Grand Ledge Virtual Field Trip Stratigraphy Project

Student Instructions

You will be assigned a group of 2-3 to work with. Although the virtual field trip will be done in groups, this is for discussion and idea-sharing purposes. You will be responsible for turning in your own work (do **not** replicate your group members' products).

Upon successfully completing this project, students will be able to:

1. Apply their course knowledge to analyze the stratigraphic characteristics of a real-world field site through a virtual field experience
2. Identify and describe lithologies from a combination of outcrop photos, 3D models, and thin sections.
3. Recognize and describe bedding styles and geometry from outcrop photos and 3D models.
4. Create a detailed, (litho)stratigraphic column using data from objectives 2-3 and additional strat column resources.
5. Develop an interpretation of the depositional environment(s) for the stratigraphic column.
6. Present final products and discuss observations and the strengths and weaknesses of different interpretations.

Part 1: Background and Framework

Each group will be assigned 1 outcrop from the **Grand Ledge Field Localities**.
[NB: While you will initially be in a small group of 2-3, after your initial outcrop investigations, your group will have the opportunity to collaborate with 1-2 groups tackling neighboring outcrops. This will be a chance to compare and share data, and figure out how your sections are related (i.e., correlated).]

1. Get oriented to your outcrop location, and where that is within the Michigan Basin:
    a. Locate your outcrop on the field trip maps found on the **Field Localities** page. You can also download the .kmz file to open in Google Earth, which will allow you to explore the area of Grand Ledge, around the outcrops.
2. Explore the **Background Geology** page, investigating the context of Grand Ledge, Michigan in geologic time and within the context of the rest of the Michigan Basin.
3. Reflect on the two sets of bolded questions posed within the **Background Geology**. Write down your hypotheses and ideas about these in your notes. You might not have definite answers to these yet, but this is the time to start brainstorming about them. This is a useful practice before going into the field anywhere – establish context, and know when, where, and what is above and below you.

Part 2: Outcrop Reconnaissance

Access your assigned site (under the Field Localities and Outcrop Models tabs), visit and carry out reconnaissance of your outcrop 3D model and panoramic photos, hand sample models, close-up photos, and thin sections. (Read the notes that are included with some imagery):

1. Using the 3D outcrop model AND the outcrop photos (full-resolution versions are linked below the photos), make an **outcrop sketch**. This is the first thing to do as a geologist when approaching a new site – take in the big picture.
2. Through sketching the overall geology of your outcrop, **define distinct units** (layers with different lithologies; how many? You may want to number or letter them from base to top of outcrop.). Building upon your geological sketching skills, focus on the geometry of bedding, sedimentary structures, and changes in lithology (which may be reflected in the weathering profile).
    a. Look past and ignore any weathering stains, fractures or joints, lichen, vegetation, or rubble! Focus on the original, primary sedimentary features.
3. **Label and annotate** your sketch. Make this a data-rich resource.
    a. This is also a time to note some hypotheses or questions in your annotations that you know you want to investigate further.

Part 3: Lithologies

On the virtual field trip site, focus in on the close-up photos (which are tied to annotations on the 3D outcrop model!), hand sample models, and thin sections (which were made from the hand samples). Read the notes that are included with some imagery:

1. Write a **rock description** for each unit. You will <u>at least</u> have as many units as there are hand samples for your outcrop, and potentially more. While you started defining your units in Part 2, it's okay if you want to revise this original assessment. (See examples of full, formal rock descriptions from your sandstone and conglomerate labs.)
    a. To properly name your rocks (especially sandstones) you will need to determine both the texture and composition using the **thin sections** and other imagery. Use the standard charts for visual estimations of percent composition, and plot your results on a **QFR** to determine the rock name. Provide both the QFR percentages and the rock name in your description, along with all textural descriptors.
2. Draft hypotheses for your interpretations of the specific types of depositional environments for the lithologies you have described. (You will be revising these as you gather more data, and you might want to look back in your book for ideas.)

Part 4: Bedding style and Sedimentary Structures

Using your outcrop and close-up photos and 3D model for your locality:

1. Use the Jacob's staff (10-cm increments; or scale bars with 1-cm increments) in the photos as your reference to:
    a. Measure and record bed thicknesses in your outcrop (add these to your sketch).
    b. Assess any trends up-section (make notes of these).
2. Identify and carefully describe any sedimentary structures (e.g. cross-beds) or fossils (e.g., root traces), add these to your notes. Make sure you include them in your outcrop sketch.
3. Revise your environmental interpretations. Focus on thinking about how the environment (flow energy, sediment supply and type, life present, etc.) changed over time, based on the succession of units present.

Part 5: Stratigraphy

Using your data from parts 2, 3, and 4:

1. Draft a detailed stratigraphic column (also called a graphic log). Use the provided logging sheet to draft your section. Please use **0.25 m per tick mark** on the vertical scale for consistency. *You can annotate the **pdf** file in pdf viewing software, or insert the **png** file into Word, PowerPoint, or a Google Slide to draw upon.*
    a. All students must complete and submit a **stratigraphic column** – this is your most refined product, and what you would present in a professional context.

Key features to include for this strat. column:

- Thicknesses of beds
- Lithologies and texture information: Lithology is indicated by a pattern or a note beside the column. Grain size is indicated by the width along the X-axis, expressed with a ragged or smoothed edge as it changes
- Sedimentary structures (physical and biogenic) -- include symbols on the column and describe them at the side.
- Fossil content
- Nature of contacts (sharp? erosional features? relief?)
- Weathering style of individual beds (note changes in color, or if a unit is more recessive vs. more ledgy or resistant)

2. Write your interpretation of your strat. column/graphic log, making your concise notes alongside your column. Include:

a. Paleoenvironmental interpretation – be detailed and precise! [i.e., not just "coastal" but specify "upper shoreface"]
b. Notes on relative sea level changes, ideas about the climate, etc.

3. Work as a group to assemble a short set of Google Slides that include a map pinpointing your locality, an outcrop sketch, a stratigraphic column, and your interpretations. [**Every** student will turn in their **own** products, but choose **one** of yours to present – *one group member will present their outcrop sketch, the other group member will present their strat. column*.]

Part 6: Collaborate

After each small group has tackled their individual outcrop and its details and assembled a basic presentation, you will meet with the other 1-2 small groups with adjacent localities (your "pod") to collaborate and share ideas to refine your ideas and work.

1. Rotate through and briefly have each small group present their site and interpretations.
2. Merge your Google Slides, and add a new slide: insert all 2-3 strat. columns for your pod here, using the locality maps to determine their approximate lateral placement. (You will want to crop everything from the logging sheets except the actual sketched columns for this part. Keep the columns all at the same scale/size!)
    a. As a group, do you see any clear similarities or differences? On the slide, try sketching any contacts you think can be traced across the columns (which beds might be similar, aka "marker beds").
    b. Compare and contrast your interpretations of the environments and their changes through time. Work together as a group to refine your paleoenvironmental story and add that to your slide with all columns (keep your original slides!).

Part 7: Disseminate Knowledge

The final part of this virtual field exercise focuses on sharing what we have each learned in different localities to piece together a full picture of the region's geologic history.

1. Export your strat. column (choose **<u>one</u>** from your small group) as a **jpg** or **png**.
2. Each small group will add their strat. column to our class Google Jamboard (make sure to include your locality name! Do crop out the rest of the logging sheet)

3. Each small group (in sets of pods) will present their outcrop, stratigraphy, and preliminary interpretations to the full class, using brief slides. Each pod will elect a representative (or two) to present their correlated stratigraphy with revised interpretations.
4. As a class, we will then arrange and annotate everyone's strat. columns on the Jamboard, generate a cohesive set of hypotheses about the depositional system (including changes in energy, sediment supply, sea level, climate, life, etc.), and revisit original hypotheses.

5. As a wrap-up, everyone will complete a short, assigned reading on published interpretations of the area.

6. Each student will submit a **final written reflection**. 1-1.5 pages, double spaced, 12 pt. Times New Roman font. Include:
    a. Summary of what you learned overall
    b. Reflections on our interpretation accuracy and class discussion of the depositional system (refer to your original hypothesis). Differences with published interpretations?
    c. Things that went well or things to change about this exercise.

Deliverables from each student:

Save each of these items as a separate (single, compiled) **pdf** and deposit in the appropriate Moodle assignment link on each due date (see Moodle):

1. Copies of "field" notes (annotated outcrop sketch, rock descriptions, etc.) and original hypothesis
2. Your stratigraphic column with interpretations (single completed logging sheet)
3. Final written reflection

Keep your work organized at all stages, and submit a professional product.