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Bathymetric Maps and Plate Tectonics

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Key Questions

- What is a bathymetric map?
- What is plate tectonics, and what are the chief tectonic plates of Earth's lithosphere?
- What will Earth's surface look like in 50 million years?



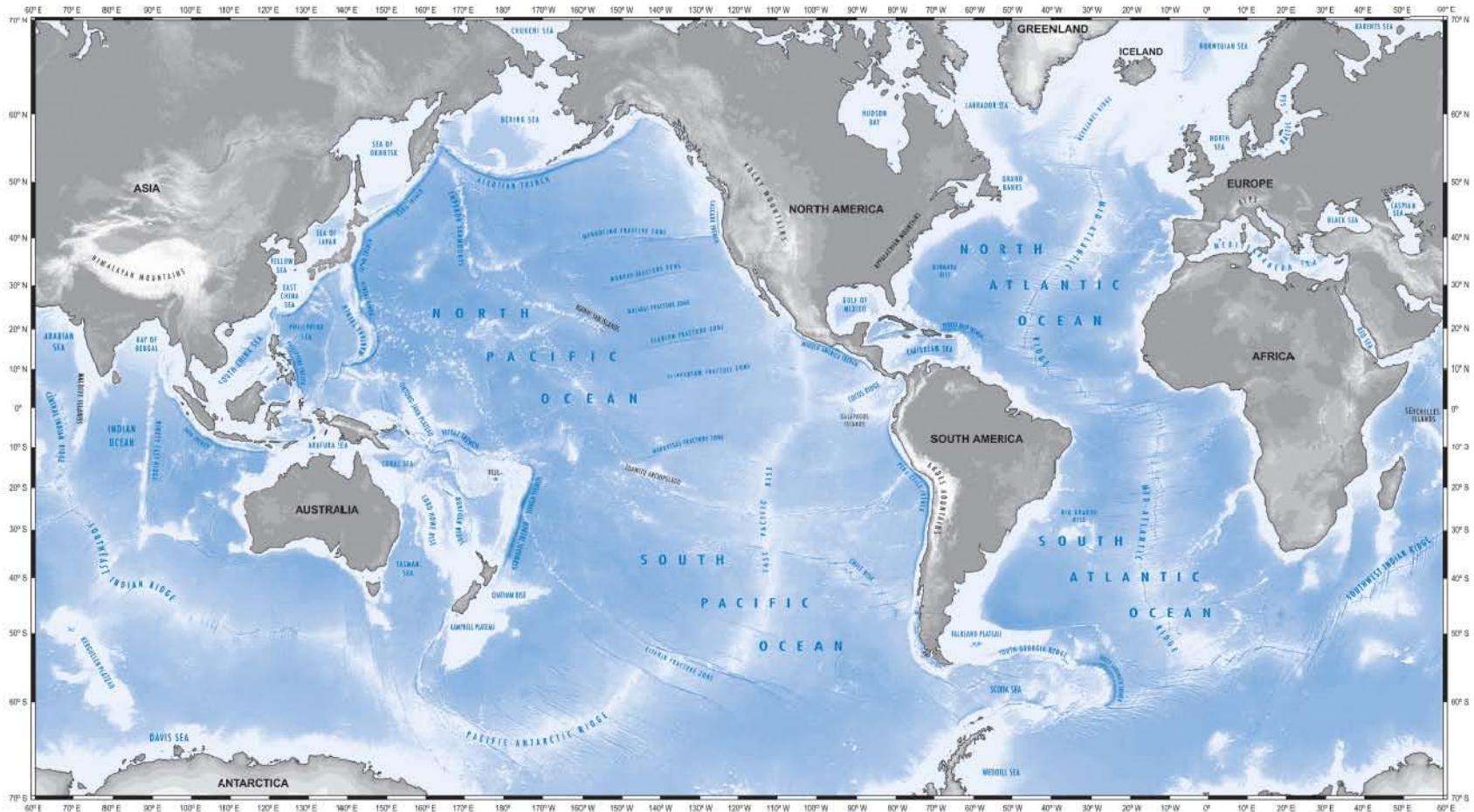
What is a bathymetric map?

- Look at your bathymetric map
- What features do you see?

The Bathymetric Map

SCALE = 1: 101,000,000, AT EQUATOR

with Land Topography - Mercator Projection



Map data assembled by W.H.F. Smith and D.T. Sandwell with funding from NASA and NSF.
Map generated using Generic Mapping Tools (GMT).



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What features do you see?



What is a bathymetric map?

- **Bathymetry** is from the Greek: bathos = deep, and metry = measure
- A **bathymetric map** shows what the ocean floor would look like if all the water drained out
- Bathymetric data from the oceans is used to help us understand **plate tectonics**



Some interesting tidbits about bathymetry

- Many got their first look at the ocean floor in the late '60s, when **National Geographic** published bathymetric maps of the ocean
- More is known about the surface of Venus, Mars, and the dark side of the moon
- **Satellite Altimetry** is an advancement over acoustic pulse/sonar mapping technology
- Recommended Reading:
 - ***Mapping The Deep* by Robert Kunzig**



Plate Tectonics

- Earth's **lithosphere** = crust + thin part of upper mantle
- Large pieces of Earth's lithosphere move about like rafts on a river
- These “rafts” are called lithospheric plates
- Two types of lithosphere:
 - Oceanic lithosphere (younger, more dense)
 - Continental lithosphere (MUCH older)
- Plate tectonics is the study of the lithospheric plates - and how they move



What we will do with the bathymetric map

- Identify seven major tectonic plates
 - Boundaries from geologic data
 - Boundaries from earthquake data
 - Boundaries from volcano data
- Figure out in what directions the plates move
- Color and Cut the plates
- Move the plates to model what Earth's surface will look like in 50 million years



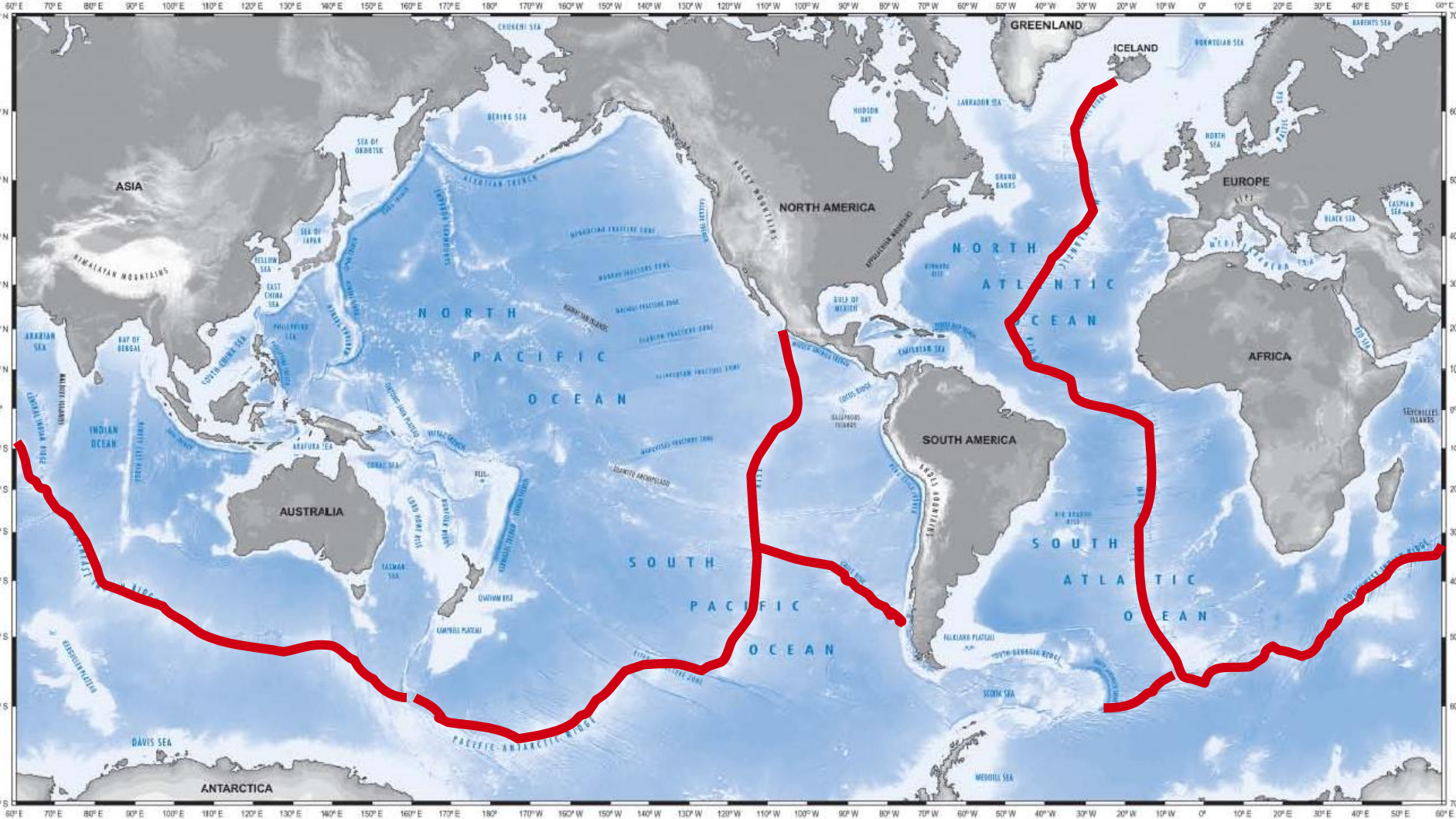
Begin to find plate boundaries

- Ocean ridges, rises, and deep ocean trenches are all geologic features that are formed at plate boundaries
- Let's use these features to draw some of our plate boundaries
- Use a colored pencil to trace over the ridges and rises (white areas). ***What do these lines represent?***

Obvious Divergent Boundaries

SCALE = 1: 101,000,000, AT EQUATOR

with Land Topography - Mercator Projection



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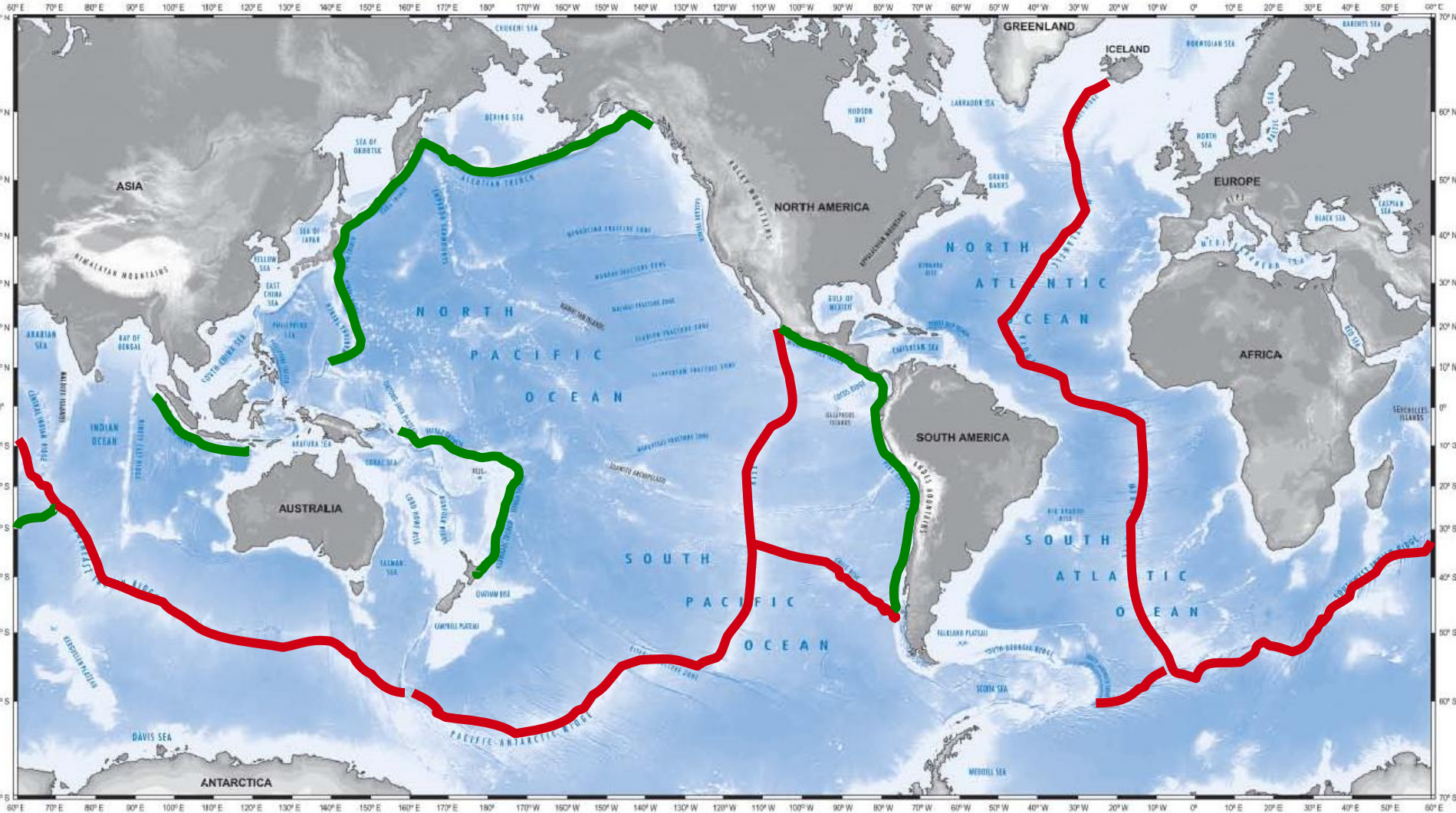
Continue finding plate boundaries

- Use a colored pencil to trace over the trenches.
- What color will these be on the map?
- ***What do these lines represent?***

Obvious Convergent Boundaries

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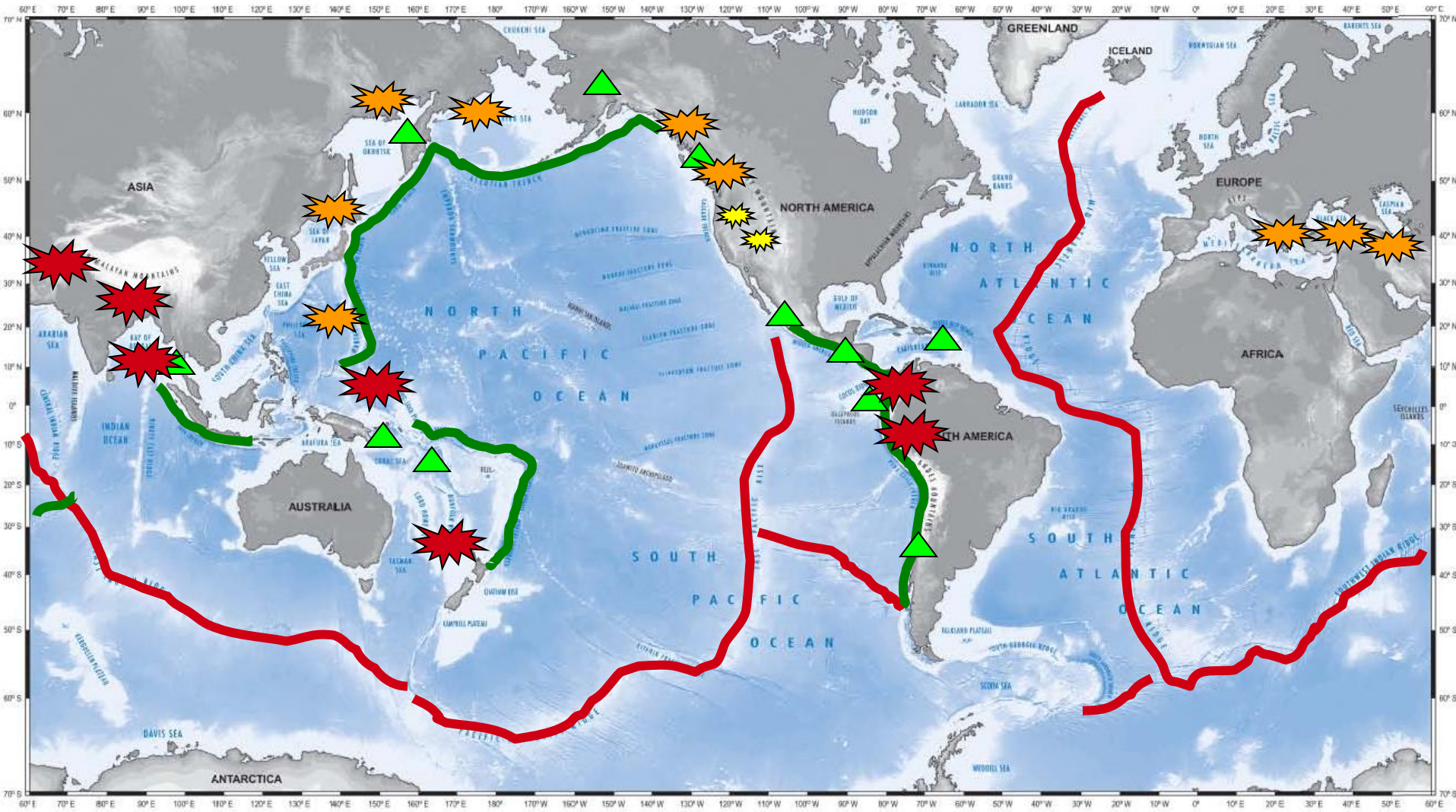
Using earthquake and volcanic activity to find plate boundaries

- Earthquakes and volcanoes are common along tectonic plate boundaries
- Plot 20 earthquakes and 12 volcanoes using latitude and longitude
- Use a key to show magnitude ranges of earthquakes:





< 5.0	5.0 – 6.9	>7.0
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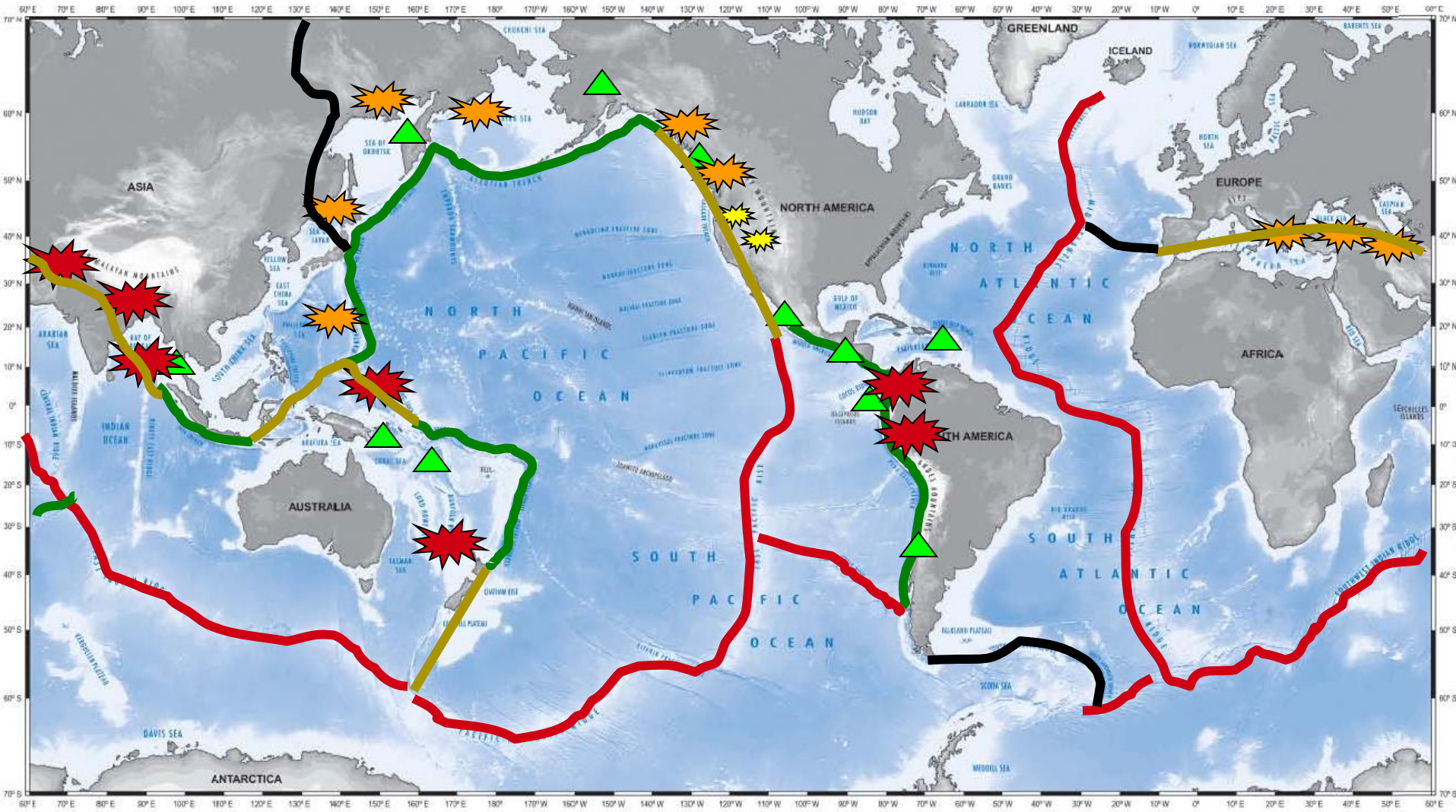
Earthquake and Volcano Data

-  EQ Magnitude less than 5.0
-  EQ Magnitude 5.0 to 6.9
-  EQ Magnitude 7.0 and above
-  Volcano

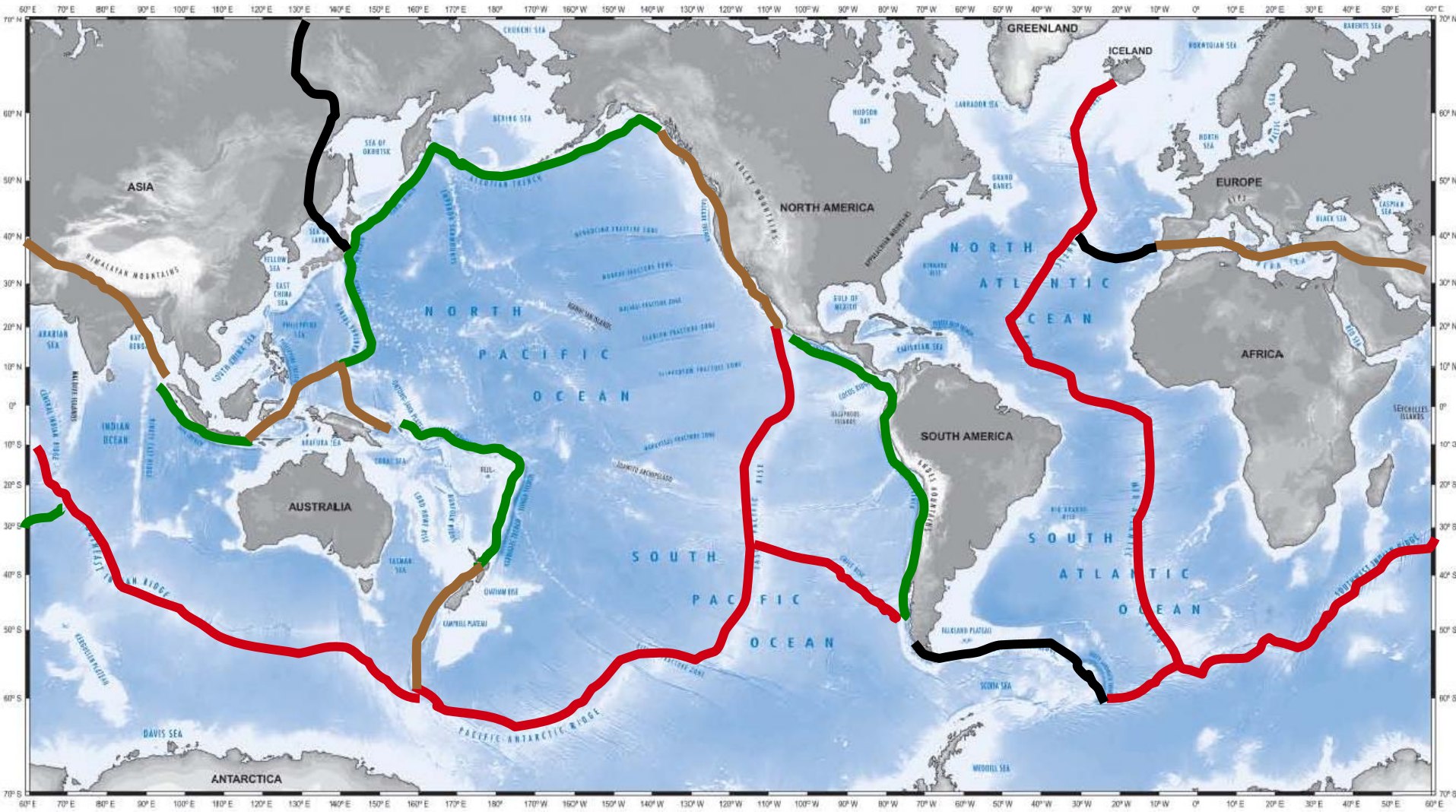


Earthquake and Volcano Data

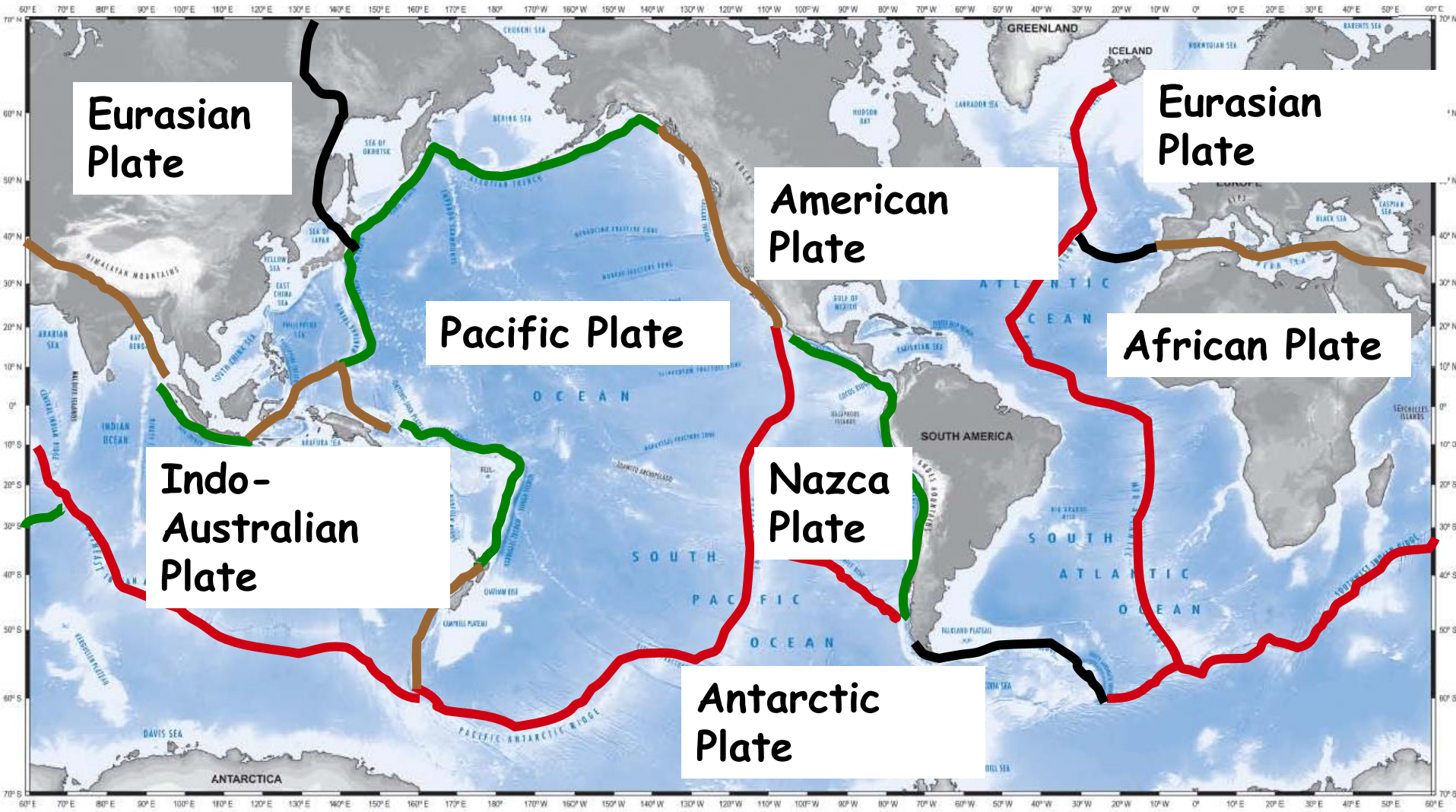
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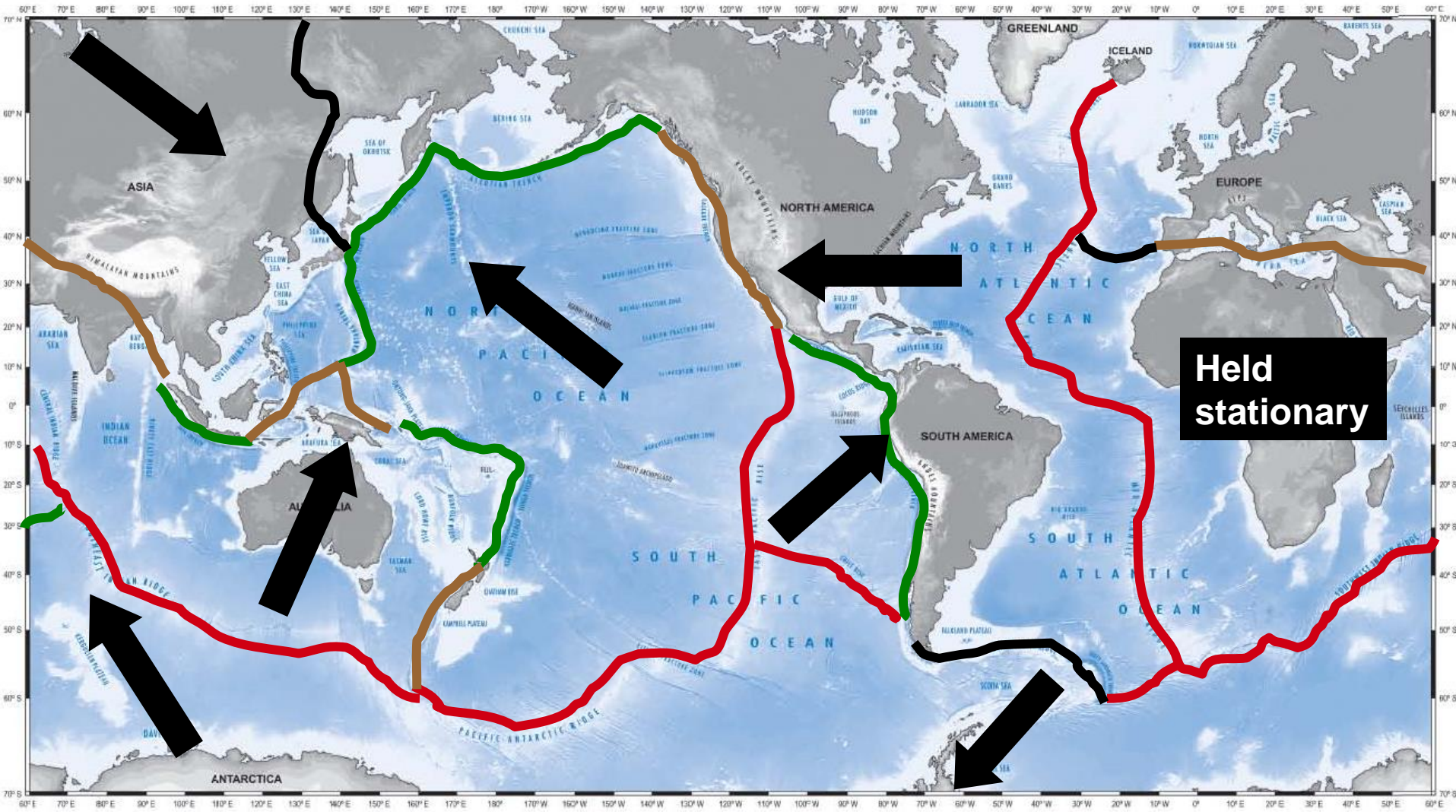
Label 7 major tectonic plates: Eurasian, Indo-Australian, Pacific, American, African, Antarctic, Nazca



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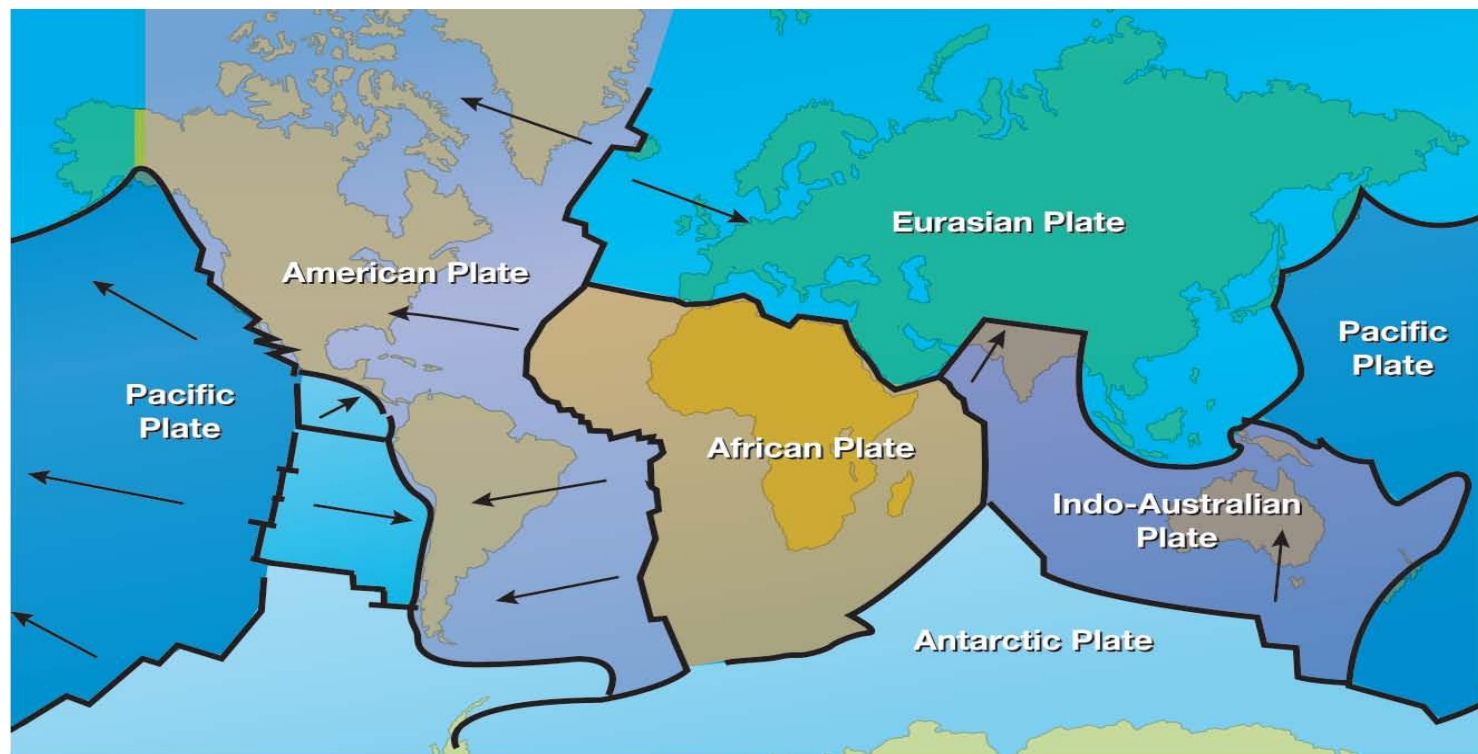
What is the direction of motion for the major plates?

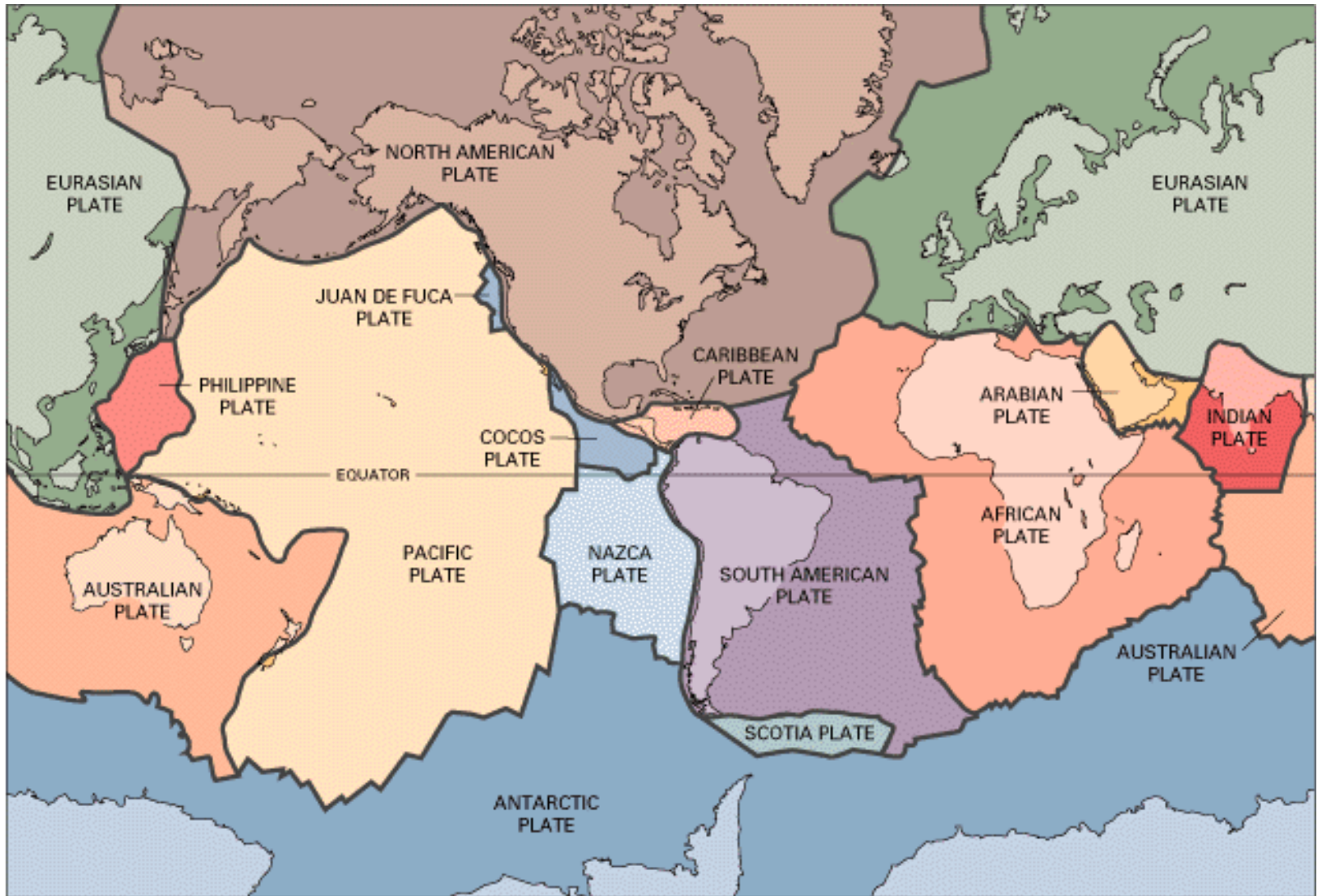




Another view of plate motion

Earth's Largest Lithospheric Plates







Color the plates

- Lightly color each plate a different color. Remember that the left and right edges of the map are connected; color any split plates with the same color! Hold the map edges together, forming a cylinder, so that you can see this relationship.
- Make sure you have an arrow on each plate (except the African plate) to show direction of motion



Cut the plates

- Before cutting out the plates, make a small cut between the map and its border. Cut the border from the map in one piece.
- Now, cut the plates along boundary lines.
- Reassemble the map on top of your backing sheet



Move the Plates

- You have a present-day representation of the major lithospheric plates
- Assume that in 50 million years the plates will move about 3% from current positions, continuing in current direction
- Hold African plate stationary. Move other plates 1.5 cm in direction indicated by arrow.



Move the Plates

- At boundaries with trenches, slide subducting plate under other plate
 - When oceanic crust and continental crust converge, the oceanic crust subducts
- Where continents come together, remember that continents cannot subduct, so mountain-building takes place. Use a black pen or crayon to draw in mountains (or more mountains)
- Glue plates in place on backing sheet



Analyze your Map

- What has happened to the area once known as the “cradle of civilization”?
 - The areas of North Africa and the Middle East have collided, forming a new mountain range. The Mediterranean Sea basin is now part of that mountain range.
- Where will the longest mountain range be located 50 million years from now?
 - Spain to the Indian Ocean, maybe even all the way to Alaska!