Lecture Outline

- Course logistics
- Historical Review
  - Petroleum use in ancient times
  - Modern Petroleum Industry

Geology 493K    Adv. Petroleum Geology

Instructor: Dr. Jaime Toro
Office: G39 White Hall
Phone: 293-9817
Email: jtoro@wvu.edu
Office Hours: 1:30-2:30 MF
Text: Elements of Petroleum Geology, R. Selley.

Geology 373   Intro Petroleum Geology

Class Web Site: http://www.geo.wvu.edu/~jtoro/Petroleum/index.htm
Prerequisites: Geology 101
Grades:
- Test 1 – Feb. 10 (Wed) 20 %
- Test 2 – Mar. 11 (Fri) 20 %
- Test 3 – April 13 (Wed) 20 %
- Test 4 – May 4 (Wed), 3:00-5:00 PM 20%
- Weekly Reading Quizzes – 12%
- Attendance – 8%

Class Topics
- 2. The petroleum system
- 3. What is Petroleum?
- 4. The subsurface environment
- 5. Well Drilling and completion
- 6. Formation Evaluation
- 7. Sedimentary Basins and Sedimentary rocks
- 8. The source: How oil forms
- 9. Migration
- 10. The Reservoir
- 11. Traps and Seals
- 12. Geophysical Methods of Exploration
- 13. Exploration Process
- 14. Prospect Evaluation
- 15. Field Development
- 16. Unconventional Resources
- 17. The future of the Petroleum Industry

Historical Review

Petroleum (πετρέλαιον, Greek)
Petra= Rock
Oleum= Oil
Term first used by Agricola in 1546
Genesis 6:13-16

“And God said unto Noah … make yourself an ark of gopher wood; make rooms in the ark and cover it inside and out with pitch”

La Brea Tar Pits, Los Angeles

Oil Seep

Oil seep

Gas Seep

Gas seeps on the seafloor
Petroleum Seep

Ancient History

- First oil wells in China by 347 AD, down to 1000 ft. as part of salt production
- Natural gas use in Japan and China prior to 10th century
- Bagdad had streets paved with tar in the Middle Ages
- Marco Polo (13th century) described the oil fields of Baku (Azerbaijan)
- Persian alchemists first distilled kerosene in the 9th century (Iran)
- Tar sands were mined in France during the Renaissance

Oil in Eurasia

Beginning of the modern oil industry

- Thorla McKee Well- 1816 Ohio
- First Modern Oil Well, USA Titusville, PA 1859

Seneca Oil

Col. Edwin Drake
Distillation
• Petroleum is a mix of hydrocarbons
• They can be separated by distillation

Distillation
• Benjamin Silliman (Yale) fractionated oil by distillation in 1854 and published first scientific paper on the process.
• First commercial refinery in Russia in 1861

Typical Percussion Cable Rig

By 1871 91% of world oil production came from the Appalachian basin (PA, NY, WV)
• 70,000 barrel of oil per day

Baku, Azerbayan, 1890’s
Pumping oil into a “reservoir lake”!

Kerosene Lamps
Whale Oil was the only alternative to kerosene

Discovery of big oil in the Gulf Coast

Spindletop, TX 1901

A real gusher! 80,000 BOD from a 1300’ deep well

Spindletop, 1903

The Internal Combustion Engine

Standard Oil

- Founded by John D. Rockefeller
- Dominated the US oil industry from 1870 to 1911
- Huge “vertically integrated” multinational corporation
- Controlled oil exploration, production, transportation (pipelines), refining, and distribution (gas stations)
Standard Oil Refinery
Cleveland, Ohio 1899

Standard Oil Break Up
• Price fixing and anti-competitive tactics
• Broken up by US Supreme Court in 1911 using Federal anti-trust law
• Descendants:
  – Exxon
  – Mobil
  – Chevron
  – Amoco
  – Conoco
  – Arco
  – Marathon, Pennzoil, Sohio, and many others

Today
• Exxon merged with Mobil again in 1999
• The largest private corporation in the world
  – Revenues: 394 billion in 2014
• If it were a country, it would rank 25th by GDP ahead of Austria

Oil and International Politics
Example: World War II
• Germany and Japan had no domestic oil sources:
  – Nazi invasion of Soviet Union and North Africa
  – Japanese invasion of SE Asia
• Key reason for Allied victory:
  – In 1940, US produced 63% of world’s oil

Oil Reserves
1. Venezuela
2. Saudi Arabia
3. Canada
4. Iran
5. Irak
6. Kuwait
7. Russia
8. Nigeria
9. USA

Oil Production
1. USA
2. Saudi Arabia
3. Russia
4. China
5. Canada
6. UAE
7. Iran
8. Iraq
9. Brazil

U.S. energy consumption by energy source, 2012

Note: Some components may not equal 100% due to rounding.
Source: U.S. Energy Information Administration, Monthly Energy Review, Table 1.3
and 10.1 (April 2013), preliminary 2012 data.
CO₂ Atmospheric concentration from Ice cores

Take home ideas

- Although oil has been known for a long time, the oil industry is a modern development
- Oil seeps were the first exploration clues
- The modern oil companies are direct descendants of 19th century enterprises
- Early in any industry’s history, environmental concerns are secondary. Often later generations pay the prize.
- Under the right conditions, a single oil well can produce incredible volume of oil, but there are risks (Spindletop!)
- Today’s Economy is fueled by Oil
- Burning fossil fuels has profound environmental consequences.

Reading for this lecture:
- Ch. 1, Selley

Reading for next time:
- Ch. 5, Selley

- ECampus Quiz will close on Sunday at 10 PM