University of Alberta

EAS 462/562: Stratigraphy and Sedimentary Basins
Section A1
Fall Term, 2012

Instructor: Dr. Octavian Catuneanu, Professor EAS
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Office Hours: available at any time without appointment. Alternatively, contact instructor for appointment, or address questions by e-mail.
Lecture Room: ESB 1-31, MWF 13:00-13:50

Course Description:
The science of rock strata in a sequence stratigraphic framework; sequence stratigraphic models; classification and evolution of sedimentary basins; applications of sequence stratigraphy to depositional systems and tectonic settings.

EAS 462. Prerequisite: EAS 336. Not available to students with credit in EAS 330.

EAS 562. Prerequisite: N/A. Not available to students with credit in EAS 330 or 462.

Required Textbook (available at the UofA Bookstore, or online):
http://www.elsevier.com/wps/find/bookdescription.cws_home/707658/description#description

Recommended Textbooks:

Course Objectives:
This course prepares the students with the skills to apply the method of sequence stratigraphy for petroleum, coal and mineral exploration and production. All concepts are illustrated with field examples of seismic, well-log, core, and outcrop data. In-class exercises emphasize the recognition of sequence stratigraphic surfaces and systems tracts on well-log cross-sections, seismic lines, and outcrop profiles. The points of agreement and difference between the various sequence stratigraphic approaches are discussed, and guidelines are provided for a standard process-based workflow of sequence stratigraphic analysis. This enables the practitioner to eliminate nomenclatural and methodological confusions, and apply sequence stratigraphy effectively for facies predictions in exploration and production.

Lecture Schedule:
- Basin analysis: definition
- Criteria for the classification of sedimentary basins
- Classification of sedimentary basins
- Inversion tectonics
- Examples of sedimentary basins on industry data
- Historical development of sequence stratigraphy
- Methods and workflow of sequence stratigraphic analysis
- Fundamental concepts of sequence stratigraphy
- Sequence stratigraphic surfaces
- Systems tracts
- Sequences and sequence models
- Time attributes of stratigraphic surfaces
- Hierarchy of sequences and sequence boundaries
- Applications to all depositional systems

Theory sections are followed by in-class exercises presented by the instructor to illustrate the concepts.

**Grade Evaluation:**
This course will be graded on the basis of three assignments: a Lab Project, a Term Assignment, and a Final Assignment. All assignments will be given a numerical score. A cumulative course mark will be calculated from those scores, weighted as tabulated below.

Marks of the Lab Project, the Term Assignment, and the Final Assignment will reflect the absolute level of performance of each student, as well as the performance relative to other students in the class.

Marks will be translated into letter grades following the University curve for 400- and 500-level courses. Grading will make use of natural breaks in the distribution of marks to define grade boundaries, and will result in a mean final grade for the course that is reasonably close to the historical means of the University for 400- and 500-level courses.

<table>
<thead>
<tr>
<th>EVALUATION</th>
<th>WEIGHTING</th>
<th>DEADLINE</th>
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<tbody>
<tr>
<td>Lab Project</td>
<td>30%</td>
<td>21 November</td>
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<tr>
<td>Term Assignment</td>
<td>30%</td>
<td>24 October</td>
</tr>
<tr>
<td>Final Assignment</td>
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<td>5 December</td>
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Grades are unofficial until approved by the Department and/or Faculty offering the course.

**Format of Assignments:**
All assignments involve independent research and a standard format as outlined below.

**Lab Project:** 30% of final mark (3 hours per week are credited towards this project)
- Topic: a case study of sequence stratigraphic interpretation
- Approach:
  - choose *one case study*, based on published outcrop, well-log or seismic data. Common sources of data include: research articles in journal or books; AccuMap well-log data base; atlases of seismic lines; the Geological Atlas of the Western Canada Sedimentary Basin: [http://www.ags.gov.ab.ca/publications/ATLAS_WWW/ATLAS.shtml](http://www.ags.gov.ab.ca/publications/ATLAS_WWW/ATLAS.shtml)
  - two or more students cannot select the same case study
- Structure: your Lab Project should include 4 sections
  1. Introduction:
     - Slide 1: title of project; source of information (i.e., cite the reference where the data come from); indicate the depositional and tectonic settings;
     - Slide 2: present the study area (i.e., location map);
     - Slide 3: present the stratigraphic objective (name and age of the unit under analysis, and adjacent units: i.e., stratigraphic chart).
  2. Presentation of data:
     - Slide 4: indicate the type of data available (e.g., sedimentologic, biostratigraphic, geophysical, etc.), and the evidence for the depositional system(s) in your case study;
- Slide 5: present the uninterpreted data (one cross-section, if you use outcrop or well-log data, or one seismic line, if you use seismic data). Indicate the location of your cross-section or seismic line on the location map. Choose the horizontal and vertical scales such that the details on your cross-section or seismic line are visible on a tabloid-size (11 x 17 inches) paper; indicate the depositional system(s) on your cross-section or seismic line.

3. Sequence stratigraphic interpretation:
- Slide 6: mark sequence stratigraphic surfaces on your cross-section or seismic line. Your interpretation may or may not agree with previously published interpretations. You must be comfortable with your interpretation and able to defend it.

4. Discussion (Slide 7): discuss the potential pitfalls of your interpretation, and the feasibility of alternative interpretations.

• Submit: one PPT file (include a figure caption in the footnote of each slide; every piece of information that is not your original work must be credited to the original source).
• Deadline: 21 November 2012 (two weeks before the last day of classes).

NB: If time permits, you may be asked to make a 15-minute oral presentation of your Lab Project anytime after the deadline, during the last two weeks of classes.

**Term Assignment:** 30% of final mark
• Topic: presentation of a tectonic setting
• Approach:
  - select one tectonic setting from the list below
  - if two or more students have selected the same tectonic setting, the case studies must be different
• Structure: your Term Assignment should include 3 sections
  1. Introduction:
     - Slide 1: title; definition of the type of sedimentary basin that you have selected;
     - Slide 2: main characteristics of that particular tectonic setting: physiography, scale, underlying crust, subsidence mechanisms, depositional systems and sources of sediment supply.
  2. Case study: present one case study that illustrates stratigraphic cyclicity in that tectonic setting.
     - Slide 3: location map (indicate study area);
     - Slide 4: stratigraphic chart (indicate stratigraphic objective);
     - Slide 5: one cross-section (if you use outcrop or well-log data) or one seismic line; indicate the depositional system(s) on your cross-section or seismic line; indicate stratigraphic cyclicity on your cross-section or seismic line (NB: no sequence stratigraphic interpretation is expected);
  3. Discussion (Slide 6): discuss the controls on stratigraphic cyclicity in that particular tectonic setting (i.e., the cycle-forming mechanisms); indicate the temporal scale(s) of the observed cycles.

• Submit: one PPT file (include a figure caption in the footnote of each slide; every piece of information that is not your original work must be credited to the original source).
• Deadline: 24 October 2012 (six weeks before the last day of classes).

NB: the case study selected for the Term Assignment must be different from the case study selected for the Lab Project.

**Final Assignment:** 40% of final mark
• Topic: application of sequence stratigraphy to a tectonic setting
• Approach:
  - select one tectonic setting from the list below (same as the one selected for the Term Assignment)
- select two case studies from published work (including the one selected for the Term Assignment)
- if two or more students have selected the same tectonic setting, the case studies must be different

• Structure: your Final Assignment should include 4 sections

1. Introduction:
- Slide 1: title (e.g., "Application of sequence stratigraphy to rift basins: Case studies A and B"); sources of information (i.e., cite the references where the data for case studies A and B come from); indicate the depositional and tectonic settings for case studies A and B.

2. Case study A:
- Slide 2: location map (indicate study area);
- Slide 3: stratigraphic chart (indicate stratigraphic objective);
- Slide 4: one cross-section (if you use outcrop or well-log data) or one seismic line; indicate the depositional system(s) on your cross-section or seismic line;
- Slide 5: mark sequence stratigraphic surfaces, systems tracts and sequences on your cross-section or seismic line. Your interpretation may or may not agree with previously published interpretations.

3. Case study B:
- Slide 6: location map (indicate study area);
- Slide 7: stratigraphic chart (indicate stratigraphic objective);
- Slide 8: one cross-section (if you use outcrop or well-log data) or one seismic line; indicate the depositional system(s) on your cross-section or seismic line;
- Slide 9: mark sequence stratigraphic surfaces, systems tracts and sequences on your cross-section or seismic line. Your interpretation may or may not agree with previously published interpretations.

4. Discussion (Slide 10): pinpoint the differences and similarities between the two case studies; if you observe common patterns, define a model that captures the typical “signature” of that particular tectonic setting (e.g., typical geometries, relative development of systems tracts, etc.).

• Submit: one PPT file (include a figure caption in the footnote of each slide; every piece of information that is not your original work must be credited to the original source).
• Deadline: 5 December 2012 (last day of classes).

NB: the case studies selected for the Final Assignment must be different from the case study selected for the Lab Project.

**Tectonic Settings:**
1. Intracratonic sag basins
2. Grabens
3. Rift basins
4. Divergent continental margins: continental shelves
5. Divergent continental margins: continental slopes
6. Divergent continental margins: basin floors
7. Convergent margins: deep-sea trenches and accretionary prisms
8. Convergent margins: forearc basins
9. Convergent margins: backarc basins
10. Convergent margins: interarc basins
11. Convergent margins: intra-arc basins
12. Convergent margins: retroarc forelands
13. Convergent margins: proarc forelands
14. Convergent margins: intramontane basins
15. Transform margins: strike-slip basins
Missed Deadlines:  
A penalty of 5% per day late will apply to missed deadlines, unless compelling reasons are presented in writing. Misrepresentation of Facts to gain a deadline extension is a serious breach of the Code of Student Behaviour.

Representative Evaluative Material:  
Examples of case studies that are representative of the work that is required to complete the class assignments will be presented in class by instructor at the end of each theory section.

Student Responsibilities:  
ACADEMIC INTEGRITY: "The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at http://www.governance.ualberta.ca/en/CodesofConductandResidenceCommunityStandards/CodeofStudentBehaviour.aspx) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University."

All forms of dishonesty are unacceptable at the University. Any offence will be reported to the Senior Associate Dean of Science who will determine the disciplinary action to be taken. Cheating, plagiarism and misrepresentation of facts are serious offences. Anyone who engages in these practices will receive at minimum a grade of zero for the exam or paper in question and no opportunity will be given to replace the grade or redistribute the weights. As well, in the Faculty of Science the sanction for cheating on any examination will include a disciplinary failing grade (no exceptions) and senior students should expect a period of suspension or expulsion from the University of Alberta.

CELL PHONES: Cell phones are to be turned off during lectures.

STUDENTS WITH DISABILITIES: Students who require accommodation in this course due to a disability are advised to discuss their needs with Specialized Support & Disability Services (2-800 Students’ Union Building).

ACADEMIC SUPPORT CENTRE: Students who require additional help in developing strategies for better time management or study skills should contact the Student Success Centre (2-300 Students’ Union Building).

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced in class.

Note: Recording is permitted only with the prior written consent of the professor or if recording is part of an approved accommodation plan.