

GEO391: Petroleum Basin Evaluation (3 credit hours)

Course for Spring 2013

Instructor: Dr. Chris Zahm, Bureau of Economic Geology, Jackson School of Geosciences

Course Description: This applied course is designed to introduce graduate and upper-level undergraduate students to the concepts of petroleum basin evaluation for hydrocarbon exploration. The course will broadly introduce students to the petroleum geosciences within the context of critical analysis of uncertainty, risk and economics. This course will use real technology on real datasets and provide relevant experience for students looking for a career in petroleum geosciences.

Active participation will be a requirement of each class period as students will be introduced to concepts in the first part of the lecture and will work exercises designed to solidify the conceptual aspects in the second portion of the class (essentially a laboratory portion). This course will have applications of 2D and 3D seismic interpretation, well logging and geochemistry incorporated into basin scale stratigraphy, structure and tectonics. As a final project, students will work in teams to complete a technical assessment of the prospectivity within a basin by defining the petroleum system and identifying the plays, prospects and leads, including risked EUR for each. Groups will make recommendations on the future exploration activity based on prevailing technical and economic conditions.

Expected Interest: The Jackson School of Geosciences is considered by most private and nationalized energy companies to be one of the premiere applied petroleum geology institutions in the world, yet no class is offered in the current JSG curriculum that teaches students to critically consider integrated geologic systems within an economic petroleum systems framework. This class is designed to teach meet this deficiency. Student enrollment will be limited to 15 maximum, 5 minimum. The ideal candidate is a second-year Master of Science student with industry internship experience.

Course Plan:

Seminar and Lectures (25% of grade)

Lecture on Fundamentals of the Petroleum System

Topical Student Lectures (sign up for topics the first week of class) – 20 min. presentations

Guest Lectures (industry-partners and JSG Staff)

Homework (15% of grade)

Four assigned homework exercises help to solidify the concepts we introduce in the class. All four are available from the Blackboard site and are due in class as per the syllabus.

Data Interpretation (35% of grade)

IBA Team

A dataset provided by the AAPG IBA committee will be the source for interpretation and development of a petroleum basin evaluation and development plan. The data will arrive on Feb. 12 and will be presented in Houston at the Schlumberger facility before a panel of 3-5 judges. In order to participate on the IBA team you will need to be available all day on April 11-12 and potentially May 18-20 if necessary.

Non-IBA Team

A dataset similar in scope to the IBA dataset will be the source for a petroleum basin evaluation and development plan. This will require the same level of commitment as the competing team and the quality is expected to be similar.

Presentation of Results (25% of grade)

Presentations by both the competing and non-competing teams will be in the style of the AAPG Imperial Barrel Rules—25 minutes in length, with 4-5 participants speaking in equal time duration. A panel of experts will judge the presentation and their scoring will be directly reflected in the grade given.

<u>Name</u>	<u>Topical Seminar Lectures</u>
	Sedimentary basin classification (Klemme, Bally, etc.)
	Basics of source rocks
	Description, construction, and usage of burial history plots
	Description and detection of overpressure in the subsurface
	Expulsion and secondary migration of hydrocarbon
	Top and lateral seal assessment
	Use of well logs for hydrocarbon detection
	AVO and other seismic analyses for hydrocarbon detection
	Mapping of the petroleum system: XOM method
	Reservoir presence and quality: porosity and permeability assessment
	Volumetric calculations for OOIP and GIP
	Principles of risk and uncertainty as applied to petroleum exploration
	Use of potential fields (e.g., gravity, magnetics for exploration)

Week	Topic
Jan. 14	Reading: Bjorlykke, Chpt. 1 & Source Rock Basics; Magoon and Dow, 1994; 2000
Jan. 18	Reading: Demaison and Moore, 1980; Homework Assignment 1 - Due in class Jan 28
Jan. 25	Reading: Mann et al. and North, 1985;
Jan. 28	Reading: Hunt, 1996, Chpt. 16; Homework Assignment 2 - Due in class Feb. 4
Feb. 1	
Feb. 4	Basics of well logs
Feb. 8	Reading: Allen and Allen, Chapter 10
Feb. 11	Reading: Allen and Allen, Chapter 10
Feb. 15	Reading: - Reserves Estimation and Basic Well Log (Bjorlykke) Homework Assignment 3 (See Blackboard Site) - Due in class on Feb. 24
Feb. 18	Homework Assignment 4 - Due in Class on Mar. 2
Feb. 22	Basics of Seismic Interpretation
Feb. 25	No class - work session
Mar. 1	No class - work session
Mar. 4	Risk and Uncertainty: Peter Rose, Chapter 1-5 Homework Assignment 4 - Due in Class on Mar. 8
Mar. 8	
Mar. 11-15	Spring Break
Mar. 18	
Mar. 22	In class presentations - Class Only
Mar. 25	
Mar. 29	In-class presentations of material to date
Apr. 1	
Apr. 5	IBA In class presentation - Mentors, Faculty and Reviewers
Apr. 8	
April 11-12	Regional IBA Competition in Houston, TX
April 19	Non-IBA Presentation
May 18-20	Global IBA Competition in Pittsburgh, PA
May 3	Term Paper Due (if necessary)
May 3	Take Home Final Exam (if necessary)

Logistics

- Classes taught in the BEG Auditorium (BEG 1.132) on the PRC campus. This course has datasets and seismic that are easily facilitated within the BEG classroom.
- Monday 9-11 am and Friday 8:30 – 10 am.
- Enrollment limited to 15 students;
- From our class, a group of 5 students will be selected to compete in the AAPG Imperial Barrel regional competition. These students will be required to prepare a concise written and oral summary of the petroleum potential of a basin assigned by the AAPG committee.
- Non-Imperial Barrel students will write a term paper and complete a take home final exam due the last day of classes (if necessary).

Grading

15% Homework Assignments
25% In-Class Presentation
60% Final Presentation

Non-IBA Team

30% Term Paper (if necessary)
30% Final Exam (if necessary)

Course References

- Allen, P.A., and J.R. Allen, 2005, *Basin Analysis: Principles and Applications*, 2nd ed., Blackwell Publishing.
- Beaumont, E.A., and N.H Foster, 1999, *Exploring for Oil and Gas Traps*, AAPG Treatise of Petroleum Geology.
- Bjorlykke, K, 2010, *Petroleum Geoscience: From Sedimentary Environments to Rock Physics*, Springer Publishing, 508 p.
- Hunt, J.M., 1996, *Petroleum Geochemistry and Geology*, 2nd Edition, Freeman and Co., 743 p.
- Magoon, L.B. and W.G. Dow, 1994, *The Petroleum System: AAPG Memoir 60*, p. 3-24.
- Morton-Thompson, D., and A.M. Woods, 1992, *Development Geology Reference Manual*, AAPG Methods in Exploration Series, No. 10
- Newendorp, P.D., 1975, *Decision Analysis for Petroleum Exploration*, Petroleum Publishing Co., Tulsa, OK, 677 pp.
- North, F.K., 1985, *Petroleum Geology*, Chapman & Hill Publishers, 631 pp.
- Rose, P.R., 2001, *Risk Analysis and Management of Petroleum Exploration Ventures*, AAPG Methods in Exploration Series No. 12
- Snedden, J.W., J.F. Sarg, and X. Ying, Handout, *Exploration Play Analysis from a Sequence Stratigraphic Perspective*, AAPG.