Glacier Erosion and Deposition

You will need: 1) ruler with mm marks; 2) two pieces of tracing paper
As usual, homework is to be neat, answers provided in the order asked with the same numbering scheme. Show all work. All prose text (as opposed to equations) will be typed, 11-12 pt. Equations and solutions will be neatly presented.

EROSION

Please observe the rock passed around in class. Note the striations in the rock. From these striations, we will calculate the abrasion rate for the glacier. Show all work.

First, we will restrict ourselves to the 4 largest striations. Measure their length and width. The depth of the striations averages 0.1 mm.

1. (3pts) Given the area of the rock (black area) estimate the fractional area of the bedrock being abraded at any one time. We will assume that these scratches were made at the same time. Make a table with column headings, "scratch", "length", "width", "area". Label the scratches 1-4 from left to right and use the number under "scratch" to identify the scratch with the measurements. Measure to the nearest mm.

2. (3pts) What volume (mm^3) of bedrock is being lost per unit area (mm^2)?

3. (3pts) If the glacier surface is moving at 2 m dy^{-1}, how long did it take to make the longest scratch? What assumption did you have to make? Give your answer in days and again in hours.

4. (3pts) If we use that time estimate as the time required to make all the scratches, what is the rate of volume loss per unit area per hour?

5. (1pt) What is the rate at which the glacier is down cutting into the bedrock (units of length per time)?

6. (3 pts) What is the yearly down cutting rate? How does this rate compare with other glaciers?

DEPOSITION

Stereographic Images - Glaciers

A. Page 10 Crillon Glacier (Identify all features drawn)

7. (3pts) Draw the main medial moraines.

8. (3pts) In stereo view, note the morainal surfaces versus the whitish glacial ice. Which appears higher and why?

9. (4pts) Draw the lateral moraine found at about C.6, 2.2. For reference, also draw the margin of the current Crillon Glacier, the terminus of the hanging glacier, and the stream from the hanging glacier to the Crillon Glacier.

10. (4pts) Based on the position of this moraine, what can you say about the relative positions of the hanging glacier and the Crillon Glacier during the time that moraine was formed?

11. (3pts) By examining the lateral erosion of the hanging glacier, what can you say about its current size relative to its former size?

12. (6pts) Note the position of the terminus and the development of a delta into the lake. Where along the terminus is the greatest amount of glacier ice being lost? Explain. Briefly discuss the development of the delta and its effect on mass loss along the

terminus of the glacier. Finally, based on what you see, any predictions for the long-term future of mass loss at the terminus of the glacier?

B. Page 11. Note Ogives

C. Page 17: Walker Lake (Label all features drawn)

13. (4pts) Draw the two sets of large moraines observed in the left hand image. As much as possible draw the complete arc of each set. Are others present? If so, please sketch in using dashed lines.

14. (2pts) Complete the sketch and in (13) by drawing and identifying the single set of large lateral moraines on either side of Walker Lake (stereo image). Include the lake for reference.

15. (3 pts) Briefly discuss the formation of the lake.

Reading: Shreve, R.L., 1985. Esker characteristics in terms of glacier physics, Katahdin esker system, Maine. Geological Society of America Bulletin, 96, 639-646.

Equipotentials - the total pressure of the water above a datum, which is the sum of the weight of the overlying ice and the height above the outlet or lowest part of the drainage. (Shreve assumes that the water pressure in the conduit is equal to the pressure of the overlying ice.) If there is no ice, then the equipotential is simply the height of the point above the outlet of the basin. Water will drain down the steepest topographic slope. If a glacier is sitting on a horizontal plane the pressure of the water (in terms of m weq) depends on the thickness of the ice. The water under thicker ice will be at higher pressure and flow to the water at lower pressure under thinner ice. The equipotential then, takes into account both the pressure due to the ice thickness and the height of the bottom of the glacier above the lowest point at the outlet of the basin.

16. (3pts) What is the purpose of the paper?

17. (6 pts) When was the esker system formed and how does it trend relative to the modern stream system? If eskers were formed in subglacial conduits, does the direction of subglacial water flow necessarily follow the topography of the land (subglacial) surface?

18. (9pts) What are the 3 main kinds of eskers identified and what are the main distinguishing features?

19. (3pts) What direction will pressurized subglacial water flow?

20. (5pts) In your own words, explain the process of creating sharp-crested eskers.