

Stratigraphy & Basin Analysis, EARTH 467 (4 credits) – Winter 2019

Principles underlying correlation, sedimentation, and paleogeographic interpretation. Regional stratigraphy and sedimentary tectonics

Instructor: Dr. Naomi Levin, nelevin@umich.edu, 2006 CCL
Office hour: Mondays 2:30-3:30pm or by appointment. Email to set up a time. You can also just stop by my office. If the door is open it means that it's usually a good time to meet.

GSI: Nikolas Midttun
Office hour: TBD

Lecture: M, W 10:00–11:20am

Lab: Tu 3:00–6:00pm

Learning Objectives – students will be able to

- Read the stratigraphic record and use it to understand the history of sedimentation, climate, tectonics and life on Earth.
- Relate depositional patterns to basin type and tectonic setting in modern and ancient settings.
- Appreciate the representation of time in the stratigraphic record.
- Reconstruct paleogeographic settings on different spatial and temporal scales.
- Understand the role of basins as archives of information and hosts for resources (e.g. hydrocarbons, water) and contaminants (e.g. nuclear waste, CO₂).
- Interpret and generate primary sedimentological and stratigraphic information.
- Engage the primary scientific literature on stratigraphy and basin analysis.

Textbooks & Resources

- There is one primary text for the course: Allen & Allen. 2013. Basin Analysis: Principles and Application to Petroleum Play Assessment, 3rd edition. Wiley-Blackwell. This is available for free as an e-book through the UM library. If you are going to rely on the e-version, know the terms for access in advance.
- Chapters from Interpreting the Stratigraphic Record by Donald Prothero and other readings and resources will be available via Canvas.

Assessment

- 2 midterms (20%)
- Writing Practice, Article Evaluation, Article Rubric (20%, grad student article presentation will count for half of this portion)
- Lab Exercises & Problem Sets (30%)
- Basin Project (20%)
- Field Trip Report (20%)

Assessment of writing will be based on adherence to the assignment, quality of writing and attention to detail, synthesis of information, diligence in producing high quality initial submissions and revisions that are attentive to feedback and understanding the role of editing and revising written work

We will use Canvas as much of the class as possible. Some assignments are currently listed as events so they appear in the calendar but more details will be provided for each.

Simplified Schedule

Date	Lecture	Lab	Topic	Reading	Class activity	Assignment
1/9	1		Intro	AA-1		
1/14	2		Basin Types and Tectonic Context	AA-1	WP review	WP1
1/15		1	Sedimentology Review			
1/16	3		Basins in geodynamic context	AA-3	WP review	WP2
1/21			MLK day - no classes			
1/22		2	Facies Analysis, Depositional Environments		intro to AE assignment	
1/23	4		Basins due to stretching	AA-4	WP review	WP3
1/28	5		Basins due to flexure	AA-5	article review	AE1
1/29		3	Stratigraphic sections, intro to Basin Project			
1/30	6		Basins due to mantle dynamics	AA-7		
2/4	7		Sediment sources	AA-8	article review	AE2
2/5		4	Petrography and Provenance		library skills	
2/6	8		Sediment fill	AA-8	article review	AE3
2/11	9		Stratigraphy - overview	AA-8	rubric review	Rubric
2/12		5	Midterm 1 (with practical)			
2/13	10		Sequence stratigraphy			rev. Rubric
2/18	11		Sequence stratigraphy			Basin Part A
2/19		6	Sequence stratigraphy			
2/20	12		peer review Basin Part A		peer review	
2/25	13		Seismic stratigraphy - I			Basin Part B
2/26		7	Sequence and Seismic strat			
2/27	14		Seismic stratigraphy - II			Basin Part C
3/2-	to 3/10		Winter Break			
3/11	15		Chronostrat, Biostrat	Proth-12		
3/12		8	Magnetostratigraphy lab			
3/13	16		peer review Part D	Proth-10	peer review	Basin Part D
3/16			field trip Grand Ledge			
3/18	17		Field data review	Proth-11		
3/19		9	Biostratigraphy			
3/20	18		Chemostrat, cyclostrat	Proth-11		Basin Part E
3/25	19		Geochron, magnetostrat		peer review	
3/26		10	Midterm 2 (with practical)			
3/27	20		Paleogeography			
4/1	21		Subsidence history			
4/2		11	Field trip prep			
4/3	22		Backstripping, Field prep	AA-9		Basin Part F
4/5	to 4/7		Field trip to SW Ohio			
4/8	23		No class - break from field trip			
4/9		12	field trip data processing			
4/10	24		Heat & Heat flow	AA-9		

4/15	25		Thermal histories	AA-10		
4/16		13	Backstripping			
4/17	26		Pore fluids			
4/22	27		Petroleum systems	AA-12		
4/23		14	field data processing, backstripping			
TBD						Field report

AA-x refers to Chapter x in the course text book, Allen & Allen Basin Analysis
 Proth-x references to Chapter x in Interpreting the Stratigraphic Record Interpreting the
 Stratigraphic Record by Donald Prothero

Readings

The text readings listed in the schedule should give you a sense for the material covered on this day of class. It is recommended that you skim the readings prior to class and then read them in more depth after each class. The assigned study questions will help guide your reading.

Additional readings may be provided via Canvas to cover material that is not in the text. You will receive more detailed guidelines on what to read through the course.

Ask for clarification if you are uncertain about what is expected with regard to the reading.

All students are expected to read the student-presented journal articles. Short assignments will be associated with each article to help guide your reading.

Additional Information & Policies

Digital Devices & Social Media: Use of digital devices should be limited class activities. Use of any kind of social media or internet access unrelated to class will not be tolerated. Have a note-taking method that allows you to draw free-hand.

Academic Integrity: In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the internet and electronic devices, unauthorized collaboration, alteration of graded assignments, lying, facilitating academic dishonesty, and unfair competition. You must cite the work of others properly. Ask for clarification if you are uncertain of what constitutes a violation. See LSA guidelines or ask for clarification if you have questions.

Specific needs: If you have any particular needs that are relevant to your success in this course, please contact the instructors directly, in person or via email.

Writing Assignments

Writing assignments for this course will require students to engage the course material, understand the components that contribute to an effective scientific paper, and synthesize primary stratigraphic data in a basin context. The sequence of activities is designed to help students engage the course material by reading scientific papers in a structured way, evaluating the components of a good scientific paper, and then implementing this knowledge in their own scientific reports which will include text, graphics and tables.

1. Writing Practice related to course readings

Goals – a) improve comprehension of content, b) experience writing concepts in student's own words, practice peer-editing process

Class time will be spent with 1) peer review and feedback and 2) group discussion of both the content and approaching ways to represent scientific information in one's own words

Writing Practice (WP) assignments will take the form of responses to study questions associated with the readings. They will be 200 words each and will be due on Jan 14, Jan 16 and Jan 23. Peer review and discussions will occur on each due date.

Assessment: Assignments will be evaluated by the GSI for accuracy of information, student comprehension and writing quality, making sure that text is truly in student's own words. Students will receive written feedback.

2. Journal Article Evaluations

Goals – a) improve reading comprehension, b) evaluate the components of what makes a good scientific study, c) practice engaging the graphical information in scientific papers

Evaluations will be done for three journal articles that will be discussed in class. For each article the students will prepare

- a plain language summary the article paper (100 words)
- a graphical diagram of the article's components (50 words)
- a critique of the figures and tables (100 words)
- a diagram of the article's abstract

Assignments will be due when articles are presented on Jan 28, Feb 4, Feb 6. Class time will be spent reviewing the article, followed by peer review of the evaluations, feedback, and group discussion. All assignments will be read by GSI or faculty member. Articles will be presented in class by graduate students taking the course.

Assessment: Students will receive detailed, written feedback on the first Article Evaluation (AE1) from the faculty member or GSI. Students will be expected to apply this feedback to their work in in the 2nd and 3rd evaluations (AE2, AE3).

3. Rubric for reports with geologic data – students submit draft and final version after

Goals – a) review the components of a scientific paper and effective scientific writing, b) generate a rubric for use in future work

Students will review the Writing Practice and Article Evaluation assignments to generate a rubric on the features that make a scientific paper effective. This will include a description of the components of a scientific paper (e.g. abstract, sections of text, figures, tables, references) and what makes each element effective.

Students will submit this assignment on Feb 11. Elements of an effective rubric will be reviewed in class. Students will be required to submit a revised version of their rubric based on the class discussion on what makes an effective rubric.

4. Basin Project

Students will choose a basin in North America, from a selection of those reported in the COSUNA charts, and will develop a report on the stratigraphy and sedimentology of this basin and how it fits into the regional depositional and tectonic history, through a series of steps outlined below. Graduate students in the class may choose a basin outside North America if justified by their thesis research.

- A. Basin Selection and Annotated Bibliography (due Feb 18)
- B. Tectonic setting and chronologic constraints (1000 words, due Feb 25).
- C. Sequence stratigraphy, facies and paleogeography (1000 words, due Feb 27)
- D. Project Outline, followed by peer review (500 words, due March 13)
- E. Basin Project report (7,000 words, due March 20)
- F. Basin Project revision (due April 3)

Goals - aggregate and synthesize information from the scientific literature in a format that is standard to the discipline, including text, figures and tables.

Assessment: Students will receive feedback from the GSI or faculty member on parts A, B and C. They will receive peer feedback on the project outline (part D) and instructor feedback on their report (part E). Students must respond to the instructor feedback in their revision (part F). Parts B and C will require the students to find specific information about their basin, which can be used subsequently in their project report (part E). Parts B, C, E and F will include figures and tables that will also be evaluated through peer and instructor review. Students will receive a grade on Part E and are expected to take this initial draft seriously.

Students will meet directly with the faculty member at least once throughout the course of the Basin Project. The timing of the initial meeting will depend on the student's comfort with the assignment. Some students may choose to have the first meeting at the start of the project and could have subsequent meetings, whereas others may be comfortable working independently and will first meet with the faculty instructor to review the feedback on the first draft (Part E).

5. Field Report

Students will produce a report that draws on their observation from the field and ties them into the regional stratigraphy and tectonic history, drawing on information in their Basin Project. The majority of this report will include graphical or tabular representation of their field observations and subsequent analyses, but it will include some text, such as a summary statement (250 words) and captions to all figures (500 words).

Goals – summarize primary field observations and integrate them into existing knowledge using text, figures and tables.

Assessment: student work will be evaluated by the GSI and faculty member with feedback given through a rubric provided with the initial assignment.