Plate Tectonic Travel

Geology 1P — Mr. Traeger

Name: Key Period: all Date: 12/5/02

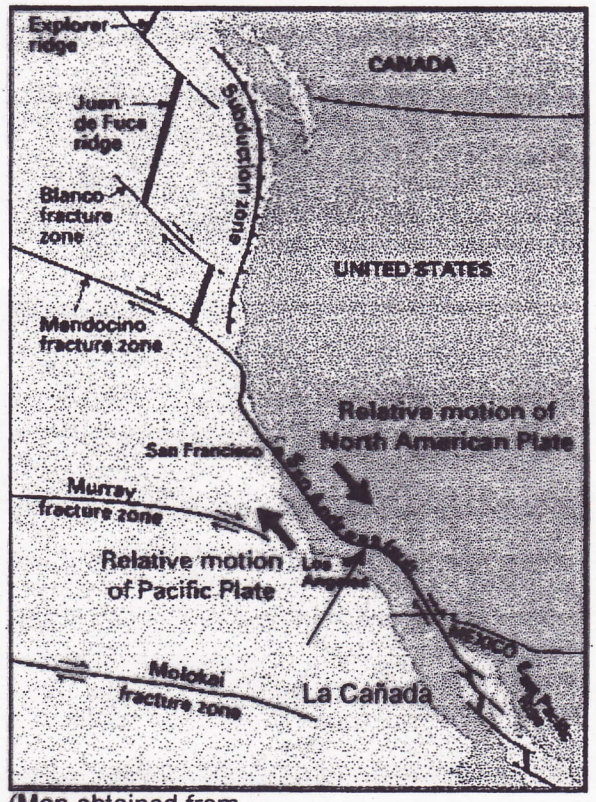
Background

The speed in which Earth's tectonic plates move is almost imperceptible within our lifetime. We know that the plates are moving because we can use satellites in space to detect the movement. This is called *geodesy*. We can also detect the movement by studying trends in the magnetic North-South orientation of rock cores at mid-ocean ridges.

The span of geologic time is so great that we must measure time in thousands or millions of years. Current estimates date the age of the earth to be 4.6 BILLION years old! If you wrote that number out, you would get 4,600,000,000. If you wrote it in scientific notation, you would get 4.6×10^9 years. You could think of this HUGE number also as 4 BILLION, 600 MILLION years old! This seems like an eternity compared to our average life span of around 65 years.

Your Task

Your task for this assignment is to calculate the movement of the Pacific Plate in relation to the North American Plate.



(Map obtained from http://pubs.usgs.gov/publications/text/understanding.html)

Use the map above to do the calculations. $r \times t = d$

1) If the relative motion of the plates indicates that we (here in La Cañada) are moving toward San Francisco at an average rate of 5 centimeters per year, how far would we move over a time of: **(Make sure to *show* your work!)** $r \times t = d$ $r = 5 \frac{cm}{yr}$ $t = 65\ yrs$

a) 65 years?

$65\ yr \times 5 \frac{cm}{yr} = 325\ cm$

$325 \frac{cm}{yr} \left(\frac{1\ m}{100\ cm}\right) = 3.25 \frac{m}{yr}$

$3.25 \frac{m}{yr} \left(\frac{1\ Km}{1000\ m}\right) = 0.00325\ Km$

5 to the left

b 5000 cm or 50m or 0.05 Km

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$r \times t = d$

b) **11,000 years?** The last ice age occurred this long ago.

$11{,}000\ yr\left(5\ \frac{cm}{yr}\right) = 55{,}000\ cm$

$55{,}000\ cm\left(\frac{1\ m}{100\ cm}\right) = 550\ m$

$550\ m\left(\frac{1\ Km}{1000\ m}\right) = 0.55\ Km$

c) **1,000,000 (1.0×10^6) years?**

$(1\times10^6\ yr)\left(5\ \frac{cm}{yr}\right) = 5\times10^6\ cm = 5{,}000{,}000\ cm$

$5\times10^6\ cm\left(\frac{1\ m}{100\ cm}\right) = 5\times10^4\ m = 50000\ m$

$5\times10^4\ m\left(\frac{1\ Km}{1000\ m}\right) = 50\ Km = 5\times10^1$

d) **11,000,000 (1.1×10^7) years?**

$\left(1.1\times10^7\ yr\right)\left(5\ \frac{cm}{yr}\right) = 5.5\times10^7\ cm = 55{,}000{,}000\ cm$

$5.5\times10^7\ cm\left(\frac{1\ m}{100\ cm}\right) = 5.5\times10^5\ m = 550{,}000\ m$

$5.5\times10^5\ m\left(\frac{1\ Km}{1000\ m}\right) = 550\ Km$

e) **4,600,000,000 (4.6×10^9) years? What significance does this number have?**

$4.6\times10^9\ yr\left(\frac{5\ cm}{yr}\right) = 2.3\times10^{10}\ cm$

$2.3\times10^{10}\ cm\left(\frac{1\ m}{100\ cm}\right) = 2.3\times10^8\ m$

$2.3\times10^8\ m\left(\frac{1\ Km}{1000\ m}\right) = 2.3\times10^5\ Km$

Age of Earth

2) Now, go back to all parts in #1 and convert the distances you found into meters and then into kilometers.

3) **If the distance between La Cañada High School and San Francisco is 617 Kilometers, how long will it take us to become neighbors with San Francisco?**

$r \times t = d \qquad t = \frac{d}{r}$

$t = \frac{617\ Km}{5\times10^{-5}\ \frac{Km}{yr}} = 1.234\times10^7\ years$ or $12{,}340{,}000\ years$

$\left(5\ \frac{cm}{yr}\right)\left(\frac{1\ m}{100\ cm}\right)\left(\frac{1\ Km}{1000\ m}\right) = 5\times10^{-5}$ 0.00005

4) **If the direction of the Pacific Plate shifts to due north after reaching San Francisco, how long will it take us to reach the North Pole from La Cañada?** San Francisco is at about 38° North latitude and there are 111 kilometers per every degree of latitude. You will need to consult your world map for this one.

North Pole = 90°

$t = \frac{d}{r}$

$90^\circ - 38^\circ = 52^\circ$

$52^\circ\left(\frac{111\ Km}{1\ degree}\right) = 5772\ Km$

$5772\ Km + 617\ Km = 6389\ Km$

$t = \frac{6389\ Km}{5\times10^{-5}\ \frac{Km}{yr}} = 127{,}780{,}000\ yrs = 1.28\times10^8\ yrs.$

5) **Look at the map on pages 712 to 713 in your book. Would it be possible for the Pacific Plate to continue traveling northward all the way to the North Pole? Why or why not?**

NO, the Pacific Plate would subduct near Alaska.

Rock Cycle