

Geology 22
Process Geomorphology
Final Exam
Fall, 1999

Name _____

This exam is closed book and closed notes. Take some time to read the questions carefully before you begin writing. Answer the questions concisely but fully; use sketches and diagrams wherever appropriate. If you are not clear on a question, feel free to ask me to clarify it. Budget your time!

Section 1. Slides- Landform Recognition (12 points—2 points each)

Slide #1.

- Name the type of river that exists at reach 1 (0.5 pts).
- Provide a brief explanation for the change in plan form of the river from reach 1 to reach 2 (1.5 pts).

Slide #2.

- What is the drainage pattern that you can see on this hillslope?
- What hillslope hydrologic phenomenon is well exemplified on this hillslope?

Slide #3.

- Name this geomorphic feature.
- What is the dominant process affecting this rock?

Slide #4.

- Name the soil horizons that you see in this photograph (from top to bottom).
- In what climatic conditions is this soil forming?

Slide #5.

- Name the landform on this hillslope.
- What is the dominant *process* affecting this hillslope.

Slide #6.

- What types of dunes are present in this photograph?
- What is the prevailing wind direction?

Section 2. Definitions (20 points)—Define the following 10 terms (20 points total—2 points each).

1. karst window

2. Hjulstrom's curve

3. drag velocity

4. 2:1 clay

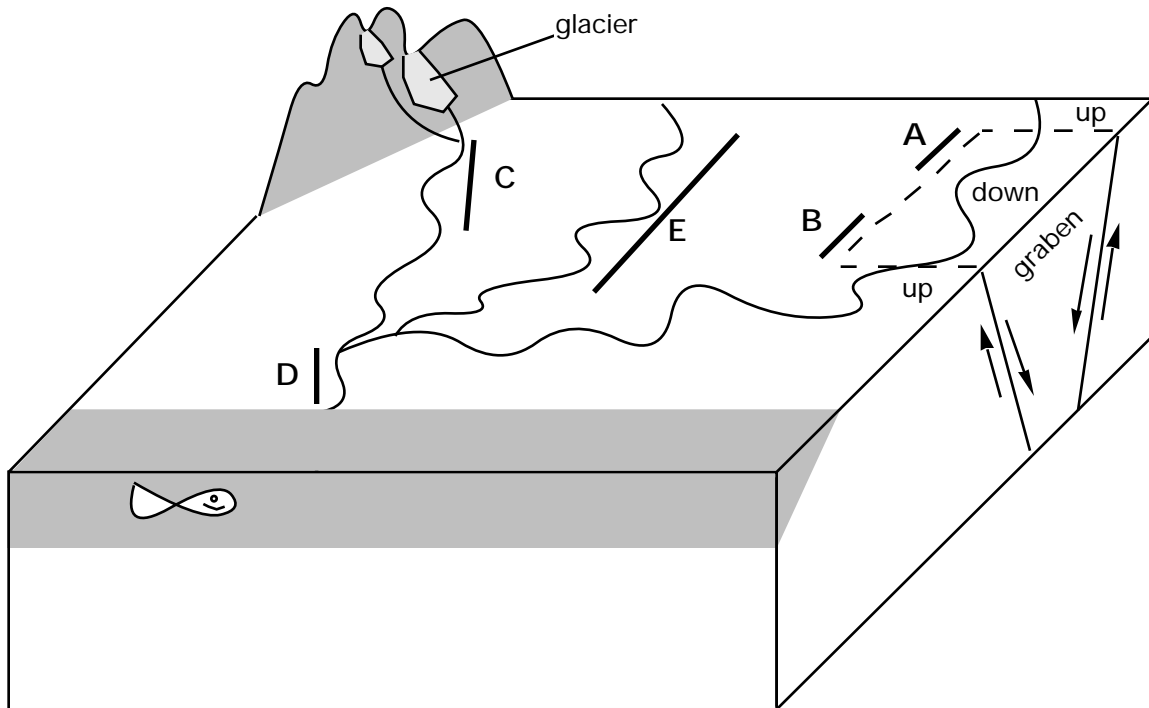
5. strath terrace
6. piezometric head
7. abrasion pH
8. creep
9. saturated overland flow
10. yardang

Section 3. Short Essays. Answer *all* of the following questions (54 points).

1) With respect to the figure below, consider the following scenario. Initially, all streams are at equilibrium (i.e. graded), and the following events occur: 1) mean annual precipitation increases from 20 cm/yr to 40 cm/yr, 2) mean annual temperature increases, which causes glaciers to shrink and sea level to rise, and 3) extensional tectonics leads to the formation of a down-dropped block (graben).

Predict ALL probable changes (e.g., *gradient, stream pattern, aggradation vs. degradation*) to **specific** stream segments (A-E) as listed below (**8 points**):

- A. Explain the effects of graben development on stream segments A and B ONLY.
- B. Explain the effects of glacier recession on stream segment C ONLY.
- C. Explain the effects of sea-level rise on stream segment D ONLY.
- D. Explain the effects of the increase in precipitation (from 20 cm/yr to 40 cm/yr) on stream segment E ONLY.



2) Explain how braided river deposits differ from meandering river deposits and discuss the geomorphic processes that are responsible for these differences (8 points).

3A) Study the trends in chemical and mineralogical parameters and label (*in the space on the graphs indicated*) the horizons that compose each profile (2 points).

3B) For Soil #1, provide an explanation of the distribution of clay, CaCO_3 , AND clay minerals in the soil. Think about the changing controls on soil formation that might explain this distribution (4 points).

3C) For Soil #2 (*RIGHT-HAND PLOTS!!*), provide an explanation for the distribution of all parameters (4 points).

3D) For Soil #3 (MIDDLE PLOTS!!), focus on carbon, clay, and Fe_2O_3 graphs and explain the origin of the distribution of these parameters (4 points).

4) Explain the climatic controls (direct and indirect) on the development of karst features (8 points).

5) Compare the entrainment of sediment by running water with that by wind (8 points).

6) Discuss the ways in which climatic change might affect the *rate* of **physical weathering**. Be specific (8 points)!

Part III. Hillslope Problem (14 points total)

- 1) A hillslope is subject to a storm. Examine the following graphs of changes in precipitation and infiltration rate through the storm.
- Sketch on this figure a possible discharge (Q) curve for a stream in the area. Be sure to label all elements of the discharge curve (4 points).

2) A mass of regolith, *which is at field capacity*, is on *the same* hillslope with the following properties.

Properties:

slope (θ): 30°

thickness of regolith: 3.0 m

field capacity: 15% (by volume)

regolith porosity: 20% (by volume)

cohesion of regolith (c): 5000 N/m^2

$\tan \phi$ (= angle of internal friction): 0.59

density of regolith (ρ_r): 1500 kg/m^3

density of water (ρ_w): 1000 kg/m^3

acceleration due to gravity (g)= 9.8 m/sec^2

- Will the slope be stable *through the entire storm*? Should the residents evacuate? Show all of your work and watch significant figures! (10 points)

