Basin Analysis
EES 6770

Instructor: Dr. Robert Mahon, Department of Earth and Environmental Sciences

Learning Objectives: The stratigraphic record is the principle archive of past surface processes in depositional environments. Unravelling this record requires an in-depth understanding of the processes involved in the preservation of strata at a variety of spatial and temporal scales. Students will be introduced to concepts of sediment mass balance; internal dynamics and external forcings on sedimentary systems; morphodynamics; rates, timescales, and stratigraphic completeness; tectonics and basin filling; sediment routing and provenance; basin scale architectures and sequence stratigraphy; and planetary stratigraphy.

Course Evaluation
Grading: Total class grade: over 90% = A, 80-89.9% = B, 70-79.9% = C, and 60-69.9% = D.
Readings and discussions – 20%
Assignments – 30%
Final Paper – 25%
Final Talk – 25%
Extra Credit: No extra credit will be offered under any circumstances.

Readings and discussions (20%): This course will introduce you to both classical and cutting-edge geologic literature defining key concepts in the understanding of sedimentary basin histories. You will be expected to complete the assigned reading and engage actively in class discussions. Additionally, each student will be assigned a subset of the readings throughout the course and they will be responsible for preparing a set of discussion points and questions (~1-page) and will lead the group discussion for that paper.

Assignments (30%): There will be 3 assignments relating to individual topics in this class. Assignments will be worth 10% each of your final grade. Assignments will require students to be familiar with some form of computer spreadsheet/coding platform (Matlab, Python, R, or Excel). Note: I can help you with programming or data manipulation in Matlab or Excel; however, my experience is limited in Python, and none in R.

Final Project (paper 25%, talk 25%): The final project will be on a topic in sedimentary geology of your choosing. You will apply the tools and understanding gained throughout this course to analyze sedimentary data, either field or experimental, in a more complete framework. The hope is that you will select a topic, in consultation with me, that has the potential to dovetail with your individual interests or thesis/dissertation topics. Topics must be decided upon and approved by me by September 30th. A ~250 word abstract of your topic will be due October 15th. You are expected to write a research paper between 10-15 pages, double-spaced 12-point font with a minimum of 15 references and prepare a ~15-minute presentation on your topic.

Some experimental data to peruse:
www.sedexp.net
https://repository.nced.umn.edu/

Some resources to help guide your writing and talk preparations:
https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/writing-scientific-papers-14239285
http://blogs.lse.ac.uk/writingforresearch/2017/07/17/how-to-write-paragraphs-in-research-texts-articles-books-and-phds/
https://schimelwritingscience.wordpress.com
https://student.unsw.edu.au/writing-engineering-science

Late Assignment Policy: Any assignment turned in after the specified due data (at the beginning of class) will be considered late, an assignment not handed in by the end of the day it is due will not be accepted without a valid University excuse. Make-ups will only be given for verifiable written excuses specifically recognized by the University (illness of the student, or of an immediate family member, death of an immediate family member, participation on trips related to certain University functions, major religious holidays). If you miss any classes, you must promptly notify me to make up the material. Make-ups after one week has passed will be permitted only under extenuating circumstances.

Class Attendance: Much of the course will emphasize seminar-type discussions, and a couple sediment experiments which cannot be made up in the event of an absence. Class attendance is therefore considered mandatory, except in the case of university approved absence. Two or three sediment experiments will be conducted for the purpose of producing datasets for the assignments listed above. These will likely be completed during a few sessions of 2-3 hours outside of class time. We will discuss finding days/times where everyone is available to help collect this data.

Academic Honesty: Academic integrity is fundamental to the process of learning and evaluating academic performance. Academic dishonesty will not be tolerated. Academic dishonesty includes, but is not limited to, the following: cheating, plagiarism, tampering with academic records and examinations, falsifying identity, and being an accessory to acts of academic dishonesty. Refer to the Academic Dishonesty Policy (http://www.uno.edu/student-affairs/documents/academic-dishonesty-policy-rev2014.pdf) for further information. The University policies and procedures regarding academic dishonesty are clearly defined in the University Code of Conduct: http://www.uno.edu/student-affairs/documents/Student-Code-of-Conduct-rev-7-16.pdf

Students with disability: It is University policy to provide, on a flexible and individual basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirement. Students with disabilities should contact the Office of Disability Services (LIB 120) as well as their instructors to discuss their individual needs for accommodations. See the UNO Policy for Students with Disabilities at http://www.ods.uno.edu/

Topics and (tentative) reading list:
The following topical outline may vary depending on student interests and time.

1) Intro, overview
2) Sediment mass balance

- Paola and Voller, 2005, A generalized Exner equation for sediment mass balance: JGR, v. 110, F04014, doi:10.1029/2004JF000274

3) Internal dynamics, cyclicity, external forcings
   - Jerolmack and Paola, 2010, Shredding of environmental signals by sediment transport: GRL, v. 37, no. 19, doi: 10.1029/2010GL044638
   - Romans, Castelltort, Covault, Fildani and Walsh, 2015, Environmental signal propagation in sedimentary systems across timescales: Earth Science Reviews, v. 153, p. 7-29.
4) Rates, timescales, completeness
   - Sadler, 1981, Sediment accumulation rates and the completeness of stratigraphic sections: Journal of Geology, v. 81, p. 569-584
   - Sadler and Jerolmack, 2014, Scaling laws for aggradation, denudation and progradation rates: the case for time-scale invariance at sediment sources and sinks: From: Smith, D. G., Bailey, R. J., Burgess, P.M. & Fraser, A. J. (eds) Strata and Time: Probing the Gaps in Our Understanding. Geological Society, London, Special Publications, 404, http://dx.doi.org/10.1144/SP404.7
5) Morphodynamics
   - Ganti, Lamb and McElroy, 2014, Quantitative bounds on morphodynamics and implications for reading the sedimentary record: Nature Communications, doi: 10.1038/ncomms4298
6) Quantitative reconstruction
7) Time and sedimentary geochronology
8) Basin tectonics, eustasy, flexure, isostacy
   - Paola, Heller and Angevine, 1992, The large scale dynamics of grain-size variation in alluvial basins, 1: Theory: Basin Research, v. 4, p. 73-90.
   - Paola, 2000, Quantitative models of sedimentary basin filling: Sedimentology, v. 47, p. 121-178.
9) Sediment routing and provenance
   - Dickinson and Suczek, 1979, Plate tectonics and sandstone compositions: AAPG Bulletin, v. 63, no. 12, p. 2164-2182
10) Sequences and basin-scale architecture
11) Planetary stratigraphy
   - Lamb, Grotzinger, Southard, Tosca, 2012, Were aqueous ripples on Mars deposited by flowing brines? From: Sedimentary Geology of Mars, SEPM Special Publication No. 102, p. 139-150

Some recommended readings:

To Interpret the Earth: Ten ways to be wrong. S.A. Schumm, Cambridge University Press, Cambridge, UK.

Foreman and Straub, 2017, Autogenic geomorphic processes determine the resolution and fidelity of terrestrial paleoclimate records: Science Advances, 3(9), e1700683, doi: 10.1126/sciadv.1700683

Wang, Straub and Hajek, 2011, Scale-dependent compensational stacking: An estimate of autogenic time scales in channelized sedimentary deposits: Geology, v. 39, no. 9, p. 811-814, doi:10.1130/G32068.1