PETE/GEOS 445/645

Petroleum Geology

3 credits

Tuesday, Thursday 3:40-5:10
Reichardt 233

Hydrocarbons fuel today's economy, but remain a relatively rare natural resource. The objective of this course is to review the geologic controls on the distribution and accumulation of hydrocarbons, how those hydrocarbons are found, and subsequently extracted. Topics to be covered in lectures will include:

- the subsurface environment
- the origin and nature of hydrocarbons
- how and where hydrocarbons accumulate
- methods of hydrocarbon exploration and exploitation
- unconventional hydrocarbon resources
- basic petroleum engineering concepts

Examples from classic hydrocarbon producing regions will be used to illustrate the principles and techniques discussed in class.

Students enrolled in the graduate class will work in teams and use the concepts and techniques discussed in class to analyze a geology and geophysical dataset from a sedimentary basin and determine its petroleum potential. Each team will summarize their results in a 5 page paper and a 25 minute presentation at the end of the semester.

Prerequisites:

For GEOS 445—GEOS F314 and GEOS F322
For PETE/GEOS 645--Graduate standing or permission of the instructor

Instructor: Cathy Hanks, NSB 346/Duckering 417, 474-5562 or 2668
chanks@gi.alaska.edu

Text: Selley, 1999, Elements of Petroleum Geology. Academic Press, 470 p.

Additional readings may be assigned to augment the lectures.

Office Hours: Duckering: Mon, Wed 10-11 am
Reichardt: Tuesday, Thursday 10:30-11:30 am

Class format:

The class will consist of lectures and homework assignments.

Grading Policy

The course grade will be a letter grade (plus, minus) and will be based on:

GEOS 445:
- 2 mid-term exams (25% each)
- final exam (25%)
- homeworks (25%)

PETE/GEOS 645:
- 2 mid-term exams (20% each)
- final exam (20%)
- homeworks (20%)
- final project paper and presentation (20%)

Students enrolled in PETE/GEOS 645 will meet with the instructor by October 1 to formulate their teams and receive the dataset. Each team will summarize the results of their project as a 5 page research paper and a 25 minute oral presentation at the end of the semester.

Grades will be determined using the following curve:

A = 90-100%
B = 80-89%
C = 70 – 79%
D = 55-69%
F = <55%

Pluses/minuses will be given when the grade is within 2 percentage points of the cut off for either the next higher letter grade (plus) or next lower letter grade (minus).

The instructor reserves the right to curve the grades.

COURSE OUTLINE: (PRELIMINARY)

Week	*Topic*	*Homeworks*	*Readings*
Aug. 30	**Intro—** What geologic factors are necessary for an oil accumulation? What are the engineering factors?		
Sept. 4	**What is Petroleum?** • Organic vs. inorganic origin of		**Selley Ch. 2, 5.1**

	petroleum • Chemical Properties • Physical Properties		
6	**The subsurface environment** • Temperature within the earth • Pressure • Subsurface waters	**Hwk 1: Calculating geothermal gradients**	**Selley, Ch. 4**
11	**Methods of Exploration** • Drilling a well • Well logging • Subsurface geology and maps	**Hwk 2: Examining well cuttings and well logs**	**Selley, Ch. 3.1, 3.2, 3.5**
13	• Geophysical methods—Reflection Seismic--acquisition And interpretation, 3 D, 4D	**Hwk 3: Interpreting seismic**	**Selley, Ch. 3.3**
18	**The source: How oil forms** • Source rock characteristics • Productivity and Preservation of Organic Matter. • Hydrocarbon Maturation and Migration	**Hwk 4: 2 D geohistory modeling**	**Selley, Ch. 5**
20	**The Reservoir:** **What makes a good reservoir rock?** • Porosity. • Permeability. • Effects of Diagenesis on Reservoir Quality.		**Selley, Ch. 6.1-6.7**
25	• Reservoir Continuity—the importance of depositional environment: o Variations due to sed structure Mesoscopic and map scale variations	**Hwk 5: Evaluating porosity from well logs**	
27	Reservoir prediction in the subsurface: the importance of depositional environment and sequence stratigraphy		
Oct. 2	***Midterm I***		
4	**Traps and Seals:** • Nomenclature of a Trap. • Trap types: o Structural Traps. o Stratigraphic Traps. o Combination Traps. o Hydrodynamic Traps	**Hwk 7: Exploration game**	**Selley, Ch. 7**
9	***Grant Shimer—Sequence stratigraphyCase study***	**Hwk 6: Sequence stratigraphic**	

		interpretation of seismic data	
11	***Dr. Whalen—Carbonate reservoirs***		
16	**Salt-related structures**	**Hwk 8: Salt play on seismic**	
18	**Structural modifications of a reservoir:** Fractured reservoirs		
23	**Petroleum system analysis:** Timing of Trap Development Relative to Migration.	**Hwk 9: Petroleum Systems, Northern Alaska**	
25	***Midterm 2***		
30	**Petroleum systems & plate tectonic habitat** • Passive continental margins		**Selley, Ch. 8**
Nov 1	• Convergent margins • Strike-slip basins	**Hwk 10: Plate tectonic setting of modern day basins**	
6	**Unconventional hydrocarbon resources** • shale resource plays		
8	• Viscous oil • Gas hydrates • Coal bed methane		**Selley, Ch. 9**
13	**Petroleum Exploration process** • Defining plays and prospects • Reserve calculations • Creaming curves • What is the risk?	**Hwk 11: Simple reserve calculation**	**Ch. 10**
15	**Reservoir engineering:** • Turning a geologic model into a reservoir model		
20	• Simulating production—why and how		
22	***THANKSGIVING: NO CLASS***		
27	**Field development** • Drilling • Production methods • Production monitoring		**Selley, Ch. 6.8-6.9**
29	• **Graduate Student presentations**		
Dec. 4	***Midterm 3***		

Course Policies: Attendance at class is your responsibility. Students are responsible for making up any missed work. Students are encouraged to arrive to class on time. Make-up examinations will be held only under exceptional circumstances (e.g. illness, family crises, etc.). Medical documentation will be required to confirm illnesses. We follow the university guidelines for plagiarism/academic integrity as outlined in the current UAF catalog (p. 71-72).

Disability Services: The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. We will work with the Office of Disabilities Services (203 WHIT, 474-7043) to provide reasonable accommodation to students with disabilities.