OLLI SG 492
Plate Tectonics

Session 8 - November 7, 2022

Today’s Meeting

- Creation of the Alpine-Himalayan Mountain Belt.
- Creation of the Himalayas.
- Convergent Boundaries Around the Pacific Rim - Ring of Fire:
  - The Sunda Plate and Indonesia.
  - The Andes.
  - Japan.

References for Today's Topics

Videos and Articles

- Scotese Animation - Africa and Eurasia.
- Scotese Animation - India and the Himalayas.
- Stanford Video - Location of the Collision Boundary.
- Wikipedia Article - Indian Plate.
- Japan - Plate Boundaries.
- Wikipedia Article - Okhotsk Plate.

Convergent Boundaries

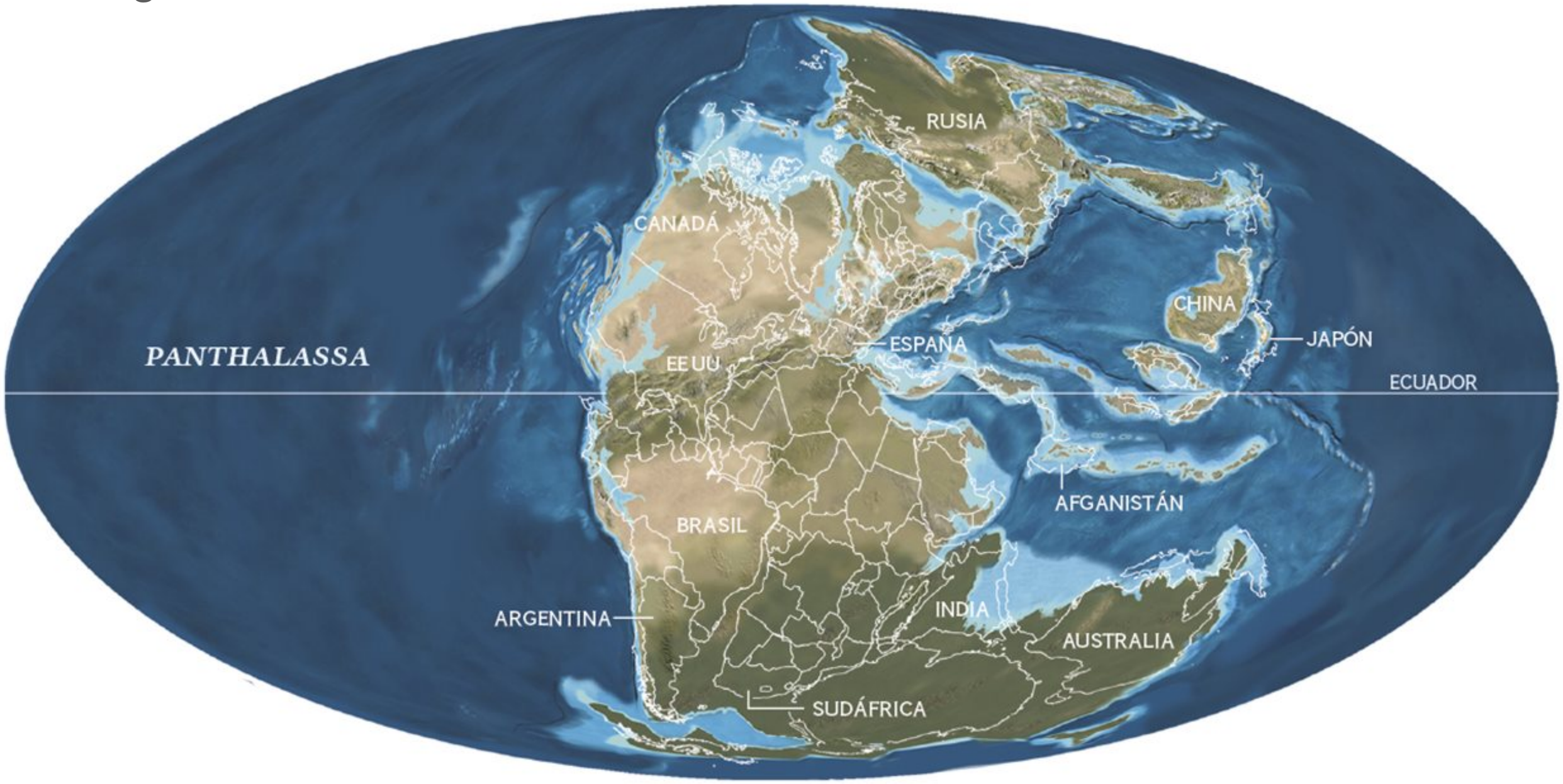
- Types of Crustal Contacts:
  - Continent to Continent.
  - Oceanic to Continent.
  - Oceanic to Oceanic.
- Effects:
  - Mountain Building - Orogeny.
  - Volcanic Arcs.
  - Volcanic Island Arcs.

Alpine-Himalayan Mountain Belt

Alpine-Himalayan Mountain Belt

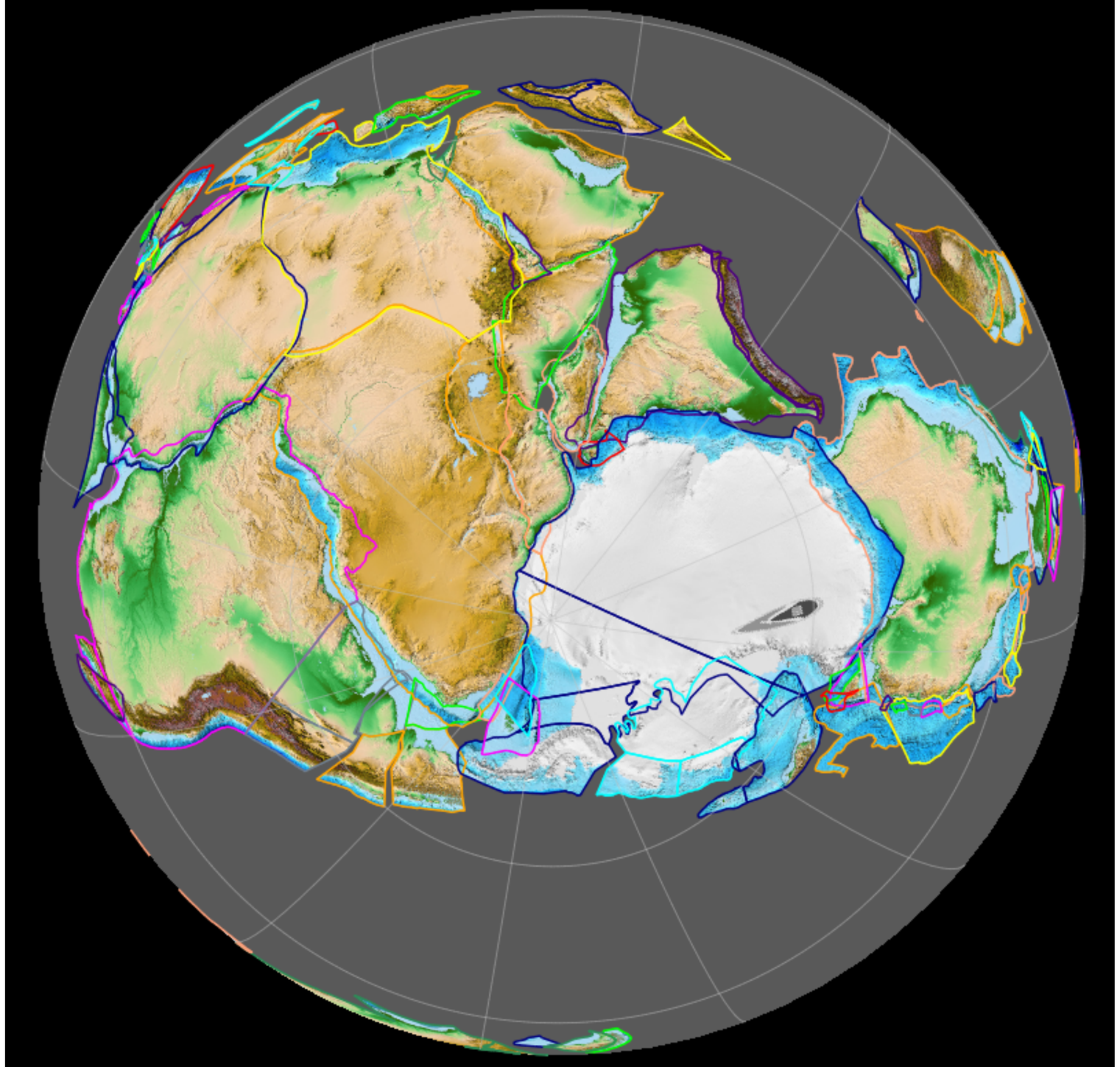
The interconnected system of mountain ranges and intermontane plateaus that lies between the stable areas of Africa, Arabia, and India on the south and Europe and Asia on the north owes its existence to the collisions of different continental fragments during the past 100 million years. Some 150 million years ago, India and much of what is now Iran and Afghanistan lay many thousands of kilometres south of their present positions. A vast ocean, called the Tethys Ocean, lay south of Europe and Asia and north of Africa, Arabia, and India. Much of the rock that now forms the mountain system, which includes the Alps and the Himalayas was deposited on the margins of the Tethys Ocean.

Supercontinent Cycle
Pangaea



Gondwana

Principal Components



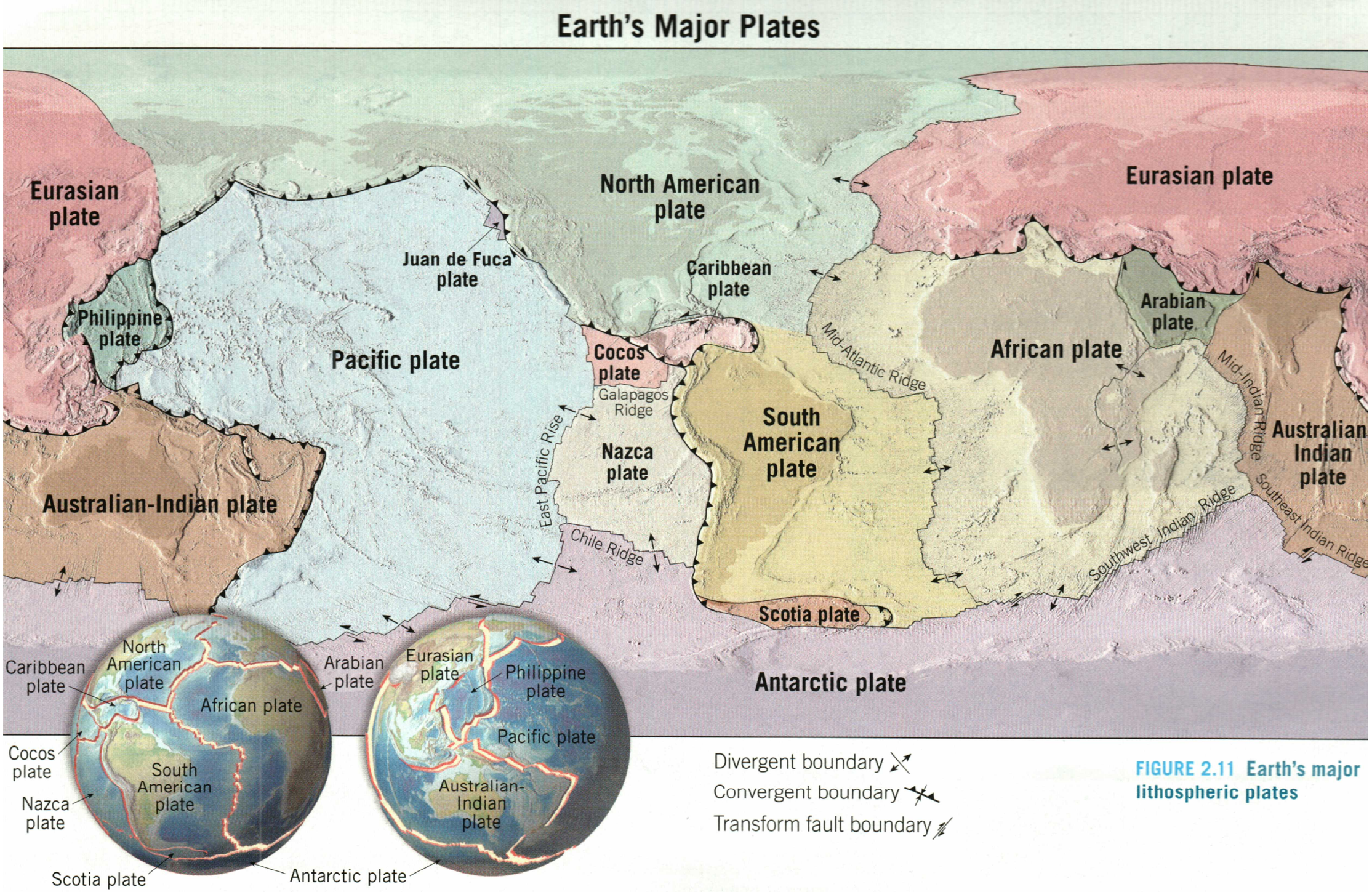
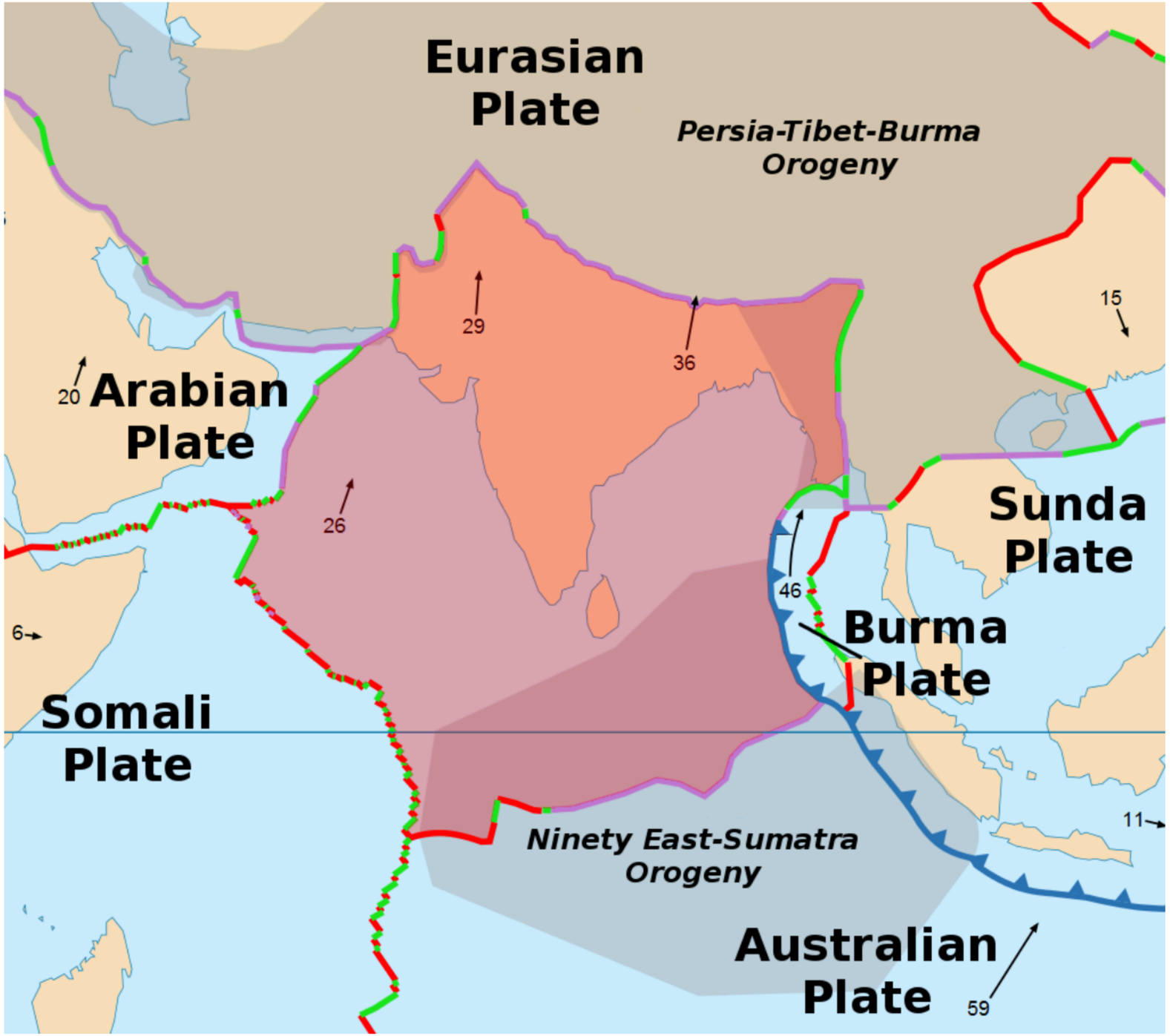
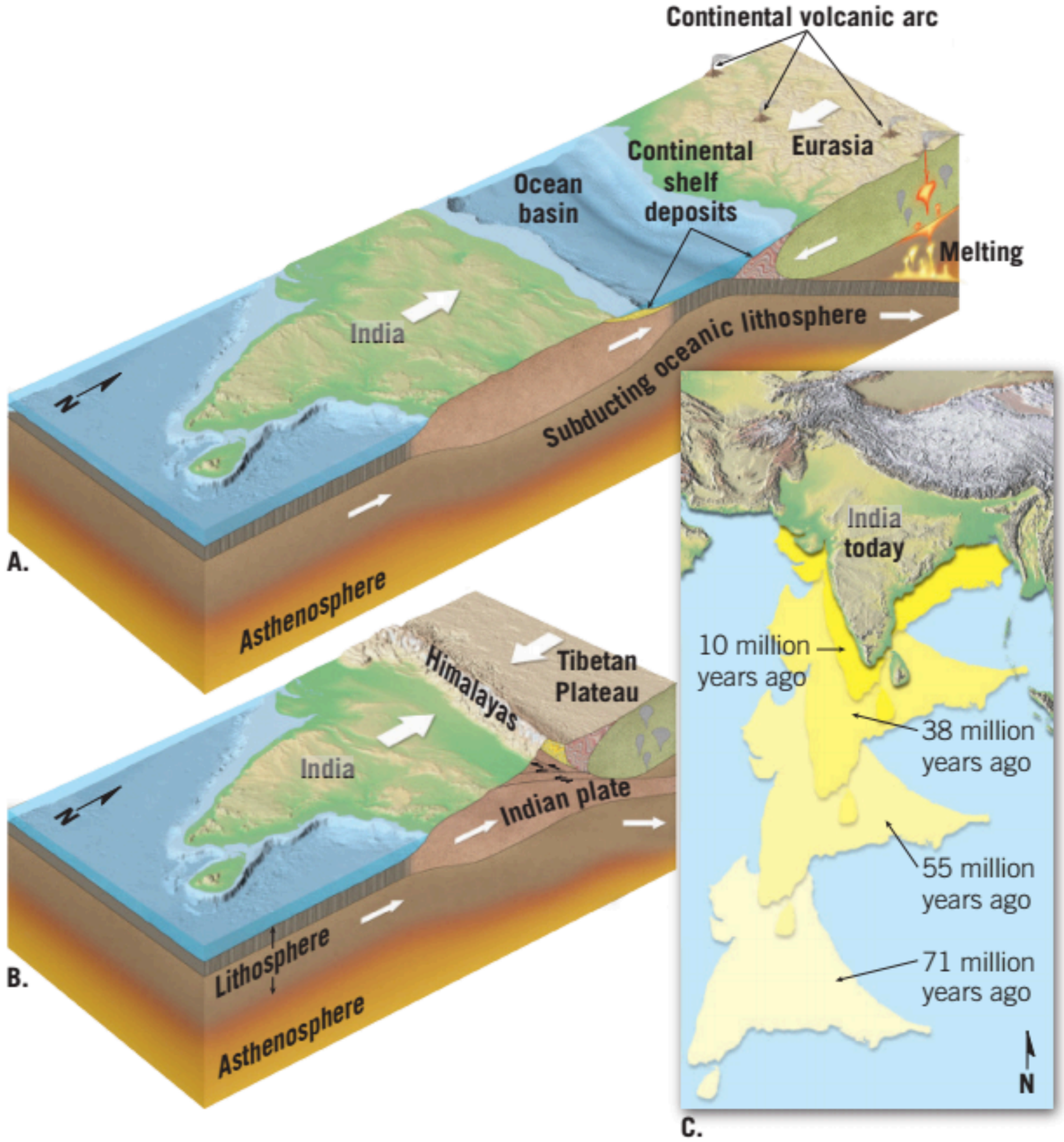


FIGURE 2.11 Earth's major lithospheric plates

Indian Plate



Creation of the Himalayas Timeline



▲ SmartFigure 2.18

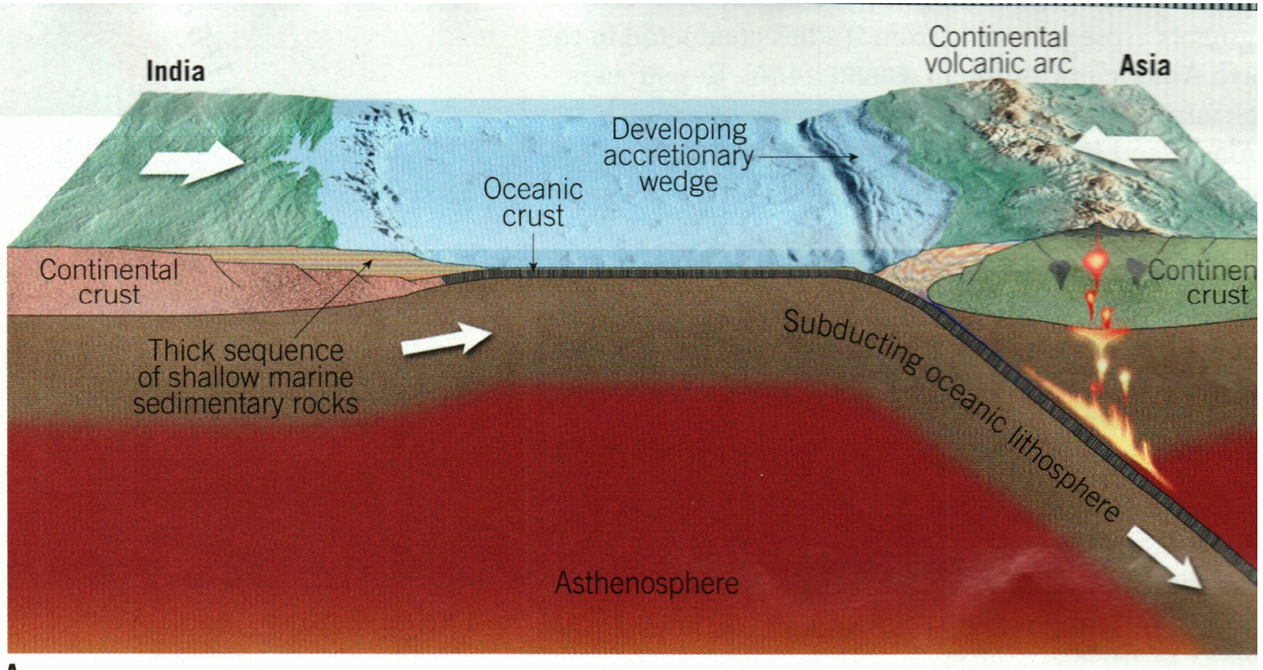
The collision of India and Eurasia formed the Himalayas The ongoing collision of the subcontinent of India with Eurasia began about 50 million years ago and produced the majestic Himalayas. Although the map in part C illustrates only the movement of India, it should be noted that both India and Eurasia were moving as these landmasses collided.

Creation of the Himalayas

Subduction and Collision

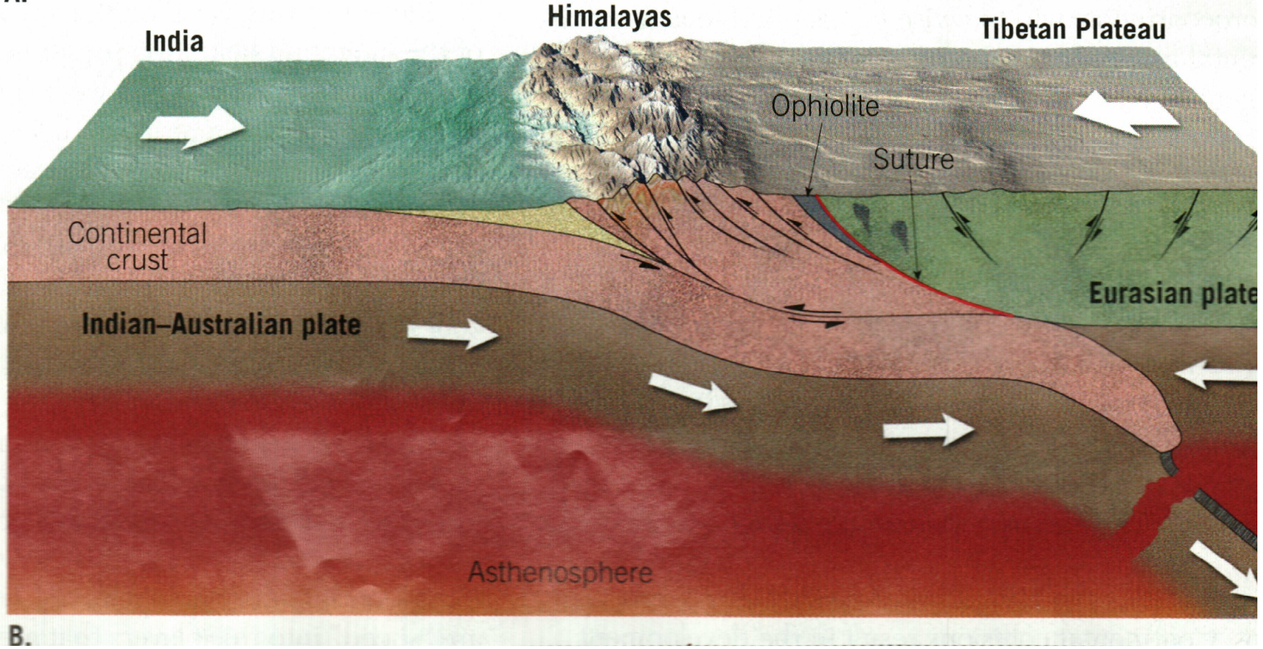
GURE 14.11 Continental ollision, the formation of e Himalayas
hese diagrams illustrate ie collision of India with ie Eurasian plate that roduced the spectacular imalayas.

Prior to the collision of India and Asia, India's northern margin consisted of a thick platform of continental shelf sediments, whereas Asia's was an active continental margin with a well developed accretionary wedge and volcanic arc.



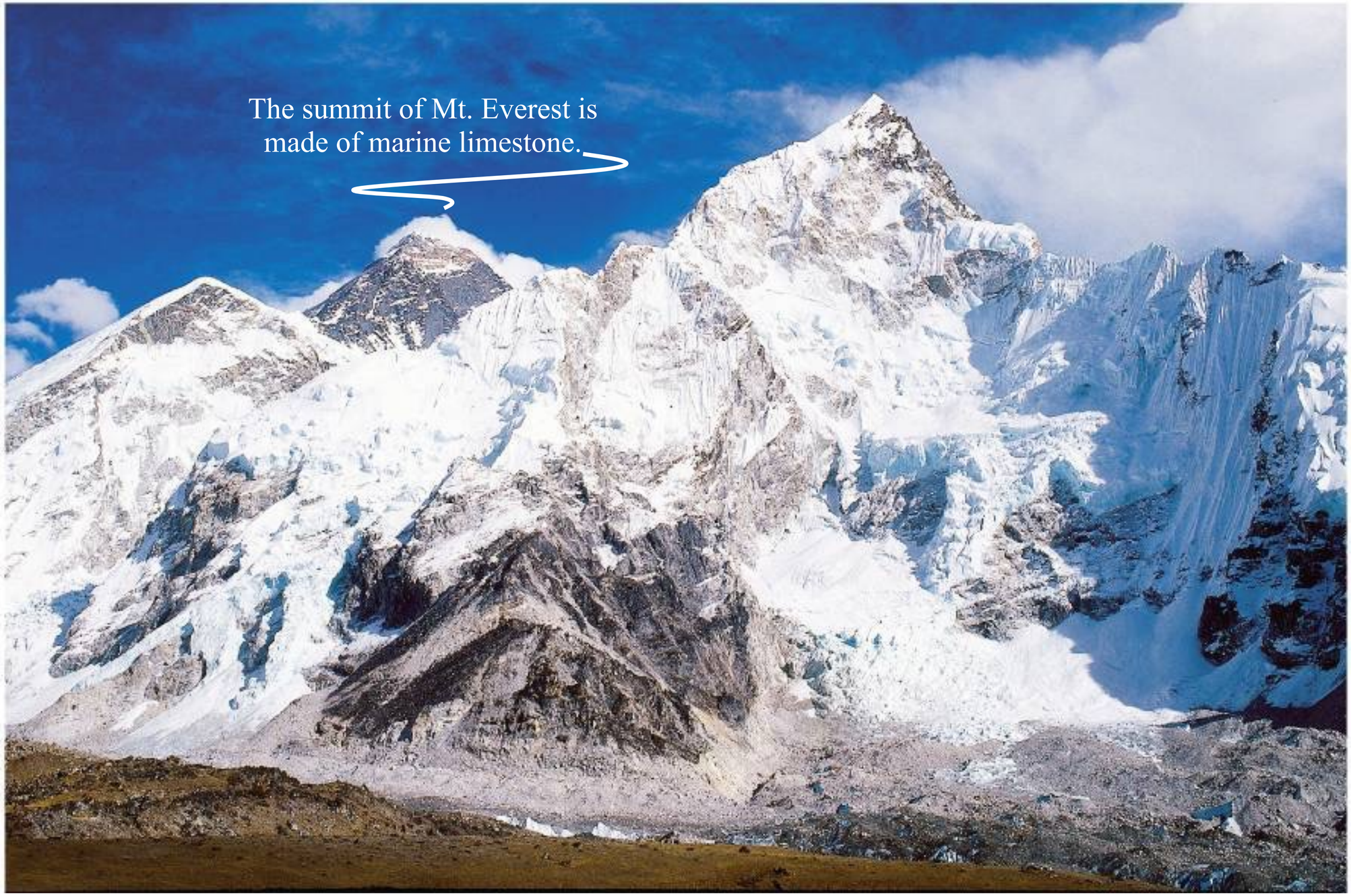
A.

The ensuing continental collision folded and faulted the crustal rocks that lay along the margins of these continents to form the Himalayas. This event was followed by the gradual uplift of the Tibetan Plateau as the subcontinent of India was shoved under Asia.



B.

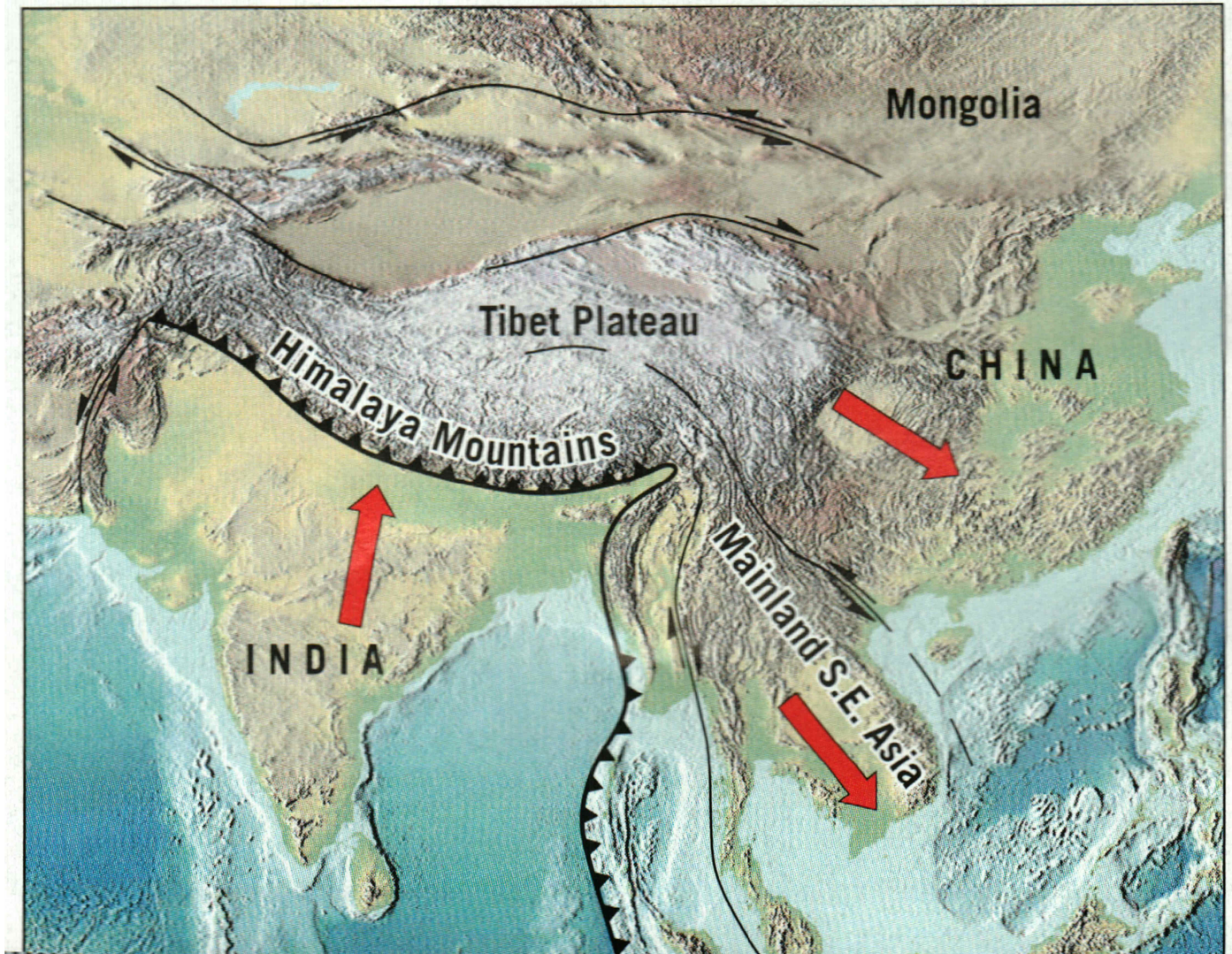
Creation of the Himalayas



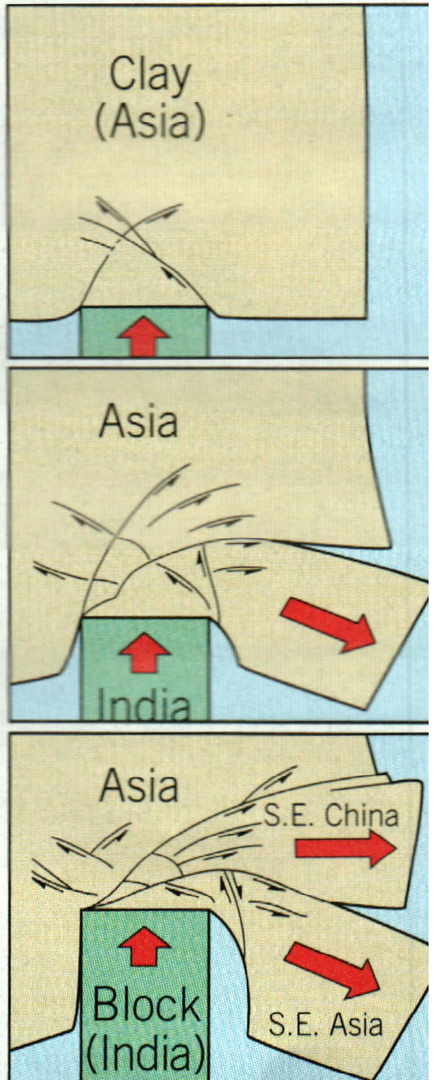
Creation of the Himalayas

Side Effects

Map view showing the southeastward displacement of China and the mainland of Southeast Asia as India plowed into Asia.



Re-creation of the deformation of Asia, using a rigid block to represent India that is pushed into a mass of modeling clay representing Asia.

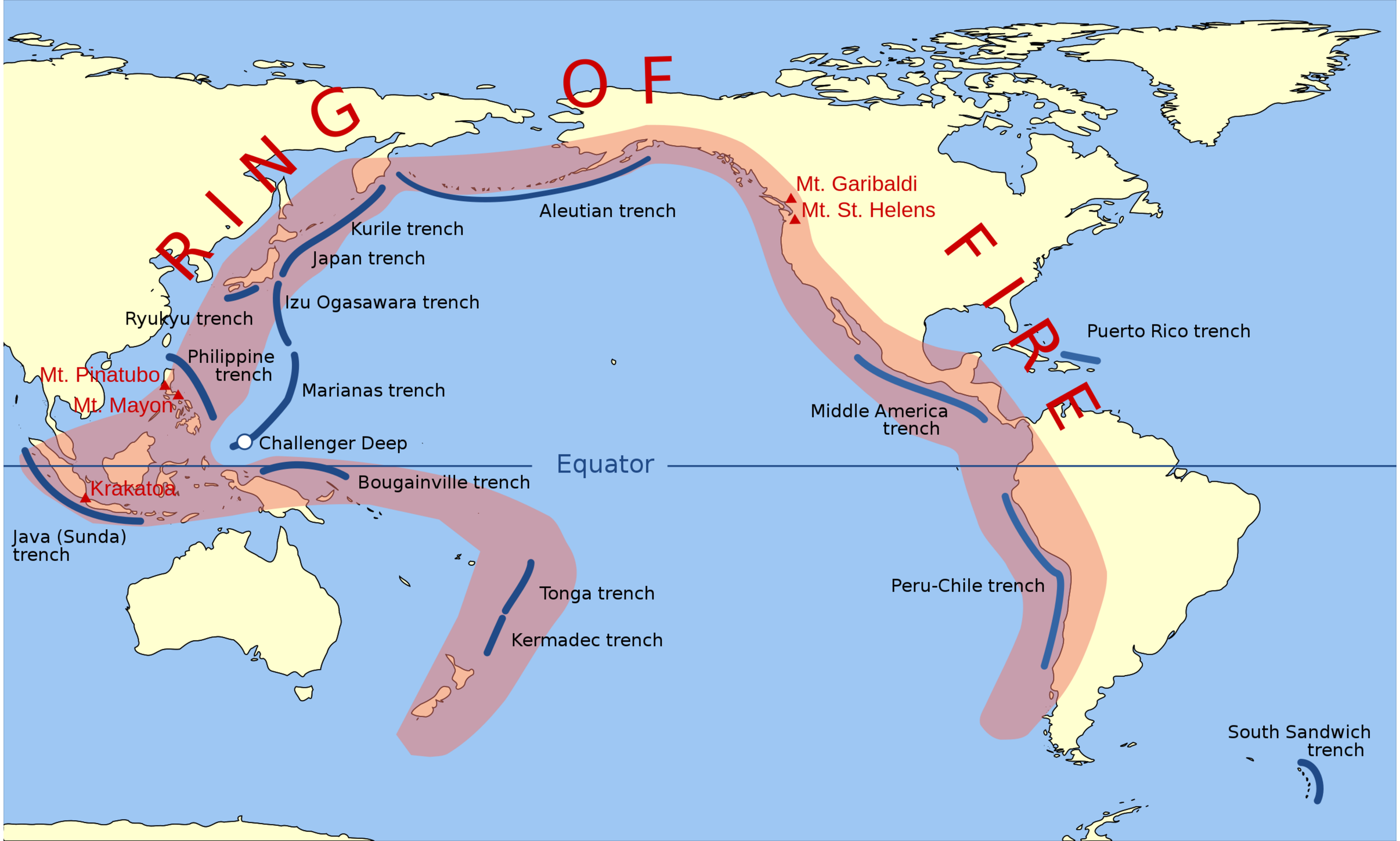


Indian Plate

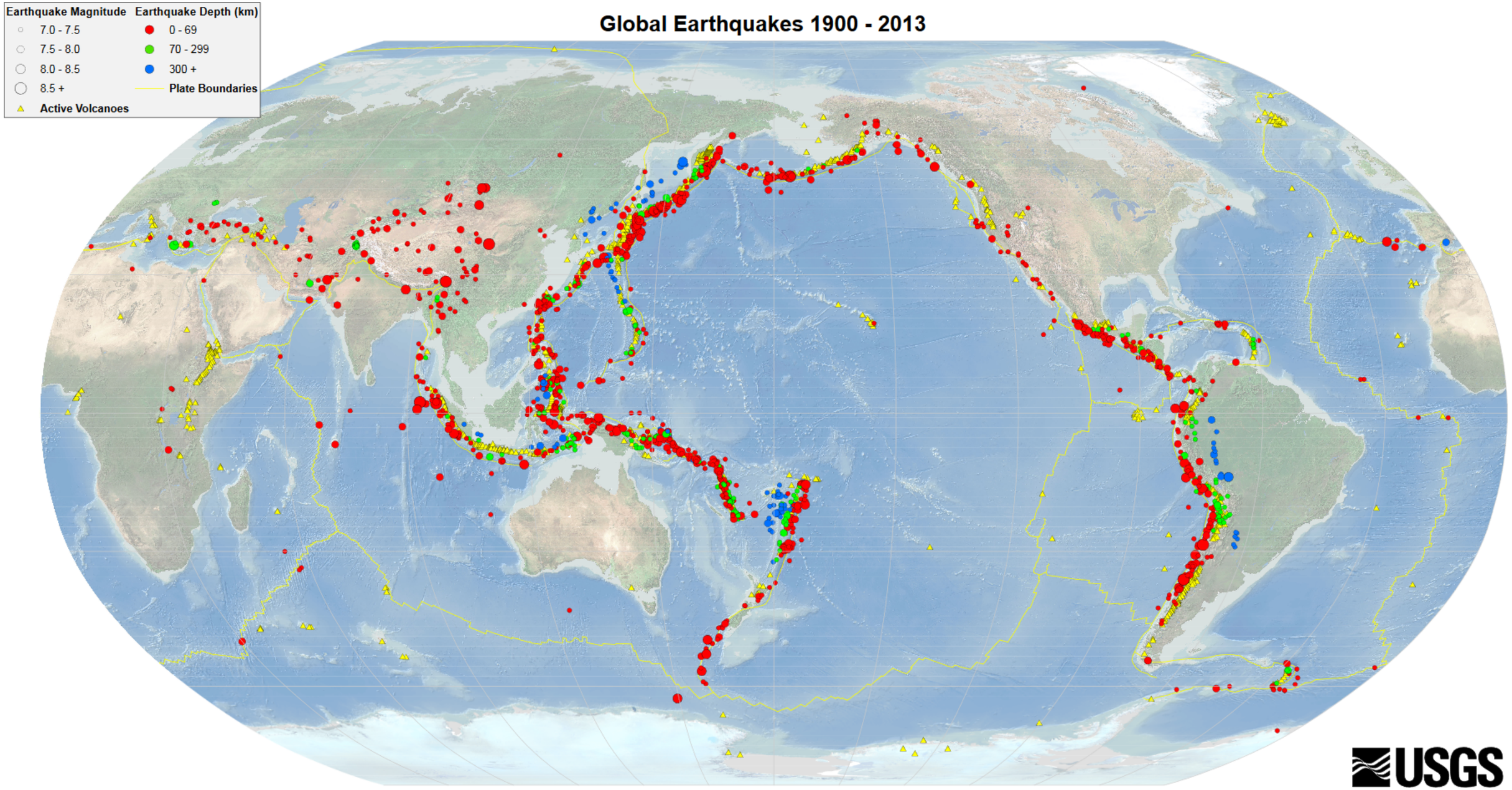
Speed of Movement

In 2007, German geologists[9] suggested the reason the Indian Plate moved so quickly is that it is only half as thick (100 kilometres or 62 miles) as the other plates[15] which formerly constituted Gondwana. The mantle plume that once broke up Gondwana might also have melted the lower part of the Indian subcontinent, which allowed it to move both more quickly and farther than the other parts.[9] The remains of this plume today form the Marion Hotspot (Prince Edward Islands), the Kerguelen hotspot, and the Réunion hotspots.[10][16] As India moved north, it is possible the thickness of the Indian Plate degenerated further as it passed over the hotspots and magmatic extrusions associated with the Deccan and Rajmahal Traps.[10] The massive amounts of volcanic gases released during the passage of the Indian Plate over the hotspots have been theorised to have played a role in the Cretaceous–Paleogene extinction event, generally held to be due to a large asteroid impact.[17]

In 2020, however, geologists at the University of Oxford and the Alfred Wegener Institute found that new plate-motion models displayed increased movement speeds in all mid-ocean ridges during the late Cretaceous, a result irreconcilable to current theories of plate tectonics and a refutation of the plume-push hypothesis. Pérez-Díaz concludes that the accelerated movement of the Indian Plate is an illusion wrought by large errors in geomagnetic reversal timing around the Cretaceous–Paleogene boundary, and that a recalibration of the time scale shows no such acceleration exists.[18][19]

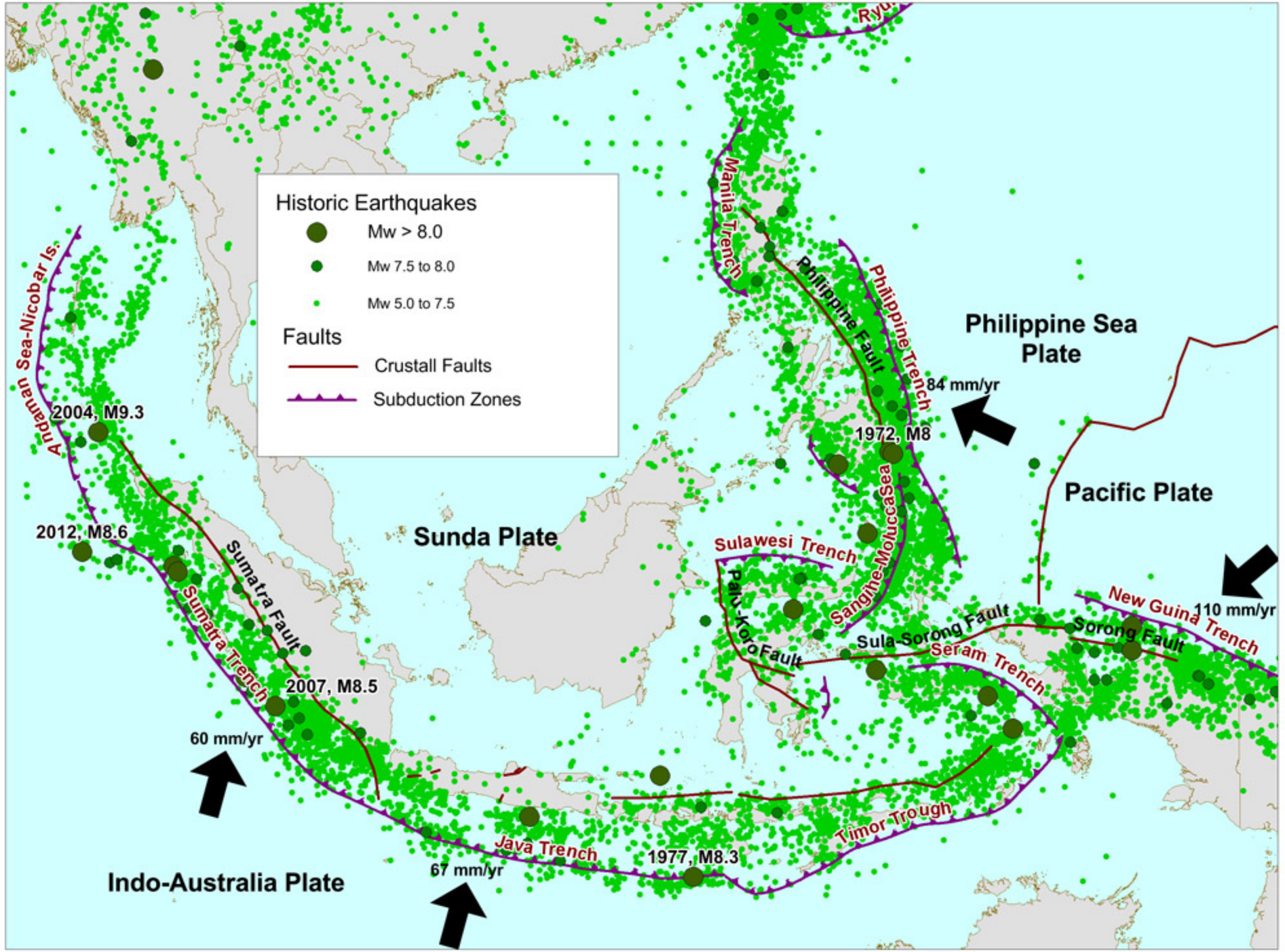

RING OF FIRE
Aleutian trench
Kurile trench
Japan trench
Izu Ogasawara trench
Ryukyu trench
Philippine trench
Marianas trench
Challenger Deep
Bougainville trench
Tonga trench
Kermadec trench
Java (Sunda) trench
Mt. Pinatubo
Mt. Mayon
Krakatoa
Mt. Garibaldi
Mt. St. Helens
Puerto Rico trench
Middle America trench
Peru-Chile trench
South Sandwich trench
Equator

Ring of Fire


Earthquake Magnitude
7.0 - 7.5
7.5 - 8.0
8.0 - 8.5
8.5 +
Active Volcanoes
Earthquake Depth (km)
0 - 69
70 - 299
300 +
Plate Boundaries
Global Earthquakes 1900 - 2013
USGS

Ring of Fire

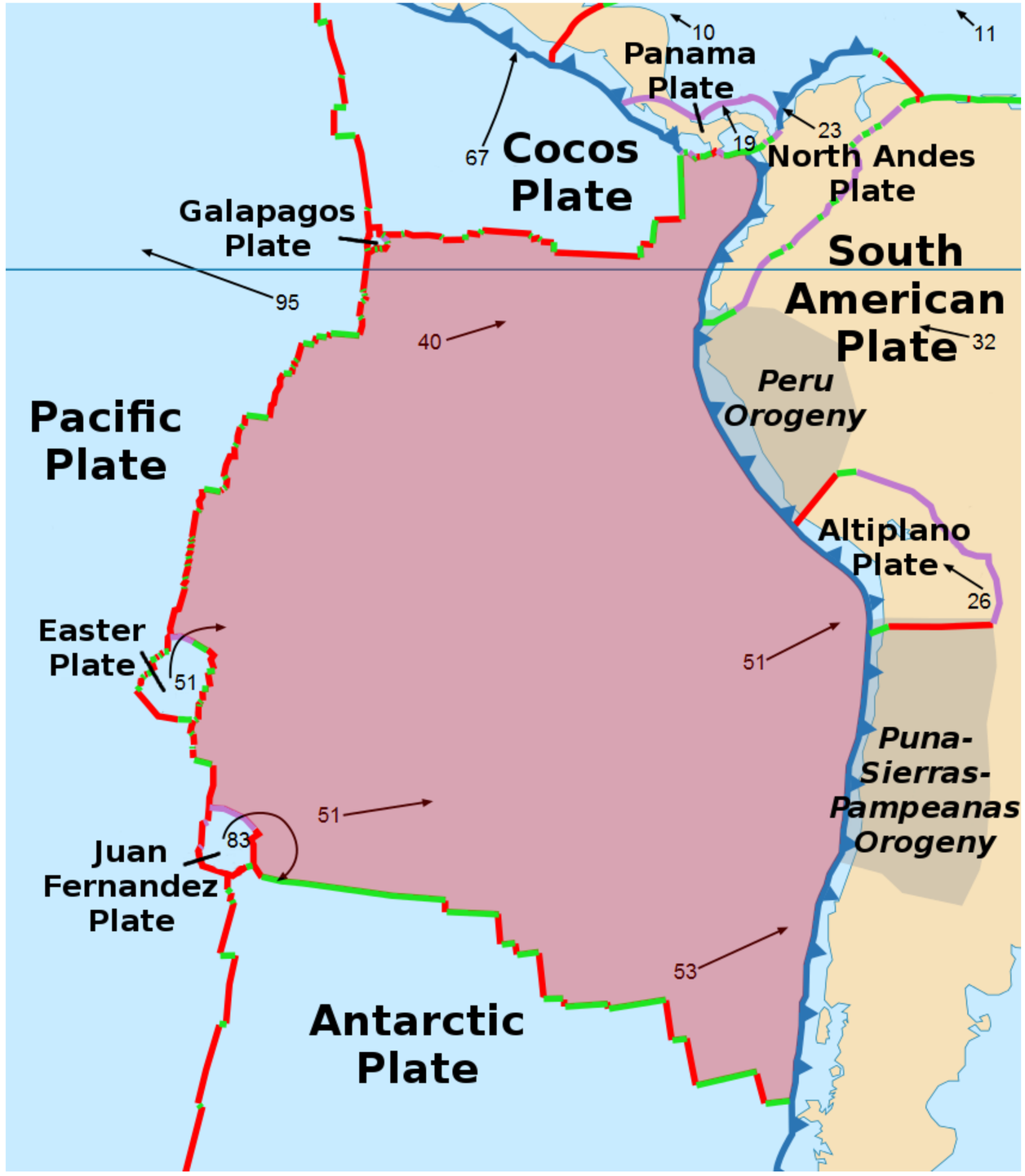
Sunda Plate



Ring of Fire - Indonesian Volcanos

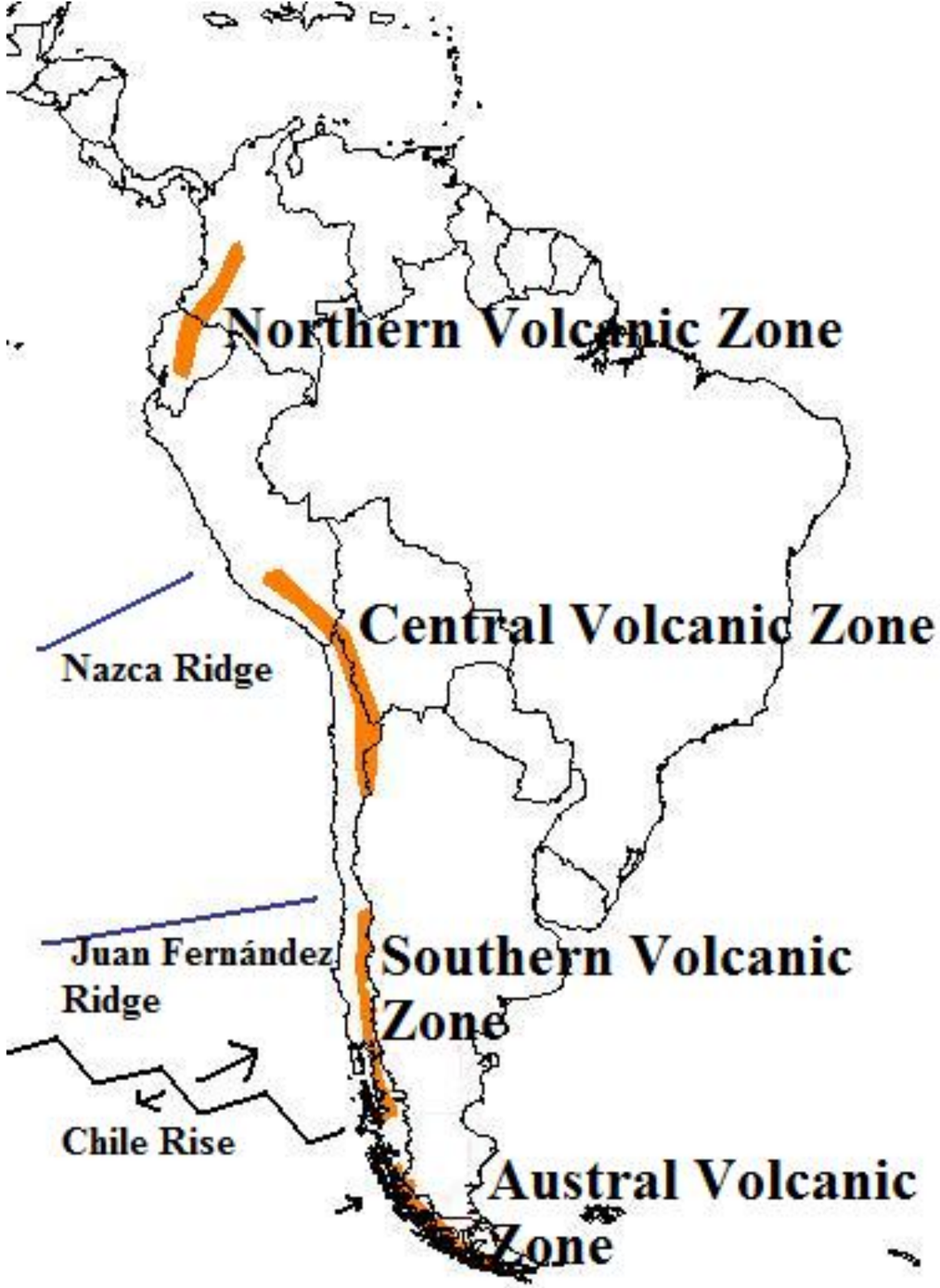
Ring of Fire

Andes - Nazca Plate



Ring of Fire

Andes - Volcanic Zones

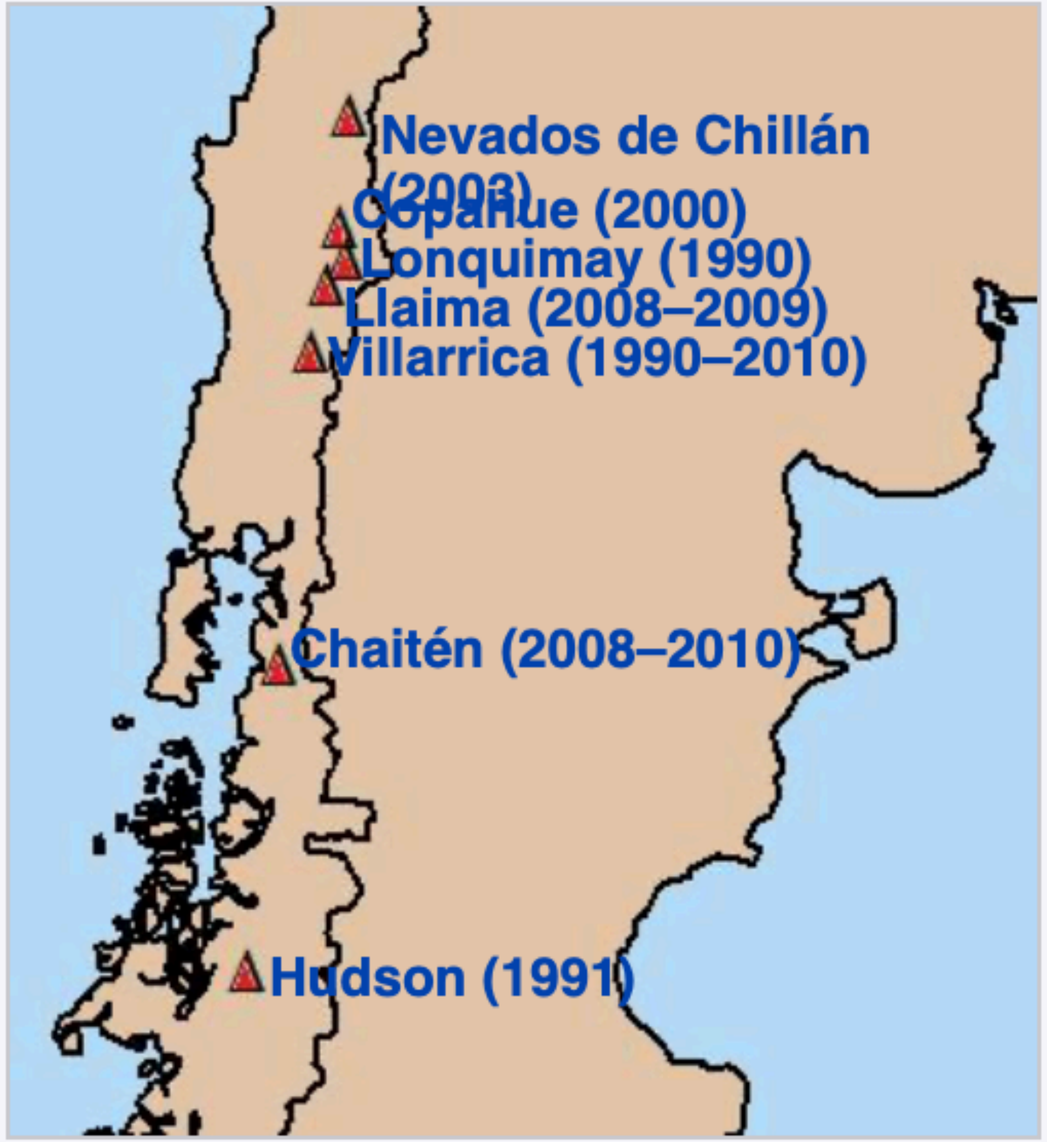


Ring of Fire

Andes Volcanos - Columbia and Ecuador

Ring of Fire

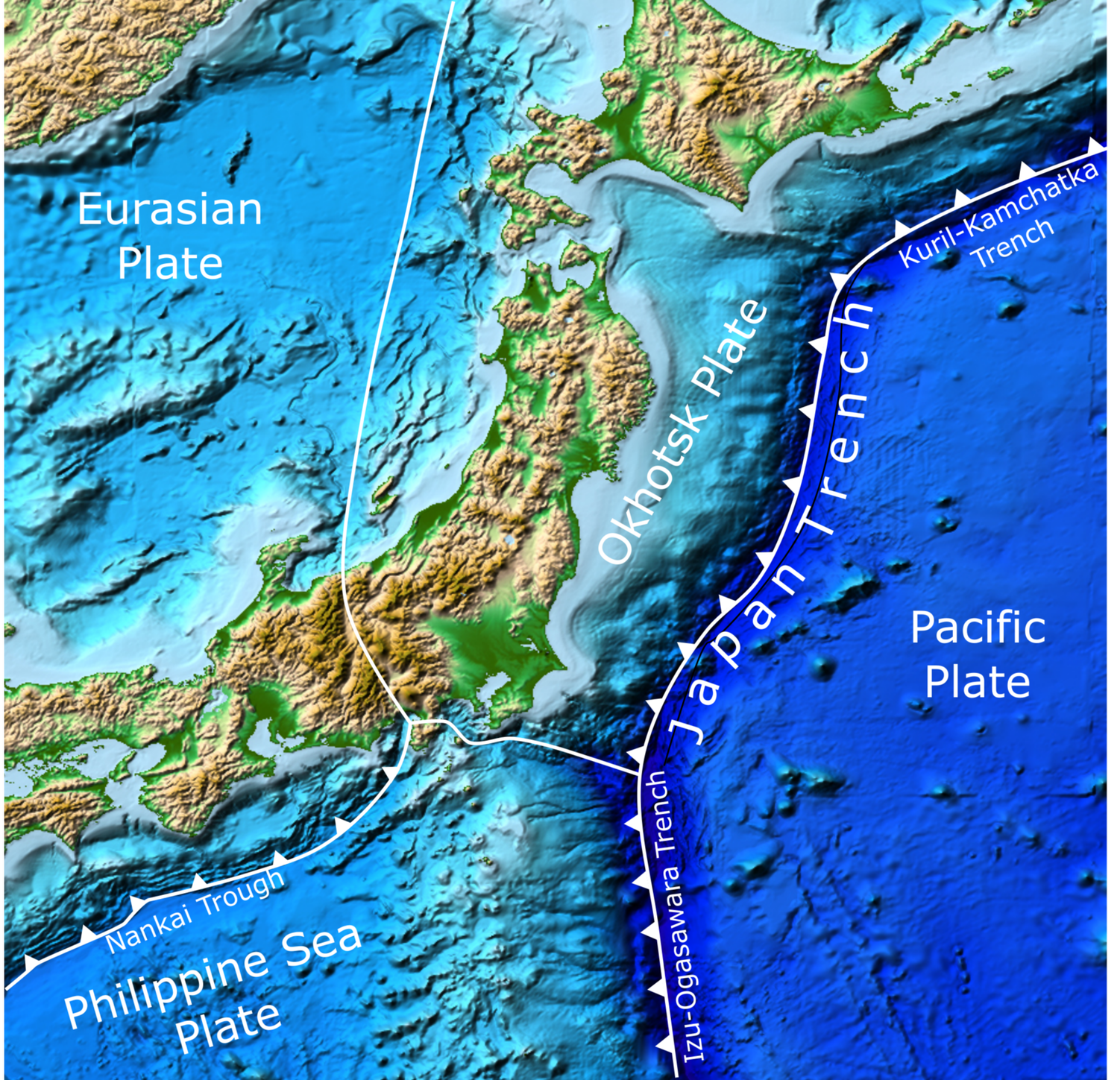
Andes Volcanos - Recent Eruptions in Chile



Map of the volcanoes of the Southern Volcanic Zone that erupted in the 1990–2010 period.

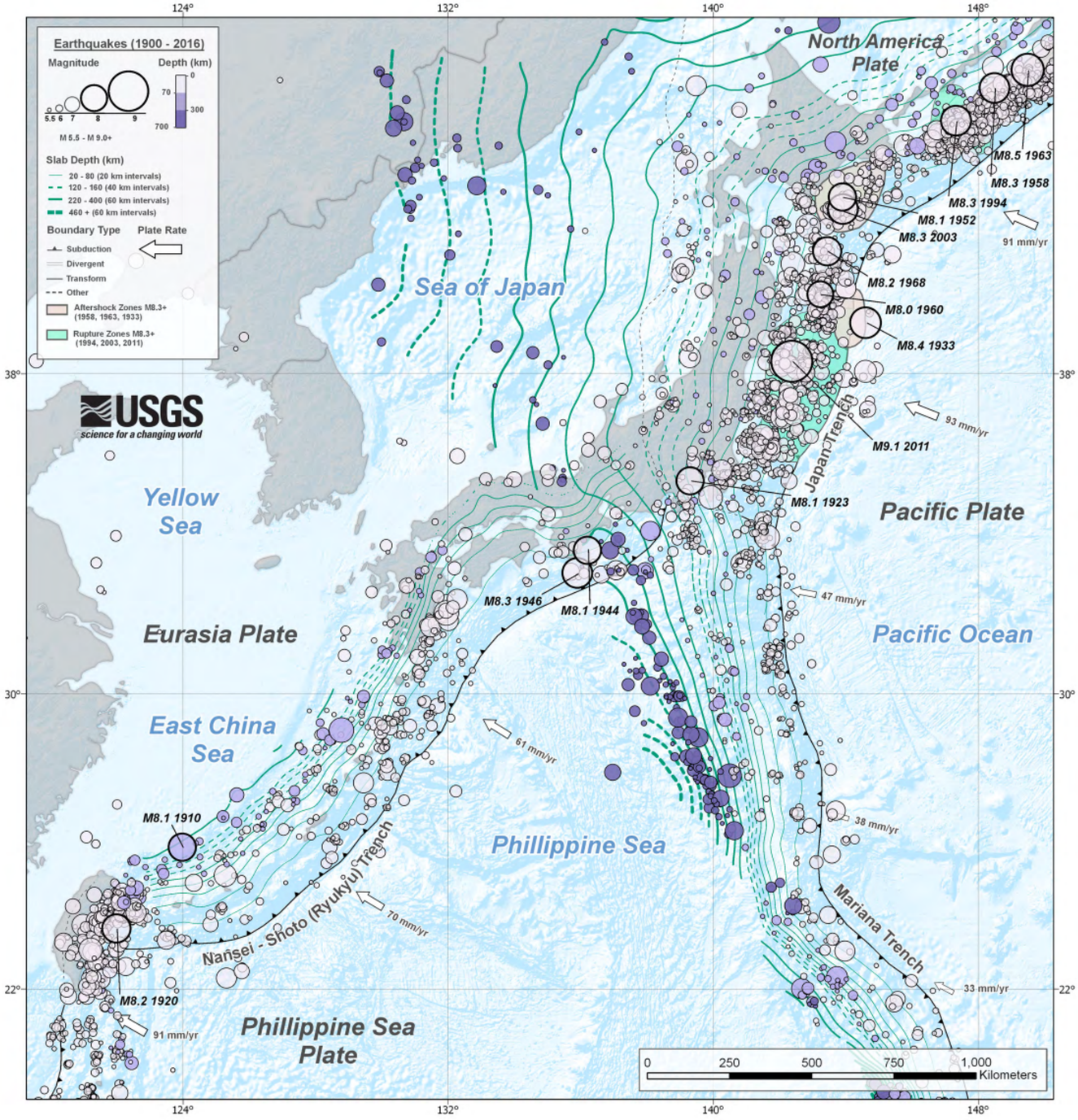
Ring of Fire

Japan - Plate Boundaries



Ring of Fire

Japan - Earthquakes

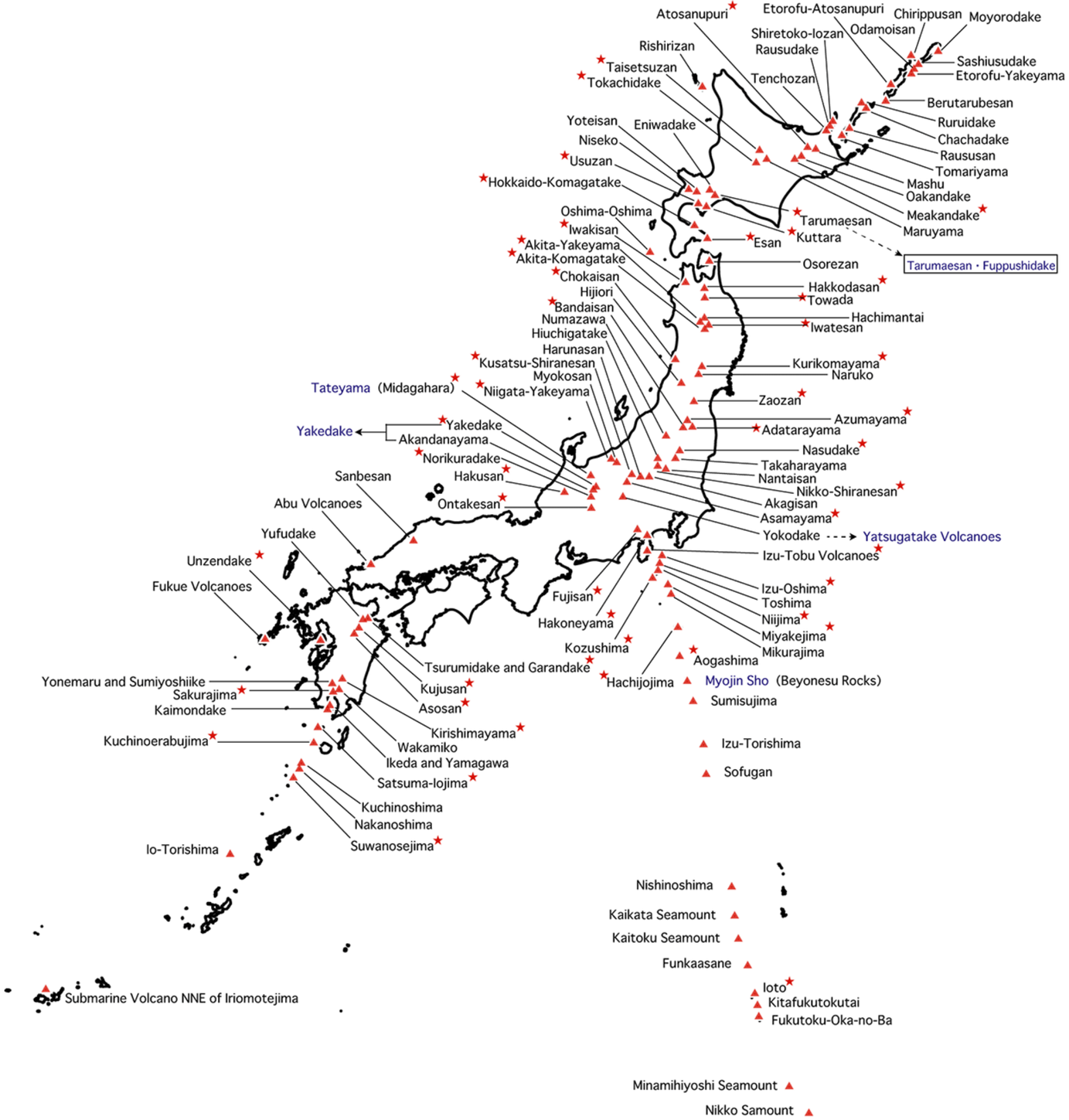


Ring of Fire

Japan - Monitored Volcanos

Ring of Fire

Japan - Active Volcanos



Ring of Fire

Japan - Mount Fuji

Mount Fuji. The most majestic and beautiful Japanese volcano.

Up Next

- Divergent Boundaries:
  - East African Rift Valley.
  - Basin and Range in Nevada.
  - Grand Tetons.
  - Failed Rifting.