Introduction to Petroleum Geology
(Non-Technical)

• Industry History
  • Technology
  • Discoveries
  • Companies

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

GEOL 4233 Class
January 14, 2008
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
Industry ‘Technological’ Milestones

1883: Anticlinal theory (where to drill)

1914: Seismograph invented (remote sensing)
Figure 18. Cross sections illustrating single-ended spread shooting.
Figure 5-19 Seismic line B: Profile shows gently dipping reflectors cut by a small growth fault. (Seismic data published by permission of TGS/GEBCO.)
Industry ‘Technological’ Milestones

1883: Anticlinal theory (where to drill)
1914: Seismograph invented (remote sensing)
1920s: Introduction of rotary drilling (well control, environment)
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
Tri-Cone Rotary Bit

Coring Bit
Nothing is Foolproof

2005 blowout in West Texas
Industry ‘Technological’ Milestones

1883: Anticlinal theory (where to drill)

1914: Seismograph invented (remote sensing)

1920s: Introduction of rotary drilling (well control, environment)
        Start of waterflooding (improved recovery)
SCHEMATIC WATER FLOOD

CROSS-SECTIONAL VIEW
Industry ‘Technological’ Milestones

1883: Anticlinal theory (where to drill)

1914: Seismograph invented (remote sensing)

1920s: Introduction of rotary drilling (well control, environment)
       Start of waterflooding (improved recovery)

1924: First electrical well logging (formation evaluation)
Industry ‘Technological’ Milestones

1883: Anticlinal theory (where to drill)

1914: Seismograph invented (remote sensing)

1920s: Introduction of rotary drilling (well control, environment)
       Start of waterflooding (improved recovery)

1924: First electrical well logging (formation evaluation)

1930s: Offshore drilling (access to prospective areas)
Jack-Up Drilling Rig (Texas Federal Waters ~150’ water depth)
Industry ‘Technological’ Milestones

1883: Anticlinal theory (where to drill)

1914: Seismograph invented (remote sensing)

1920s: Introduction of rotary drilling (well control, environment)
       Start of waterflooding (improved recovery)

1924: First electrical well logging (formation evaluation)

1930s: Offshore drilling (access to prospective areas)

1960s: Digital computers (data manipulation)

1970s: Directional drilling

1980s: 3D seismic (enhanced imaging)
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 Wicey 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
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.

From the Paleontological Research Institute <http://www.priweb.org/ed/pgws/history/pennsylvania/pennsylvania.html>
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

Glenn Pool Oil Field Educational Center
<http://www.glennpoooilfield.org/history/index.html>
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

Insufficient Replacement

1975-83 Boom Hiring

Increasing Retirement

Age (yrs)

>25 26-29 30-34 35-39 40-44 45-49 50-54 55-59 60+

3 23 75 140 255 191 90 48 15

For a Typical Major Oil Company
Cyclic Job Market
Typical of Today’s Global Industries

- Growth
- Crash
- Retrench
- Rosy Prediction
- Rebirth

Employment (number of jobs) vs. Time
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