

PETR 571 (3cr. Hrs.)
Reservoir Geology and Reserves/Resources Assessment
Spring 2009, TR 9:30-10:45am, MSEC 376

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Office Hrs: By appointment or DB

Course Description: Basic elements of Petroleum Geology, Basic Statistics for Reserves/Resources Assessment, and the new SPE/WPC/AAPG/SPEE reserves/resources terminology/definitions.

Course Objectives:

- Understand basic geologic terminology, symbols, and classification in relation to petroleum origination, migration, and accumulation.
- Become familiar with geologic methods in the exploration and production of hydrocarbons with emphasis on structural and stratigraphic map applications and well logging.
- Develop a confidence in the application of geologic data.

Materials: Course materials will be provided.

Grading:

Homework Assignments	15%
Project	30%
<u>Class Participation</u>	<u>5%</u>
Total*	50%

*i.e., 50% of your total grade will be determined on the Reservoir Geology portion of this course.

Course Outline:

WEEK

TOPIC

- 1 Composition of the earth/Geologic Time/Plate tectonics
- 2 Weathering/Erosion/Deposition/Lithification
- 3 Reservoir rock types/Classification/Properties/Symbols
- 4 Traps -- Structural/Stratigraphic
- 5 Sed. Basins/Hydrocarbons -- Origination/Migration/Accumulation
- 6 Geological & Geophysical Exploration Techniques
- 7 Surface Maps, Subsurface Maps, and Cross-Sections
- 8 Well Logs

I. Composition of the earth/Geologic Time/Plate tectonics

- i. Core, Mantle, Asthenosphere, Lithosphere
 - 1. Behaviors, Properties, and Composition of each
 - a. Lithosphere Rocks: igneous basement, metamorphic, sedimentary
 - 2. Lithostatic, Hydrostatic, Geothermal gradients
- ii. Plate Tectonics
 - 1. Convergent, Divergent, and Transform margins
 - 2. Subduction zones and fore-arc basins, reservoir case example
 - 3. Spreading zones and continental basins, more reservoir case expls.
- iii. Geologic Time Scale
 - 1. Absolute time scale/Relative time scale
 - a. Radioactive isotope dating
 - b. Flora, Fauna, Strata division
 - 2. Wilson Cycle or Earth's face through time
 - 3. How old is Petroleum?
- iv. Glossary

II. Weathering/Erosion/Deposition/Lithification

- i. Process of weathering
 - 1. Mechanical, Chemical
 - 2. Origination of Sediments
- ii. Process of erosion
 - 1. Transport: Aeolian (wind), alluvial (stream), gravity, etc.
- iii. Deposition
 - 1. Depositional environments
 - a. Continental
 - b. Coastal
 - c. Marine
 - 2. Strata and Stratigraphic Column
- iv. Lithification
 - 1. Compaction
 - 2. Cementation
 - 3. Crystallization
- v. Glossary

III. Reservoir rock types/Classification/Properties/Symbols

- i. Sedimentary Rocks
 - 1. Shale, Sandstone, Limestone
 - a. Grain shape, size, sorting and textures (e.g., cross-bedding); affect on formation properties, e.g., porosity, etc.
 - b. Associated map symbols
- ii. Aside: Transgressions and Regressions in sedimentary column

- 1. Indicator for potential local HC-containing-formation pinchouts
- iii. Carbonate Reservoirs
 - 1. Description, Classification, Properties, History, and Occurrence
 - 2. Case example
- iv. Sandstone Reservoirs
 - 1. Description, Classification, Properties, History, and Occurrence
 - 2. Case example
- v. Glossary

IV. Traps -- Structural/Stratigraphic

- i. Seals/Caps as barriers
 - 1. Shales, impermeable strata
- ii. Structural traps
 - 1. Faults and Folds
 - a. Normal faults
 - b. Anticlines/Synclines
 - c. Anticlinal domes/Synclinal domes
- iii. Stratigraphic traps
 - 1. Angular unconformities
 - 2. Pinch-out
- iv. Other
 - 1. Salt-dome traps
- v. Glossary

V. Sedimentary Basins

- i. Cratonic Basins
- ii. Troughs
- iii. Rift-zones
- iv. Strike-slip basins

VI. Hydrocarbons -- Origination/Migration/Accumulation

- i. Origin
 - 1. Biogenic material
 - 2. Burial
 - 3. Kerogens → Hydrocarbons → Oil and Gas
- ii. Migration
 - 1. Mechanisms
 - 2. Preferential movement (?)
 - 3. The role of subsurface waters—and how they got there
- iii. Accumulation
 - 1. Gas on Oil on Water
- iv. Unconventional HC reserves

1. Tight-gas sands, coal-bed methane
- v. Glossary

VII. Geological & Geophysical Exploration Techniques

- i. Geological Exploration Techniques
 1. Outcrop data
- ii. Geophysical Exploration Techniques
 1. Seismic data
- iii. Glossary

VIII. Surface Maps, Subsurface Maps, Stratigraphic Sections and Cross-Sections

- i. Surface Maps
 1. Constructing a Geologic Map—Elements of, e.g., Contours, Symbols
- ii. Subsurface Maps
 1. Isopach maps
- iii. Stratigraphic Sections
 1. Markers
 2. Correlations
- iv. Cross-Sections
 1. How to make a Cross-Section
- v. Inferring potential reserves using all of the above
- vi. Glossary

IX. Well Logs

- i. Types of well logs
 1. SP logs
 2. Gamma logs
 3. Etc.
- ii. Glossary

References:

Hyne, Norman J., *Geology for Petroleum Exploration, Drilling, and Production*, McGraw-Hill

Book Company, New York, 1984

Link, Peter K., *Basic Petroleum Geology*, Oil & Gas Consultants International, Inc., Tulsa,

Oklahoma. 1987

Selley, Richard C., *Elements of Petroleum Geology*, Academic Press, San Diego, 1998