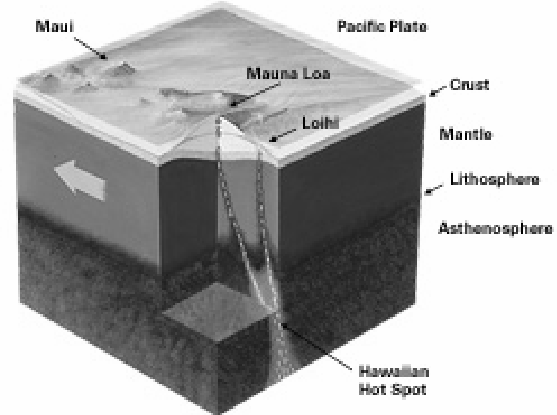


Laboratory # _____

Hawaii Hotspot (Crustal Plate Movement)

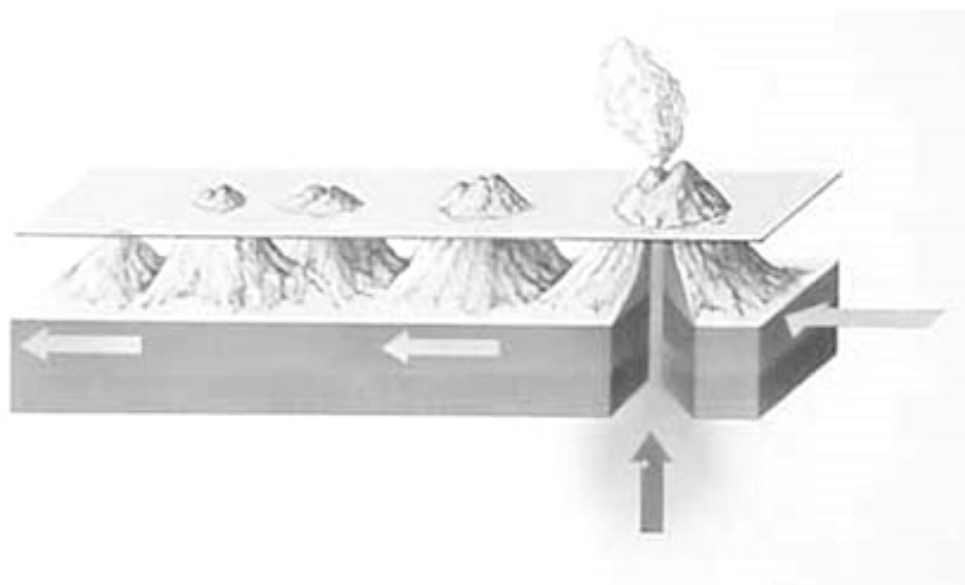


Introduction:

Plate tectonics has been an accepted theory since the 1960's. According to this theory, the crust of the Earth is composed of plates that move **over the asthenosphere**. There are two basic types of plates: **heavy, thin and dense oceanic plates, which are primarily composed of basalt; and thick, lighter continental plates, which are comprised of silicate rocks (granite).** .

Movement of the Pacific plate over the Hawaiian Hot Spot:

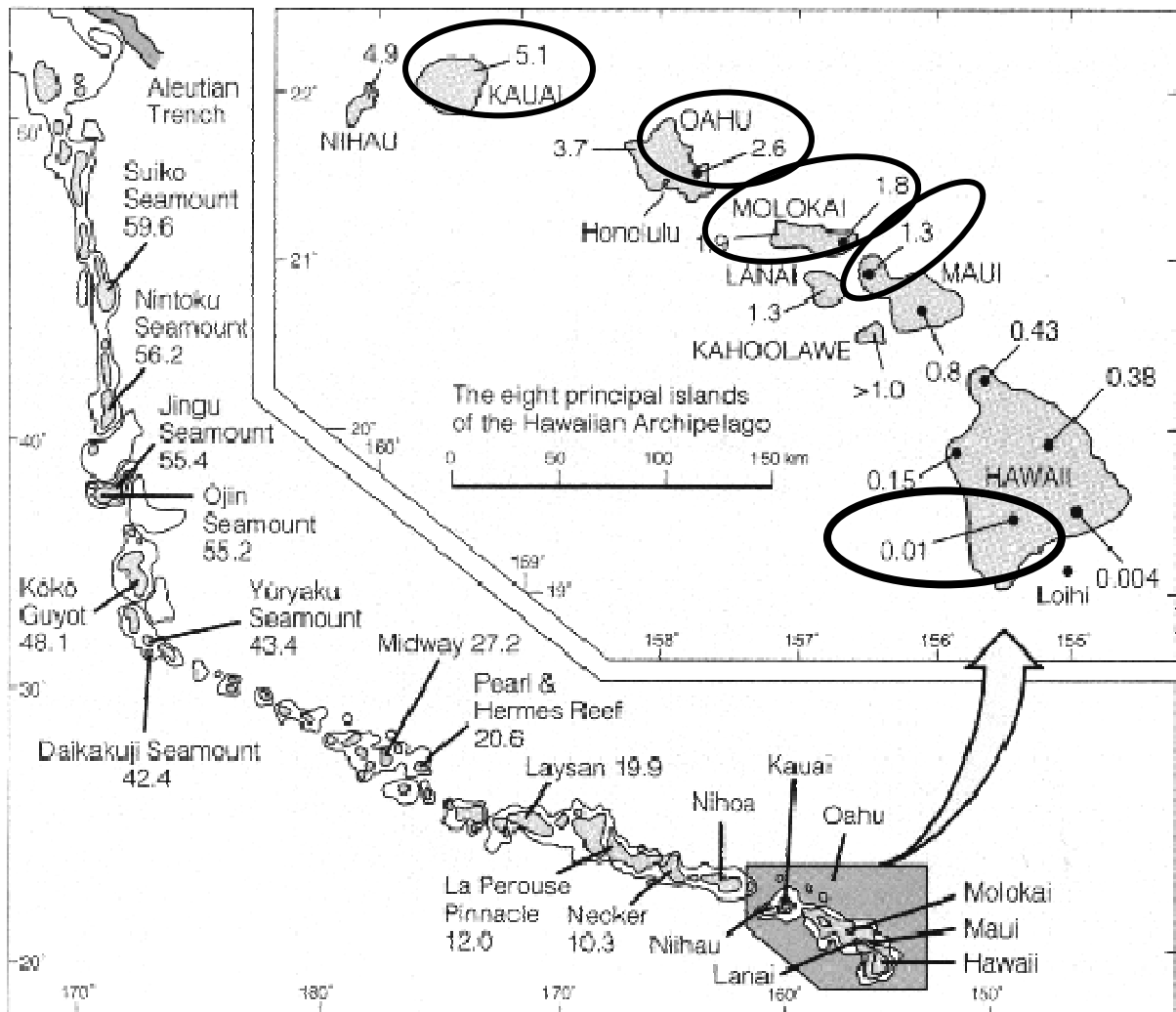
The idea behind plate tectonics is that the crustal plates are moving with respect to one another over geologic time. The rates of movement of crustal plates can be determined by using data from the plate margins along the mid-ocean ridges, or at regions known as "**HOTSPOTS**" where the distance and age can be measured. The Hawaiian Islands are volcanic islands which are produced as superheated molten material rises upward from deep within the mantle. As the molten material breaks through weak places in the crustal plate a new "island" will form.



Procedures:

1. Using **Map 1** on this page and the absolute dates of lava in bold black numbers that represent **millions of years before the present**. Calculate the age difference between the islands and enter the data in the table on page 3.
2. Make distance measurements between the “dots” of each circle using the scale on the diagram.
3. Convert the distance from kilometers to “land” or “real” centimeters (**NOT what you measure on the map!**) by multiplying the distance in KM by 100,000 (which is the number of cm in 1 km. HINT: This will be a **big** number!
4. Hawaii contains an active volcano, Mauna Loa, so the lava from it is zero years old (labeled **“.01”**). The lava on Kauai Island is 5.1 million years old. Thus, according to the hot spot hypothesis, Kauai Island was once an active volcano standing where Hawaii stands today.

Map 1



Islands	Distance (km)	Land Distance (cm)	Difference in Age (years)	Rate of Movement (cm/year)
Hawaii - Maui				
Maui - Molokai				
Molokai - Oahu				
Oahu - Kauai				

5. Figure the rate in centimeters per year using the distances from Hawaii to each of the three dated lavas on the map and the following rate equation.

$$\text{Rate of Movement} = \frac{\text{Distance between islands (cm)}}{\text{Difference in Age (years)}}$$

Round your answers to the nearest tenth (0.1 cm/year)

6. Now calculate the *average speed* of crustal movement and round to the nearest 0.1.

$$\text{Average rate} = \underline{\hspace{2cm}} \text{ cm/year}$$

7. In which direction was the crustal plate apparently moving when the Hawaiian Islands were formed? _____

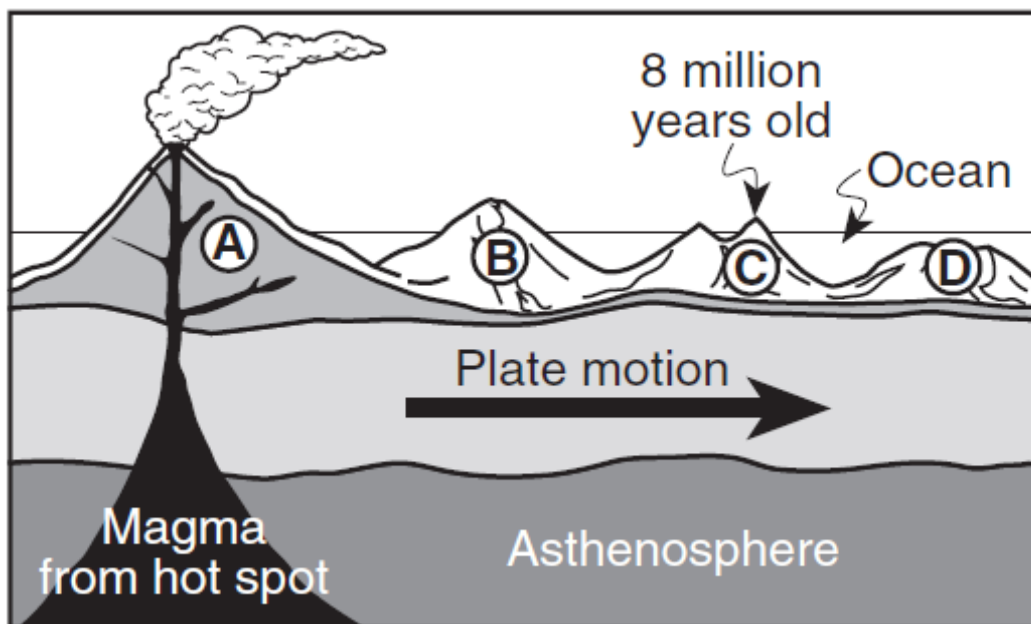
8. Explain how you can tell. _____

9. According to your data, did the crustal plate always move at the same speed? Explain your answer. _____

10. Convection currents in the plastic mantle are believed to cause divergence of lithospheric plates at the

- (1) Peru-Chile Trench
- (2) Mariana Trench
- (3) Canary Islands Hot Spot
- (4) Iceland Hot Spot

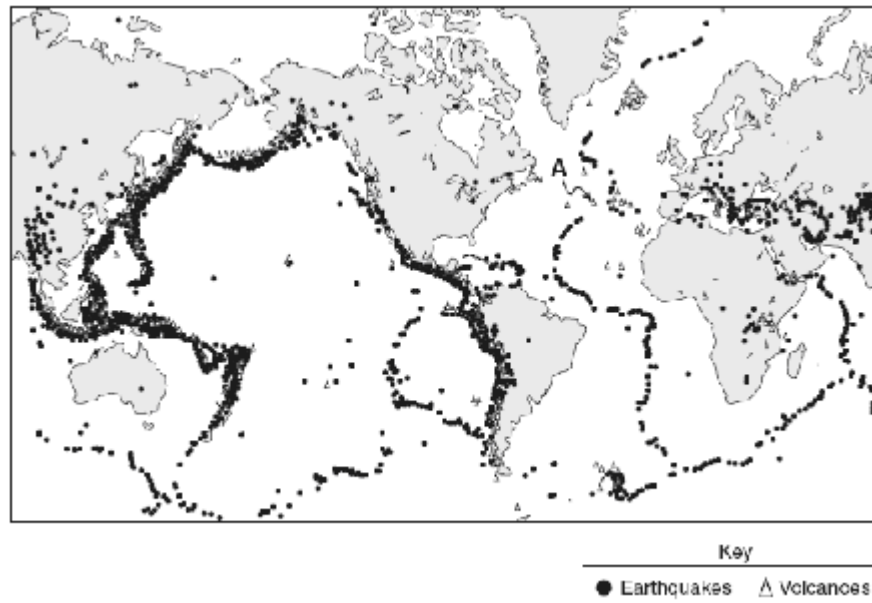
The cross section below shows the direction of movement of an oceanic plate over a mantle hot spot, resulting in the formation of a chain of volcanoes labeled *A*, *B*, *C*, and *D*. The geologic age of volcano *C* is shown.



11. What are the most likely geologic ages of volcanoes *B* and *D*?

- (1) *B* is 5 million years old and *D* is 12 million years old.
- (2) *B* is 2 million years old and *D* is 6 million years old.
- (3) *B* is 9 million years old and *D* is 9 million years old.
- (4) *B* is 10 million years old and *D* is 4 million years old.

Base your answer to the question on the world map below and on your knowledge of Earth science. The map shows major earthquakes and volcanic activity occurring from 1996 through 2000. Letter A represents a volcano on a crustal plate boundary.



12. Explain why most major earthquakes are found in specific zones instead of being randomly scattered across Earth's surface.

13. Identify the source of the magma for the volcanic activity in Hawaii.

14. Identify the type of plate movement responsible for the presence of the volcano at location A.