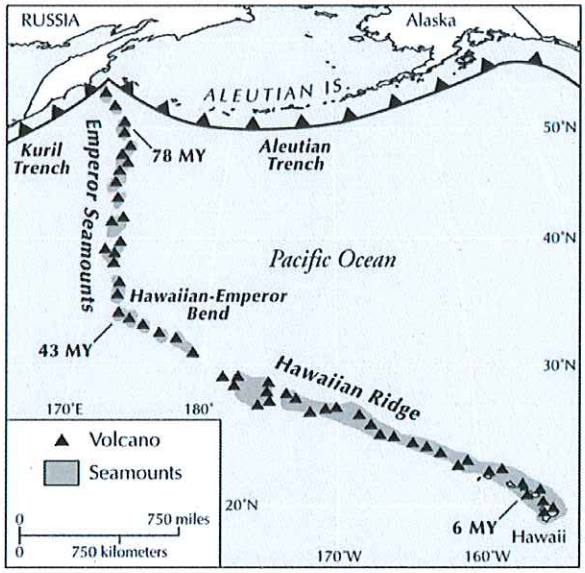
Name KEY

How Fast is the Pacific Plate Moving?

The Hawaiian Islands are part of a long chain of islands and seamounts (including the Emperor Seamounts) extending into the northern Pacific ocean where they are being subducted down a deep ocean trench. This chain of volcanic islands and seamounts was formed as the Pacific plate moved over a relatively stationary mantle hot spot. The current position of the hot spot can be assumed to be under Kilauea (the site of active volcanism) on the Big Island of Hawaii.



The volcanoes of this chain became extinct as they moved off the mantle hot spot (carried on the Pacific plate) and get progressively older further away from the position of the hot spot. From the figure, it is clear that the current direction of motion of the Pacific Plate is to the West-Northwest. Approximately 43 million years ago, the plate changed its relative direction of motion — it had previously been moving in a more northerly direction greater than 43 million years ago.

The rate at which the Pacific plate is moving over the Hawaiian hot spot can be easily estimated from the geographic and age data. In this activity, calculate the average rate of motion (km/year and cm/year) of the Pacific plate based on data from 5 different Hawaiian Islands. The distance of each island can be estimated using the map bar scale. Assume that the hotspot is located beneath the Big Island of Hawaii. Measure the distances from the volcanic centers indicated by the red stars on the map.

The table includes average age data for the volcanic rocks on each island. These age data were obtained by *radiometric techniques* that measure the age of the rock since it formed (similar to carbon dating). The rate of motion is simply the distance divided by time — in this case the distance from the hot spot and the age of the island.

Please fill in the blanks in the table and answer the questions below. Please show your work (calculations) for the answers to the questions and don't forget to use the units to get credit for your answer.

Name KEY

Island	Distance from hot spot (km)	Approximate age of island (year)	Rate of motion (km/year)	Rate of motion (cm/year)
Hawaii	0	0	—	—
Maui	210	1,100,000	0.00019	19
Molokai	(65 + 210) 275	1,800,000	0.00015	15
Oahu	(275 + 110) 385	3,100,000	0.00012	12
Kauai	(175 + 385) 560	4,100,000	0.00013	13
Niihau	(70 + 560) 630	4,900,000	0.00013	13

Conversion factor: 1 km = 1000 m = 100,000 cm

What is the average rate of motion of the Pacific plate (cm/year)?

$$\frac{(19+15+12+13+13)\ cm/yr}{5} = \frac{72}{5} = 14.4\ cm/y$$

How far will the island of Hawaii move (relative to the hotspot) in 50 years (give you answer in km)?

$$(50\ y)\left(14.4\ \frac{cm}{y}\right)\left(\frac{1\ km}{100{,}000\ cm}\right) = 0.0072\ km$$

How far will the island of Hawaii move (relative to the hotspot) in 1 million years (give your answer in km)?

$$(1{,}000{,}000\ y)\left(14.4\ \frac{cm}{y}\right)\left(\frac{1\ km}{100{,}000\ cm}\right) = 144\ km$$

How far will the island of Hawaii move (relative to the hotspot) in 10 million years (give your answer in km)?

$$(10{,}000{,}000\ y)\left(14.4\ \frac{cm}{y}\right)\left(\frac{1\ km}{100{,}000\ cm}\right) = 1440\ km$$

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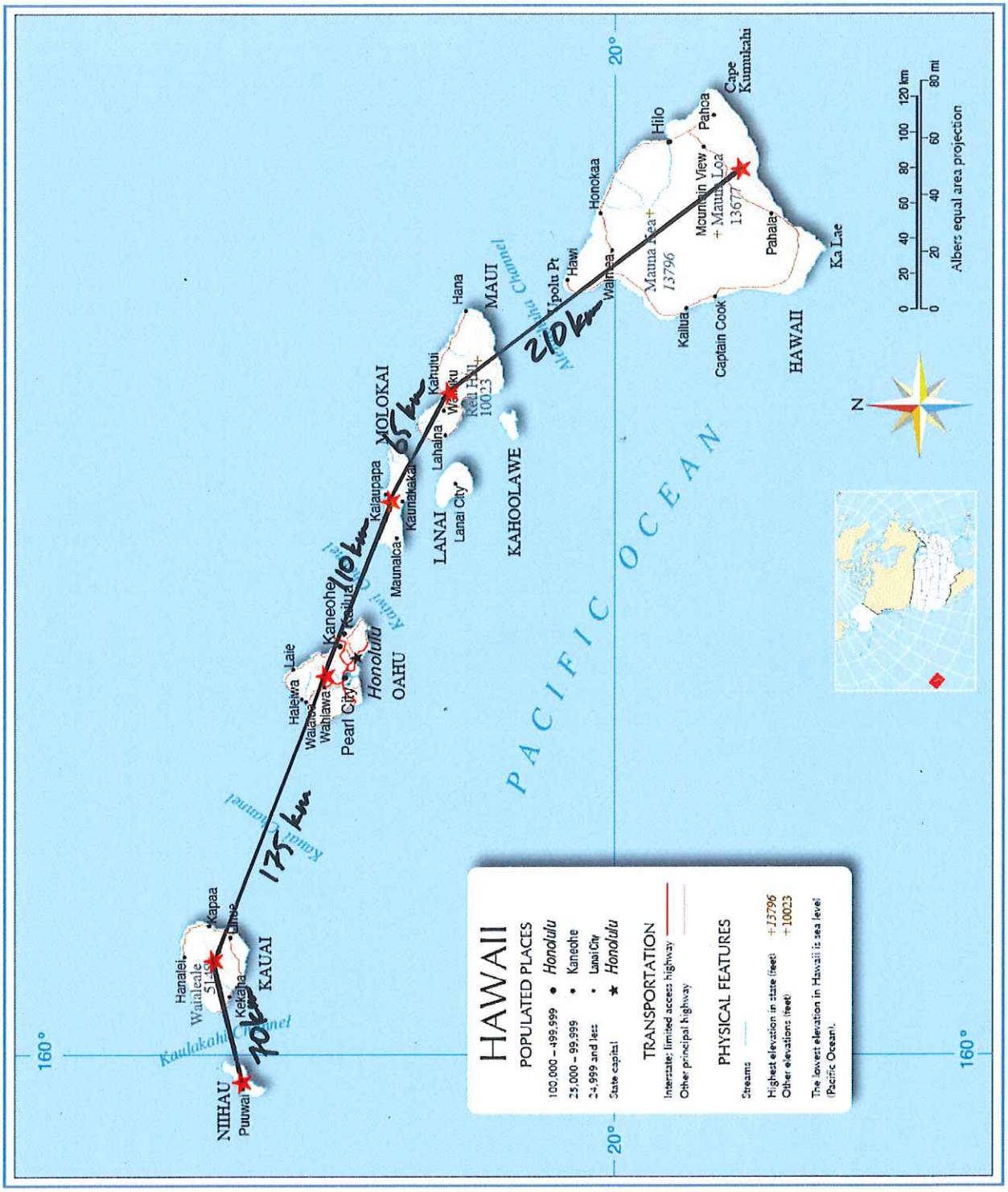

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