Advances in Unconventional Shale Gas Resources
GEO371C

Fall 2011(3hr a week)

Class location: VR room, Bureau of Economic Geology (Bldg 130) at the JJ Pickle Research Center

Class meeting times: Monday 8:00-9:30 am and 9:30-11:00 am

Instructor: Dr. Farzam Javadpour

farzam.javadpour@beg.utexas.edu

Office hours: Monday 11:00am-12:00noon or by appointment.

Course Description

Gas-bearing shale strata, important energy supplies in North America, are projected to become important as well in Europe, Latin America, and Asia in the near future. Gas and oil production from these fine grained reservoirs is technically challenging, however production is much higher than predictions based on conventional models (Darcy's equation). Because of this abnormal behavior, these types of gas reservoirs are categorized as "unconventional", and recently became the focal interest of oil companies and researchers. An understanding of these natural, fine-grained, porous systems is necessary in making capital investments, as well as in making field-development decisions by governments and major oil companies.

This course presents a wide spectrum of subjects related to shale gas and mudrocks, and the major differences between "conventional" and "unconventional" reservoirs will be covered. The course is suitable for students in both geosciences and petroleum engineering programs. Graduate students and senior undergraduate students alike can learn and develop a useful knowledge base from this course on cutting-edge subjects dealing with mudrock/shale gas.

Course Objectives

1. Introduction of unconventional terminology and worldwide industry activities.
2. Explanation of the differences and issues in dealing with fluid, rock, and rock-fluid characteristics in mudrock/shale gas resources.
3. Introduction of the gas desorption and geochemistry of shale strata.
4. Discussion of permeability measurements and formation evaluation techniques for shales.
5. Introduction of mudrock/shale gas facies interpretation.
6. Discussion of natural fractures (micro- and macro-) in shale strata.
7. Detailed explanation of non-Darcy fluid flow in nanopores of mudrock/shale.
8. Introduction of hydraulic fracturing and reservoir engineering aspects of shale-gas strata.
9. Hands-on experience with Atomic Force Microscopy to study nanopores in shale samples.

Final Grade Determination

1. Assignments (25%): A total of five assignments will be given to students, which will be due within a week after distribution.
2. Midterm examination (35%): Open book and open note. Tentative schedule 11/14/2011.
3. Term project report (30%) and presentation (10%): The term project is a thorough literature review of 3 to 5 peer-reviewed publications related to mudrock/shale-gas topics chosen by the student. The deadline for the term-project report submission is 12/02/2011.

Tentative Course Schedule: This syllabus represents my current plans and objectives. As we go through the semester, those plans may need to change to enhance the class learning opportunity. Such changes, communicated clearly, are not unusual and should be expected.

Class meeting	Topics (90 min lectures) Invited speakers: Dr. Julia Gale; Dr. Tongwei Zhang
08/29	Course overview, introduction, and technical background
08/29	Introduction to shale gas, coal bed methane, tight gas, and gas hydrate
09/05	Labor day, Holiday
09/12	Comparison of conventional and unconventional reservoir characteristics
09/12	Fluid properties of shale system [HW# 1]
09/19	Rock properties of shale system
09/19	Capillary pressure and pore size distribution, [Students' term project proposals]
09/26	Pores and pore imaging, SEM and AFM basics,
09/26	Mudrock facies interpretation (thin-section and core examinations), Correlation of mudrocks, Introduction of mudrocks/shale gas facies interpretation.
10/03	Details of resistivity, acoustic, and neutron logs
10/03	Determination of the Total Organic Contents (TOC) from logs
10/10	Geochemistry of shales and gas reserve assessment, Gas generation kinetics and determination of gas maturity and aging
10/10	Gas adsorption and gas storage components in shale [HW# 2]
10/17	Fluid flow fundamentals
10/17	Gas transport in nanoppores of shale systems [MW# 3]
10/24	Permeability measurements of the shale gas samples
10/24	Pulsed decay permeability analysis [HW# 4]
10/31	Natural fractures fundamentals
10/31	Natural fractures in shales [HW# 5]
11/07	Well completion and hydraulic fracturing in shale gas
11/07	Material balance and reservoir engineering of shale gas strata
11/14	*Midterm examination*
11/14	*Midterm examination*
11/21	Lab: Hands on experience with SEM to detect nanopores
11/21	Lab: Hands on experience with AFM to detect nanopores and measure interactive forces
11/28	Students' term project presentations
11/28	Students' term project presentations
12/02	Term project submission deadline

Regular class attendance is recommended.

Textbook: Instructor's course notes.

Recommended Readings:

1. SPE Reprint Series No. 55: Shaly Sand Analysis
2. Tissot and Welte, 1978, Petroleum formation and occurrence, Springer-Verlag.

Students with disabilities: Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Please contact Services for Students with Disabilities, 471-6259, http://www.utexas.edu/diversity/ddce/ssd/

Academic dishonesty: Please read the University Honor Code at the link below: http://registrar.utexas.edu/catalogs/gi09-10/ch01/index.html)

Accommodations for religious holidays: By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.