GEOL580: Seismic Interpretation & 3D Visualization

Fall 2016
Sched# 21741

COURSE INFORMATION

Class Day and Time: T 3-5:40
Lab Day and Time: Th 3-5:40
Class Location: CSL-425
Lab Location: CSL-427
Instructor: Jillian Maloney, Dept. Geological Sciences
Office Hours (and by appointment): T 1-2, W 11-12
Office Hours Location: GMCS-117
Contact: jmaloney@mail.sdsu.edu, 619-594-6394

Course Overview

Computer-based seismic interpretation, mapping, and modeling in both 2D and 3D. Overview of basic seismic processing. Emphasis on industrial applications, both petroleum and shallow geotechnical.

This course will cover the basics of seismic reflection data acquisition and processing with a more in depth focus on data interpretation. Students will learn the main principals of sequence and seismic stratigraphy and will gain hands on experience working with seismic reflection data.

Prerequisites: Geological Sciences 306

Broader Context

This class is for graduate students and upper-level undergraduates in the Geological Sciences major and builds upon the goals and skills gained from lower-division preparatory and Major courses.

Geological sciences is the study of the earth, its past, present, and future. Geoscientists apply basic physical, chemical, and biological principles to understand how the earth was formed, how it evolved, and how it may change in the future. In addition to understanding the origin and evolution of our planet, geologists seek to discover, use, and manage earth’s resources in clean and environmentally responsible ways, and manage our water resources in a renewable way.

Most of the rocks and sediments in the earth’s crust are not accessible at the surface of the earth and cannot be studied through classical mapping or outcrop studies. Seismic reflection provides a tool for geoscientists to study structures and stratigraphic relationships of buried and submerged geologic units. The study of seismic stratigraphy is important because:

1. Most of the world’s petroleum and natural gas is contained in buried geologic units
2. Earth’s groundwater is found in beneath the earth’s surface
3. On continental margins, submerged stratigraphy can help to reconstruct the Earth’s sea level cycles
4. The data can be used to identify submerged or buried archaeological sites
5. The data can be used to assess geohazards

Course Materials

There is not a required text book for this class. Required class readings, notes, and activities will be posted on the Blackboard (blackboard.sdsu.edu) for this class.

These are some other suggested text that you may want to use for reference:
Kearey, Brooks, & Hill, An Introduction to Geophysical Exploration (2002), Blackwell Publishing
Veeken, Seismic Stratigraphy, Basin Analysis and Reservoir Characterisation, Handbook of Geophys. Exploration, V 37, Elsevier
Yilmaz, Seismic Data Analysis (2001), SEG
Learning Outcomes

There are several course specific learning expectations for students that will guide the course content. I have divided the learning outcomes into overarching goals that we will build on throughout the semester and ancillary skills goals that we will accomplish through activities and assignments.

Overarching goals:

1. Given a seismic stratigraphic dataset, interpret the region’s geologic history and its evolution through space and time (relative importance of sediment supply, subsidence, and/or base level in creating the sequence).
2. Given a tectonic setting, predict what types of sedimentary processes and depositional environments would result and what their stratigraphic signature would be.

Ancillary skills goals:

1. Identify faults, horizons, truncation surfaces, and stratal geometries in seismic sections.
2. Use seismic interpretation software (Kingdom Suite) to map faults, stratigraphic horizons, measure thicknesses, and correlate wells.
3. Identify common data artifacts
4. Explain the limitations of seismic data for geologic interpretation
5. Determine data resolution
6. Communicate, orally and in writing, your interpretations of a seismic dataset and defend your interpretation using data.

Prior Background

Based on your previous coursework, I will assume that you know the following:

1. The three main types of plate margins and, within this, the three types of convergent margins. You should be able to draw a reasonable cross section through these margin types and have a pretty good idea of the rock types that form in them.
2. You should know the major principles of stratigraphy.
3. You should be able to identify the different types of unconformities.
4. You should be able to identify major geologic structures including faults (reverse, normal, strike-slip), anticlines, synclines, horsts, grabens, monoclines.
5. You should know what is meant by ‘strike and dip.’
6. Given a reasonably simple geological map, you should be able to outline a geological history of the mapped region.
7. You should have an understanding of geometric and trigonometric functions, and differential calculus.

If you are unfamiliar with these concepts, please refresh your understanding prior to the start of this class.

Course Assessment and Grading

The course assignments are designed to assess your mastery of the learning outcomes listed in this syllabus. Due dates can be found in the course schedule in this syllabus and will be posted on Blackboard.

Midterms (2) – 15% each

The midterms will be take-home exams based on lecture/lab material and assigned readings. They will assess your mastery of the learning outcomes listed in the syllabus.

Labs (6) – 30%

Lab reports will be based on activities conducted in class or lab period.

Project – 40%

The project will focus on interpretation of a seismic dataset. Projects will be presented at the end of the semester. Additional details will be provided early in the semester.

Students with Disabilities

If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that accommodations
based upon disability cannot be provided until you have presented your instructor with an accommodation letter from Student Disability Services. Your cooperation is appreciated.

**Academic Honesty**

The University adheres to a strict policy regarding cheating and plagiarism. These activities will not be tolerated in this class. Become familiar with the policy [here](http://www.sa.sdsu.edu/srr/conduct1.html). Any cheating or plagiarism may result in failing this class and a disciplinary review by Student Affairs.

Examples of Plagiarism include but are not limited to:

- Using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work)
- Copying and pasting work from an online or offline source directly and calling it your own
- Using information you find from an online or offline source without giving the author credit
- Replacing words or phrases from another source and inserting your own words or phrases
- Submitting a piece of work you did for one class to another class

If you have questions on what is plagiarism, please consult the policy [here](http://www.sa.sdsu.edu/srr/conduct1.html) and this helpful guide from the Library: [here](http://infodome.sdsu.edu/infolit/exploratorium/Standard_5/plagiarism.pdf)

**Turnitin**

Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. You may submit your papers in such a way that no identifying information about you is included. Another option is that you may request, in writing, that your papers not be submitted to Turnitin.com. However, if you choose this option you will be required to provide documentation to substantiate that the papers are your original work and do not include any plagiarized material.

**Course Schedule**

**Table 1: Lecture Topics Outline**

<table>
<thead>
<tr>
<th>Week:</th>
<th>Class: Tuesday 3-5:40</th>
<th>Lab: Thursday 3-5:40</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aug 30 &amp; Sep 1</td>
<td>1. Introduction</td>
<td>Lab 1: Signals</td>
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</tr>
<tr>
<td>2. Sep 6 &amp; 8</td>
<td>2. Acquisition</td>
<td>Kingdom Introduction</td>
<td>Due: Lab 1 by Thurs. end of lab</td>
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<tr>
<td>3. Sep 13 &amp; 15</td>
<td>No Class: SCEC</td>
<td>Lab 2: Kingdom</td>
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<tr>
<td>4. Sep 20 &amp; 22</td>
<td>2. Acquisition: The seismic pulse</td>
<td>Lab 3: Kingdom</td>
<td>Due: Lab 2 by Thurs. end of lab</td>
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| 5. Sep 27 & 29 | 3. Processing | Lab 4: Kingdom | Due: Lab 3 by Thurs. end of lab  
Due: Midterm 1 by Sept. 30 11:59pm |
<p>| 6. Oct 4 &amp; 6 | 3. Processing | Lab 5: Kingdom | Due: Lab 4 by Thurs. end of lab |
| 7. Oct 11 &amp; 13 | 4. Interpretation | Lab 6: Sequence Stratigraphy | Due: Lab 5 by Thurs. end of lab |
| 8. Oct 18 &amp; 20 | 4. Interpretation | Project | Due: Lab 6 by Thurs. end of lab |
| 10. Nov 1 &amp; 3 | 4. Interpretation | Shannon Klotsko guest lecture | Due: Midterm 2 by Nov. 4 11:59pm |</p>
<table>
<thead>
<tr>
<th>Week</th>
<th>Class: Tuesday 3:5-40</th>
<th>Lab: Thursday 3:5-40</th>
<th>Assignments</th>
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</thead>
<tbody>
<tr>
<td>11. Nov 8 &amp; 10</td>
<td>4. Interpretation</td>
<td>Project</td>
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<tr>
<td>12. Nov 15 &amp; 17</td>
<td>4. Interpretation</td>
<td>Project</td>
<td></td>
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<tr>
<td>14. Nov 29 &amp; Dec 1</td>
<td>4. Interpretation</td>
<td>Project</td>
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<tr>
<td>15. Dec 6 &amp; 8</td>
<td>Class Presentations</td>
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<td>Due: Project database &amp; presentations</td>
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<td>Dec 12-16</td>
<td>Final Exam Week</td>
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**Disclaimer**

I reserve the right to change parts of this syllabus throughout the semester. I will notify the class during lecture and on Blackboard of any updates.