Continental Drift to Plate Tectonics: From hypothesis to theory

Part B: Evidence to support plate tectonics

Key understandings:

Difference between continental drift and plate tectonics.

Internal structure of the earth.

The structure of the crust.

The six pieces of evidence used to support plate tectonics.

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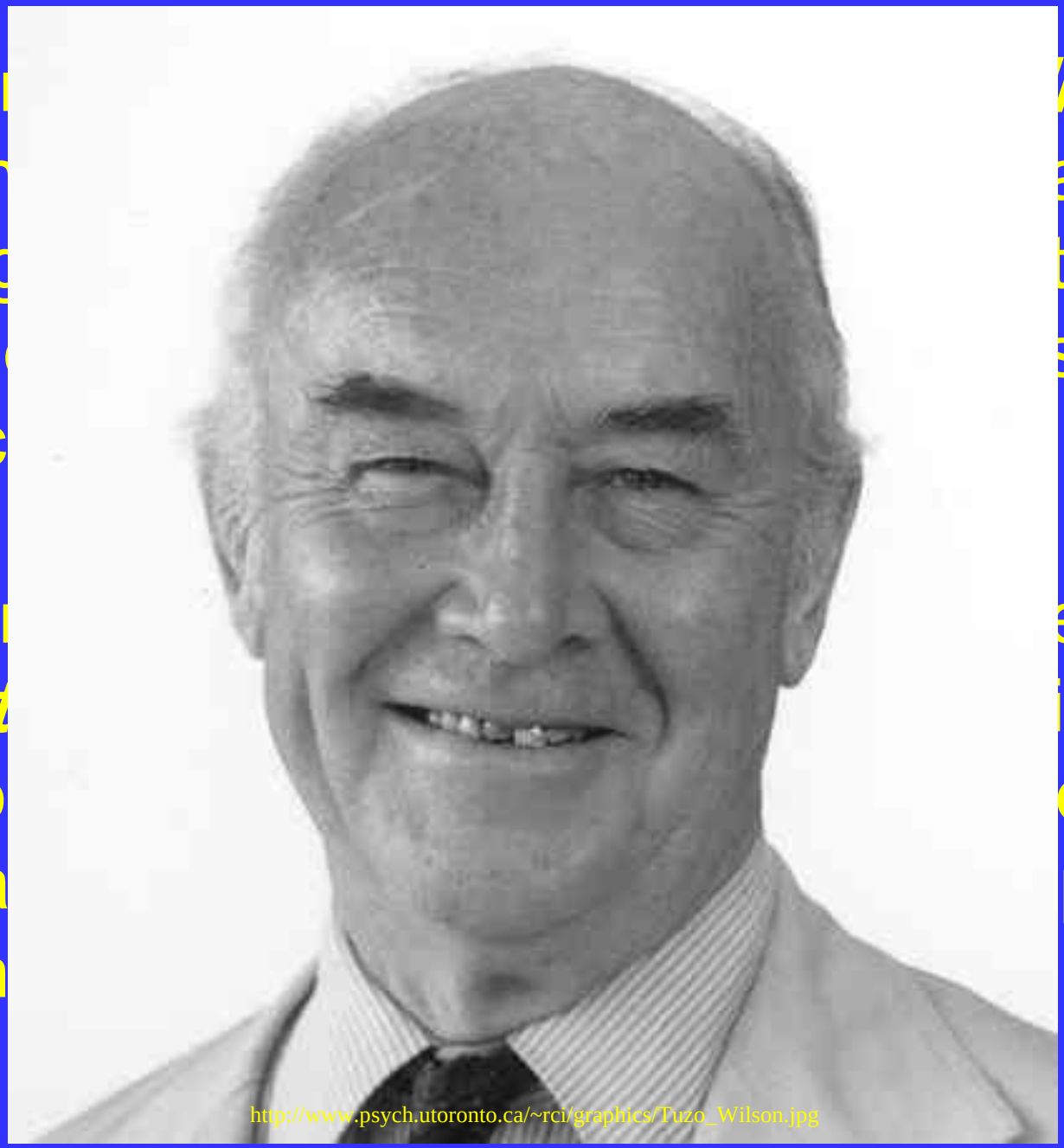


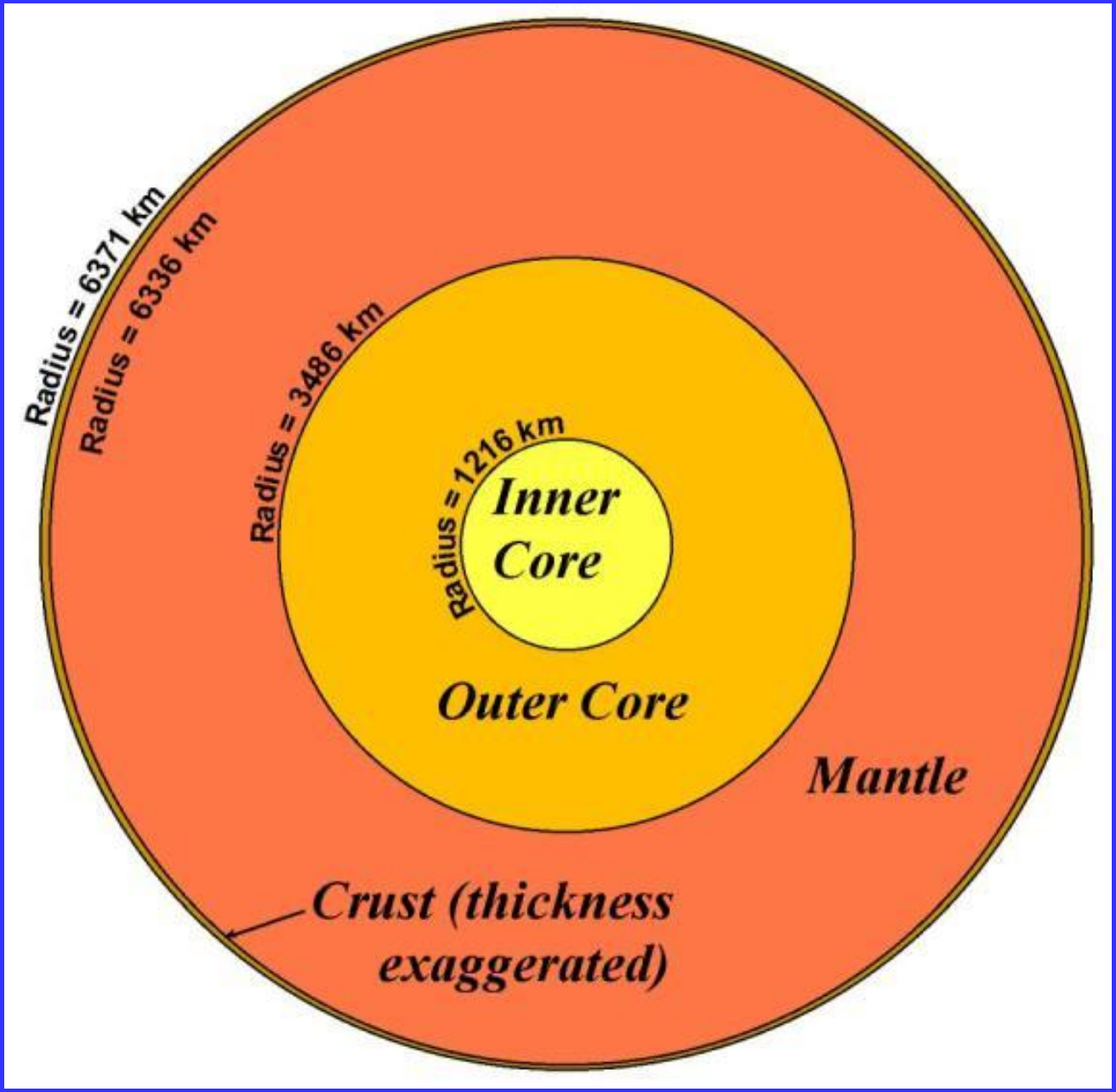
http://www.psych.utoronto.ca/~rci/graphics/Tuzo_Wilson.jpg

Six “discoveries”, and deductions from those discoveries, led to the **theory** of plate tectonics. These include:

1. Knowledge of the internal structure of earth
2. Accurate maps of the sea floor
3. Maps of earthquakes and volcanoes
4. Measurements of the heat flow
5. Geomagnetic imaging of the sea floor
6. Determination of the age of the sea floor

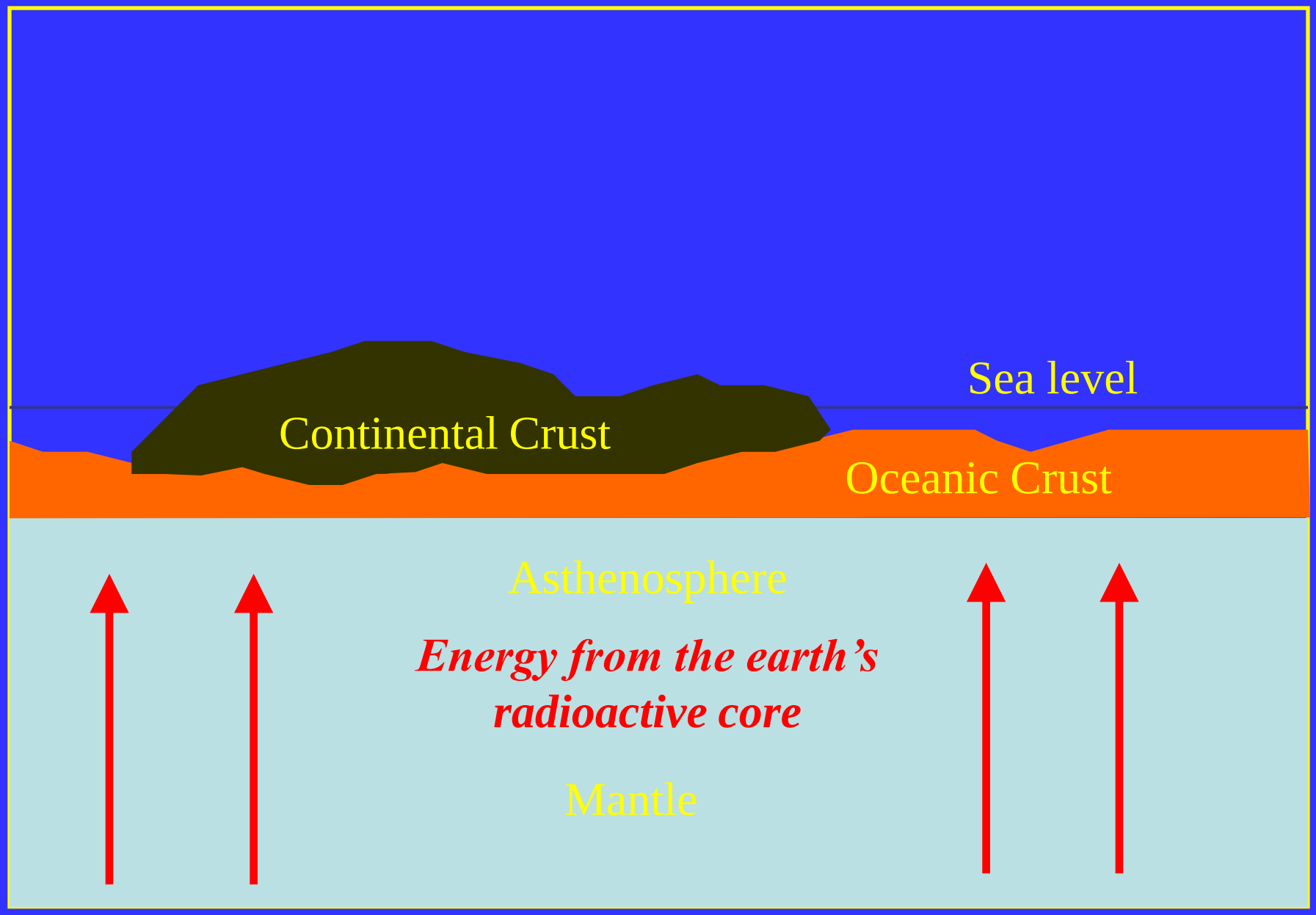
1. Internal structure of the Earth

- the crust of the earth is in two layers.
- lower layer or **oceanic crust** is made of denser basaltic rock that is continuous (extends) all over the earth.
- a lighter and discontinuous **continental crust**, made of less dense granitic rock, “floats” on the oceanic crust.



http://www.eas.purdue.edu/~braile/edumod/journey/journey_files/image006.jpg

- the upper **mantle** is the **asthenosphere**
- has “plastic” characteristics, thus allowing the plates of the Earth to float on top and move.
- Earth radiates huge amounts of energy from the radioactive decay of elements in the core
- this energy makes its way to the crust

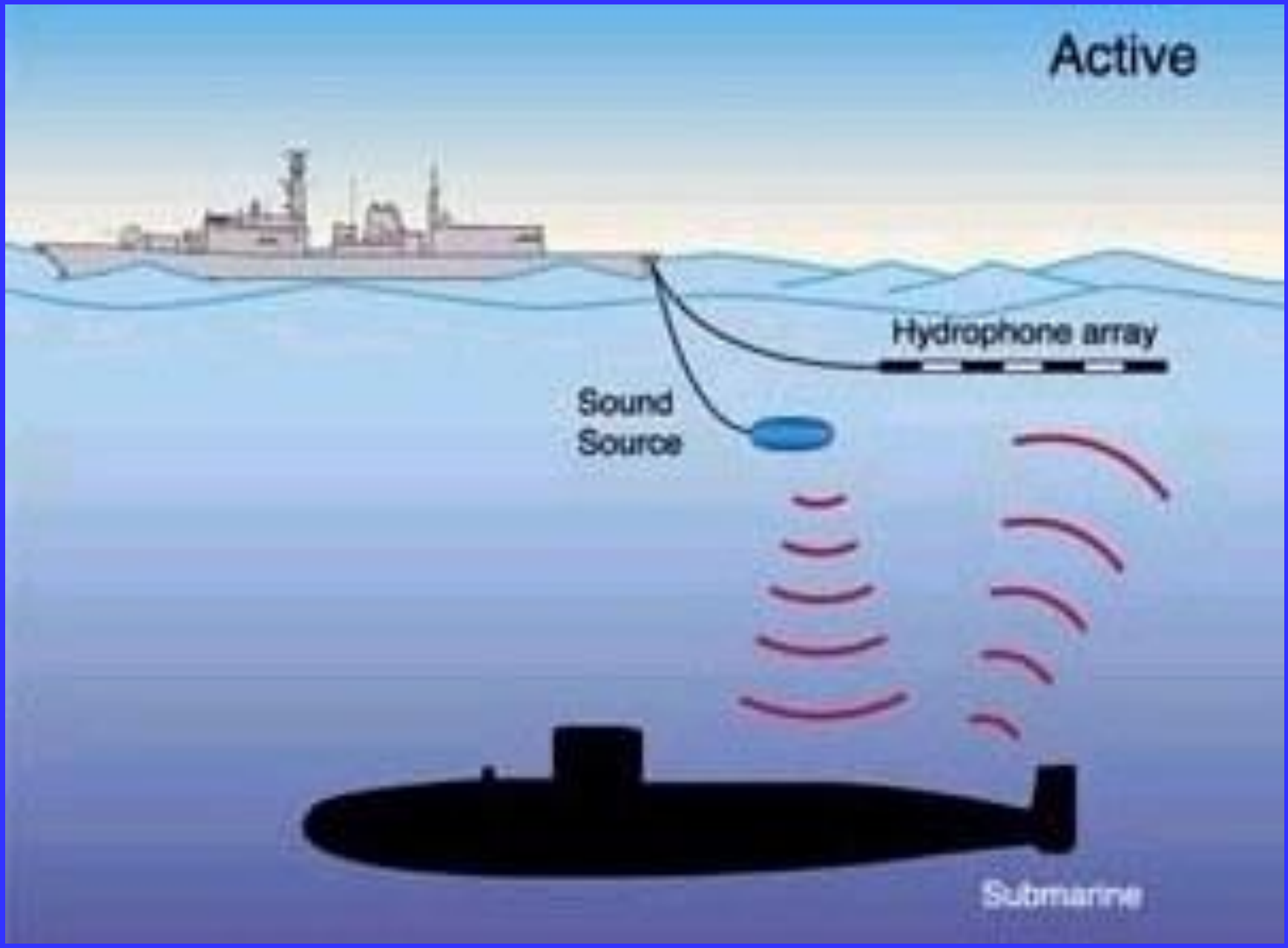

Sea level
Continental Crust
Oceanic Crust
Asthenosphere
Energy from the earth's radioactive core
Mantle

2. Accurate maps of the sea floor

- mid-oceanic ridges rise 3000+ meters from the ocean floor
- bigger than the Himalayas in size
- also, incredibly deep trenches in some locations were located

One key invention began this process:

- SONAR
- during World War II to find submarines
- led to detailed maps of the ocean floor



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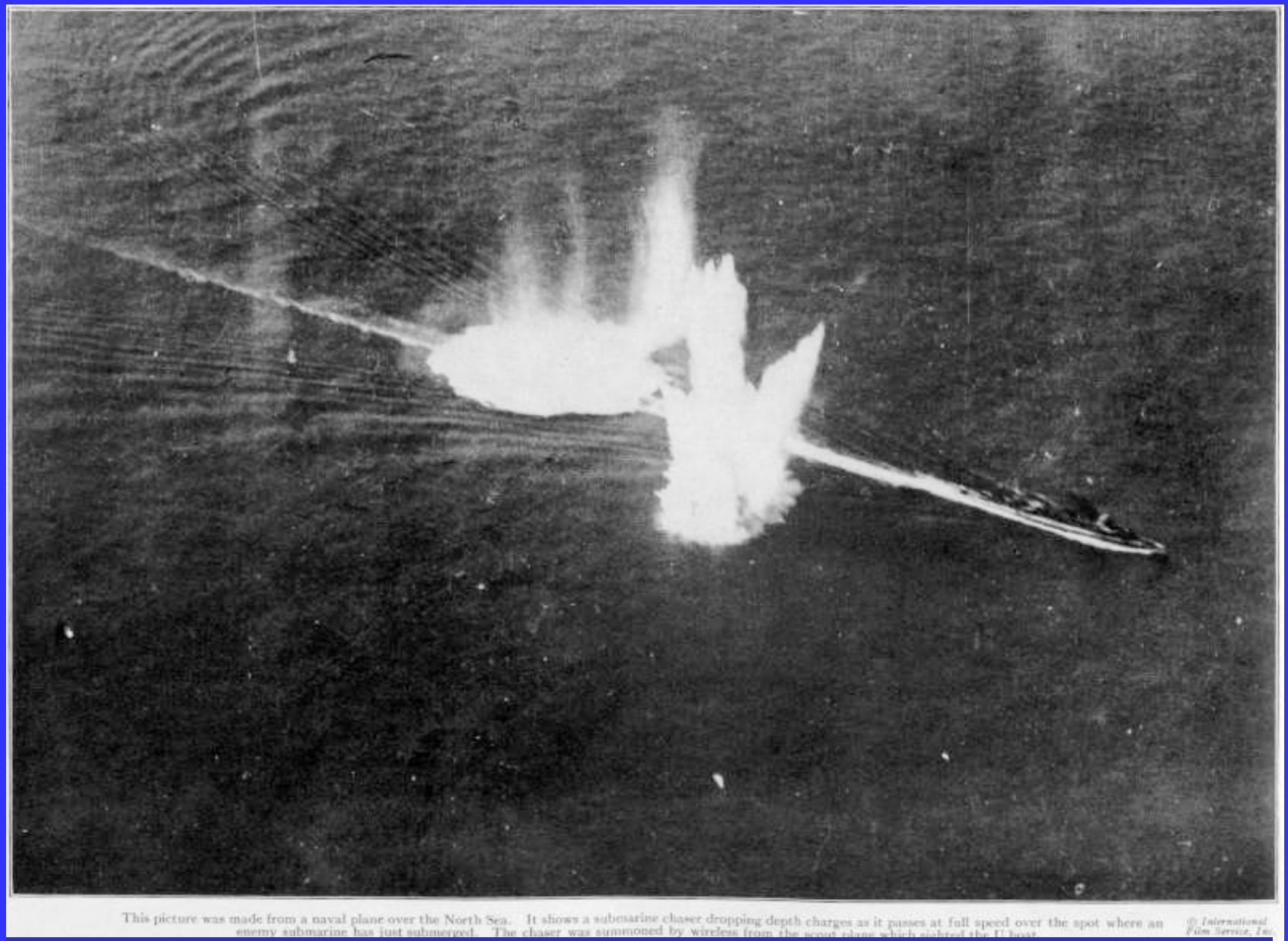
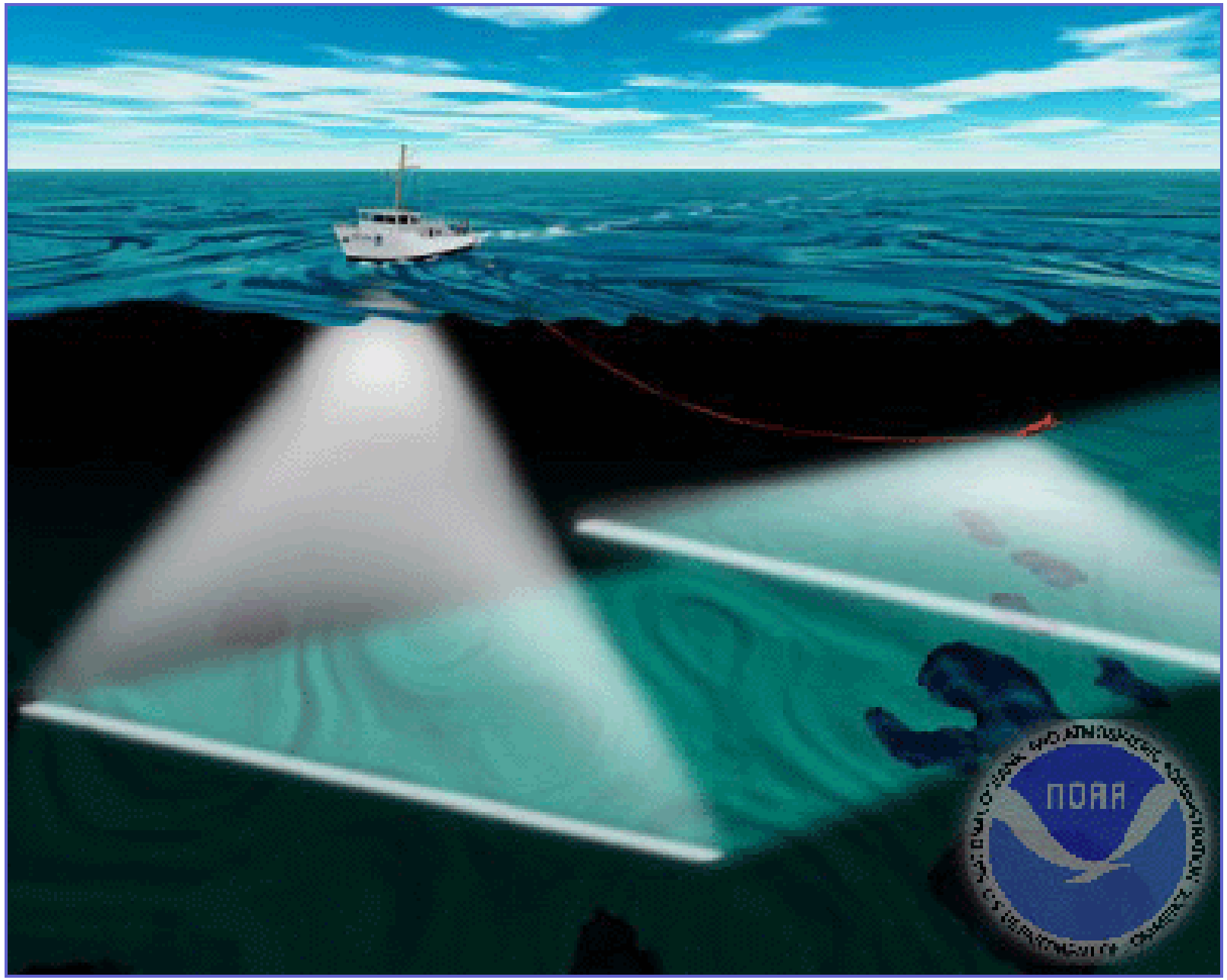
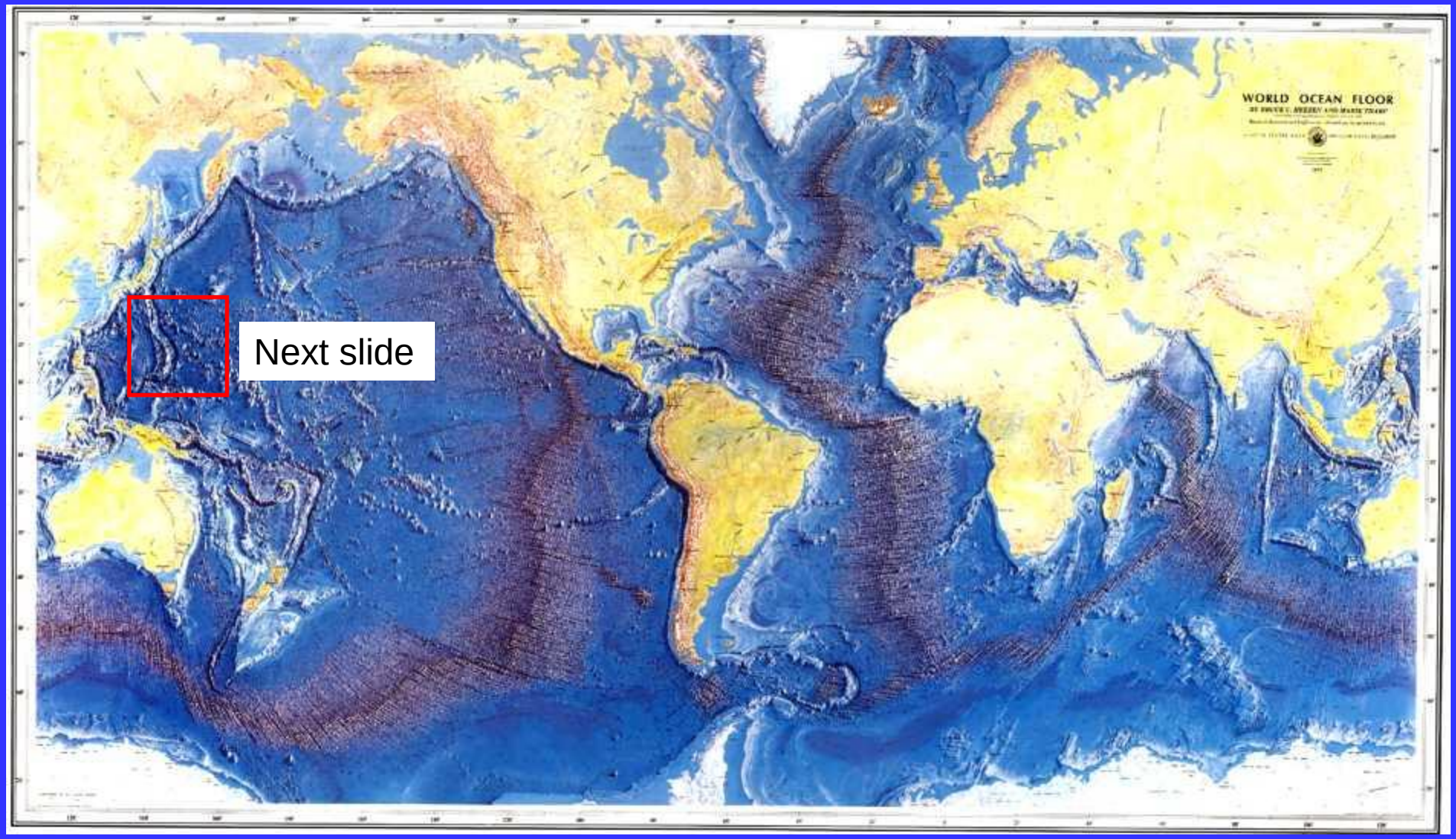


This picture was made from a naval plane over the North Sea. It shows a submarine chaser dropping depth charges as it passes at full speed over the spot where an enemy submarine has just submerged. The chaser was summoned by wireless from the scout plane which sighted the U-boat.

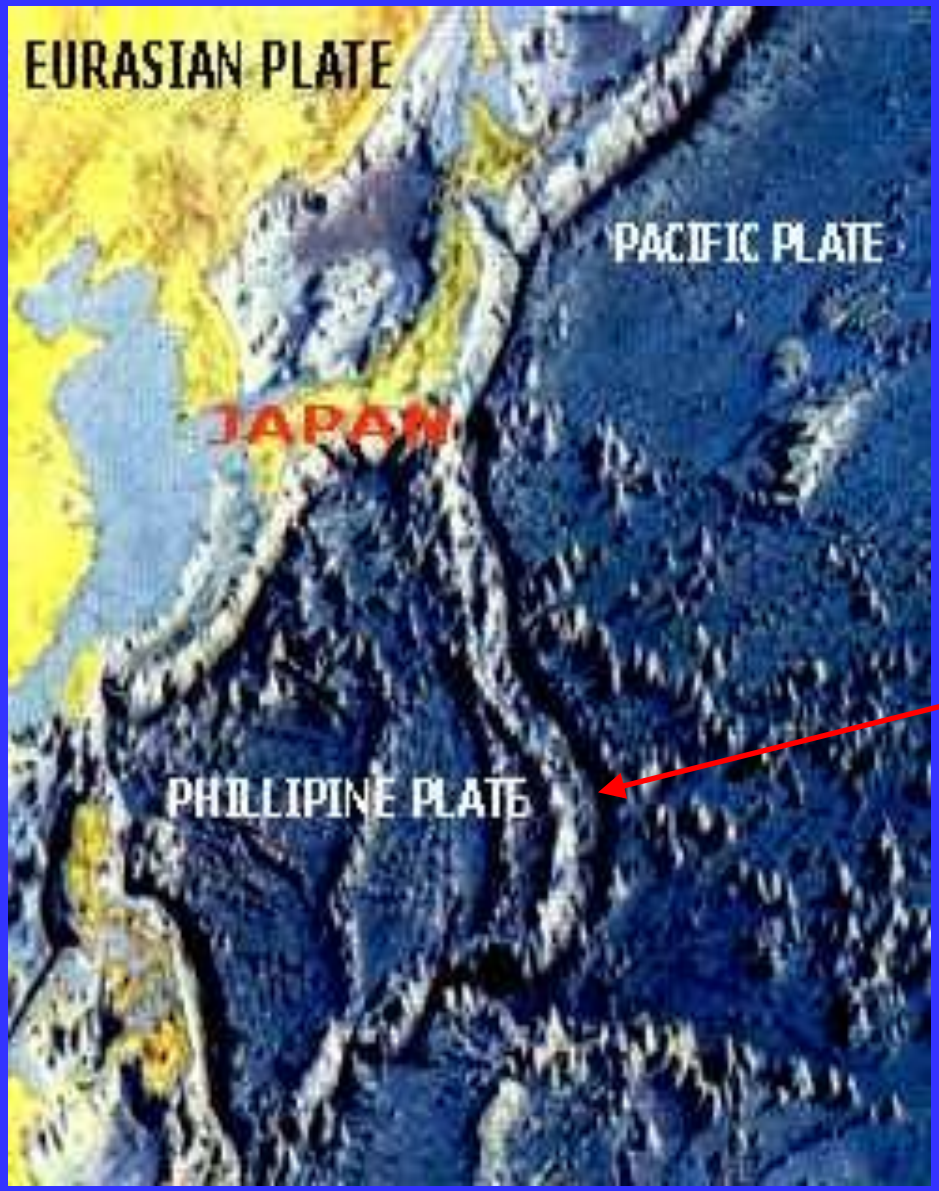
http://www.rootsweb.com/~nelancas/wwi/ww1/subchaser-depthchrg.jpg



http://chartmaker.ncd.noaa.gov/hsd/images/sonar.gif

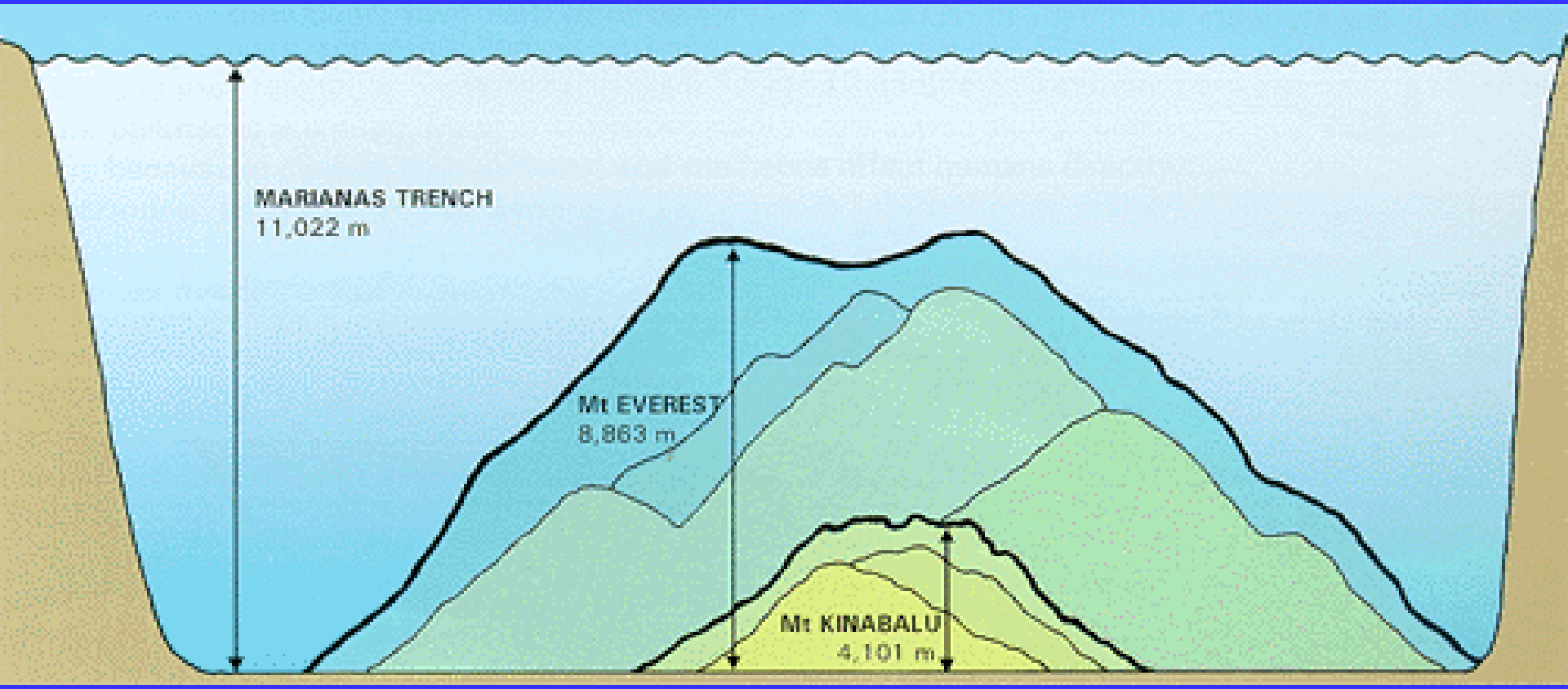


http://geo.web.ru:8104/~tevelev/ocean/largemap.jpg



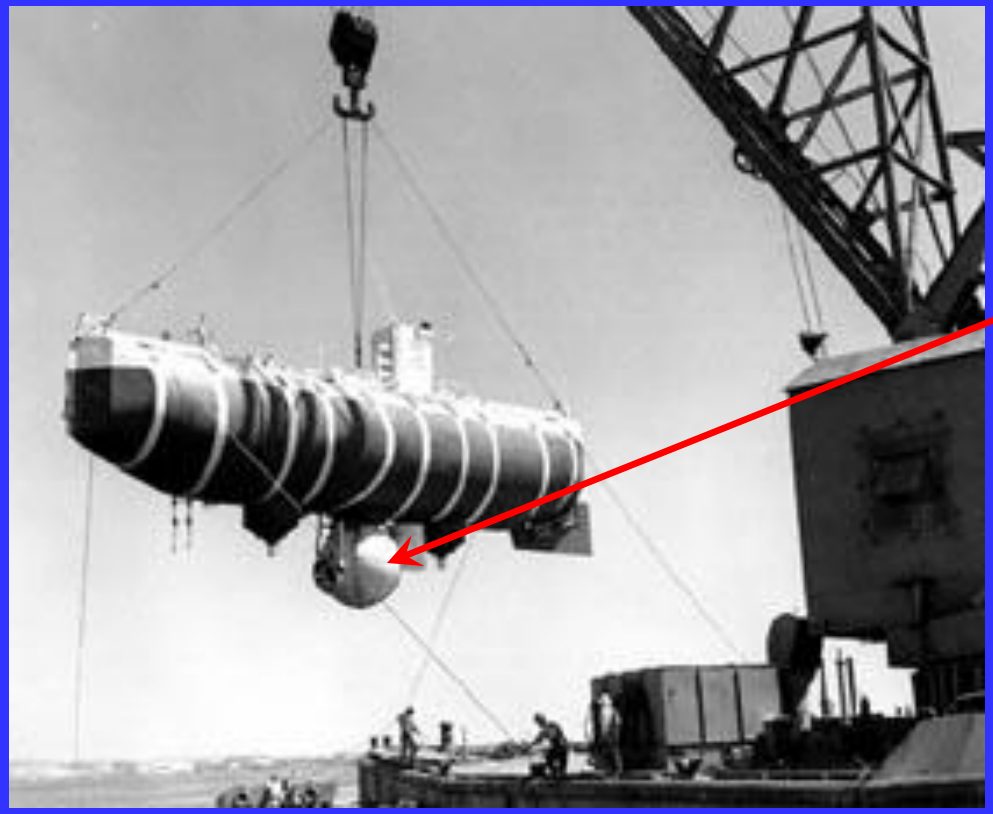
www.platetectonics.com/ oceanfloors/japan.asp

- some of the trenches are really deep
- the Marianas Trench goes down over 11 km



Mt. Everest (8,863 m) could be completely sunk in the 11,022 m deep Marianas Trench

http://agrolink.moa.my/dof/edukit/seaocean/fact1.gif



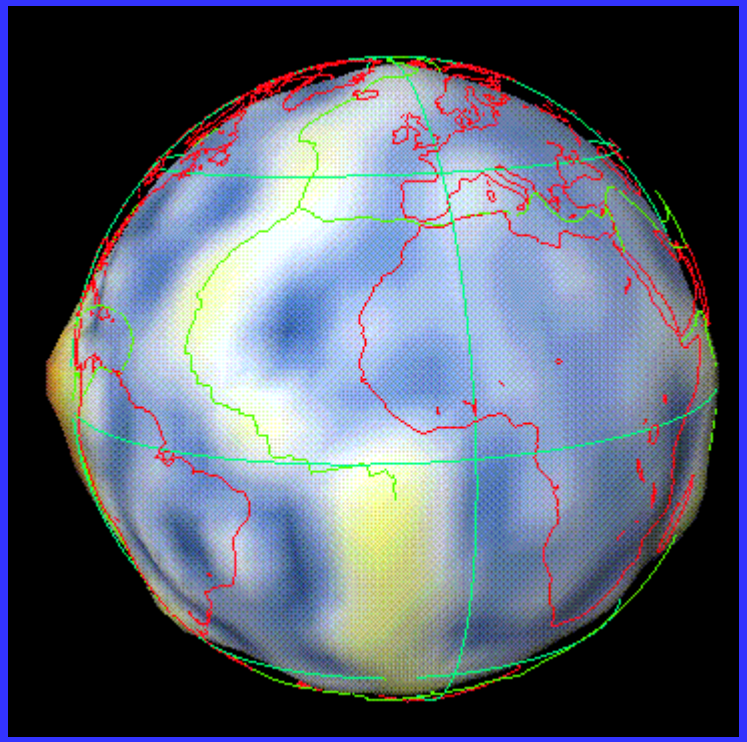
Two men were in this little sphere.

Idiots.

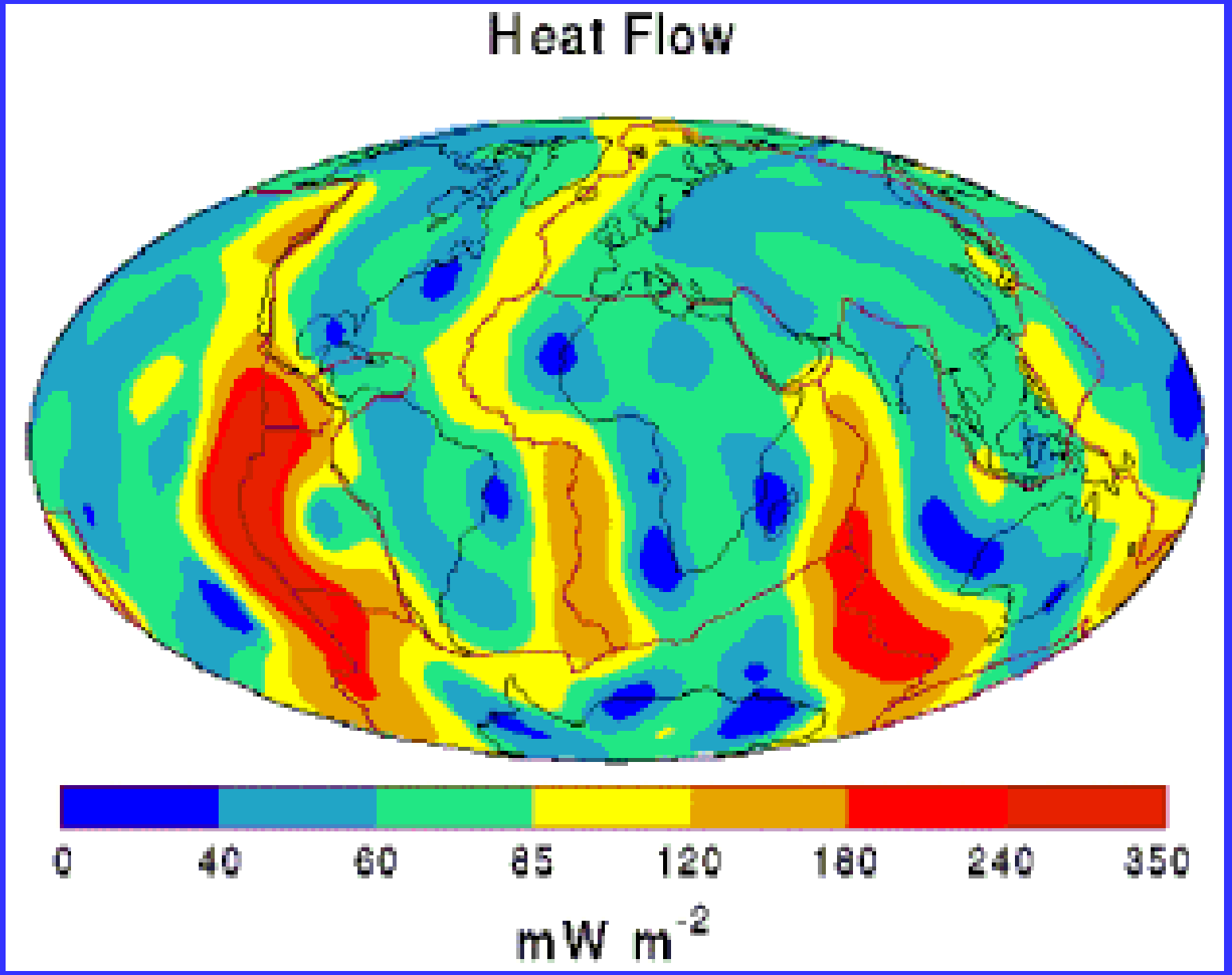
1960 – Bathyscaphe *Trieste* descends to 10,912 m in the Marianas Trench

3. Heat Flow

- the greatest heat flow is centered at the crests of these mid-oceanic ridges
- the lowest rates of heat flow are in the deep ocean trenches.



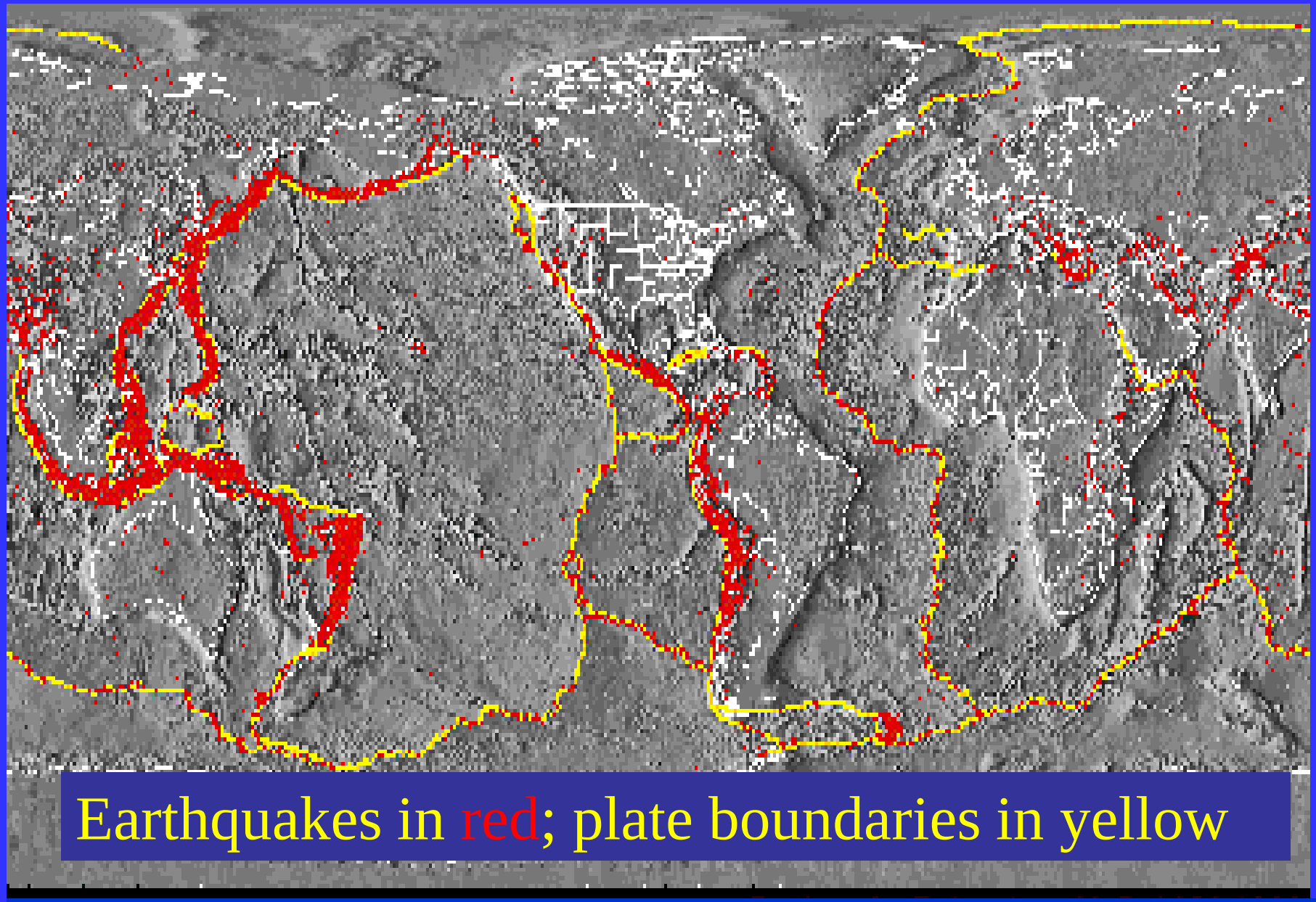
http://geophysics.ou.edu/geomechanics/notes/heatflow/heat2.gif



http://ems.gphys.unc.edu/modeling/conduction/images/heatflow.gif

4. Seismic surveys

- the mid-oceanic ridges and trenches have far more earthquakes
- indicates intense geological activity at the mid-oceanic ridges and trenches.

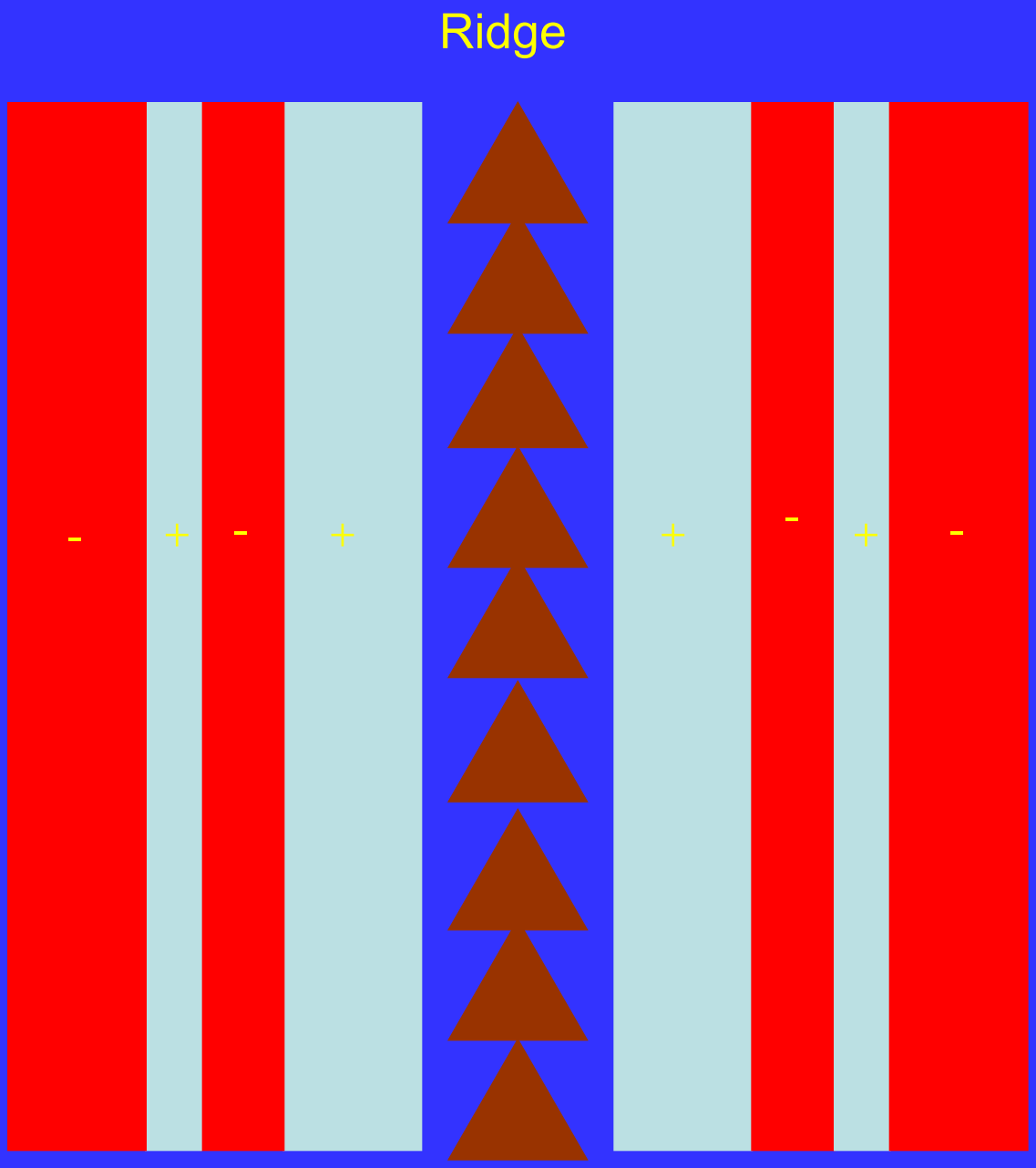


Earthquakes in red; plate boundaries in yellow

http://www.uh.edu/~jbutler/anon/platejr.gif

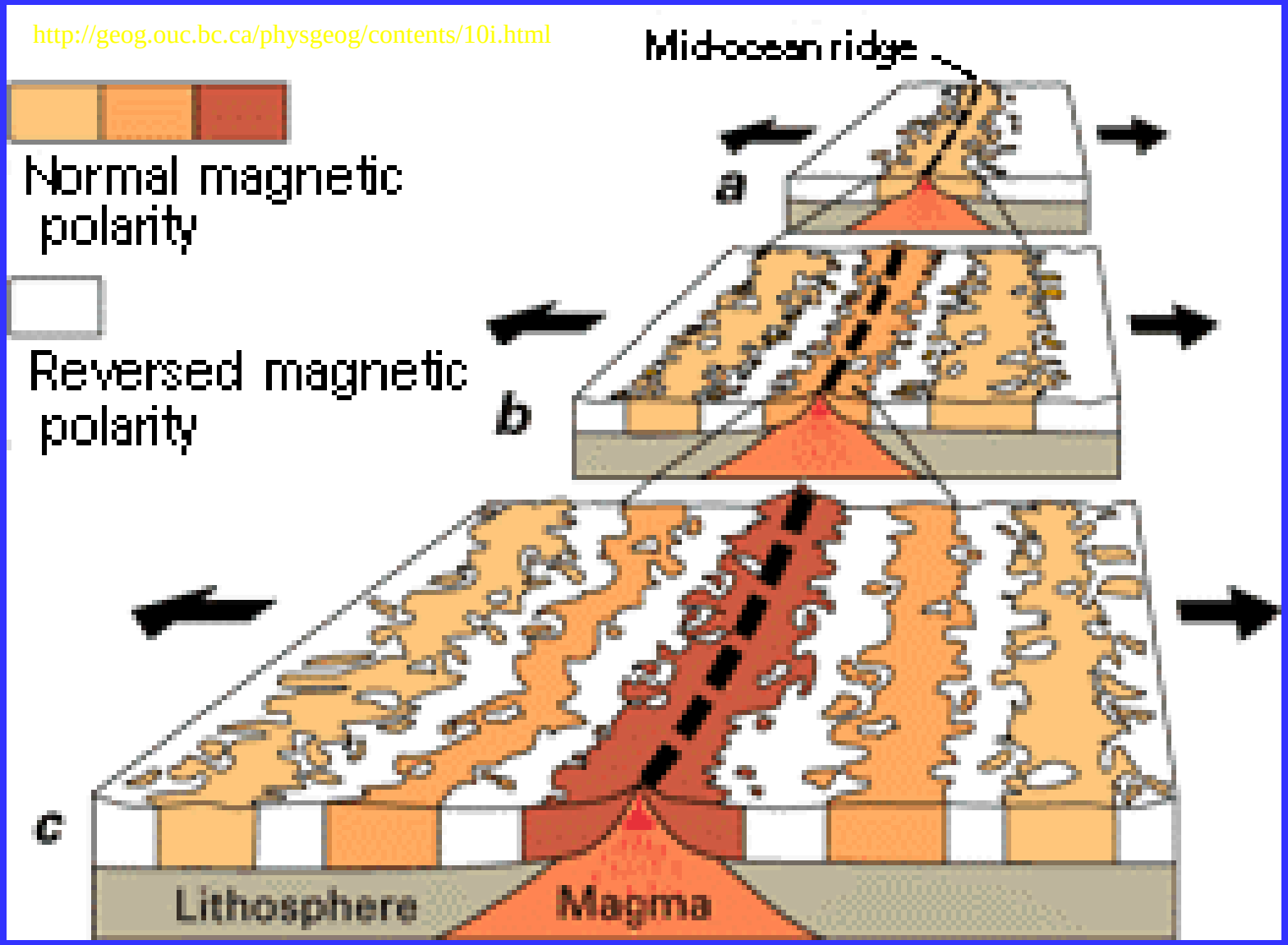
5. Geomagnetic imaging of sea floor rocks

- Earth's magnetic field has often reversed itself in geologic history
- the north pole has become the south pole and vice versa
- when rock solidifies, any iron particles in the rock "line up" with earth's magnetic field, showing the the polarity
- symmetrical pattern of reversing polarity on both sides of mid-ocean ridges



Reversing Polarity

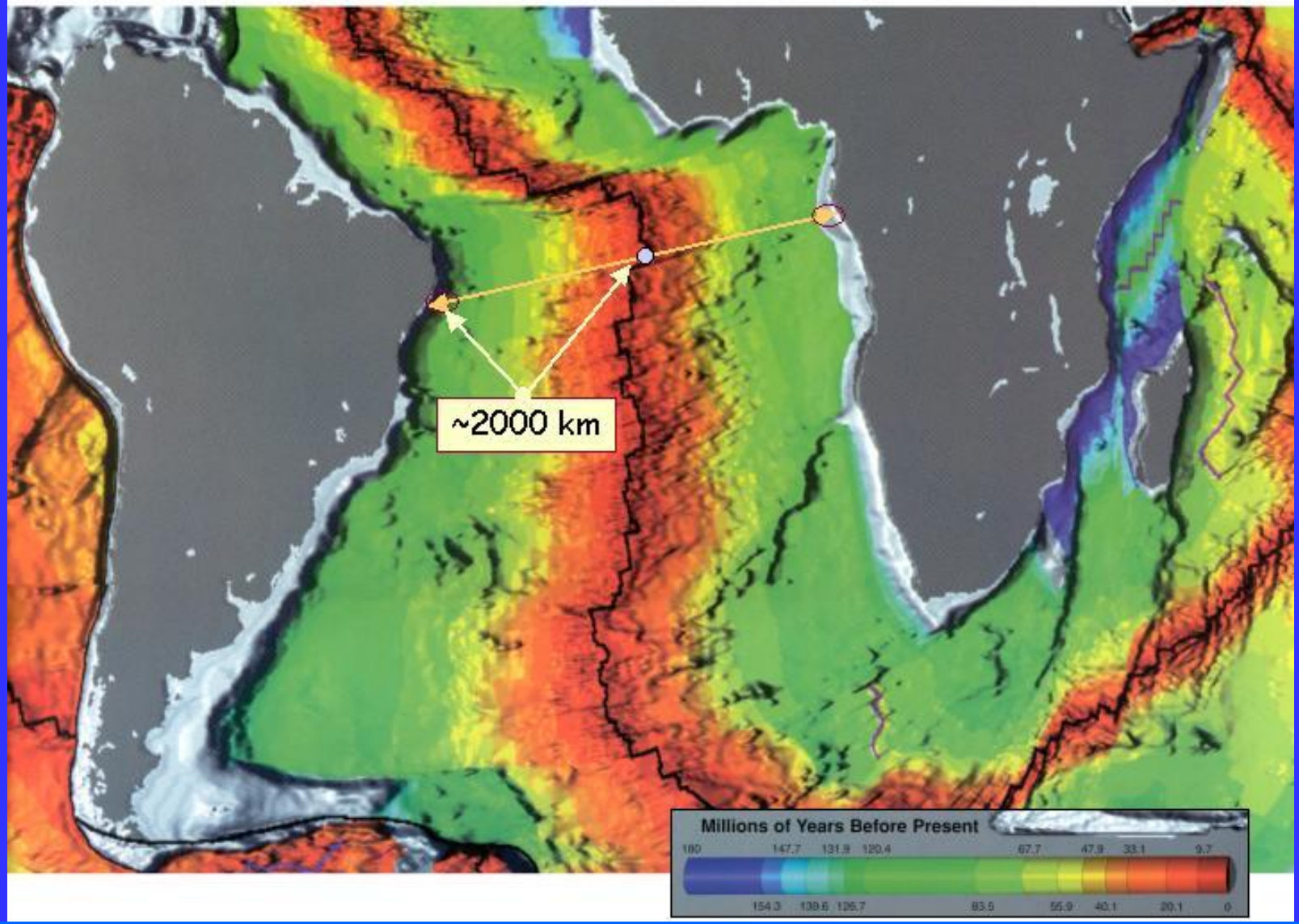
The polarity of the sea floor rock shows a mirror image pattern on both sides of the mid-oceanic ridge.



This is what reversing polarity actually looks like.

6. Age of the sea floor rocks

- youngest regions of the ocean floor are along the mid-oceanic ridges
- the age of the ocean floor increases with distance from the ridges
- the oldest seafloor often ends in the deep-sea trenches.



The crust near the continental margins is about 200 million years old. It gets progressively younger toward the mid-Atlantic ridge, where oceanic crust is forming.

In summary:

- plate tectonics started as a **hypothesis** to explain **how** continental drift could happen
- the six major ideas or pieces of information led earth scientists to the **theory** of plate tectonics