GEOSC 479 Advanced Stratigraphy: Midterm project

Goal: *Conduct a sequence-stratigraphic and mass-balance analysis, interpretation, and comparison of experimental data.*

Due: 5:45 pm Tuesday, March 29

Turn in: Final report including ~8-10 pages of text (double-spaced) and many figures (see below for list of figures).

Grading: Worth 25% of your course grade (adjusted from syllabus). If you follow the outline (below) and include everything in a well-written, neatly complied report, you will earn an A. Points will be deducted for missing pieces, unclear writing, poor organization, or gross misapplication of methods.

What to do: Use Martin et al. (2009) as your guide. Martin et al. compared stratigraphically mapped packages and boundaries to known depositional/erosional patterns throughout an experiment (XES 02). You will reconstruct depositional history of another, similar experiment (XES 10) from the strata only (i.e., you will not have topographic data or full 3D stratigraphy as they had) and compare results to the XES 02 experiment. You can think of the XES 10 panel as a 2D seismic line from a different margin of the same ocean as the XES 02 data.

First, think about some hypotheses. XES 10 has the opposite subsidence pattern as XES 02. What do you think might be different about how surfaces and packages are deposited and preserved given the difference in subsidence?

You will be provided a high-resolution digital scan of the experimental stratigraphy. I suggest you work digitally in a program such as Adobe Illustrator or something similar. Your workflow will be similar to that you used for Homework #4, where you mapped surfaces on the XES 02 data. Once you have your bounded stratal packages (c.f. Martin et al.), you will need to export them and calculate the center of mass in a program such as ImageJ. We will go over this after you have defined important surfaces and boundaries in the stratigraphy.

Come see me by Tuesday, March 22 with your stratal packages outlined for help calculating center of mass.

Your analysis and final report should include the following figures (minimum requirement) as lines, polygons, and labels overlain on the experimental panel (note: these don't necessarily each have to be separate figures as long as all data are included and clearly displayed):

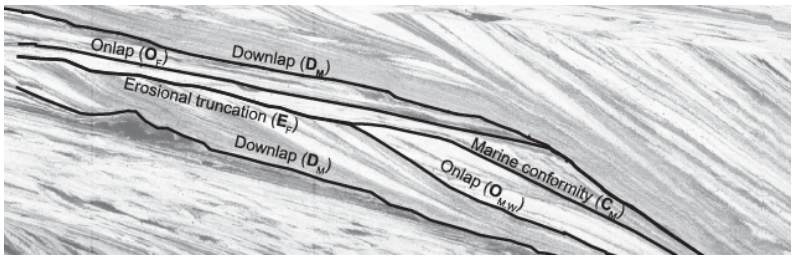
1) **Depositional Environments:** transparent overlay polygons indicating depositional environment (one color each for fluvial and marine deposits)
2) **Stratal Terminations:** experimental section with markers (arrows) indicating stratal terminations labeled as onlap, erosion, downlap, etc.
3) **Shoreline Position:** Mark shoreline position (indicated by clinoform rollover) with triangles or another marker
4) **Stratal Stacking Patterns:** indicate with arrows (and transparent overlay polygons, if you can) progradational, aggradational, retrogradational, and degradational packages
5) **Martin et al. surfaces:** draw in and label fluvial erosion (Ef), marine conformity (Cm), marine onlap (Om), fluvial onlap (Of), and marine downlap (Dm) surfaces.
6) **Martin et al. bounded stratal packages:** transparent overlays indicating stratal packages defined by Martin et al. surfaces (e.g., their Figure 13)
7) **SB, TS, MFS surfaces:** draw in sequence boundaries, transgressive surfaces, and maximum flooding surfaces (see Martin et al. Figure 14)
8) **Systems Tracts:** transparent overlay polygons indicating deposits comprising different systems tracts (highstand, lowstand, transgressive, +/- falling stage; see Martin et al. Figure 14)
9) **Comparison with XES 02**: overlay your shoreline and center-of-mass data on Martin et al. Figure 13C)

You will write up a final report (~2000-3000 words) describing your results. I recommend an outline similar to the example below. Think of each number/letter as requiring approximately a short paragraph. If you fill in the outline that way, you should be on track to earning a good grade.

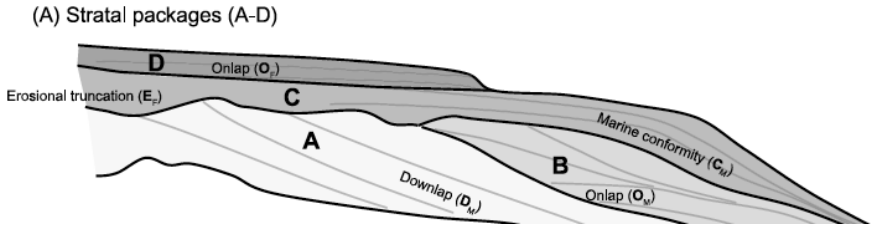
Example outline (recommended):

1. **Introduction** – Explain the project purpose and background
    a. Purpose and goals of the project
    b. Background on XES-02 experiment and Martin et al. paper
    c. Hypotheses – what do you expect to be different between XES 10 and XES 02?

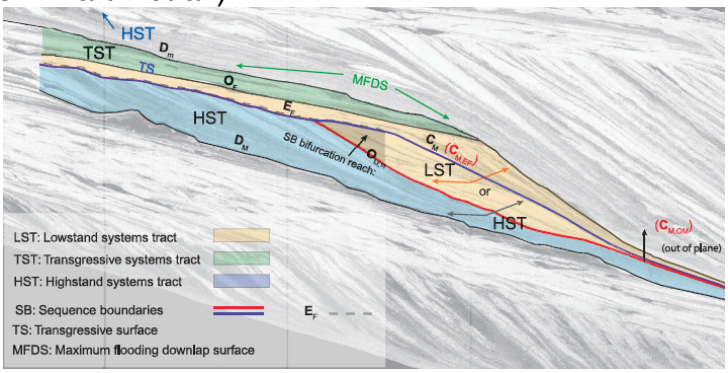
2. **Methods** – Explain how you did your sequence stratigraphic analysis and include figures of the following:
    a. Examples of stratal terminations (close-up pictures and descriptions of each type)
    b. Examples of shoreline position (clinoform rollover)
    c. Typical fluvial and marine experimental deposits
    d. Examples of each surface (after Martin et al., using your interpretations, e.g., Figure 6A, below)



e. Examples of each stratigraphic package (again, after Martin et al., e.g. Martin et al., Figure 13A, below)



3. **Results** – show and describe your findings (include images for each with interpretations as lines or transparent overlays on experimental stratigraphy). In your text you should describe the character and number of, and other observations about, each of these surfaces or packages
    a. Stratal terminations and shoreline rollover (label shoreline rollover sequentially 1-n)
    b. Surfaces (after Martin et al., label each type in stratigraphic order, e.g., E_{F1}, E_{F2}, etc.)
    c. Bounded stratal packages (after Martin et al., A-D, labeled sequentially, e.g., A_1, A_2, etc.)
    d. Stacking patterns through time (arrows indicating progradation, aggradation, retrogradation, and degradation – again, enumerate each event)
    e. Sequence stratigraphic surfaces (sequence boundaries, transgressive, and maximum flooding surfaces numbered in order; e.g., figure below)
    f. Systems tracts numbered stratigraphically (e.g., figure below, 14B from Martin et al.)



4. **Interpretations** – what is your interpretation of the base-level history based on the surfaces and packages you mapped in XES 10 only? Detail the depositional history of the deposit and discuss how shoreline movements, depositional patterns, and center of mass changed through time (relative time is OK here).

5. **Comparison** – describe how your results are similar to and different from those presented by Martin et al. from the XES 02 experiment. Include the following comparisons:
    a. Center of mass through time (you will have to make an educated guess about time correlations between XES 10 and XES 02; overlay data on Martin et al.'s Figure 13C)
    b. Shoreline position through time (also overaly on Figure 13C) – compare the magnitude of changes between experiments
    c. Comparison of the number and spatial distribution of each surface compared to XES 02
    d. Comparison of the number and spatial distribution of each bounded stratal package
    e. How did was the signal of basin boundary conditions (sea-level change) preserved in XES 02 in comparision to XES 10?

6. **Discussion** –
    a. Discuss the comparisons above and comment on implications of similarities and differences.
    b. Discuss whether you accept or reject your initial hypotheses about the influence of subsidence pattern on sequence stratigraphic packages
    c. Evaluate uncertainty in your analysis – what surfaces, packages, etc. have the most and least uncertainty and why? How confident are you in your correlation between XES 10 and XES 02? What type of data, if you could get it, would help reduce uncertainty?
    d. Compare your results to movie of overhead photos taken during XES 10. Does that additional data help or confuse any of your interpretations?

7. **Conclusions** – summarize your findings and implications

8. **References**

Note: you are welcome to work in groups for the analysis and discuss your progress with others, but you each must submit a report that you clearly wrote independently.