

Name: _____

ERTH 1 – Planets
Instructor – Memorie Yasuda
Assigned – April 13, 2007
Due – April 20, 2007

Homework 2 – The Earth (100 points total)

- Answers must be typed, double-spaced, and printed. Except equations and hand-drawn illustrations.
- All papers must be stapled together. Name on front with initials at top right-hand side of each page.
- You will need to use the following resources as you see fit:
 1. Resources on the Web (you may want to look at the posted websites for ideas first, although you will need to look beyond that)
 2. Your textbook and any other printed materials you want to use.
 3. Notes
- You are encouraged to confer with other students, but individual answers must be original, i.e. crafted and written by individuals. No credit will be given for unusually similar responses.
- Homework is due at the start of class. No late work accepted.

A. The Basics – Short answer (30 points)

- a. What is the current scientific estimate of the age of the Earth?
- b. What is the current scientific estimate of the age the Sun?
- c. When a rock of igneous origin, such as granite, is said to be 500 million year old, what is the reference event from which the age is counted?
- d. What are the ages of the oldest and youngest rocks that make up continental crust?
- e. Why is it hard to find rocks on Earth that are more than 4 billion years old?
- f. What are the ages of the oldest and youngest rocks that make up oceanic crust?
- g. Why is there such a difference in the ages of rocks that make up oceanic vs. continental crust? Explain in less than 100 words.

B. Internal layering (30 points)

For reference **The Interior of the Earth**
 by Eugene C. Robertson
 <http://pubs.usgs.gov/gip/interior/>

Mass of the Earth	~ 6.00 x 10²⁴ kg
Mean radius of the Earth	~ 6,370 km
Volume of a sphere	= 4/3 π r³
Density of mantle	~ 5 g / cm³
Density of core	~ 12 g / cm³

- a. What's the average density of the Earth based on the known size (radius) and mass of the Earth given above? Give your answer in g / cm^3 .
- b. What would be the total mass of the Earth if it were made up entirely of mantle rock? Is this mass greater or less than the actual mass of the Earth? Show your calculations and include units in each step.
- c. Assume that you have an Earth that has only two compositional layers, mantle and core (which is close to the actual case), and that the core material is the lower layer. What size (radius) does the core need to be, in order to match the observed total mass of the Earth?

2. The Cascadia Region (40 points)

- a. What is the general name of the plate tectonic feature marked by the heavy dashed line on the map below (Fig. 1)? The upper most map shows paleomagnetic lineations on the seafloor.
 - b. How old is the basaltic crust along the strip marked by the heavy dashed line (Fig. 1)?
 - c. In which compass direction does the seafloor at Point A move (Fig. 1)?
 - d. What major plate tectonic process is taking place near the coast between Cape Mendocino and Vancouver Island (Fig. 1)?
 - e. At the time that the oceanic crust at Point A was formed, was the earth's magnetic field Normal or Reversed (Fig. 1)?
 - f. When did the oceanic crust under Point A form? You will need to use the "Paleomagnetic Age Model" (given below the map, Fig. 2) to make this determination. The paleomagnetic age model gives known information about when the Earth's magnetic field reversed in the past.
 - g. Estimate how fast new seafloor has been created, in cm/year , between the time seafloor was created at Point A and at the heavy dashed line. Estimate distance in any way you can. You might use the length of Vancouver Island as a reference for distance.
 - h. How does this value compare with modern GPS measurements of how fast the Pacific Plate moves? Is your answer in the ballpark?
- http://cfa-www.harvard.edu/space_geodesy/WUSC/
- i. Give one good reason why the value you calculated in Question 2g might differ from the GPS-based value in Question 2h. There are several good reasons why this might occur.
 - j. The Cascadia region is marked by volcanoes such as Mt. St. Helens and under the threat of large offshore earthquakes (as high as magnitude 9 and capable of generating tsunami). Explain, in a sentence or two, why we do not face the same dangers in southern California. In southern California, we have no major stratovolcanoes and the magnitudes of the largest earthquakes have been in the high 7s. You may want to refer to the reference diagram showing the setting of the San Andreas Fault Zone, given below (Fig. 3).

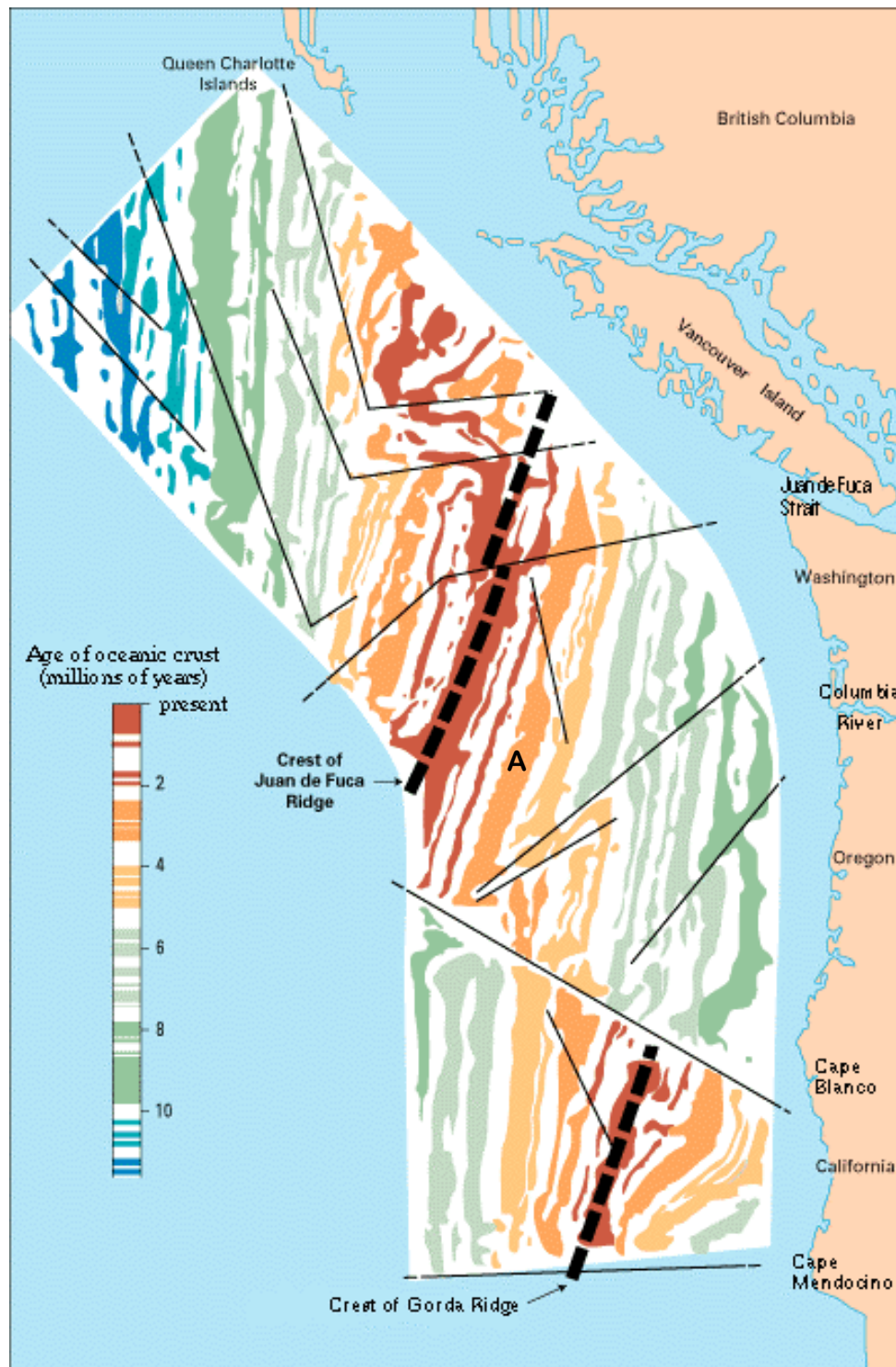


Figure 1. Pattern of seafloor paleomagnetic reversals recorded in oceanic crust in the Cascadia region.

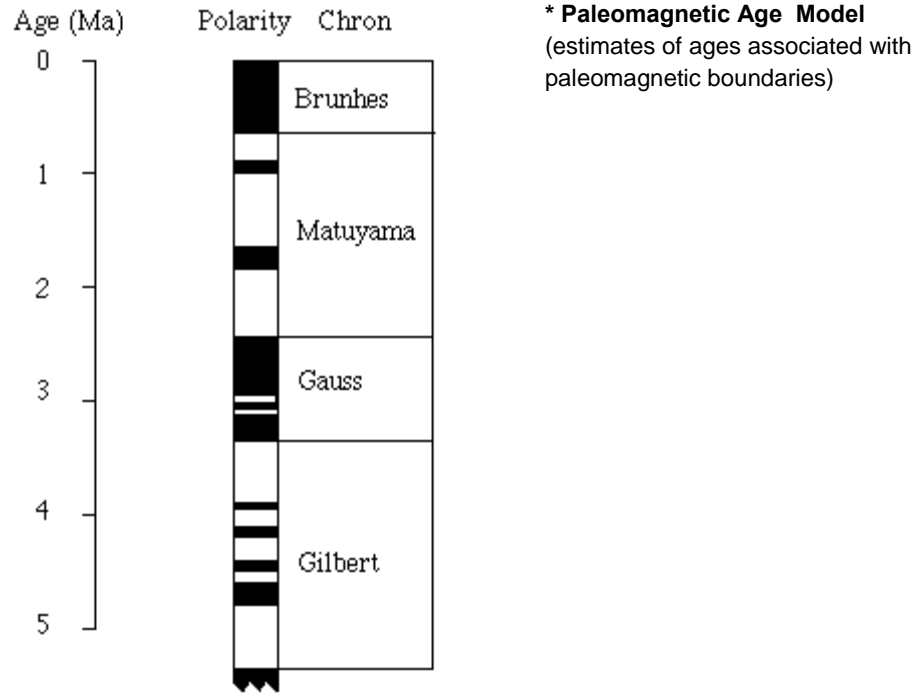


Figure 2. Paleomagnetic age model or time-scale.

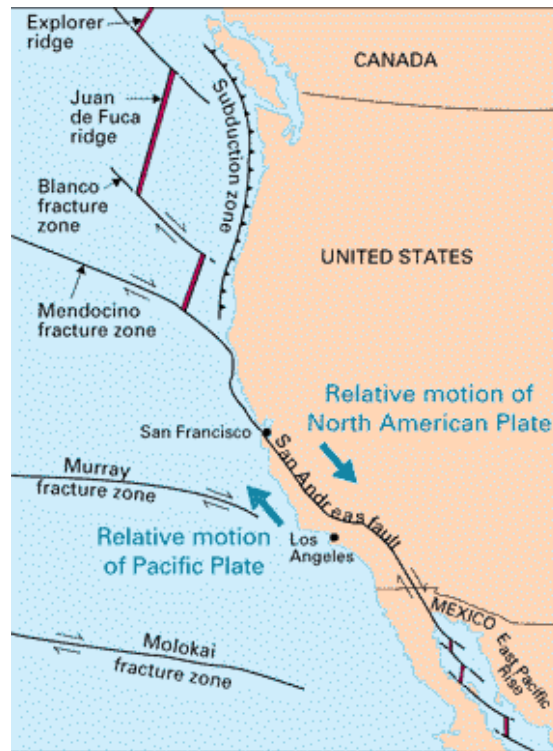


Figure 3. General plate tectonic setting along the west coast of the U.S.