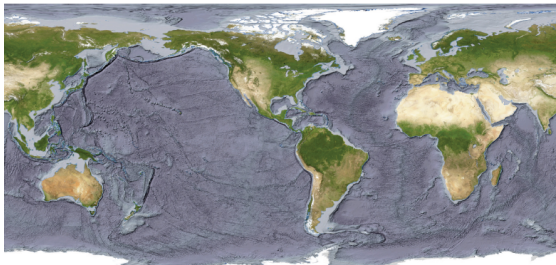

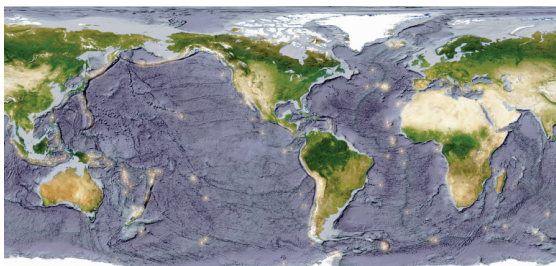



**Plate Detective.** *A tool that enables students to compile scientific data from sea floor topography, volcano distributions, earthquake distributions, sea floor age, and magnetic patterns to create a model of plate boundaries.*



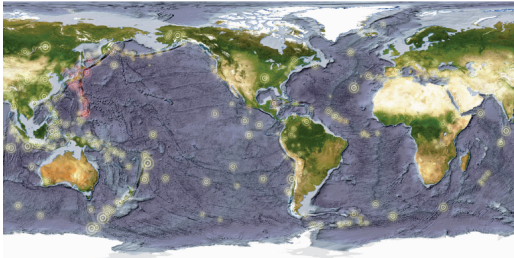
*How I Use “Plate Detective” training video*

**Summary of Use.** Place the six colored sheets inside a transparent sheet protector in the following order: sea floor map; volcanoes; earthquakes; sea floor age; magnetic patterns; answer key. Instruct students to read the title and then choose one colored marking pen to trace the evidence. Move through each sheet until a map of plate boundaries emerges. Discussion questions are included on each sheet. The answers to these questions appear below.

<p><b>Sea Floor Map</b></p> <p>How does a map of the sea floor reveal evidence for the location of plate boundaries? Use this data to create a model of plate boundaries.</p>  <p>How would knowing whether the map feature was a ridge or trench lead us to predict the type of plate boundary?</p> 	<p><i>How would knowing whether the map feature was a ridge or trench lead us to predict the type of plate boundary?</i></p> <p>Ridges like the Mid-Atlantic Ridge are usually associated with divergent boundaries. Trenches are usually associated with convergent boundaries.</p>
<p><b>Volcano Data Set</b></p> <p>How does a map of volcanoes reveal evidence for the location of plate boundaries? Use this data to create a model of plate boundary locations and types.</p>  <p>How do we explain the location of isolated volcanoes (like the Hawaiian Islands) in the model? Can the uneven distribution of volcanoes on the planet—concentrated in the ring of fire—lead us to predict the type of boundary?</p> 	<p><i>How do we explain the location of isolated volcanoes (like the Hawaiian Islands) in the model?</i></p> <p>The model does not explain them. Models have limitations. This model describes volcanic activity at plate boundaries. The Hawaiian Islands have volcanoes that arise by a different mechanism, hot spots!</p> <p><i>Can the uneven distribution of volcanoes on the planet—concentrated in the ring of fire—lead us to predict the type of boundary?</i></p> <p>The data will reveal that the Pacific is ringed by subduction zones of the convergent boundaries arising from a fast growing/moving Pacific plate.</p> <p><i>Can the students locate the “Ring of Fire”?</i></p>

#### Earthquake Data Set

How do earthquakes provide evidence for the location of plate boundaries? Earthquakes that occurred at shallow depths are shown in yellow. Deep earthquakes are shown in red. Use this data to create a model of plate boundaries.



Can we use the depth information to predict the type of plate boundary?  
Should the model accommodate all of the earthquake data?  
How do we explain data that does not fit easily into the model?



*Can we use the depth information to predict the type of plate boundary?*

Yes. Deep earthquakes occur at subduction zones of convergent boundaries. Shallow earthquakes occur at transform boundaries.

*Should the model accommodate all of the earthquake data?*

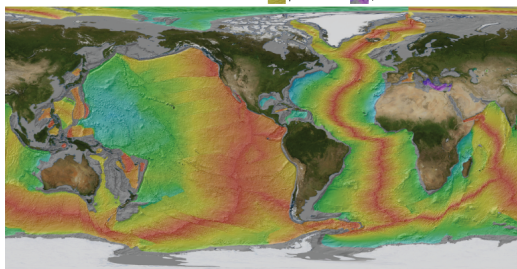
No. Ancient plate boundaries exist that are still geologically active.

*How do we explain data that does not fit easily into the model?*

We need to either refine our model or recognize that all models have limitations.

#### Sea Floor Age

How does a map of the age of the sea floor reveal evidence for the location of plate boundaries? Use this data to create a model of plate boundary locations and types.



Can we identify different types (convergent, divergent, transform) of plate boundaries?  
Consider the Atlantic and Pacific coasts of North America. What does the difference in width of the red/orange/yellow regions tell us?



*Can we identify different types (convergent, divergent, transform) of plate boundaries?*

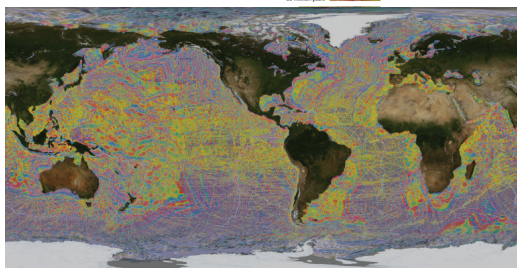
Yes. Divergent boundaries produce new crust and are red on the map. Convergent boundaries occur when plates collide and colors are very different. See the collision of Philippine Plate and Pacific Plate where orange meets blue, respectively. Transform boundaries are easily seen close to the divergent boundaries. A divergent boundary grows at different rates and the banding that is seen in the eastern Pacific derives from divergent boundaries that are offset and connected by transform boundaries. These transform boundaries produce a striping feature that runs horizontal across this portion of the Pacific.

*Consider the Atlantic and Pacific coasts of North America. What does the difference in width of the red/orange/yellow regions tell us?*

Divergent boundaries produce crust at different rates. The width of a "new crust" red area is large if crust is produced fast (like the Pacific), but is narrow if crust is produced more slowly (like the Atlantic).

#### Magnetic Patterns

How does a map of magnetic patterns reveal evidence for the location of plate boundaries?



Why is it fortunate that the first data was collected in the North Atlantic?  
What does the direction and symmetry of the banding pattern in the North Atlantic reveal?  
How can we estimate the time of a magnetic pole reversal? See the inset for a hint.



*Is it fortunate that the first data was collected in the North Atlantic?*

Yes. The Pacific is more complicated.

*What does the direction and symmetry of the banding pattern in the North Atlantic reveal?*

That crust grew out from the mid-Atlantic ridge pushing the continents apart horizontally (as depicted).

*How can we estimate the time of a magnetic pole reversal (See the inset for a hint)?*

By dividing the total amount of time by the number of magnetic reversals (colored bands) we count, we can estimate the value. The data shown here do not provide the most accurate of measurements, because it is hard to count bands. Mathematically, 10 million years/9 bands = about 1 million years per reversal.

## Current map answer key

*What is missing and why?*

Not all the plate boundaries are shown (arrows) because scientists have not located them with 100% certainty yet.