

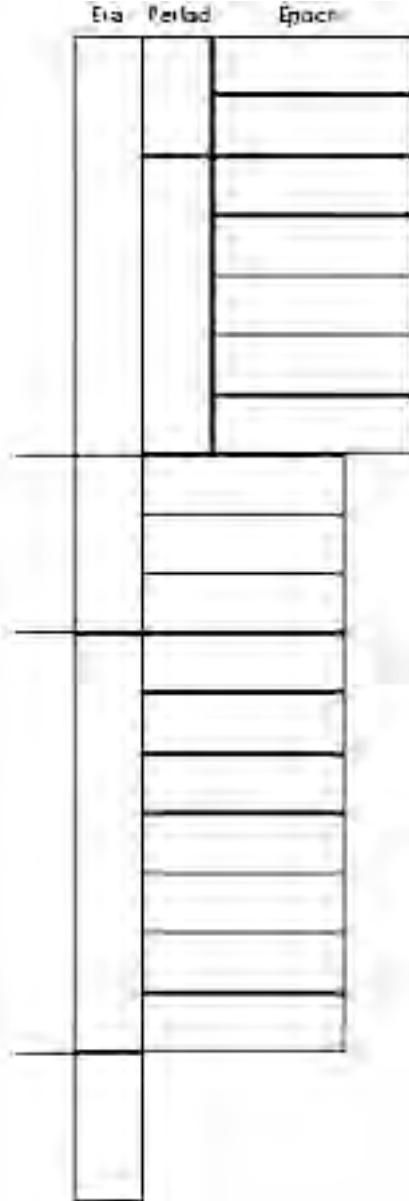
ERTH 101 Final Exam (3 hour)

Fall 2002 (200 points total)

Name _____

Short answer questions (give brief answers in a few words):

1. (9) Fill in the geologic eras, periods, and epochs on the diagram below. Also indicate the ages of the boundaries between the eras, on the left hand side.



2. (5) Element P radioactively decays to element D with a half-life of 50 million years. A rock has 10 atoms of P and 70 of D. You may assume that no P or D has been lost from the rock, and that there was no D present initially in the newly formed rock. How old is the rock in years, and what geologic **era** it is from?

3. (4) What is the principle of uniformitarianism? Why is it fundamental to our interpretations of geologic history?
4. (2) What are the two dominant minerals in a gabbro?
5. (3) What are the major compositional differences between oceanic and continental crust (use general rock names)?
6. (4) Provide a sketch illustrating the tectonic setting in which blueschist and greenschist metamorphic facies rocks occur. Label the positions of these two rock types on the sketch.
7. (4) The water in a lake has a residence time of 100 years. The average flow of the stream discharging from the lake is $10 \text{ m}^3 \text{ s}^{-1}$. What is the volume of the lake?
8. (2) Why is there more water vapor in the atmosphere at the equator than at the poles?
9. (2) What are the two main climate variables that control whether a glacier grows or shrinks?
10. (2) How do medial moraines form?

11. **(3)** What are the three fundamental things that control Earth's temperature?

12. **(3)** Why is water vapor omitted in the discussion of the human-caused greenhouse effect, even though it is a powerful greenhouse gas?

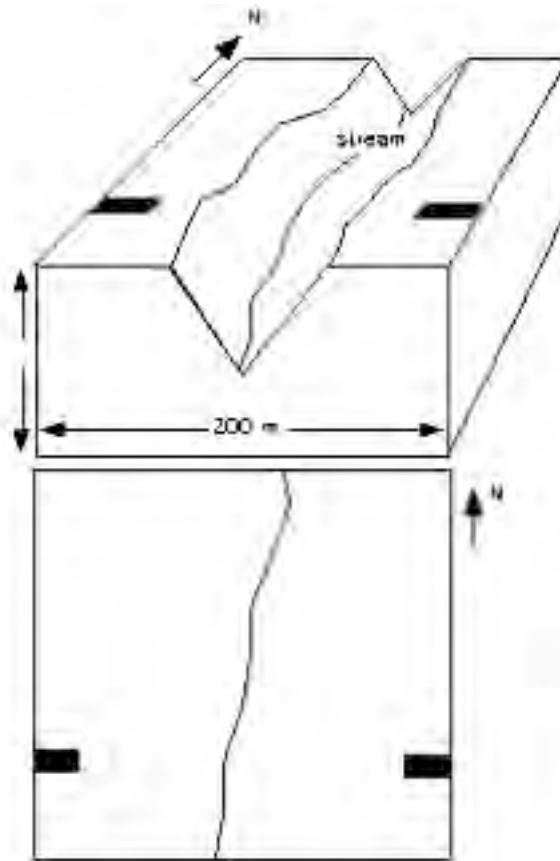
Essay questions:

13. **(6)** There are three distinct ways to partially melt a rock. Which of these three causes partial melting at mid-ocean ridges? At subduction zones? What types of rocks are produced in each of these settings?

14. **(3)** How are large oceanic plateaus and flood basalt provinces related to mantle plumes?

15. **(3)** Explain the sequence of events that lead to the formation of oxbow lakes.

20. (3) On the block diagram below, the black rectangles show parts of outcrops of a dike that dips 30° to the north. On the diagram and the map view below it, sketch the complete outcrop pattern of this dike.



21. (8) Sketch the Earth-Sun system for today and for 11,000 years ago to illustrate the cyclic process that makes glaciers increase their volume every 21,000 years. What process accounts for the differences between your two sketches?

22. **(10)** What are the two main processes that remove carbon dioxide from the atmosphere-ocean system on geological (million-year) timescales? Write down the relevant chemical equations.

23. **(7)** How do we know the bulk composition of the earth? Describe three lines of evidence.

24. **(6)** What characteristics distinguish the inner planets from the outer planets? How did these differences arise?

25. (6) Two key processes occurred/developed on Earth and caused the atmosphere to become enriched in oxygen. Briefly describe each process and how it led to the relative enrichment in free oxygen.

26. (5) Partial melting of the mantle produces basaltic liquids. Yet continents contain appreciable volumes of granite. How can such large volumes of granite be produced?

27. (4) Why are there no Precambrian coal deposits?

28. (5) A new planet has been discovered and we would like to know whether plate tectonics is occurring on this planet. What types of evidence should we look for?

29. (4) Why is the slip rate on the section of the San Andreas fault east of San Diego only 2 cm/yr while the full rate of motion between the Pacific and North American plates is ~5 cm/yr.?

30. **(6)** What are two lines of evidence that subduction occurred beneath California during the Mesozoic? How does this differ from the present day tectonic setting?

31. **(8)** Explain in detail how seafloor magnetic anomalies were key in the acceptance of the theory of plate tectonics.

32. **(8)** This question requires some integration of what you have learned, to address a problem that is unfamiliar. If seafloor spreading rates were doubled, then held at this high level for hundreds of millions of years, what would happen to Earth's climate and why? How would the increased spreading rate affect sea level and why?

33. (6) Illustrate with a sketch the seismic evidence that the outer core is liquid. Use specific numerical values. What are three lines of evidence that it is made of iron?

34. (8) How do the Earth's crust, mantle and core differ in composition? Explain why this difference occurs ?

35. (8) Many of the characteristics of a section of oceanic crust are developed within the central few kilometers of the spreading center at which it is created. Sketch a cross-section of a mid-ocean ridge from the axis out a few tens of kilometers. Illustrate the relative depth of the seafloor, the nature of the upper mantle (lithosphere and asthenosphere), the crustal compositional layers. Indicate whether your drawing is typical of a fast or slow spreading ridge axis. Below the sketch, *briefly* explain the processes (for example melting, extrusion, faulting and hydrothermal activity) that occur in the various parts of the system.

36. (5) Describe in detail the two attributes of quartz (and their underlying causes) that are responsible for its high abundance in clastic sedimentary rocks.

37. (5) Explain how the concept of base level is related to the formation of entrenched meanders. What might be responsible for changes in the base level?

38. (6) Describe the sequence of events leading to the formation of economically viable oil deposits. Your description should include the environment of formation as well as tectonic and stratigraphic conditions that allow such deposits to accumulate. Why is oil one fifth as common as coal?

39. **(10)** Sketch and label a cross-section to the center of the Earth with layers based on composition, physical properties, and seismic velocity. Sketch curves of approximate S and P wave velocities. Include lithosphere, asthenosphere, crust, mantle, Moho, low velocity zone, inner core, outer core. Your sketch need not be to scale, but please draw and label clearly. Be sure to include the depth of the bottom of each layer.