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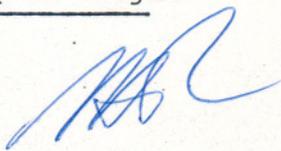
of APPLIED ARTS and TECHNOLOGY

Sault Ste. Marie

COURSE OUTLINE

OIL, NATURAL GAS & COAL GEOLOGY
GEO 210-5

revised November, 1977 by M. Engel



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Oil, Natural Gas and Coal Geology

GEO 210-5

TEXT:

Leveresen: "Geology of Petroleum"

REFERENCES:

Dunbar, Rodgers: "Principles of Stratigraphy"

W. Francis: "Coal"

W. F. Rogars: "Composition and Properties of Oil Well
Drilling Fluids"

Landes: "Petroleum Geology of the United States"

Gatlin: "Petroleum Engineering"

OIL, NATURAL GAS AND COAL GEOLOGY

Course Outline

5 hours per week

A. Oil and Natural Gas

- 1) Principles of Stratigraphy - 8 hours
 - Stratification
 - Breaks in the Record
 - Facies and facies change
 - Correlation
 - The fossil record
- 2) Formation of oil - 3 hours
 - Theories of formation
 - Periods of oil formation
- 3) Migration of oil - 6 hours
 - Primary and secondary migration
 - Forces causing oil movement
 - Factors influencing oil movement
 - Porosity and Permeability of rocks
- 4) Entrapment of Oil - 6 hours
 - Conditions of deposition
 - Structural traps
 - Fault Traps
 - Salt Plugs
 - Stratigraphic traps
 - Sand bars, Reefs, Unconformity traps
- 5) Exploration for Oil & Gas - 3 hours
 - Gravity
 - Magnetic
 - Seismic } application of these methods
in the search for oil.
- 6) Drilling of Wells - 4 hours
 - Rotary drilling equipment and drilling procedure
 - Casing and cementing of wells
 - Safety and antipollution devices
 - Preparation of the well for production

- 7) Borehole Surveys - 6 hours
 - Resistivity
 - Radiation Logging
 - Self Potential

- 8) Development and Production of an oil or gas field - 6 hours
 - Size of Reservoir
 - Well spacing
 - Reservoir control (Pressure, Gas/Oil/Ratio)
 - Production control

- 9) Secondary Recovery Methods - 4 hours
 - Artificial lift (pumping)
 - Water, Gas injection
 - Thermal methods

- 10) Composition and Properties of drilling fluids - 8 hours
 - Properties of drill muds
 - Types of drill muds
 - Water-Clay muds
 - Oil in Water muds

- 11) Laboratory Procedures - 12 hours
 - Determination of Porosity and Permeability of rocks
 - Determination of specific gravity of muds
 - Determination of mud viscosity
 - Preparation of drill cuttings for microscopic examination.

- 12) A term paper will be written on particular oil and gas fields in North America.

B. Coal Geology

- 1) Formation of Coal - 3 hours
 - Origin of Coal
 - Carboniferous Stratigraphy

- 2) Classification and Properties of Coal - 4 hours
 - Types of Coal
 - Composition of Coal
 - Petrology of Coal
 - Properties of Coal

- 3) Discussion of Major Coal Fields - 2 hours
- 4) Underground Coal Mining Methods - 4 hours
 - Procedures and Equipment
 - Stresses around Mine openings
 - Roof control.
- 5) Strip Mining Methods - 2 hours
 - Procedures and Equipment
 - Land Reclamation.

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... casing and cementing of wells
... Safety and environmental control
... Preparation of the well for production

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Oil, Natural Gas and Coal Geology

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Course Objectives

GENERAL:

The student should be familiar with the formation of sedimentary rocks in the various geological environments. The principles of formation, migration and entrapment of oil and gas are studied.

He should be familiar with exploration methods for oil and gas and should be knowledgeable in well drilling procedures and in surveying methods associated with wells.

The student should be familiar with the structures of major Canadian Oil Fields.

Further, the student should be familiar with the formation of coal deposits and the classification and properties of coal. He should possess a working knowledge of coal mining methods.

Oil, Natural Gas and Coal Geology

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SPECIFIC OBJECTIVES

- A) The student should be familiar with the transportation and deposition of sediments in the various geological environments.
1. The student should be able to write a classification of sedimentary rocks.
 2. Be able to name and describe the processes involved in the formation of Sedimentary Rocks.
 3. Be able to name and describe forms of sediment transport by streams.
 4. Be able to show in a graph the relationship between stream velocity, sediment size and show when erosion, transportation or deposition takes place.
 5. Be able to show in a graph the relationship between particle size and settling velocity of particles in still water.
 6. Be able to name forms of sediment transport in the sea.
 7. Be able to name conditions when turbidity currents form.
 8. Be able to describe the appearance of sedimentary deposits formed by turbidity currents.
 9. Be able to describe the forms of sediment transportation by wind.
 10. Be able to describe characteristics of wind deposits.
 11. Be able to describe features of sedimentary rocks formed by glaciers.
 12. Be able to name and describe non marine environments of deposition of sediments.
 13. Be able to name and describe marine environments of deposition of sediments.
 14. Be able to describe the geologic environments of closed basins, beach environment, tidal flat environments, organic reef environment.
 15. Be able to describe the concept of geological facies.

16. Be able to show in sketches types of marine facies relations.
- B) The student should be able to describe theories of formation, migration and entrapment of oil and gas.
1. He should be able to name conditions which could lead to the formation of oil.
 2. Be able to name and describe types of hydrocarbons.
 3. Be able to name the organic source material for oil.
 4. Be able to name processes by which organic matter can be transferred into oil.
 5. Be able to describe primary and secondary migration of oil.
 6. Be able to name geological conditions which permit the migration of oil.
 7. Be able to explain how buoyancy and hydrodynamic flow effect the formation of oil pools.
 8. Be able to show in sketches possibilities for oil entrapment.
- C) The student should be familiar with the various types of Reservoir Traps.
1. He should be able to name 4 essential elements of a petroleum reservoir.
 2. Be able to write a definition of Porosity.
 3. Be able to write a definition of Permeability.
 4. Be able to name values for good and poor porosity.
 5. Be able to describe methods of measuring porosity.
 6. Be able to give a sketch of a trap formed by an anticline.
 7. Be able to give a sketch of a trap formed by a syncline.
 8. Be able to give a sketch of a trap formed by a monocline.
 9. Be able to give a sketch of a trap formed by a buried hill.
 10. Be able to give a sketch of traps formed by normal, reverse, and thrust faults.

11. Be able to describe the characteristics of stratigraphic traps.
 12. Be able to show a sketch and describe a shoestring trap.
 13. Be able to show a sketch and describe an offshore bar.
 14. Be able to show a sketch and describe a channel filling.
 15. Be able to show a sketch and describe traps formed by a porous carbonate facies.
 16. Be able to show a sketch and describe traps formed by organic reefs.
 17. Be able to show in a sketch traps associated with salt domes.
 18. Be able to describe the structures of the following oil fields: Leduc, Redwater, Belcher, Norman Wells.
- D) The student should be familiar with exploration methods for oil and gas.
1. Be able to name types of geophysical surveys used to detect possible oil and gas bearing structures.
 2. Be able to describe seismic survey procedures adapted for oil exploration.
- E) The student should be familiar with drilling procedures and methods of testing the formations.
1. Be able to name components of an oil-drilling rig.
 2. Be able to show in a sketch the flow sheet for drill mud.
 3. Be able to describe the make up of the drill string.
 4. Be able to describe the procedure used to pull the drill string out of the hole and the procedure to lengthen the drill string.
 5. Be able to name the functions of the drill mud.
 6. Be able to describe the types of drill muds and name the applications for each type of mud.
 7. Be able to make up drill mud to specifications in the Laboratory.
 8. To describe the methods used to determine the properties of drill mud.

9. Be able to measure the viscosity of mud by using the Marsh Funnel, a Boroid Viscometer.
 10. Be able to measure the density and shearstrength of drill mud.
 11. Be able to name the reason for cementing the wells.
 12. Be able to describe the procedure used in cementing of wells.
 13. Be able to name types of Electric Logs.
 14. Be able to describe methods of radiation logging.
 15. Be able to describe the procedure used to perform a Drill Stem Test.
 16. Be able to describe the function of the equipment in a Drill Stem Test.
- F) The student should be familiar with production procedures in an oil field.
1. The student should be familiar with procedures used to take an oil field into production.
 2. The student should be familiar with variables of the formation which effect well spacing.
 3. Be familiar with Reservoir Control.
 4. Be able to name primary recovery methods.
 5. Be able to name and describe secondary recovery methods.
- G) The student should be familiar with the Canadian Oil and Gas production, the transportation routes and with future trends.
- H) The student should be familiar with the production of oil from the Athabasca Tar sands, the reserves and the recovery methods.
- I) The student should be familiar with the formation of coal deposits, the classification and properties of coal and the mining methods.
1. He should be able to name major periods of coal formation.

2. Be able to name the location of coal deposits in Canada.
3. Be able to describe the formation of coal.
4. Be able to name types of coal.
5. Be able to name the composition of the major coal types.
6. Be able to name the major coal forming minerals.
7. Be able to name the properties and uses of the different types of coal.
8. Be able to describe the application of the Room and Pillar method of mining coal.
9. Be able to describe the Long-Front coal mining methods.
10. Be able to name and describe the function of equipment used for coal mining.
11. Be able to show the stress distribution around mine openings.
12. Be able to name various methods of roof support.
13. Be able to name health hazards associated with the operation of coal mines.
14. Be able to describe safety measures to reduce the hazard of gas explosions.
15. Be able to describe stripmining methods.
16. Be able to name ecological problems associated with stripmining.