Name:_____Class:_____ Date: _____EN:____

Polar Wandering

The Earth keeps a record of the location of its poles. That record is written in the rocks. But it is not written in words, it is written in a form of magnetic memory. (A little like in a computer!) We call that record the rocks' paleomagnetism.

Above a temperature know as the Curie temperature, atoms of iron are free to line up in any direction. However, they usually align with the direction of the magnetic field of planet Earth. When the rock cools below the Curie temperature, that magnetic alignment is frozen in the rock, and will not change unless the rock is heated. Sensitive instruments can then be used to measure the magnetic orientation in the rocks. Using several lava flows from the same time period enables geologists to locate the magnetic poles for that particular time.

Although we don't know for sure, we think that the magnetic field of the Earth is caused by convection currents within the liquid iron of the outer core. (It's too hot down there to hold magnetism the way a bar magnet does.) That magnetic field determines the positions of Earth's North and South Magnetic Poles. Although it would be nice to know the past locations of the geographic poles (as determined by the spin of the Earth), the magnetic poles are probably as close as we can get. Fortunately, the Earth's motion keeps those currents in the outer core lined up fairly well with Earth's spin axis. So the magnetic poles tend to be close to the geographic poles.

In this activity you will find evidence that the magnetic poles seem to wander over the Earth. However, closer investigation will show a very different reason for this apparent wandering of the magnetic poles.

Materials: This Lab, a Ruler, A Pencil (or a pen), Tracing Paper

Procedure:

1. Look at the map on page 2 of this lab. The arrows on the lava flows in Africa show the compass directions to Earth's Magnetic South Pole 420 million years ago. Use a ruler to determine where these lines intersect. (Make your lines very light.) Label that point, A-420. (For African data, 420 million years ago) This will show you how the data at the top of page 3 was obtained.

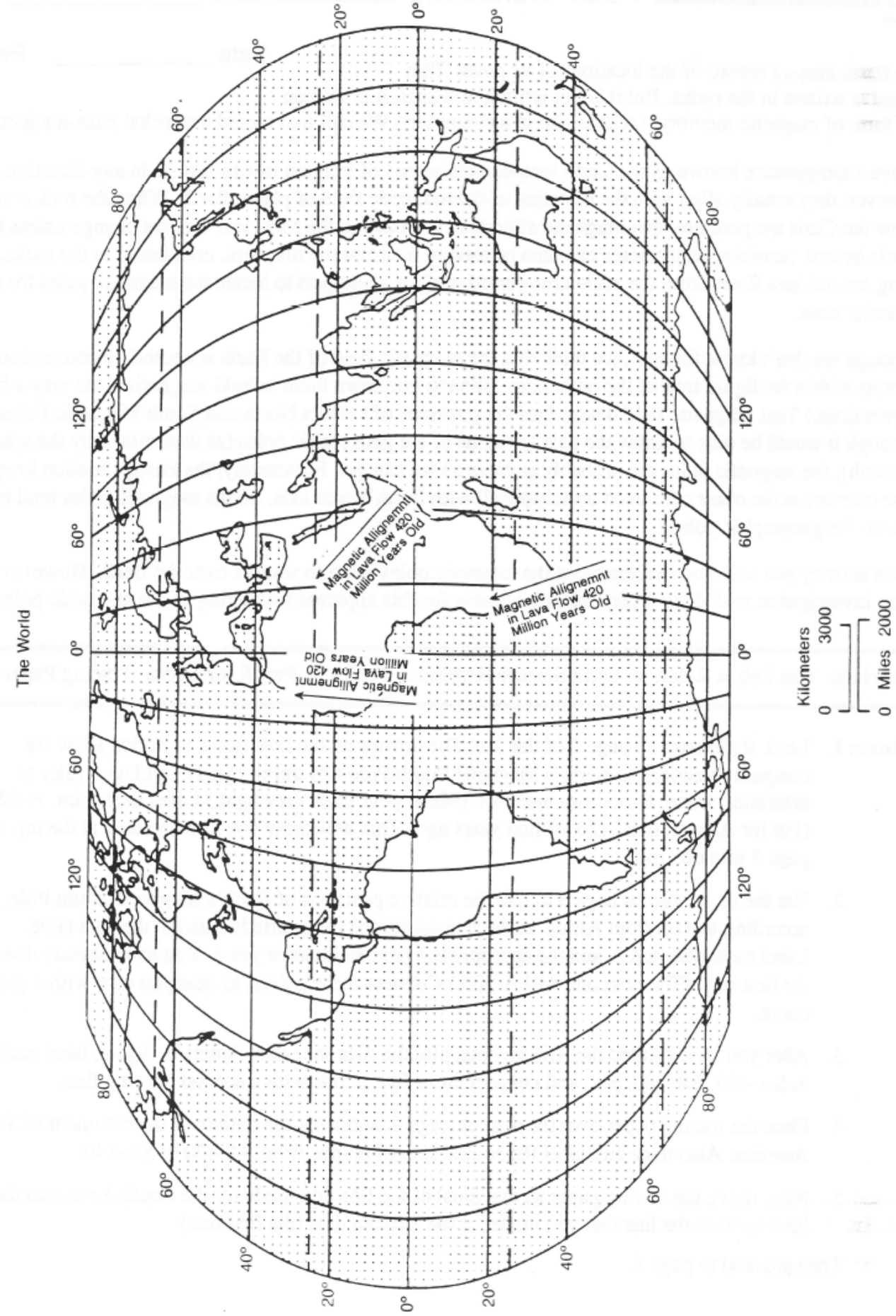
2. Use the data table on page 3 to plot the relative positions of Earth's Magnetic South Pole, according to data from Africa, in the five additional time periods listed in the data table curve.

3. After you have plotted the African data, plot the data for South America. Again, label each as SA-420, SA-380, etc., and connect these five points with a second curving line.

4. Place the tracing paper over the map on page 2, and trace the outline of the continent of South America. Also trace and label the second line of point, from SA-420 to SA-140.

5. Next, move the tracing paper so that most of the line you made for the South American data lines up with the line that you made for the African data (the first line).

Then proceed to page 4


The World
Magnetic Allignemnt in Lava Flow 420 Million Years Old
Magnetic Allignemnt in Lava Flow 420 Million Years Old
Magnetic Allignemnt in Lava Flow 420 Million Years Old
Kilometers
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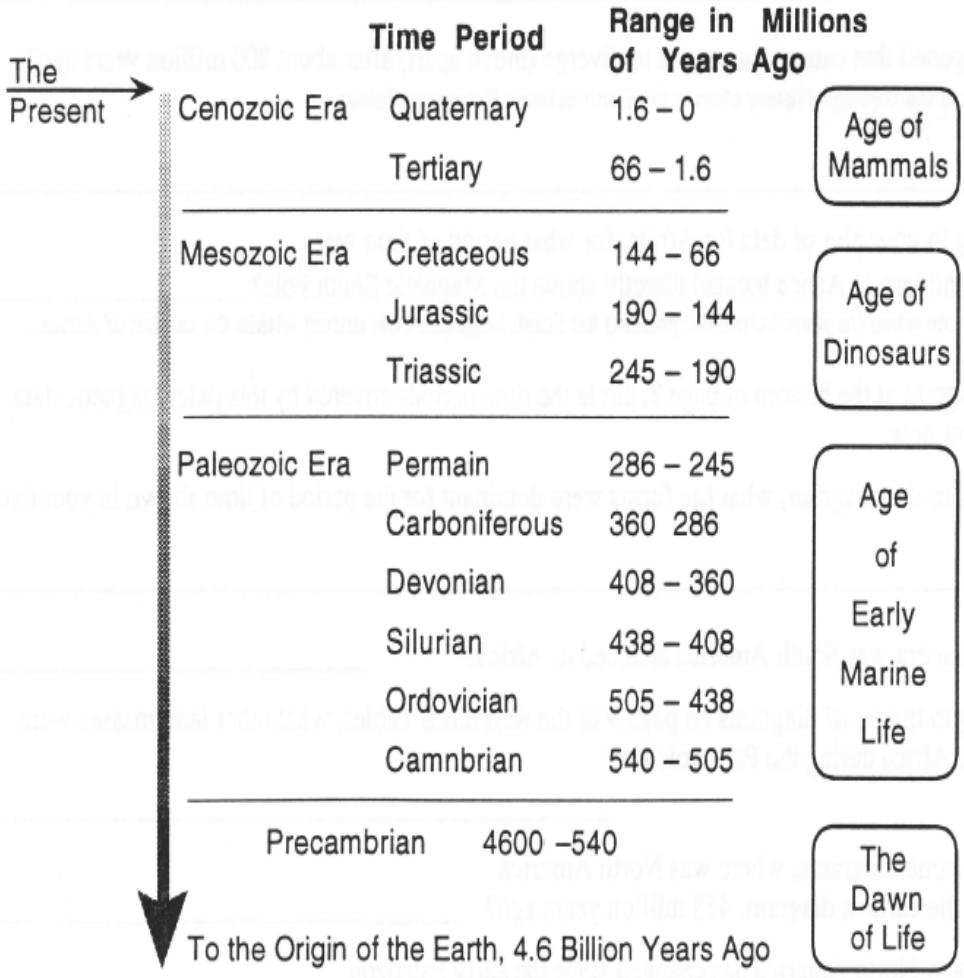
Polar Wandering Data[1]

Paleomagnetic Data for Africa				Paleomagnetic Data for South America		
	Age in Millions of Years	South Pole Latitude	South Pole Longitude	Age in Millions of Years	South Pole Latitude	South Pole Longitude
A	420	50°N	11° W	SA 420	39° N	20° W
	300	17° S	23° E	380	8° S	32° W
	260	38° S	65° E	300	35° S	36° W
	200	68° S	50° E	260	75° S	22° W
	170	67° S	98° E	140	85° S	54° E
	109	62° S	79° E			

Earth's Geologic Time Scale



[1] Data from "A Teaching Strategy Employing Polar Wandering Data, *Journal of Geologic Education*, 1977, v. 25, p. 106

Conclusion Questions:

(You will need to complete the lab procedure before you answer these questions.)

1. For the first 150 million years of data, how are the changing positions of the South Magnetic Pole, for Africa and for South America, different, and how are they similar?

2. If you move the tracing of South American data, for how many years can we match the two curves?

3. By overlapping the two curves, what else matches?

4. Scientists believe that a magnet can have only on North Pole, and one South Pole. Does the fact the Africa and South America show two different locations for the South Magnetic Pole show that our planet had two different South Magnetic Poles?

5. What *does* it show?

6. What happened that caused the curves to diverge (move apart) after about 200 million years ago? (Hint: Refer to the Geologic History Chart)

7. According to your plot of data Africa, for what period of time was the continent of Africa located directly above the Magnetic South Pole? (Hint: Just note when (in years before the present) the South Magnetic Pole drifted **within** the outline of Africa.)

8. On the diagram at bottom of page 3, circle the time periods covered by this paleomagnetic data. Circle them now.

9. According to this diagram, what life forms were dominant for the period of time shown in your data?

10. During what era was South America attached to Africa?

11. According to the Geolgic History Chart, what other land masses were attached to Africa during the Paleozoic era?

12. Using the same diagrams, where was North America located in the earliest diagram, 458 million years ago?

13. Describe how North America has changed since the early Paleozoic.