EAS 465/565 – 2010, Winter Term (3-0-0):

Clastic Sedimentology

Instructor: Dr. Octavian Catuneanu
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Office hours: contact instructor for appointment.

Lecture room and time: Tory Building, T 3-58; Mon, Wed, Fri: 11:00 – 11:50

Course description:

The science of sedimentary rocks, focusing on the interpretation of sedimentary strata; advanced treatment of facies characteristics and interpretation; processes of facies formation, and facies model concepts; applications of process sedimentology to siliciclastic successions, from nonmarine to coastal and marine environments.

Prerequisite: EAS 336 [Faculty of Science]

Required textbook (provided by instructor):

Posamentier, H.W. and Walker, R.G., 2006. *Facies Models Revisited*. SEPM, 527 pp.

Recommended textbooks:

Reading, H.G. (Ed.), 1996. *Sedimentary Environments: Processes, Facies and Stratigraphy*. Third edition, Blackwell Scientific Publications, Oxford, 688 pp.

Collinson, J.D. and Thompson, D.B., 1989. *Sedimentary Structures*. Second edition, Unwin Hyman Ltd., 207 pp.

Course objectives:

This course presents the processes and products involved in the formation of depositional systems, from the scale of individual grains to the larger scale of facies and facies associations. Depositional-system associations are also discussed to provide an understanding to the predictable distribution of depositional elements across a sedimentary basin. The course applies to various industries, including petroleum-field development (sub-depositional system scale), petroleum exploration (depositional system and depositional-system association scales), and mineral resources.

Course attendees will learn the method of facies analysis, which is the foundation for the interpretation of depositional systems from well-log, core, outcrop and seismic data sets. The concepts of seismic geomorphology and seismic sedimentology are integrated with the classic rock-based methods of facies analysis to provide the full spectrum of methodologies used in modern exploration and production. In-

class exercises emphasize the use of various types of data for the development of facies models and paleogeographic maps. This process-based approach to the understanding of sedimentary systems enables the practitioner to generate accurate models that describe the origins, internal architecture and relationships of mineral placers, petroleum reservoirs, source rocks and seal facies.

Lecture schedule:

- Sedimentary textures
- Flow regimes and sedimentary structures
- The method of facies analysis
- Facies models for eolian systems
- Facies models for fluvial systems
- Facies models for coastal systems: estuaries, deltas, open shorelines
- Facies models for shallow-water clastic systems
- Facies models for deep-water clastic systems

Readings will be assigned from the required textbook.

Course evaluation:

1. Term Assignment #1: 30% of final mark.

• Topic: exercise of interpretation of facies and paleogeography
• Approach:
  - independent research
  - choose *one case study*, based on published outcrop, core or well-log data [NB: common sources of information include: research articles published in journal or books; AccuMap well-log data base; the Geological Atlas of the Western Canada Sedimentary Basin: http://www.ags.gov.ab.ca/publications/ATLAS_WWW/ATLAS.shtml]
• Structure: your Term Assignment #1 should include 4 sections
  1. Introduction: indicate the source of information (i.e., cite the reference where the data come from); present the study area (show a map); present the stratigraphic objective (age of the unit under analysis; show a stratigraphic chart).
  2. Presentation of uninterpreted data: define the type of data available (e.g., sedimentologic, biostratigraphic, geophysical, etc.); present the uninterpreted data (e.g., outcrop sections, cores or well logs). Indicate the location of your data on the map of the study area. The horizontal and vertical scales may vary with the type of data that you are using. A good scale is one that permits a good visualization of the data on a tabloid-size (11 x 17 inches) paper.
  3. Presentation of interpreted data: interpret the facies and depositional systems that are present within your data set; based on your interpretations, present a paleogeographic map of your study area. Your interpretation may or may not agree with previously published interpretations. You must be comfortable with your interpretation and be able to defend it.
  4. Discussion: explain why your interpretation provides the best fit for the data; discuss the potential pitfalls of your interpretation.

NB: at least one example of such exercise will be presented in class by instructor.

• 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). There is no limit to the number of slides which you can include in your PPT file.
• Deadline: 19 February 2010 (end of Reading Week).

NB: if time permits (depending on enrollment figures), you may be asked to make a 15-minute oral presentation of this assignment anytime after the Reading Week.

2. Term Assignment #2: 30% of final mark.

• Topic: depositional systems (1)
• Purpose: to prepare you for the Final Essay (see below)
• Approach:
  - choose *one depositional system* from the list below
  - in case two or more students have selected the same depositional system, the examples must be different
• Structure: your Term Assignment #2 should include 4 sections
  1. Introduction: definition of that particular depositional system; subenvironments.
  2. Modern analogues: photos of modern examples (e.g., Google Earth; satellite images; aerial photographs).
  3. Sedimentary textures: which once are typical (diagnostic) of that depositional system, which ones are common among different depositional systems. Illustrate with SEM, thin sections, core or outcrop photographs.
  4. Sedimentary structures: photographs from modern environments and rock record. Indicate which once are typical (diagnostic) of that depositional system and which ones are common among different depositional systems (i.e., non-diagnostic).

• 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). There is no limit to the number of slides which you can include in your PPT file.
• Deadline: 19 March 2010 (one month after the previous deadline).

NB: if time permits (depending on enrollment figures), you may be asked to make a 15-minute oral presentation of this assignment anytime after the deadline.

3. Final Assignment: 40% of final mark.

• Topic: depositional systems (2)
• Approach:
  - choose *one depositional system* from the list below (same as the one selected for Term Assignment #2)
  - in case two or more students have selected the same depositional system, the examples and case studies must be different
• Structure: your Final Assignment should include 5 sections
  1. Introduction: definition of that particular depositional system; subenvironments; mechanisms of

sediment transport.
2. Modern analogues: photos of modern examples (e.g., Google Earth; satellite images; aerial photographs).
3. Sedimentary textures: which once are typical (diagnostic) of that depositional system, which ones are common among different depositional systems. Illustrate with SEM, thin sections, core or outcrop photographs.
4. Sedimentary structures: photographs from modern environments and rock record. Indicate which once are typical (diagnostic) of that depositional system and which ones are common among different depositional systems (i.e., non-diagnostic).
5. Case study: present *one case study* to illustrate the interpretation of that particular depositional system in the rock record. The presentation of the case study should follow the structure of Term Assignment #1.

NB: some sections of your Final Assignment coincide with sections of Term Assignment #2; this is a chance to improve on your earlier work.

• 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). There is no limit to the number of slides which you can include in your PPT file.
• Deadline: 29 April 2010 (last day of examinations).

Depositional systems:

1. Alluvial fans, colluvial fans and fan deltas
2. Meandering fluvial systems
3. Braided fluvial systems
4. Anastomosed fluvial systems
5. Single-straight fluvial channel systems
6. Lacustrine systems
7. Aeolian systems
8. Wave-dominated estuarine systems
9. Tide-dominated estuarine systems
10. Wave-dominated deltaic systems
11. Tide-dominated deltaic systems
12. River-dominated deltaic systems
13. Beaches, coastal plains, tidal flats
14. Shallow-water systems: shoreface
15. Shallow-water systems: inner and outer shelf
16. Deep-water systems: contourites
17. Deep-water systems: mudflows
18. Deep-water systems: turbidites
19. Deep-water systems: grainflows
20. Deep-water systems: slides and slumps

Teaching assistant:

Ryan King <mrking@ualberta.ca>, Tory 3-9.

University regulations:

DEFERRED exam policy:

These are NOT automatically granted and documentation is required for those applying for or requesting a deferral. Students who are granted deferral for the mid-term exam (if applicable) or term work will have that percentage transferred to the final exam (or final essay, as applicable). Students granted a deferred final exam (or final essay, as applicable) must make arrangements with the instructor. You must apply to your department for deferred final exams (or final essays, as applicable).

Deferral of term work is a privilege and not a right. There is no guarantee that a deferral will be granted. Misrepresentation of Facts to gain a deferral is a serious breach of the Code of Student Behaviour.

RECORDING of lectures:

Recording is permitted only with the prior written consent of the professor or if recording is part of an approved accommodation plan. This is at the instructor's discretion.

If an instructor grants permission, the default should be that the recording is solely for the personal use of the student. If a lecture is to be recorded, the instructor must notify the class that this is taking place. If the recorded lecture is intended for the usage beyond individual study, the person making the recording needs to obtain the permission of all other individuals that appear in the recording. This should be verified beforehand by enquiring with the University's Information and Privacy Office.

SPECIALIZED SUPPORT AND DISABILITY SERVICES:

Students who require accommodations in this course due to a disability affecting motion, vision, hearing, learning, or mental or physical health are advised to discuss their needs with Specialized Support and Disability Services, 2-800 Students' Union Building, 492-3381 (phone) or 492-7269 (TTY). Please ensure that the required forms for exams are submitted to the instructor several days before the date of the midterms or final (where applicable).

GFC POLICY ON COURSE OUTLINES:

Policy about course outlines can be found in Section 23.4(2) of the University Calendar.

ACADEMIC STANDARDS:

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 www.ualberta.ca/secretariat/appeals.htm) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offense. Academic dishonesty is a serious offense and can result in suspension or expulsion from the University.

A copy of the 'Don't Cheatsheet' is available online at www.uofaweb.ualberta.ca/secretariat/