Western University - Department of Earth Sciences

ES3372B: Introduction to Petroleum Systems

Winter 2016

Course Information

Lectures: Tuesday & Thursday 8:30 – 9:20 (PAB 34)

Lab: Friday 10:30 – 1:30 (BGS 0184)

Pre-requisites: Earth Sciences 2260 A/B

Anti-requisite: Earth Sciences 4471 A/B

Statement on Requisites: Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Aims of the course:

At the end of the course, the student should be able to identify and describe the major components of ***petroleum systems***. The student should be able to assess how the sedimentary basin setting influences the physical and geochemical characteristics of source, reservoir and seal rocks. The student should be able to explain the roles of plate tectonics and related structural processes in the maturation and migration of hydrocarbons and the formation of structural traps. Finally, the student should be able to illustrate how petroleum system components interact to create petroleum ***plays*** and ***prospects***. Lectures, assigned readings from the required textbook and instructional slides will form the basis for achieving these learning objectives.
In order to attain these goals, students will receive feedback on their techniques through weekly labs. The labs will incorporate the use of geoSCOUT©, a standard industry software package, as well as other interactive exercises to explore and describe the basic characteristics of petroleum system components. In addition, students will be evaluated on a combination of lecture and lab material via short lab assignments, a mid-term assignment, and a final exam based on lecture and lab material.

Instructor Information

Instructor: Dr. Burns A. Cheadle, Associate Professor, Department of Earth Sciences

Email: bcheadle@uwo.ca **(Note: Please include 'ES 3372' in the subject line of all emails about this course)**

Office: Biological & Geological Sciences Building, Room 1078

Tel: (519) 661-2111 x89009

Office Hours: Monday 1:30 – 2:30, or by request (email bcheadle@uwo.ca)

Lecture Resources Website: https://owl.uwo.ca (log in with UWO username and password)

Note: PowerPoint presentations for each lecture will be posted no later than the evening before

the lecture, and will remain on the website for the rest of the term. Note, however, that **some material in the presentations will be deliberately left out**, requiring you to fill in important terms and other information critical to the topic. You will therefore be required to come to the lectures. It follows that the PowerPoint presentations posted on Web CT are not to be used as a substitute for coming to class (you have been warned). It is up to you to download the presentations when they are available and to obtain information from your classmates if you miss a class.

Course Syllabus

(Note: This is an outline of topics that will be covered, but we will adjust the emphasis on certain topics if the class has specific interests or requires more in-depth explanation. Consequently, lecture numbers may not necessarily correspond to a standard 50-minute lecture.)

Lecture	Lecture	Lab
1	Gas in the Tank • energy resources & society • petroleum geology as a profession • course outline & objectives	Lab 1 (8 Jan 2016) Orientation • oil and gas drilling operations • sources of petroleum geology data • introduction to geoSCOUT • survey systems and well identifiers • using the search tools
2	Ducks in a Row • introduction to petroleum systems • components of a petroleum system	
3	The Play's the Thing • uncertainty and risk • play maps and classification • prospects and plays	Lab 2 (15 Jan 2016) Working with Well Logs in geoSCOUT • types of well logs • twinGRAM basics • creating a frameWORK • working with raster log data
4	A Whole Lotta Shaking Going On • Basins and tectonic settings • Extensional Basins • Flexural Basins • Translational Basins	
5	Black Rain • production of sedimentary organic matter • preservation of organic matter • organic matter types & kerogen	Lab 3 (22 Jan 2016) Basic Well Log Interpretation • lithology responses • porosity responses • fluid responses • “quick-look” analysis
6	Dark, Cold and Stuffy • source rock characteristics • mudstone sedimentology • depositional settings of source rocks	
7	Cooking in the Kitchen • kerogen pyrolysis • source rock quality • primary migration	Lab 4 (29 Jan 2016) Well Log Stratigraphy - I • creating a frameWORK • creating a Cross Section • introduction to User Data • structural and stratigraphic datums
8	Hitting the Road • secondary migration • carrier bed characteristics • migration efficiency	
9	Storing up Treasure • fundamental reservoir attributes • storage capacity and porosity • flow capacity and permeability	Lab 5 (5 Feb 2016) Subsurface Mapping - I • data management • creating structural data • posting structural data
10	Rolling and Tumbling • fluvial depositional systems • meandering river deposits • braided river deposits	
11	A Day at the Beach • wave-dominated shorelines • barrier island deposits	Lab 6 (12 Feb 2016) Subsurface Mapping - II • contouring methods

Lecture	Lecture	Lab
12	Innies and Outies • wave-dominated estuaries • tide-dominated estuaries • deltas	• Surfer and geoSCOUT • isopach mappings
Reading Week Feb 15 – 19 2016		
13	Back to the Deep • slides and slumps • sediment gravity flows • deep marine depositional systems	Lab 7 (26 Feb 2016) Sandstone Reservoir Quality - I • gross vs. net sand determination • net porous sand thickness • porosity-thickness
14	Born to Run • the carbonate factory • platforms and ramps • fundamental autogenic controls	
15	Ramps, Rims and Reefs • ramp system deposits • rimmed shelves and reefs • carbonate bank facies	Lab 8 (4 Mar 2016) Sandstone Reservoir Quality - II • water saturation calculation • using cut-off criteria • hydrocarbon pore volume • permeability indicators
16	Bump and Grind • structural traps • fault-dependent closures • independent closures	
17	Pinched, Plugged, and Petered Out • stratigraphic traps • diagenetic traps • incisions and unconformities	Lab 9 (11 Mar 2016) Working with Pressure Data • sources of pressure data • basic DST interpretation • pressure gradient plots
18	Signed, Sealed, Delivered • seal properties • capillary pressure • hydrocarbon columns	
19	Bursting Bubbles • fluid properties • hydrocarbon phase behaviour • critical ratios	Lab 10 (18 Mar 2016) Working with Fluid Data • water analysis quality check • Rw determination • brine chemistry mapping
20	Pushing and Pulling • reservoir drive mechanisms • recovery factors • enhanced recovery techniques	
21	Money in the Bank • conventional oil case study • exploration and discovery • development and extension	Lab 11 (1 Apr 2016) Production and Reserves Analysis • working with production data • production scoping maps
22	Scraping the Barrel • unconventional oil plays • oil sands • oil shale	
23	The Waters and the Wild • unconventional gas plays • shale gas • coal bed methane • methane hydrate	
24	Through the Looking Glass • course summary	

Course Materials

Optional Text:	Bjørlykke, K., 2010. ***Petroleum Geoscience: From Sedimentary Environments to Rock Physics***. Springer. 508p. (note that this textbook is available through the Western Library system as a Springer e-book / Title: **Petroleum Geoscience [electronic resource] : From Sedimentary Environments to Rock Physics / by Knut Bjorlykke**)
Optional Text:	James, N.P. and Dalrymple, R.W. (editors), 2010. ***Facies Models 4***. GEOtext 6, Geological Association of Canada. 586 p. *(this is the required textbook for ES 4460 A/B, and an essential reference for aspiring petroleum geologists)*
Required Materials:	a set of coloured pencils, a straight edge / ruler, and a scientific calculator or notebook computer with spreadsheet software such as Microsoft Excel will be required for the labs

Methods of Evaluation

Labs (40% of total): *(all lab assignments due by the beginning of the following lab session)*

- *assignments will be graded individually and combined for total grade out of 40*

Lectures (60% of total):

- mid-term examination (20%): *take-home, short essay style and illustration format. The mid-term instructions will be provided at the end of the lecture on Wednesday Feb 10. The completed exam must be submitted to the student's Drop Box on the course OWL site no later than 5:00 p.m. on Friday Feb 12. The mid-term examination will evaluate understanding of both lecture and lab material.*
- final exam (40%): *during the scheduled exam period*
- use of electronic calculators is permitted during examinations, but all other electronic devices (phones, tablets, laptops) must be turned off for the duration of the examination period

*** due dates for assignments are firm - 10% per day will be deducted for late assignments. See note (4) under "University Policies" for exceptions due to illness or special circumstances.*

The Exceptional Contributor: "The Class Was Better Because You Were Here."

As part of the learning process I expect all students to participate actively in class. Here are some guidelines to keep in mind when in class:

- You provide clear, concise, and correct explanations that help others gain a better understanding of concepts.
- You make outstanding, original, and informative comments.
- You make highly attentive and constructive comments on other people's statements.
- You ask questions that are penetrating or help clarify.
- You raise your hand strategically (understanding that there are other students in the class).
- You actively encourage others to express their ideas.
- You display body language that communicates interest in what others are saying.
- You arrive to class on time and are not absent without reason.

University Policies:

1) Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: *http://www.uwo.ca/univsec/handbook/appeals/scholoff.pdf*

2) Unless you have either the requisites for this course or written special permission from your Academic Counselling Unit to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

3) All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

4) If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Academic Counselling Unit as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Academic Counselling Unit immediately. For further information please see: http://www.uwo.ca/univsec/handbook/appeals/medical.pdf
A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Academic Counselling Unit) for visits to Student Health Services. The form can be found here: https://studentservices.uwo.ca/secure/medical_document.pdf

Accessibility Statement:

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x.82147 for any specific question regarding an accommodation.