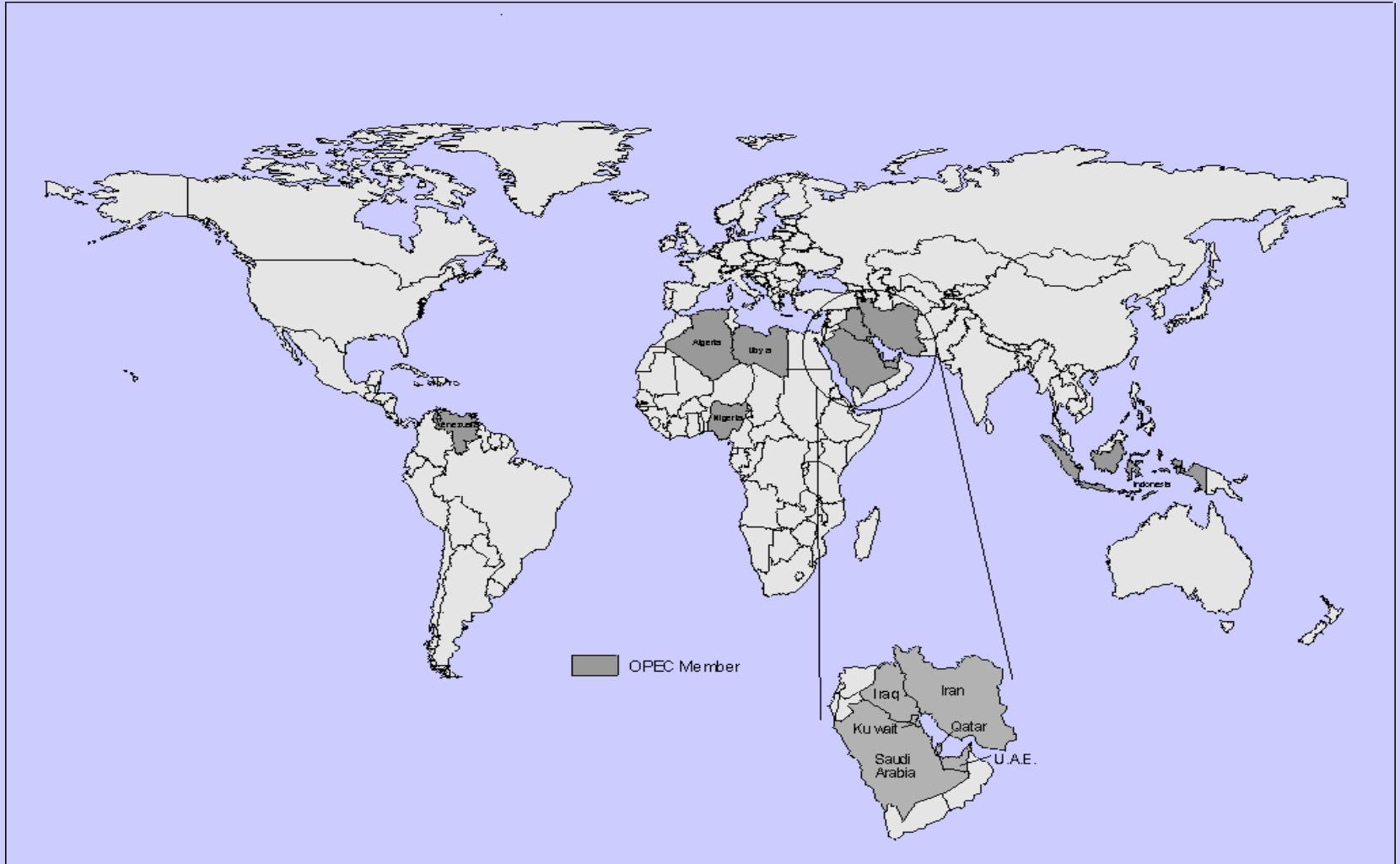
Chevron with Texaco – 2001 (Now Chevron)

Conoco with Phillips - 2002

Today's Super-Majors

- **Exxon-Mobil**
- **Shell**
- **BP** (formerly BP-Amoco)
- **Total**
 - Merged with Petrofina (Belgium) 1999
 - Merged with Elf Aquitaine (France) 2000
- **Chevron** (formerly Chevron-Texaco)
- **Conoco-Phillips**

Map of world regions showing OPEC member states.



Major State-Owned Companies

- **Saudi Aramco (Saudi Arabia)**
- **Gazprom (Russia)**
- **CNPC (China)**
- **NIOC (Iran)**
- **PDVSA (Venezuela)**
- **Petrobras (Brazil)**
- **Petronas (Malaysia)**
- **Pemex (Mexico)**

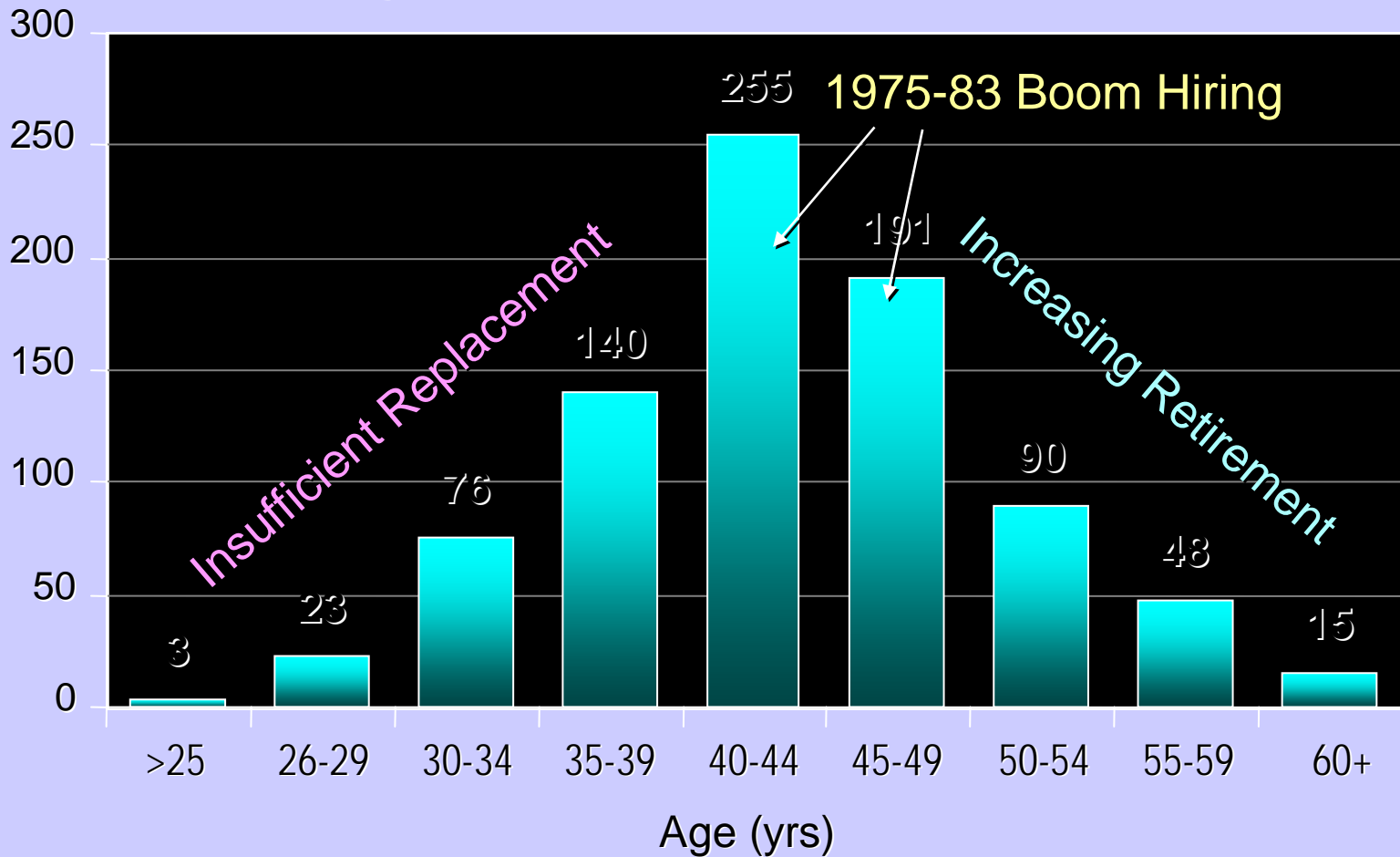
Petroleum Geology Careers

- **Professional Demographics**
- **Job Market**
- **Expectations & Skills**
- **Career Paths Decisions**
- **The Key**

Geoscience Demographics in 1998

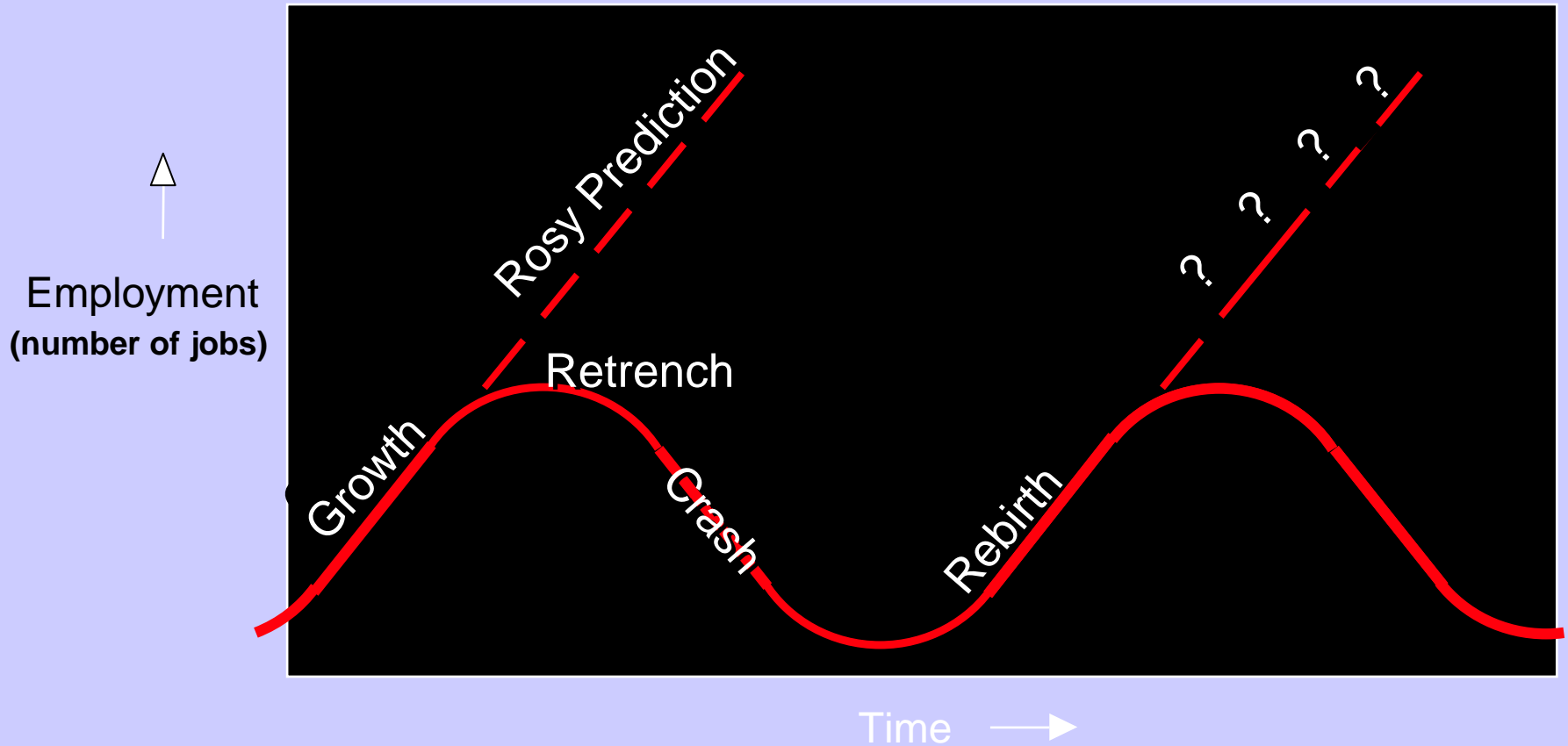
For a Typical Major Oil Company

Age Brackets for Geoscientists Worldwide



Cyclic Job Market

Typical of Today's Global Industries



Employer's Expectations

- **Immediate Impact**
 - **Bottom Line Focus**
 - **High Productivity**
 - **Continuous Training**
 - **Problem Solving**
-

Necessary Skills

- **Well-educated (love of geology)**
- **Self-motivated**
- **Team Player**
- **Excellent Communicator (oral, written, graphical)**

Career Path Decisions

- **Technical vs. Managerial Ladder**
- **Domestic vs. International**
- **Exploration vs. Development Geology**
- **Mergers and Acquisitions**
- **Where to Start & If and When to Bail**

The Key To Success:

Attitude