Lab Activity: Identifying Landforms Produced by Stream Erosion and Deposition

Introduction

Streams are water flowing in a channel and can go by other names, such as river, brook, and creek. Stream channels are topographically low features made by stream erosion. Running water has kinetic energy, so streams can pick up and transport sediment (load). As streams flow, their load does abrasion to the landscape, wearing it down and shaping it as if it were a conveyor belt of sandpaper. This makes streams geologically destructive and the most important erosional force on Earth.

Eventually, streams slow and lose kinetic energy and their ability to transport sediment. Consequently, deposition happens. Deposition is the opposite of erosion, resulting in alluvium, stream-deposited sediment, accumulating to make new landforms, which may eventually lithify into sedimentary rock.

In this exercise, you will apply what you've learned about reading topographic maps to identifying and interpreting some of the common landforms produced by stream erosion and deposition.

Learning Objectives

- Course SLOs
    - Students can describe the role weathering, mass wasting, and erosion play in shaping Earth's surface and can provide and/or identify examples of each of these processes
    - Students can describe the evolution of landforms and geologic structures in the context of constructive and/or destructive geologic processes
- Module SLOs
    - Use topographic maps to identify stream-related landforms and make interpretations of geologic processes
    - Calculate the gradient of a stream
    - Compare and contrast the physical characteristics of the three types of stream channels and locate each along a typical stream profile
    - Describe the relationship between sinuosity, valley width/channel width ratio, and gradient

Materials

- Maps provided by your instructor
- Google Earth imagery

Background Information

- Canvas module exercises
- **Calculating gradient**:
  Step 1 - Determine the ***rise*** by measuring the vertical difference (relief) in feet between two points
    - For example, if the elevation at point A is 1260 feet and at point B is 1020 feet then the rise = **240 feet**

Step 2 - Measure the ***run*** by using the scale bar at the bottom of the map to determine the horizontal distance in miles between the two points

- An example of a run measurement might be **1.5 miles**

Step 3 - Divide the ***rise*** by the ***run*** to determine the ***gradient*** in feet per mile.

- Using the examples above, the gradient would be: 240 feet/1.5 miles = **160 feet/mile**

Pre-lab Assignment

Using your textbook, lecture, previous exercises, and the internet define in words **and** review an image of each of the following stream-related landforms. Alternatively, make a simple sketch showing how the vocabulary words or words are related to streams. Once you've completed this pre-lab exercise, you're ready to move on to the maps.

Your pre-lab work will be assessed in class for accuracy and completeness. You will cannot move onto the maps until the pre-lab work is completed.

Streams vocabulary

1. alluvium
2. base level
3. distributary
4. delta
5. tributary

Landforms typically (but not always) associated with straight (bedrock channel) streams

6. alluvial fan
7. straight (bedrock) stream
8. V-shaped valleys

Landforms typically (but not always) associated with braided streams

9. braided stream
10. channel bar
11. stream terrace

Landforms typically (but not always) associated with meandering streams

12. cut bank
13. floodplain
14. meandering stream
15. natural levee
16. oxbow lake
17. point bars

In-Class Laboratory Exercise

For each topographic map, work with your classmates to answer the questions. You may use your textbook, lecture, videos, animations, and other class materials to help answer the questions.

At least one person at each table should click the link to open a Google map of the area covered by the topographic map. Analyze the maps carefully to find the answers to the following questions.

Ennis, Montana, 15-minute quadrangle map. Record your answers after each question.

1. Describe the topography of the landscape. Is it flat, hilly, mountainous, etc.?
2. There are many streams on this map, all of which flow to the local low point or **base level** of this region. What feature on the map represents the local base level, and what is its elevation?
3. How would you describe the valley width/channel width ratio (small, medium, large) of Cedar Creek?
4. Considering the sinuosity and the valley width/channel width ratio, how would you describe the gradient of Cedar Creek?
5. What type of stream channel (straight/braided/meandering) is Cedar Creek as it flows through the mountains in the southeastern portion of the map?
6. Along the course of Cedar Creek in the mountains are many smaller streams, these are called _________________ for Cedar Creek.
    a. Calculate the gradient of Cedar Creek between the red 29 (near the eastern margin of the map - the elevation is 7320 feet), and the elevation point 6244 feet (within square 22).
    On a **separate sheet of paper**, show your work below and circle the final answer with the correct units.
7. A depositional feature has developed at the mouth of Cedar Creek in the southern part of the map. What is the name of this feature?
8. Cedar Creek splits into many stream channels at the top of the depositional feature, what is the name for these types of channels?
9. Describe why an alluvial fan should develop at this location.
10. How would you describe the maturity of the sediment making up this fan?
    a. Do you think it would be more coarse or fine-grained?
11. What type of stream channel is Madison River south of Ennis Lake? (straight/braided/meandering)
12. What direction does the Madison River Flow south of Ennis Lake? To help answer the question, observe elevations along the river, such as BM (elevation benchmark) 5006, which is near the western margin of the map.
13. Calculate the gradient of the Madison River south of Ennis Lake between BM 5006 and the mouth of Madison River at Ennis Lake. Step-by-step instructions are given in Background Information.
    On a **separate sheet of paper** show all work AND include the correct units for credit.
14. How does the gradient of Madison River compare to the gradient of Cedar Creek and do the different gradients agree with the type of stream channel each river represents?
15. What depositional landform has developed along the southern shore of Ennis Lake?
16. On the same paper you calculated the gradient, draw a 1-inch section of Madison River that shows the channel bars with the channel. Label the channel bars.

Philipp, Mississippi, 15-minute quadrangle map.

1. What type of stream is Tallahatchie River?
2. Hampton Lake and Fish Lake are both examples of what type of lake?

3. East of Tallahatchie River and surrounding small Wolf Lake, Bear Lake, and White Lake, the map is colored green, filled with fine blue lines. What does this indicate about this part of the map?
    a. Why does this feature exist here?
    b. Considering the type of stream channel containing the Tallahatchie River, what stream-related landform feature makes up this part of the map, extending from the western margin of the map to Highway 35 along the base of the mountains?
4. Imagine the Tallahatchie River floods its banks and crests at 150 feet above sea level. In very general terms, describe the portion of the map that such an event would flood (imagine you're a news reporter giving out evacuation instructions in a way that everyone in the area would understand).

Furnace Creek, California 15-minute quadrangle map

1. Are the streams perennial or intermittent?
2. What depositional landforms extend eastward from the base of the Panamint Mountains?
3. What is the lowest elevation on this map? Hint, it is labeled on the map.
4. Considering your answer to the previous question, what is the elevation of the base level for this region?

Ord Ferry, California 7.5 minute quadrangle map

1. Is Sacramento a perennial or intermittent stream?
2. How would you describe the sinuosity of the Sacramento River?
3. How would you describe the valley width/channel width ratio (small, medium, large) of the Sacramento River?
4. Considering the sinuosity and the valley width/channel width ratio, how would you describe the gradient of the Sacramento River?
5. What type of stream is the Sacramento River?
6. Sacramento River is situated in a broad, flat valley called a ________________________________?
7. What feature is found at "C"?
8. What feature is found at "D"?
9. What feature is found at "E"?
10. What used to be at the Dunning Slough "F"?
11. Calculate the gradient between "A" and "B." *Show all work AND include the correct units for credit.*

Stream Table Questions

1. When water is first released onto the stream table does a stream form immediately? ______________________
   What processes that we've discussed in class do you observe? ____
2. At which part of the stream (head or mouth) do you observe erosion? ___________________________________
   How about deposition? ____
3. What type of erosional landforms do you observe being created? ____
4. What type of depositional landforms do you observe being formed? _____________________________________
5. If we turn up the pump so water comes out faster, how will it affect the discharge (volume of water flowing) and kinetic energy of the stream? ____
6. How do changes in discharge affect erosion? ____

7. If we could increase the gradient by lifting the stream table on one end, would this affect erosion rates? How so? ____

8. How do different materials change the erosion and deposition along a stream? What would happen if the stream channel was hard rock and not sediment? ____