# The Himalaya Sphere of Influence

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CHINA
TIBET
NEPAL
INDIA
PAKISTAN

# 16 nations within the Himalaya Sphere

| | Population | Land Size |
|---|---|---|
| China | 1,354.0M (12/2012) | 9,569.90M $km^2$ |
| India | 1,210.6M (03/2011) | 2,973.19M $km^2$ |
| Pakistan | 183.8M (07/2013) | 856.69M $km^2$ |
| Bangladesh | 152.5M (07/2012) | 130.17M $km^2$ |
| Vietnam | 88.8M (07/2012) | 310.07M $km^2$ |
| Thailand | 65.9M (09/2010) | 510.89M $km^2$ |
| Myanmar | 53.2M (07/2013) | 653.51M $km^2$ |
| Malaysia | 29.8M (07/2013) | 329.61M $km^2$ |
| Nepal | 26.5M (06/2011 | 140.80M $km^2$ |
| Afghanistan | 25.5M (01/2013) | 652.23M $km^2$ |
| Cambodia | 15.1M (07/2013) | 176.52M $km^2$ |
| Tajikistan | 8.0M (04/2013) | 141.51M $km^2$ |
| Laos | 6.6M (07/2013) | 230.80M $km^2$ |
| Kyrgyzstan | 5.6M (07/2012) | 191.80M $km^2$ |
| Mongolia | 3.0M (07/2014) | 1,564.12M $km^2$ |
| Bhutan | .7M (07/2012) | 47.04M $km^2$ |

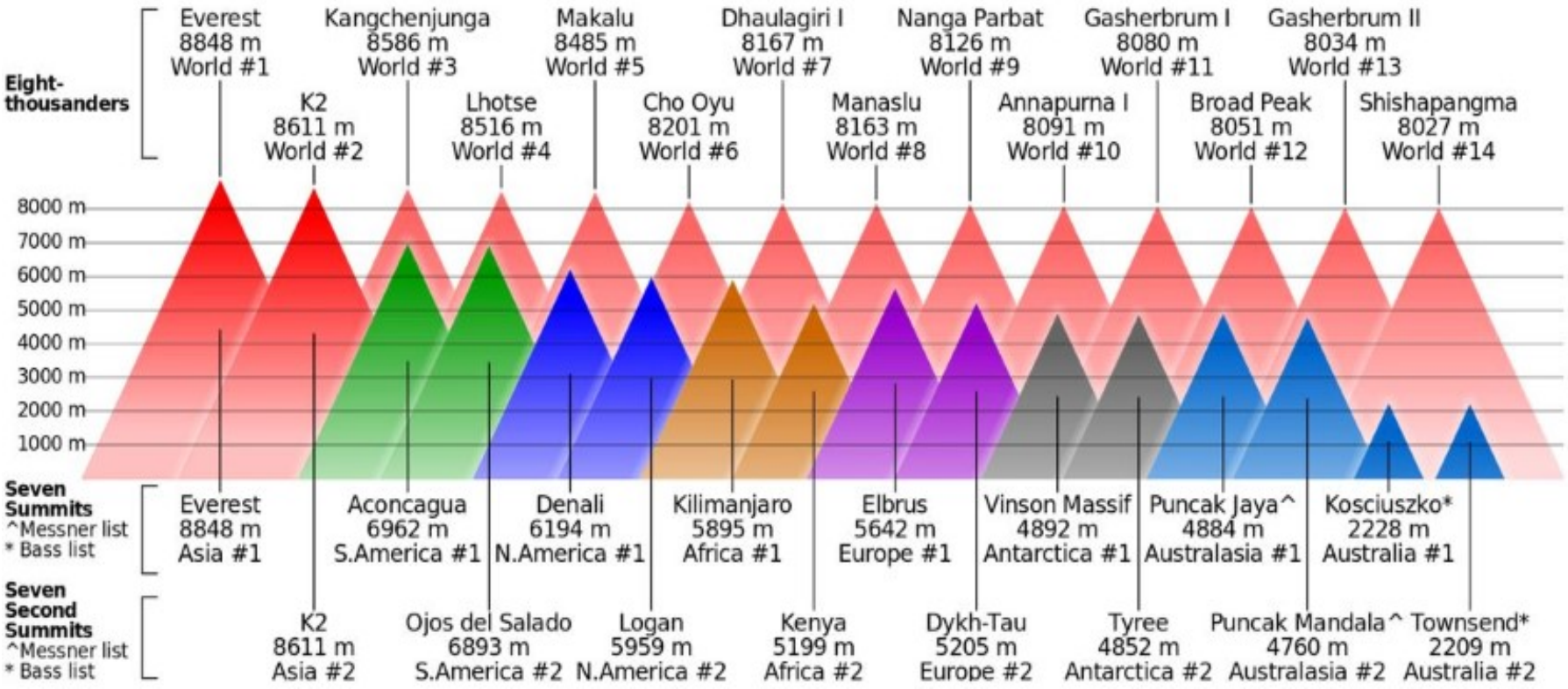
Regional Population = 3,230M (45% of 7,100M world population according to UCSB world population clock).
Regional Land Size =18,291M $km^2$ (12.3% of 148,940M $km^2$ world land size)

# We know there is a massive mountain range

# Crowned by Mount Everest - the world's highest

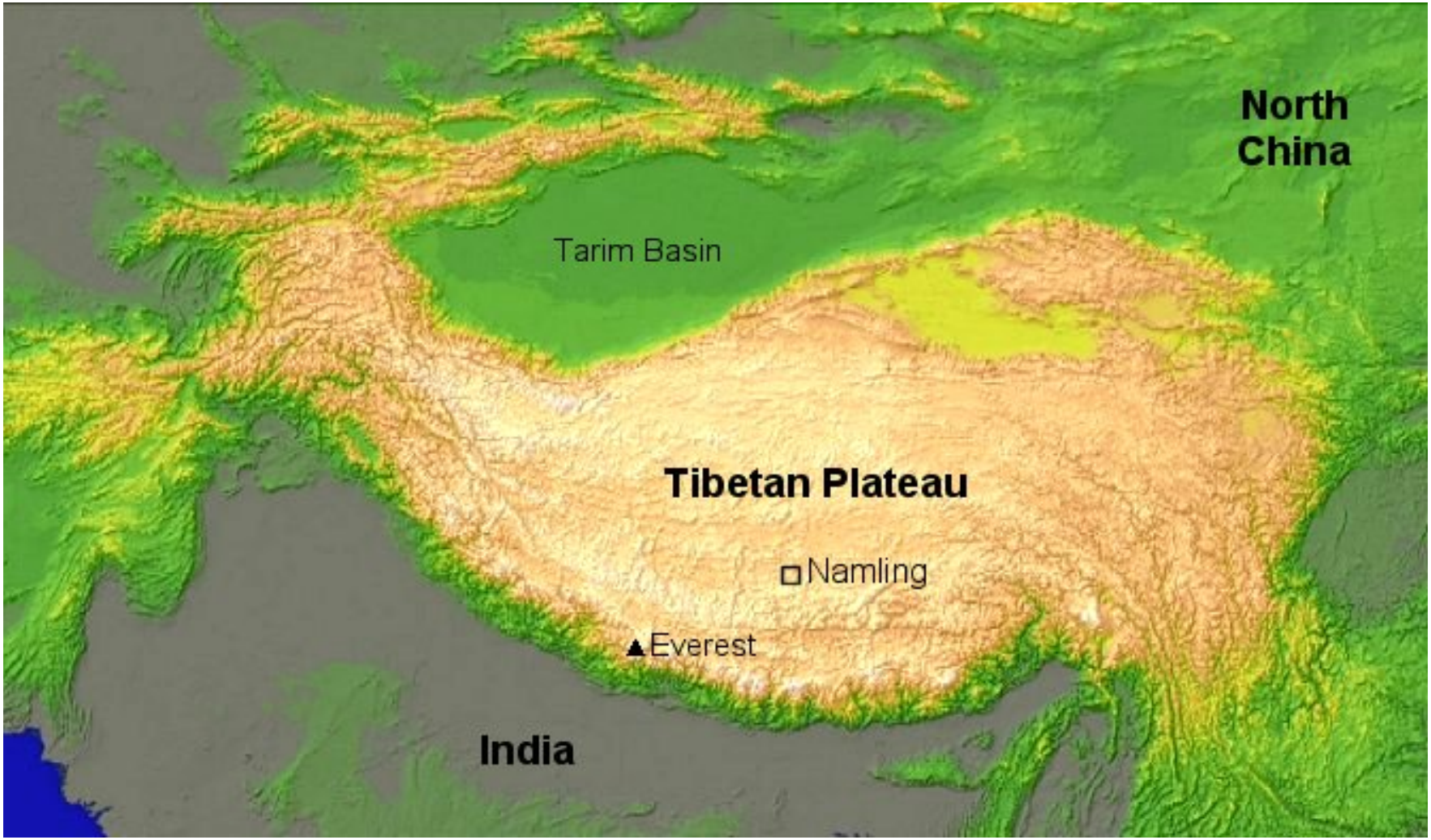
8848m

# Including 14 highest mountains of the world
## - and 100 peaks over 7000m



# Beside it is the Tibetan Plateau ‘Roof of the World’

largest and highest plateau on planet Earth: altitude 5km and 3 Mkm$^2$



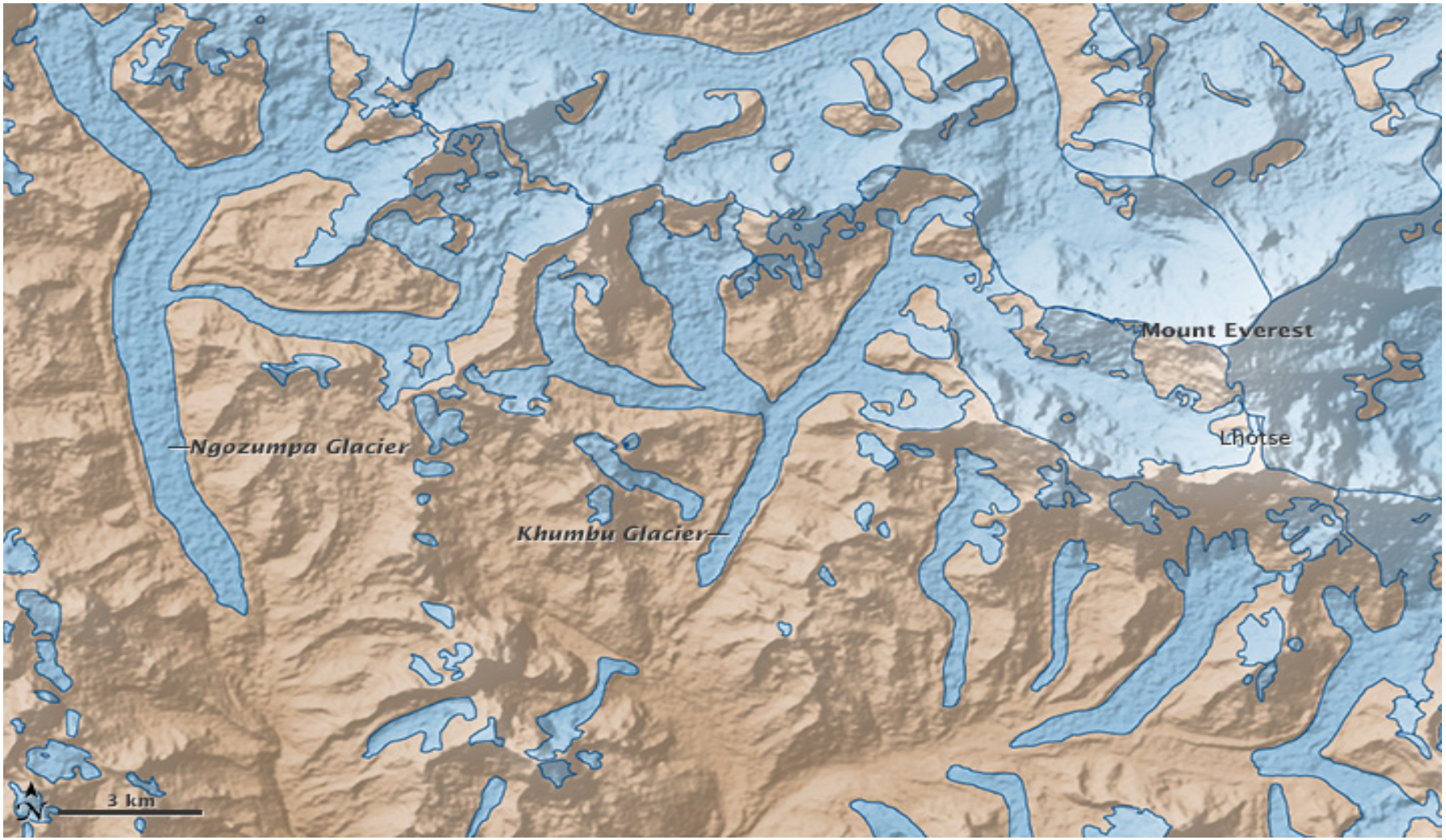
For climate studies, HTP should be regarded as a single combined geological system

# HTP is the source of 12 major Asian rivers

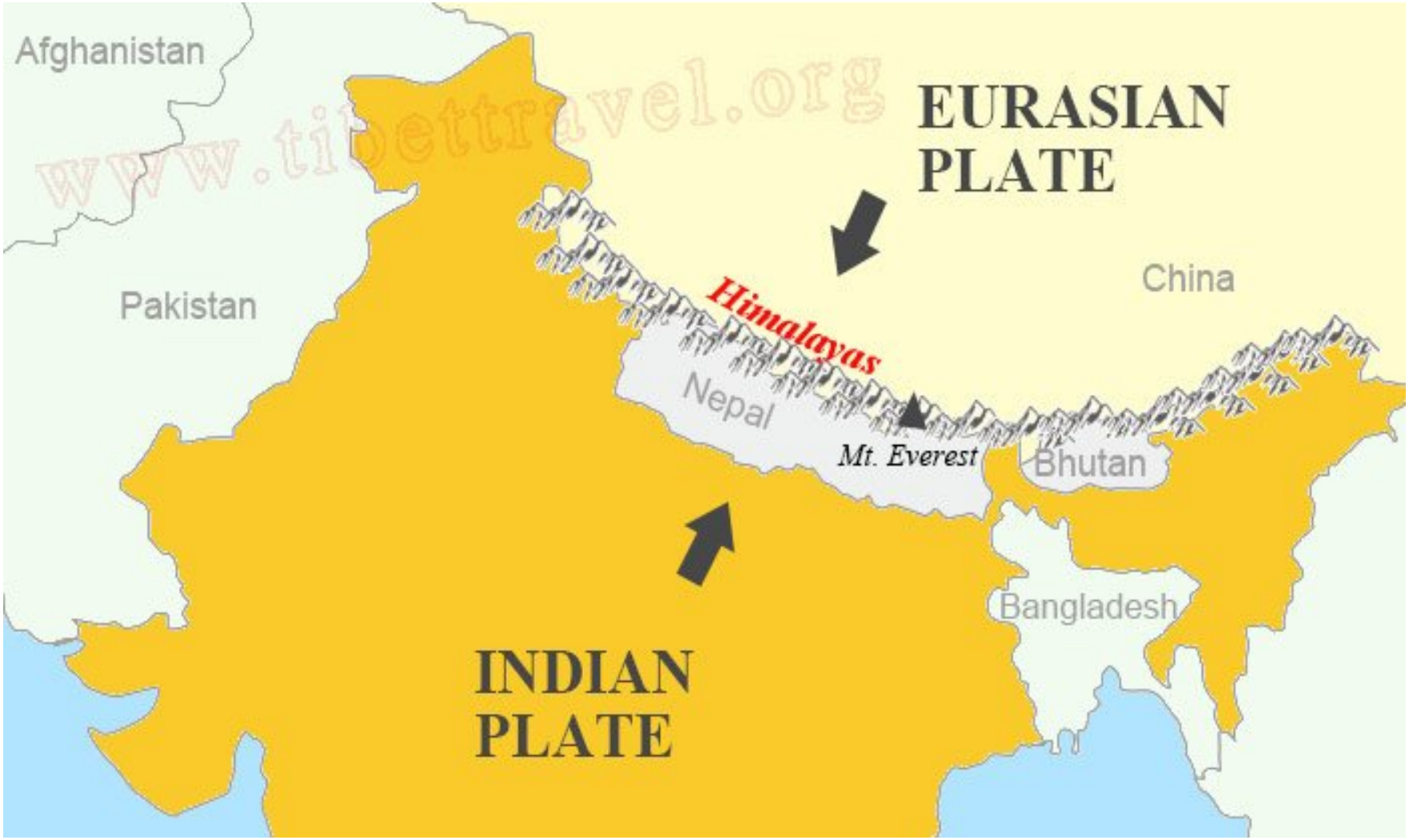
(delivering water at ~80,000$m^3$/sec)

# HTP has more than 15,000 glaciers

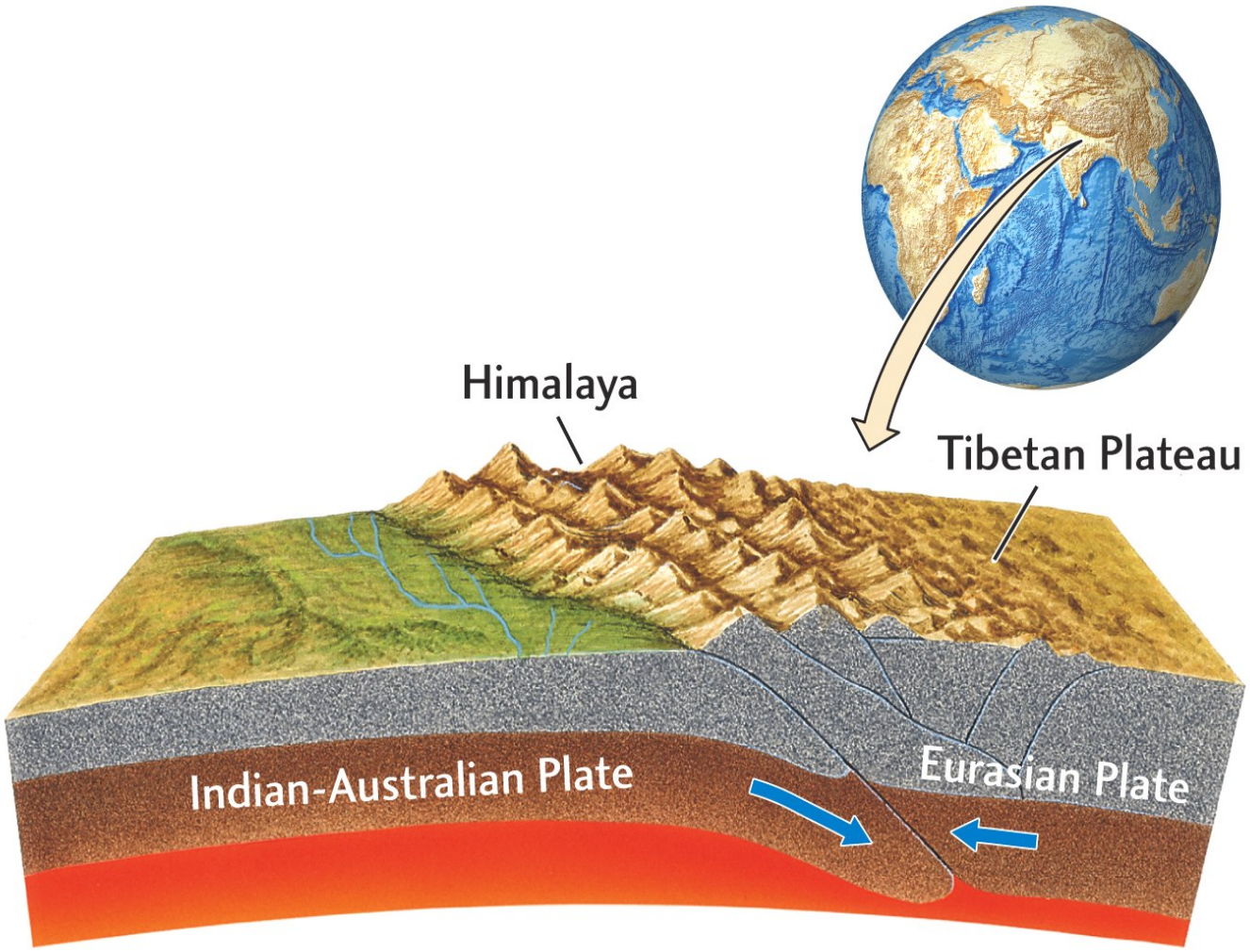
(which store 12,000 $km^3$ of freshwater)



# The HTP formation process was complex

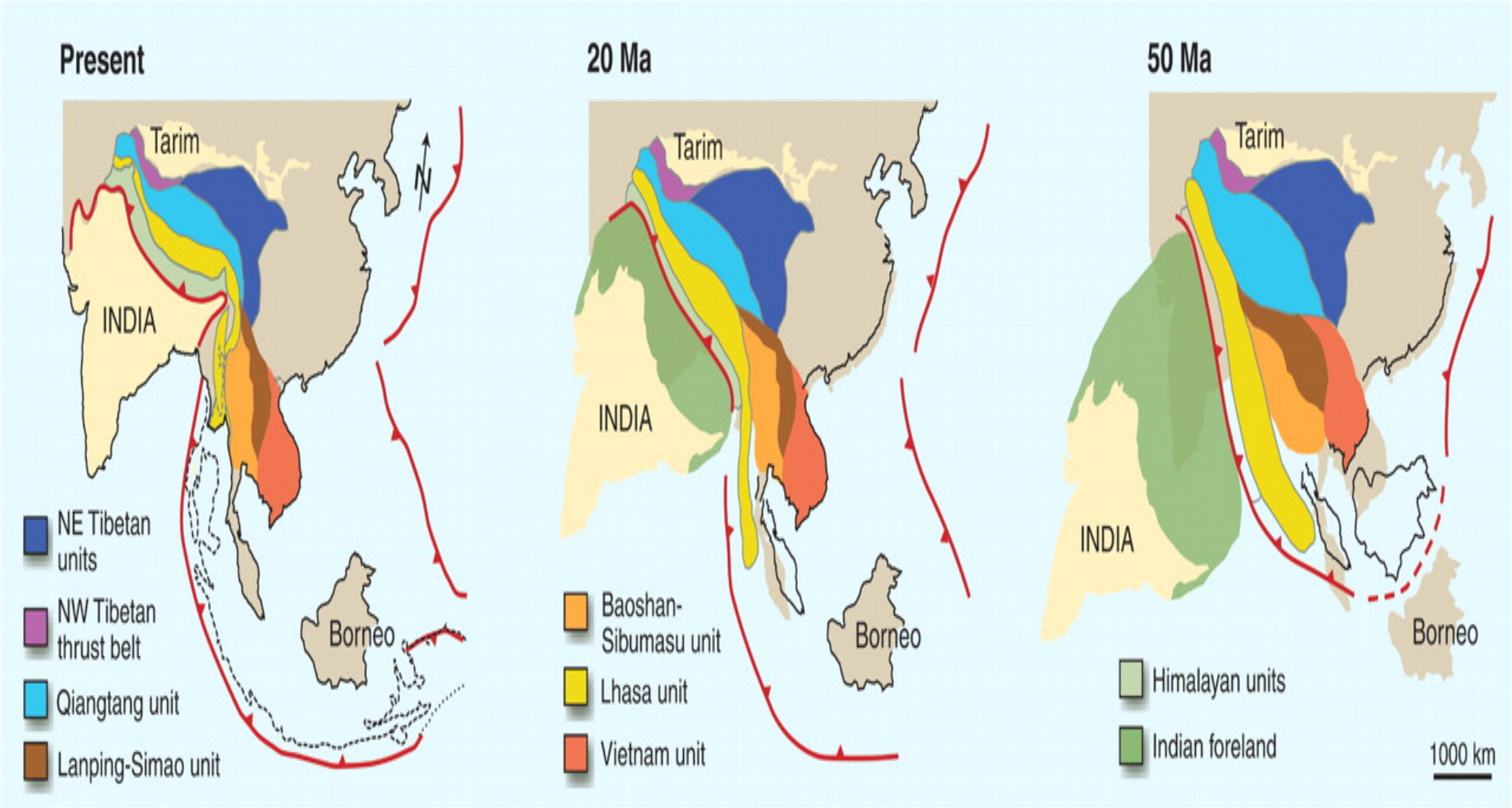


# Involving a Tectonic Plate Collision

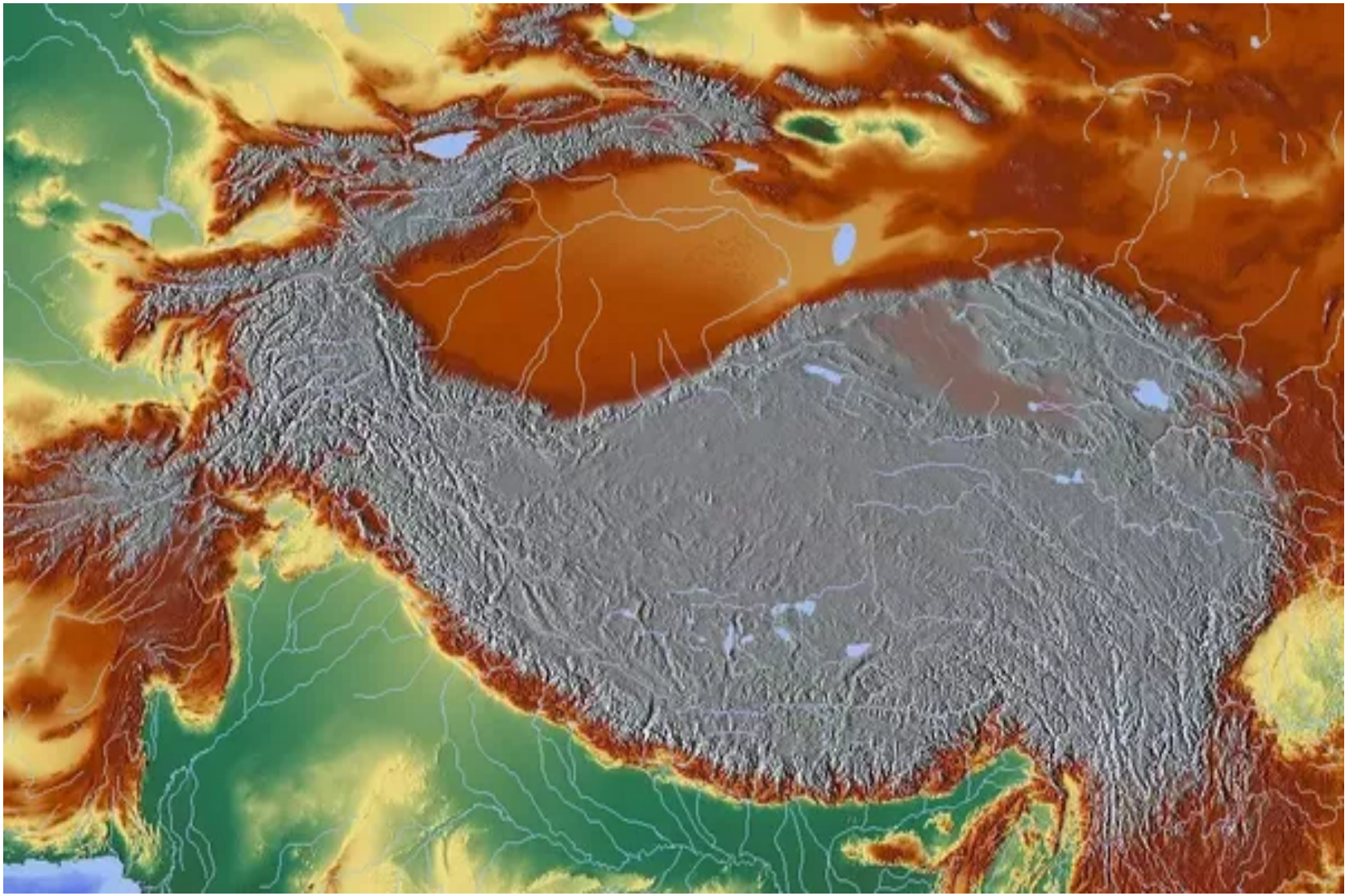


This tectonic collision began some 70 Mya, driving the India land mass 2000+ km into the Eurasian land mass

# The Tibetan Plateau was created in the process with much compression, folding, plastic flow, drainage & erosion



# Today, the HTP unit is highly significant to the ASM



The entire process began with supercontinent

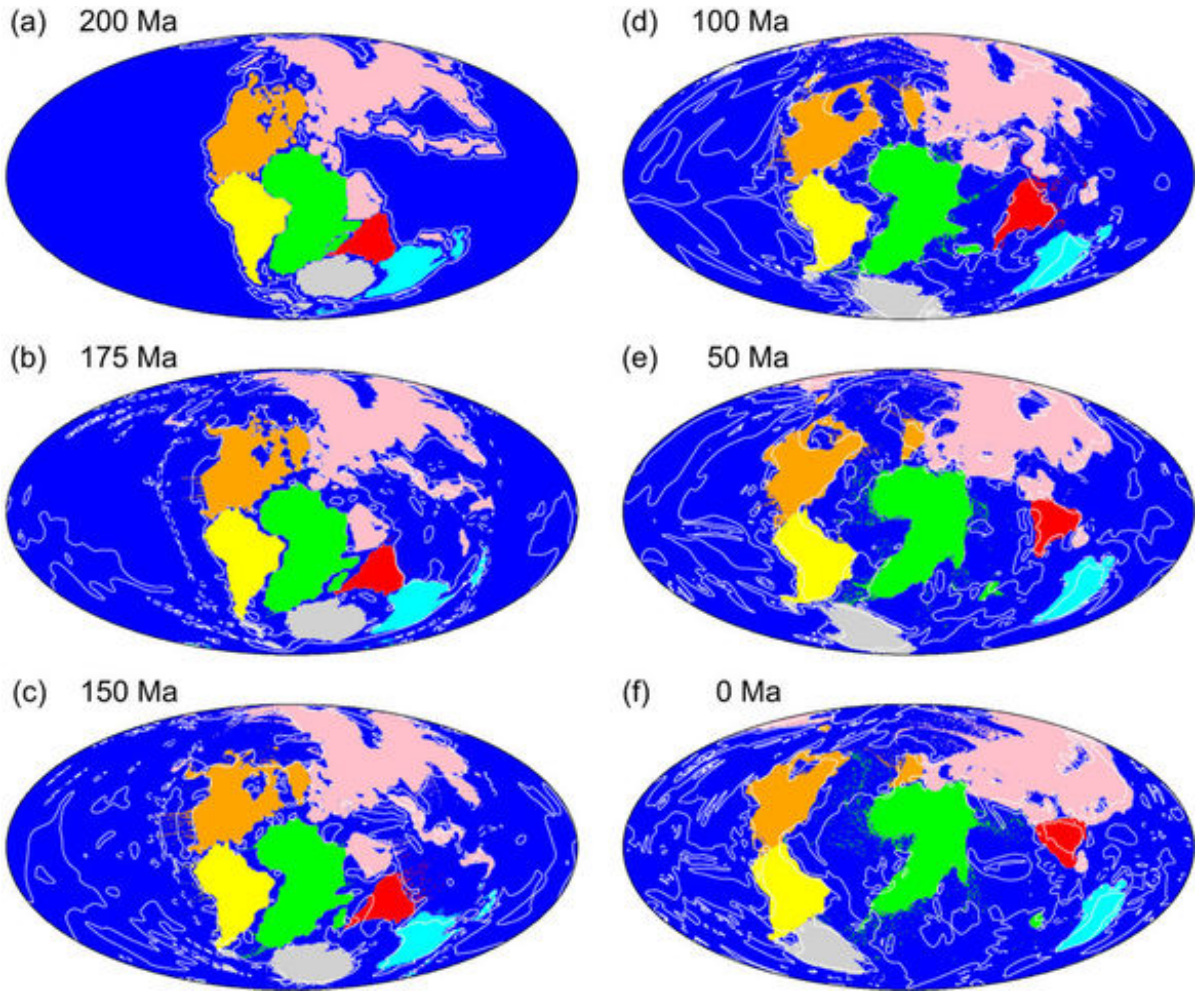
# Pangea


250 mya

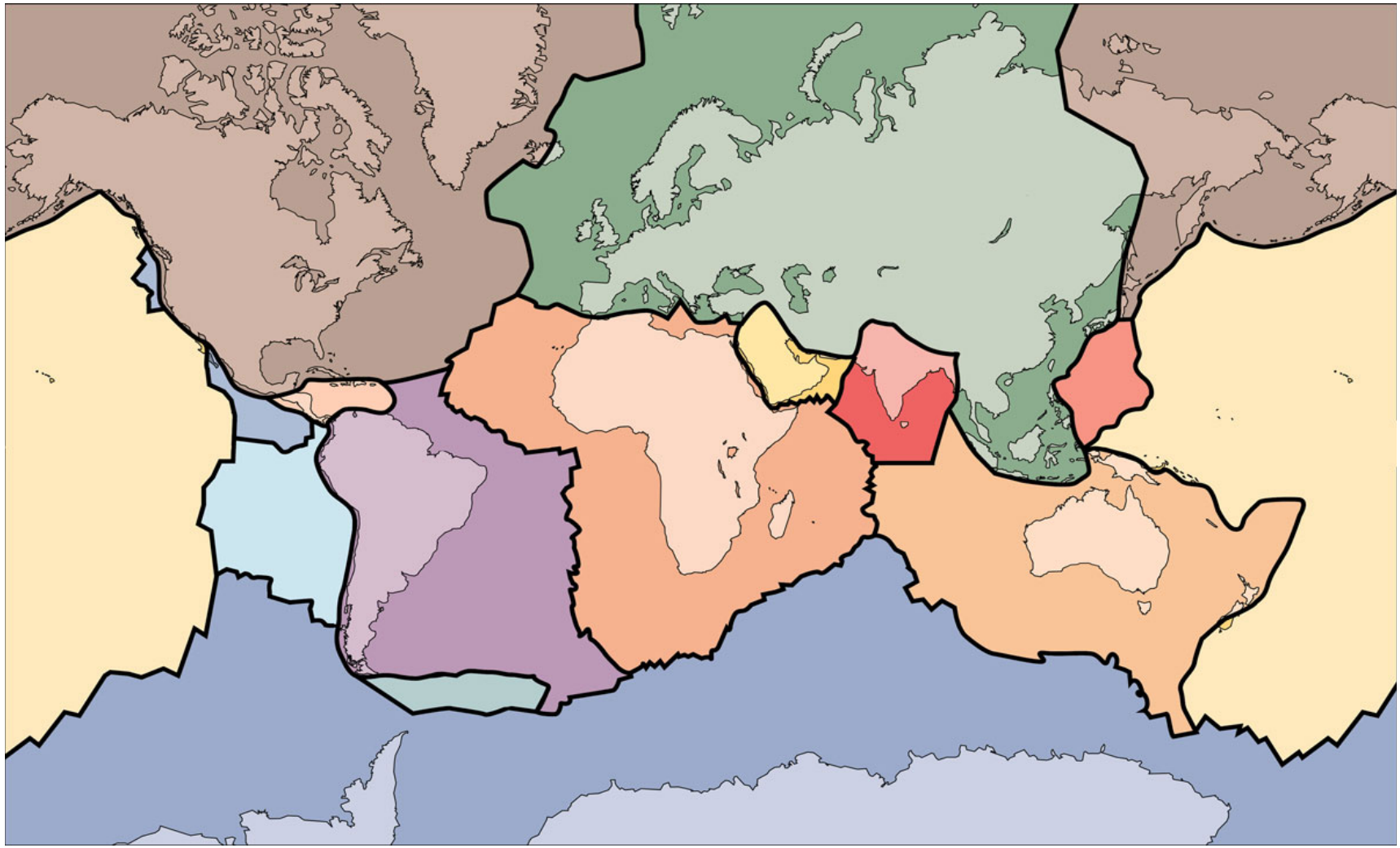
# Pangea consisted of Laurasia + Gondwana


250 mya

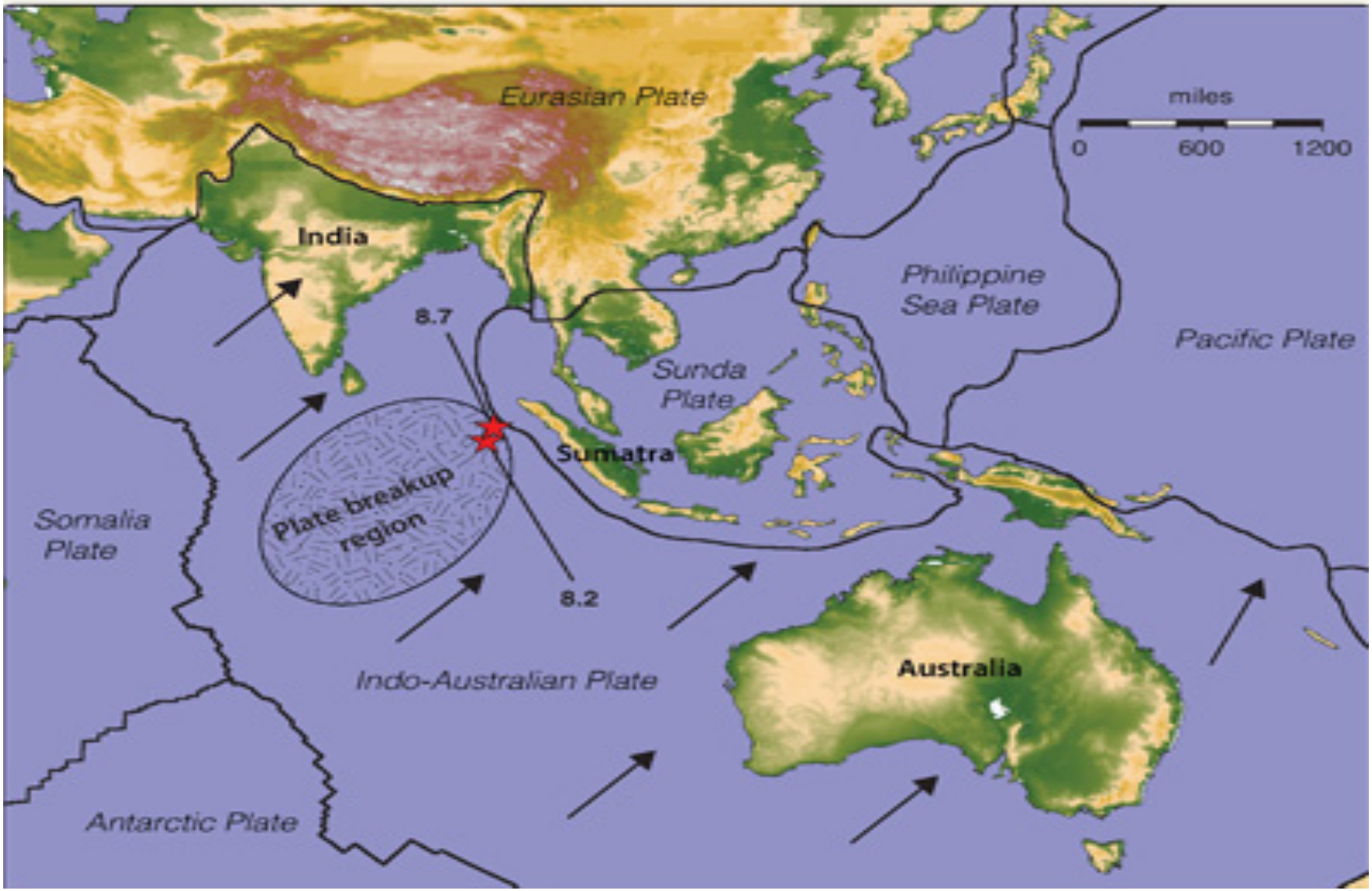
# Pangea began to breakup 250Mya



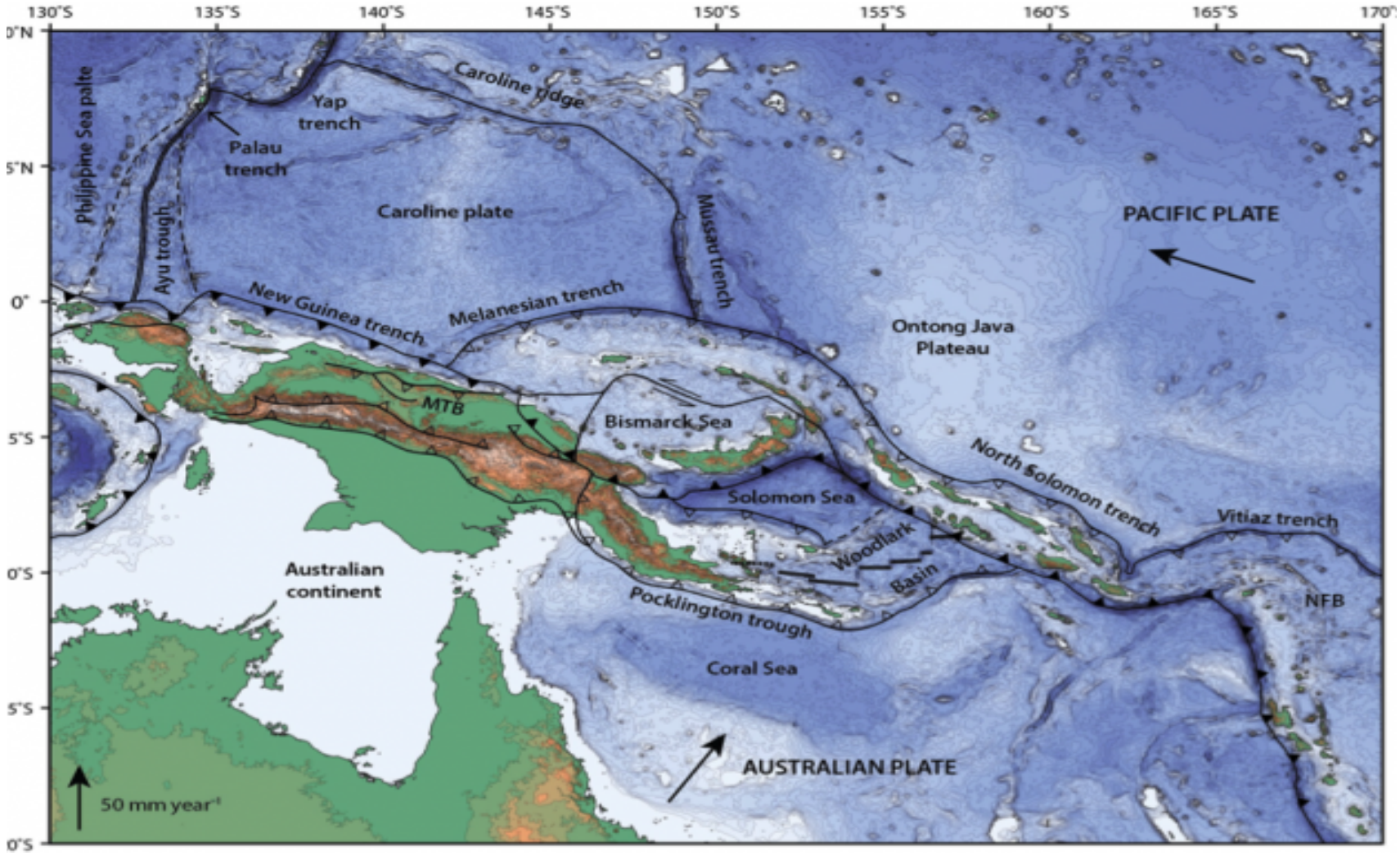
# Continents Rifted & Drifted on Tectonic Plates



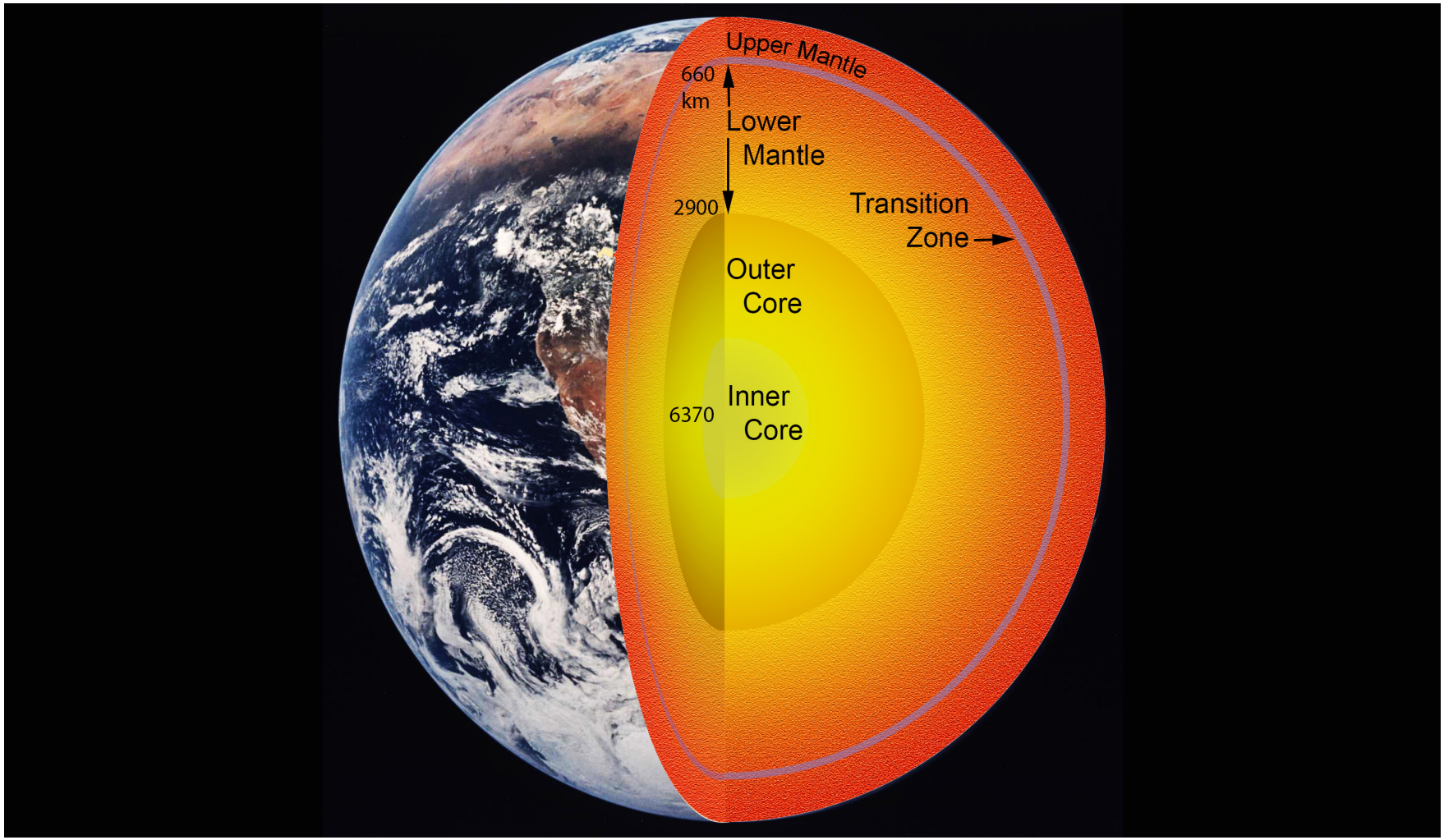
# The Indo-Australian Plate still moves in a NE direction



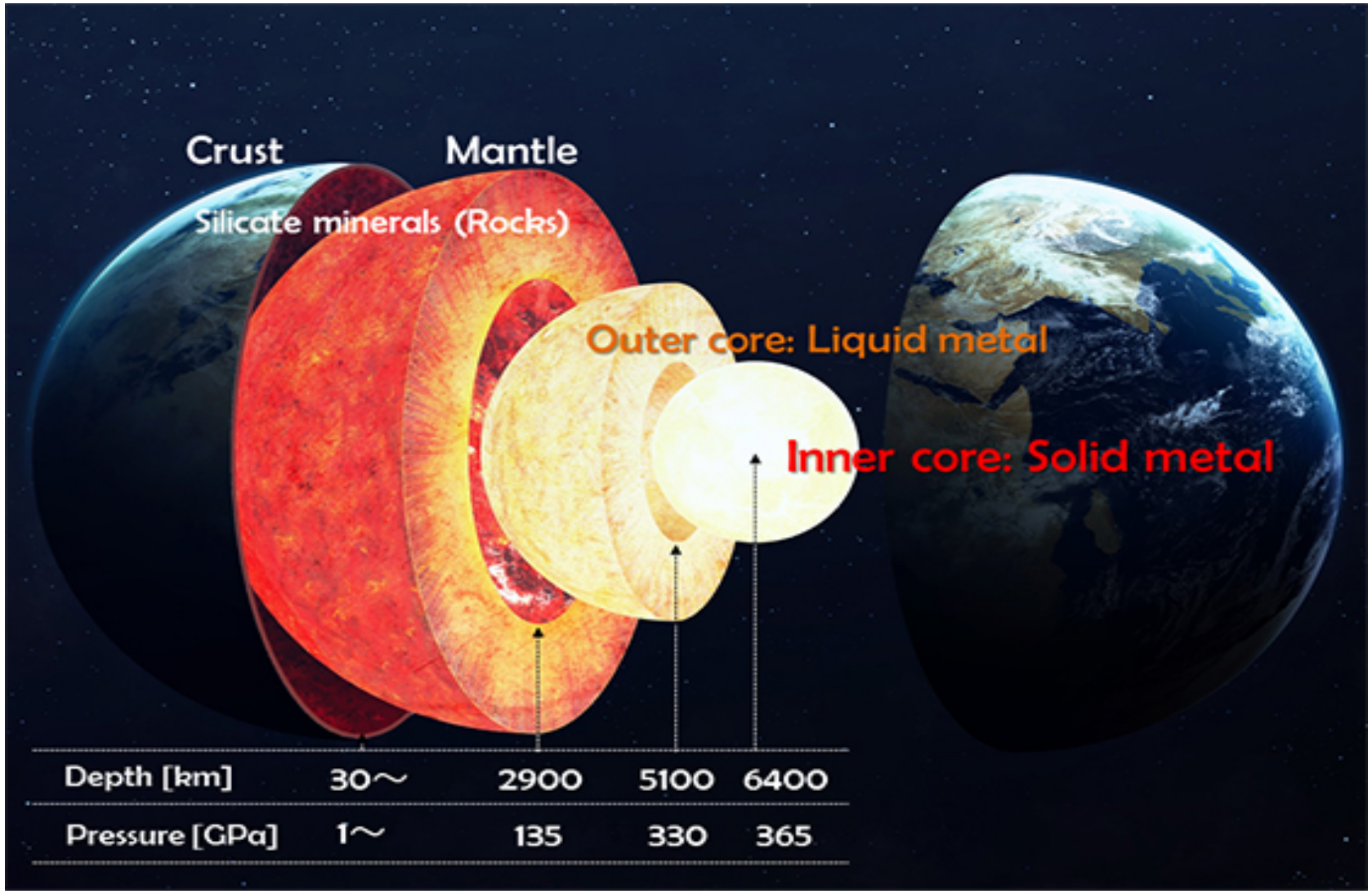
# Plate collisions are always highly complicated



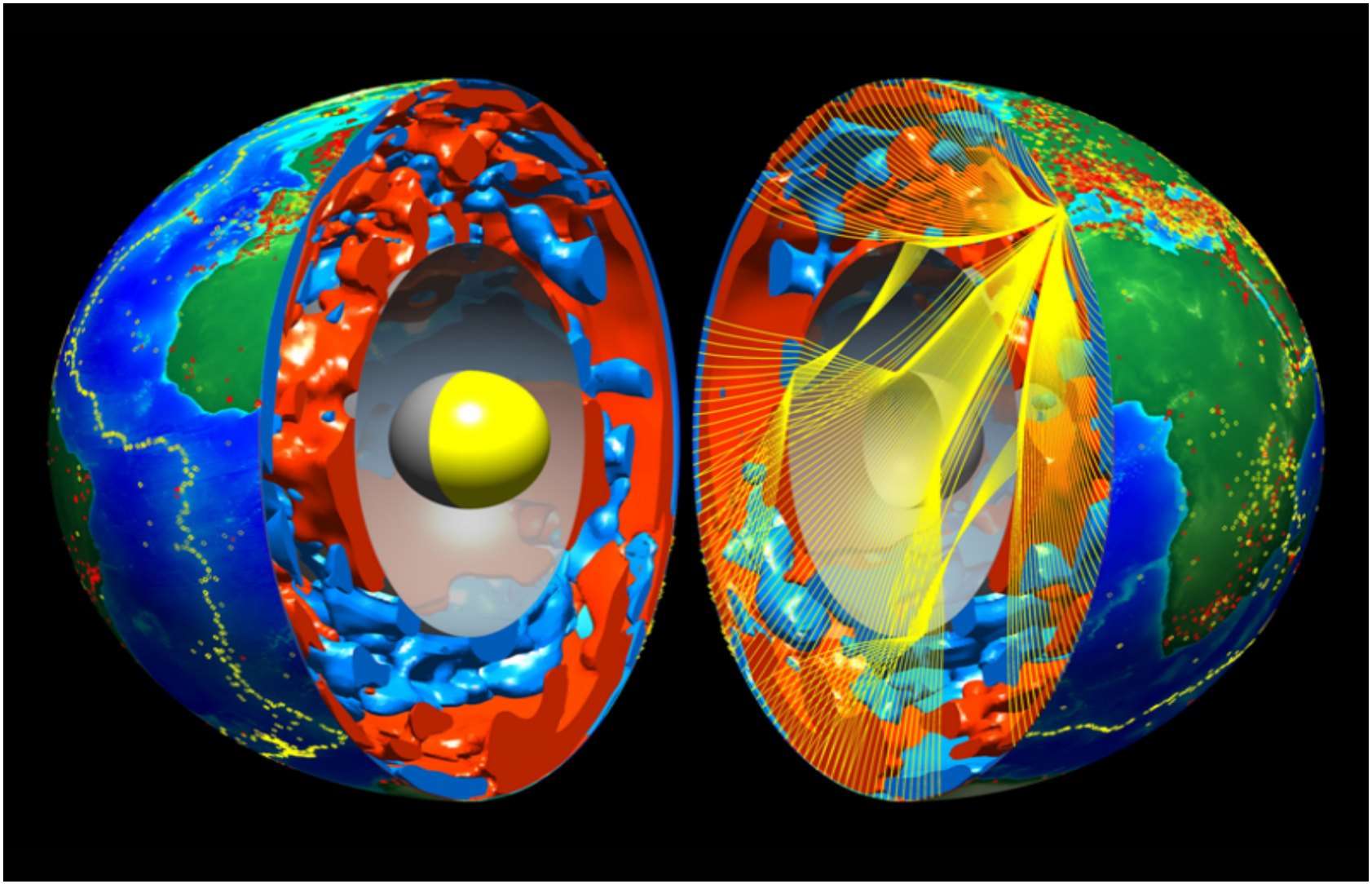
# How well do we know the structure of the Earth?



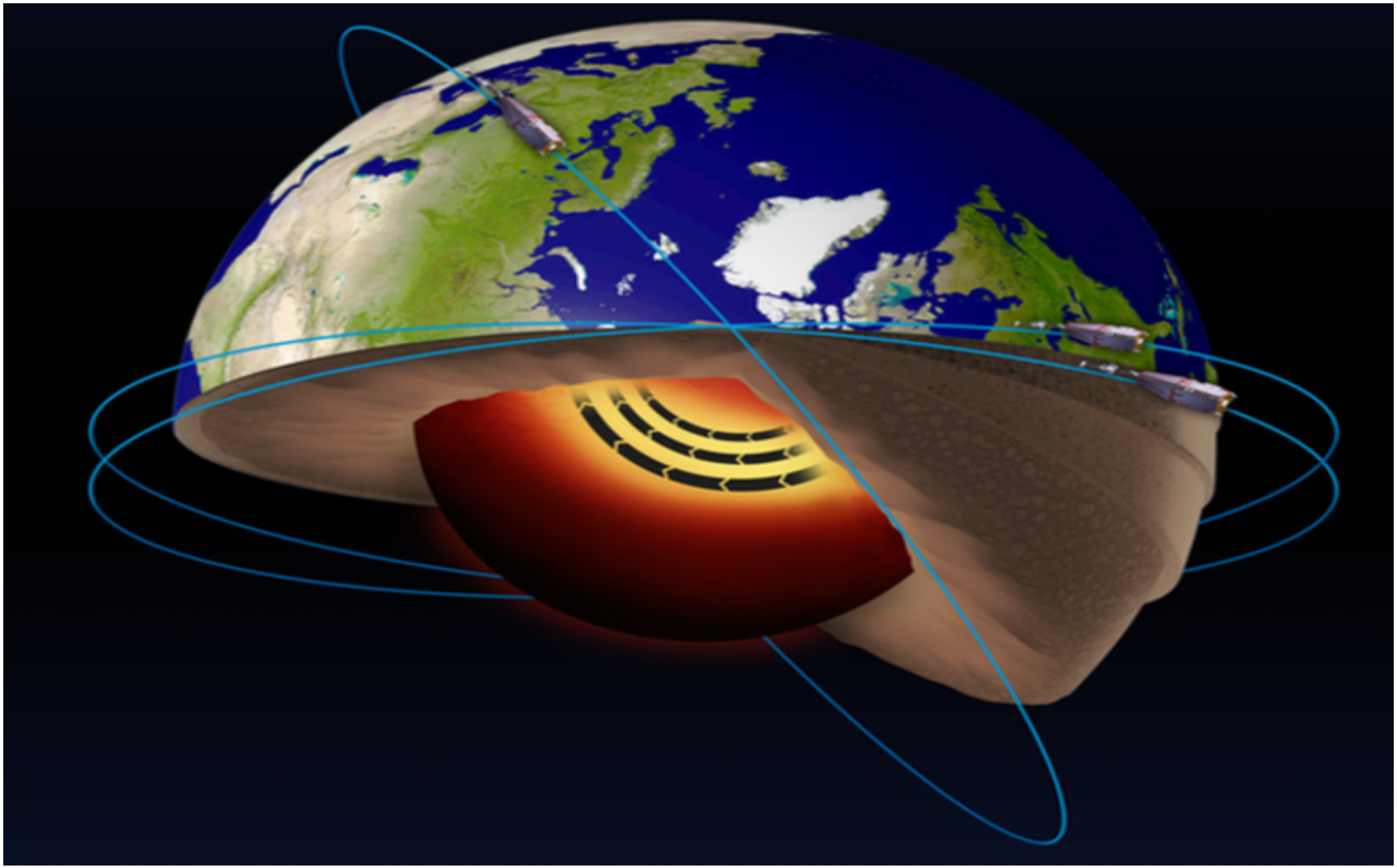
# Today we know the Earth's crust well



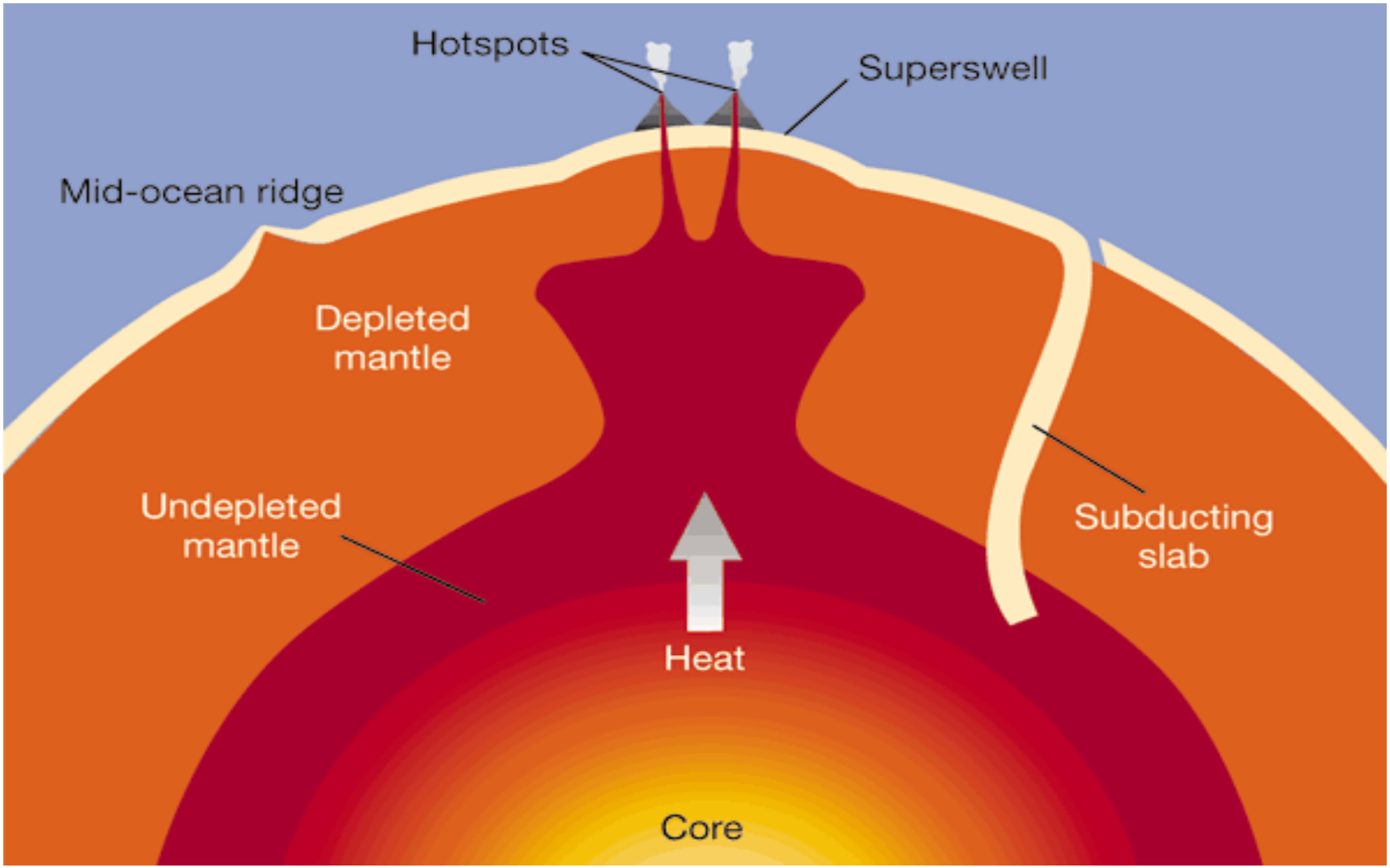
# Earth’s inner structure derived from seismic waves



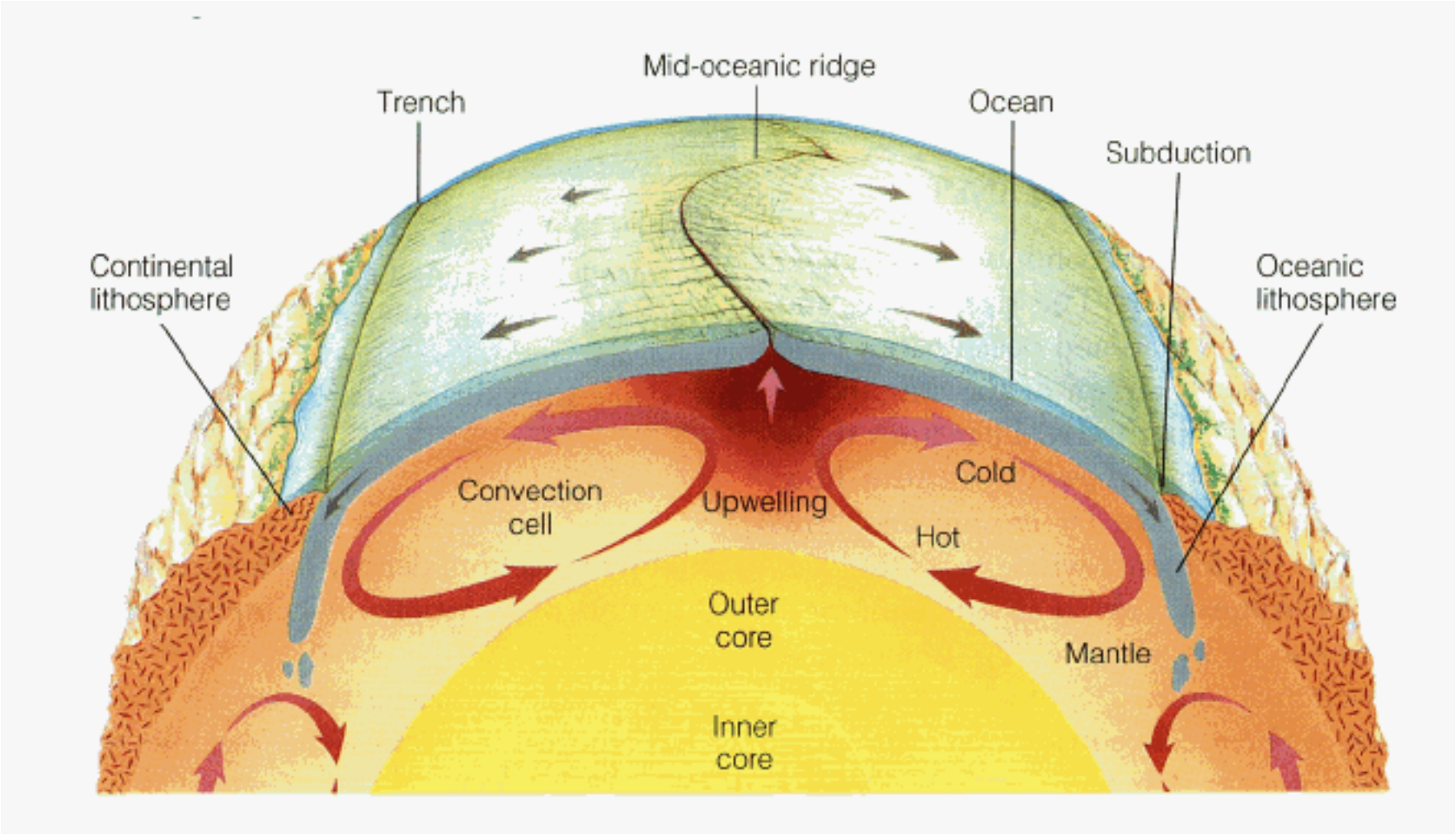
# Earth’s liquid outer core has molten jet-stream of iron



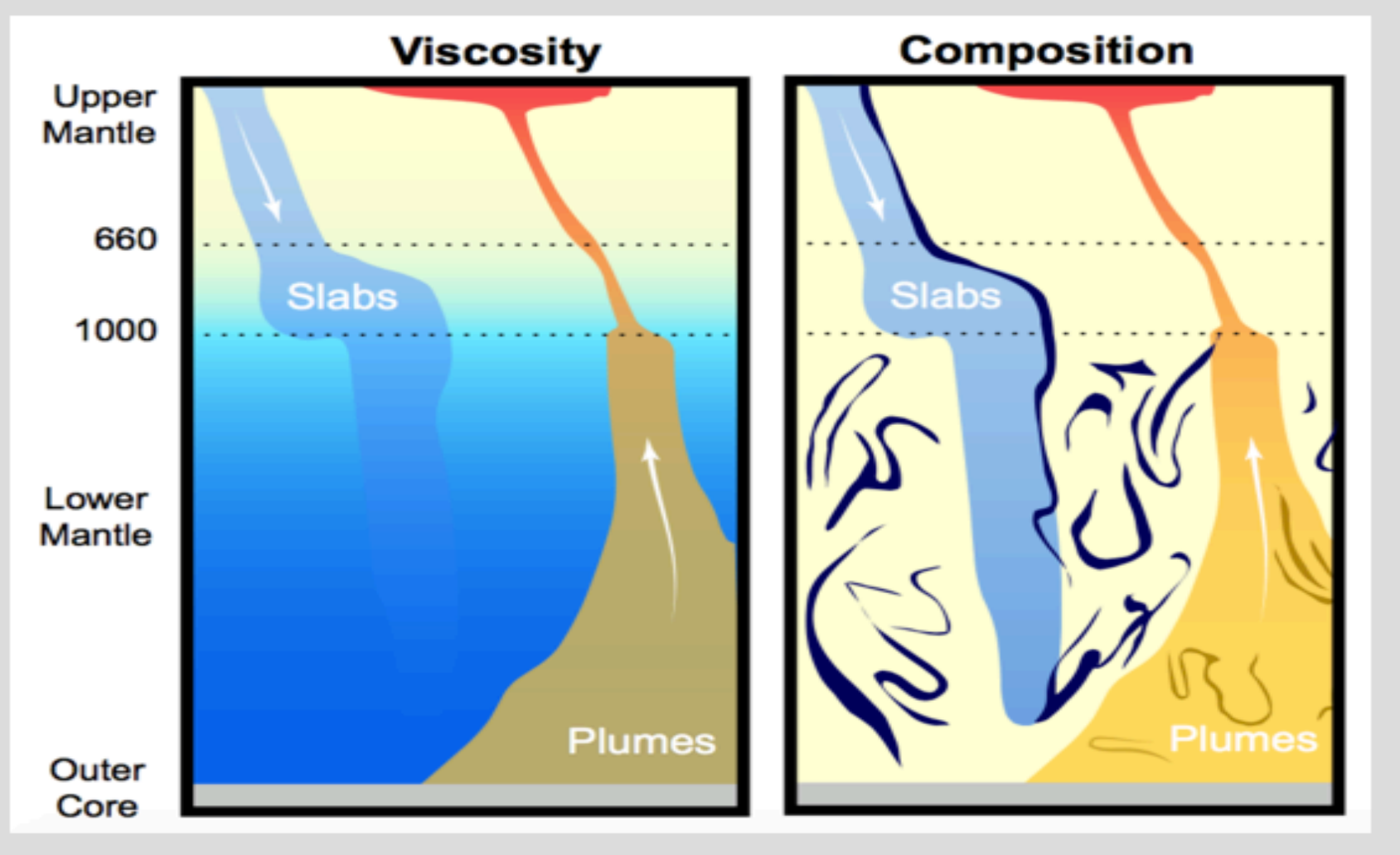
# We are now learning full dynamics of Earth's Mantle



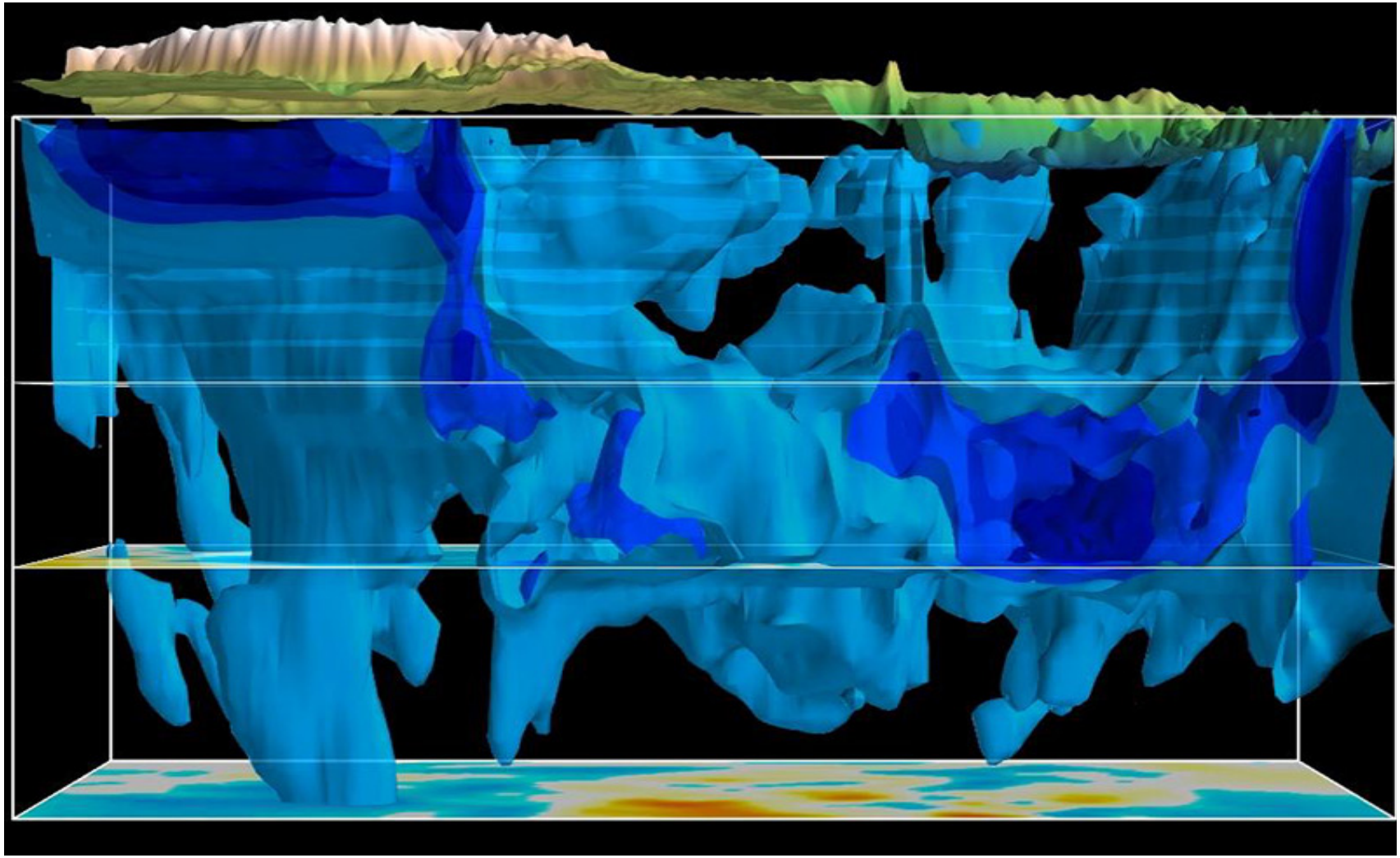
# Mantle Convection is driving force of Continental Drift



# Sinking slabs & rising plumes

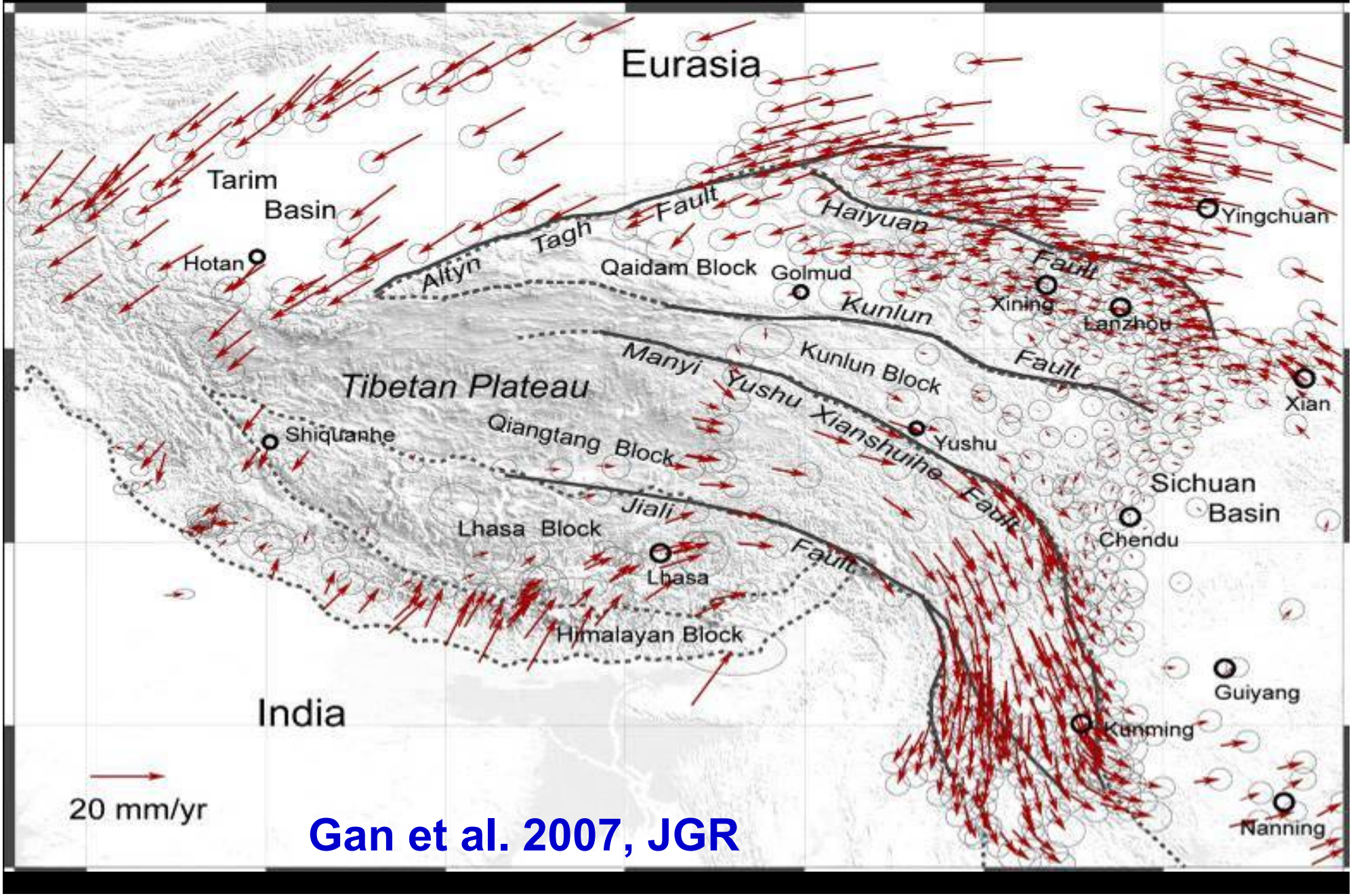


# We can derive the sub-surface structure of the Tibetan Plateau



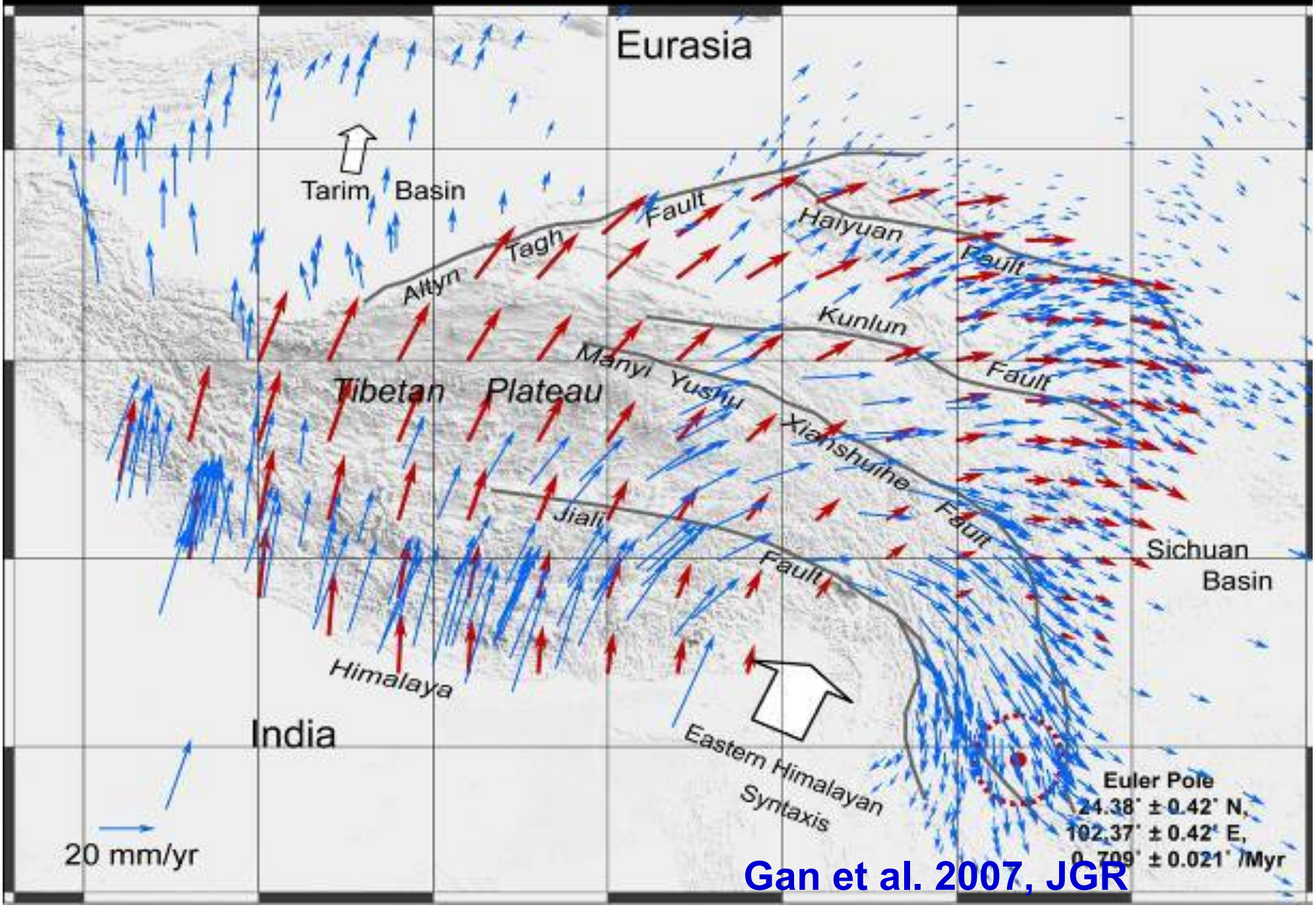
# We know interior deformation within Tibet Plateau

(Highlighted after Removing the Overall Rigid Rotation)

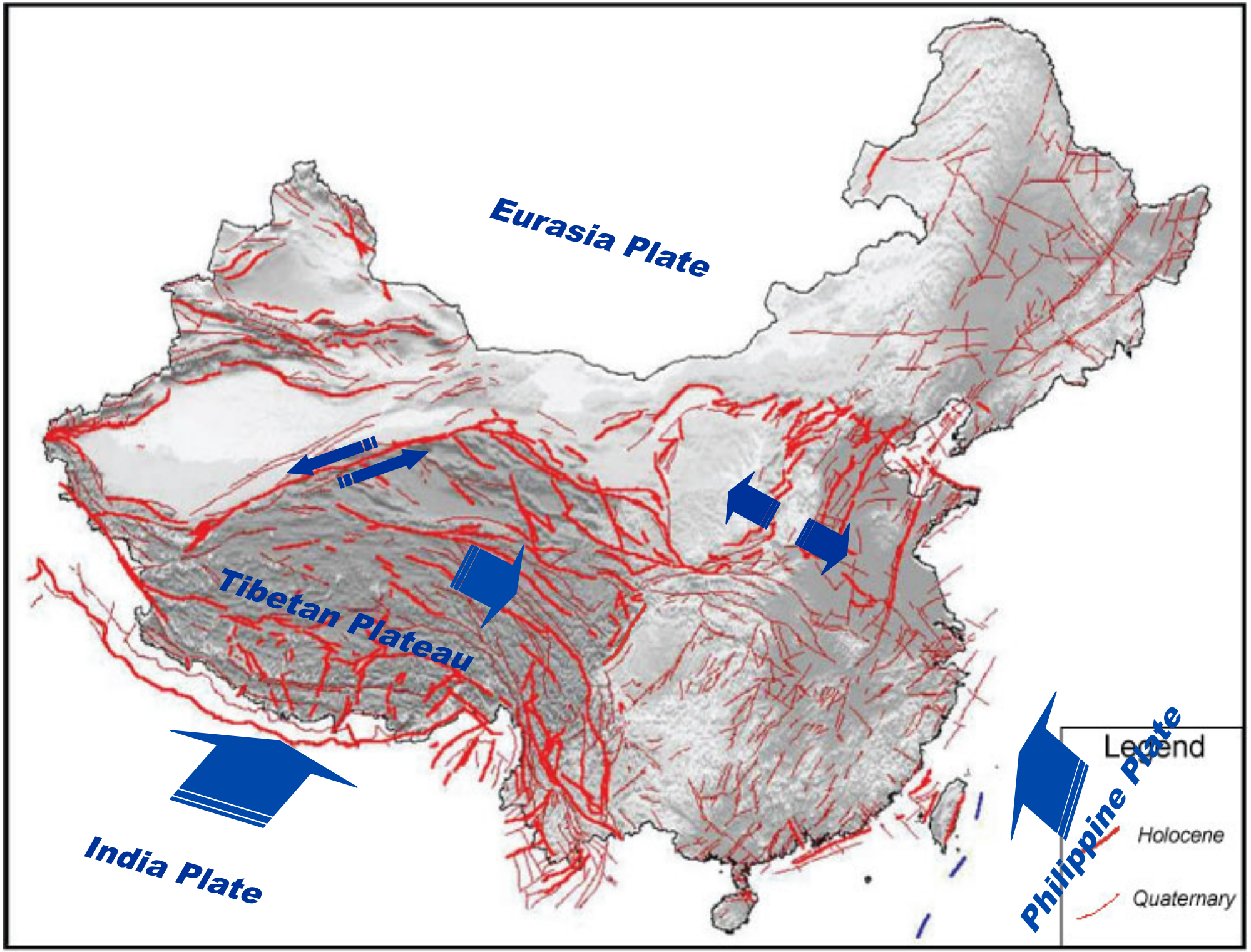


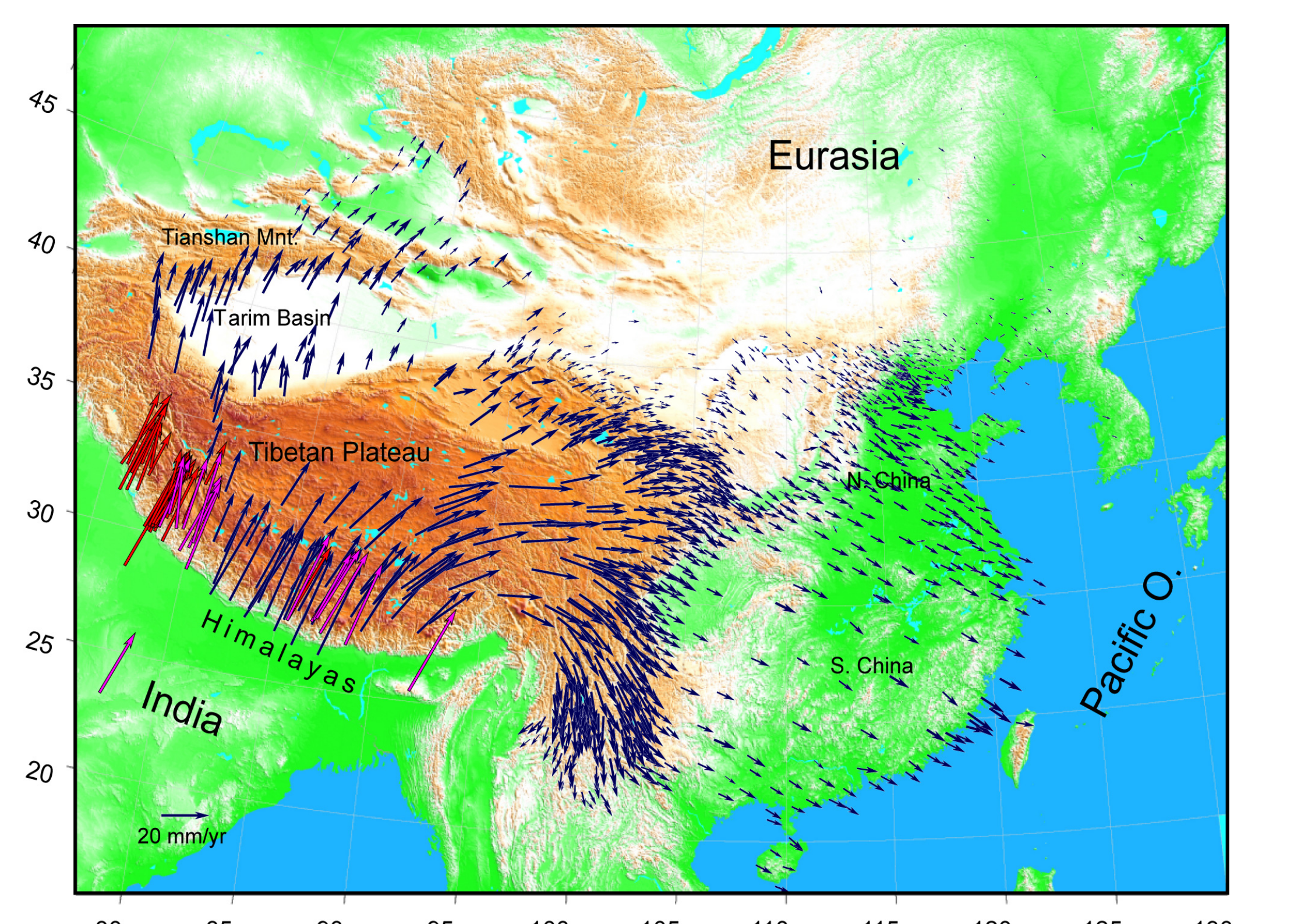

Gan et al. 2007, JGR

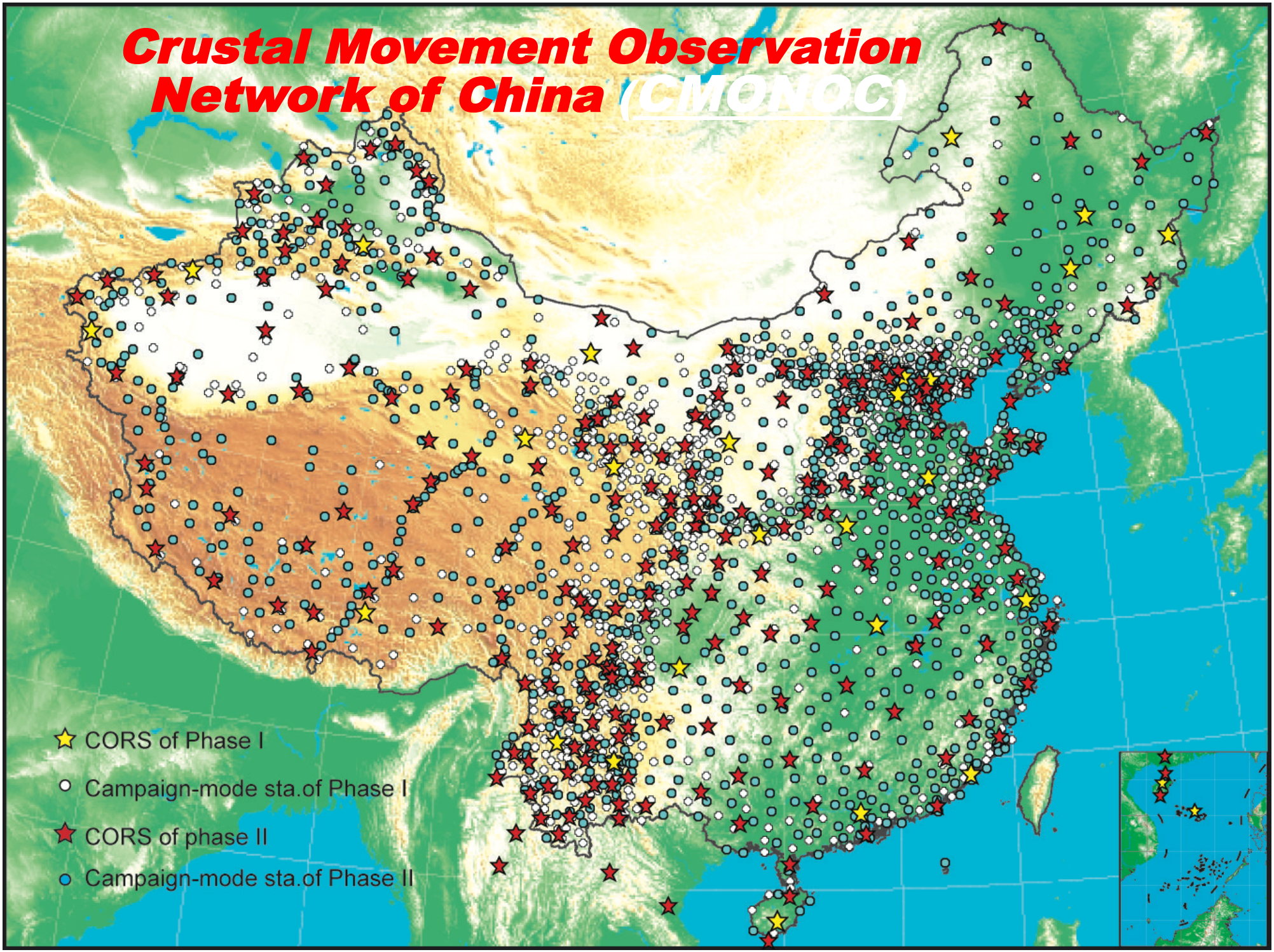
# GPS gives overall rigid rotation of Tibet Plateau



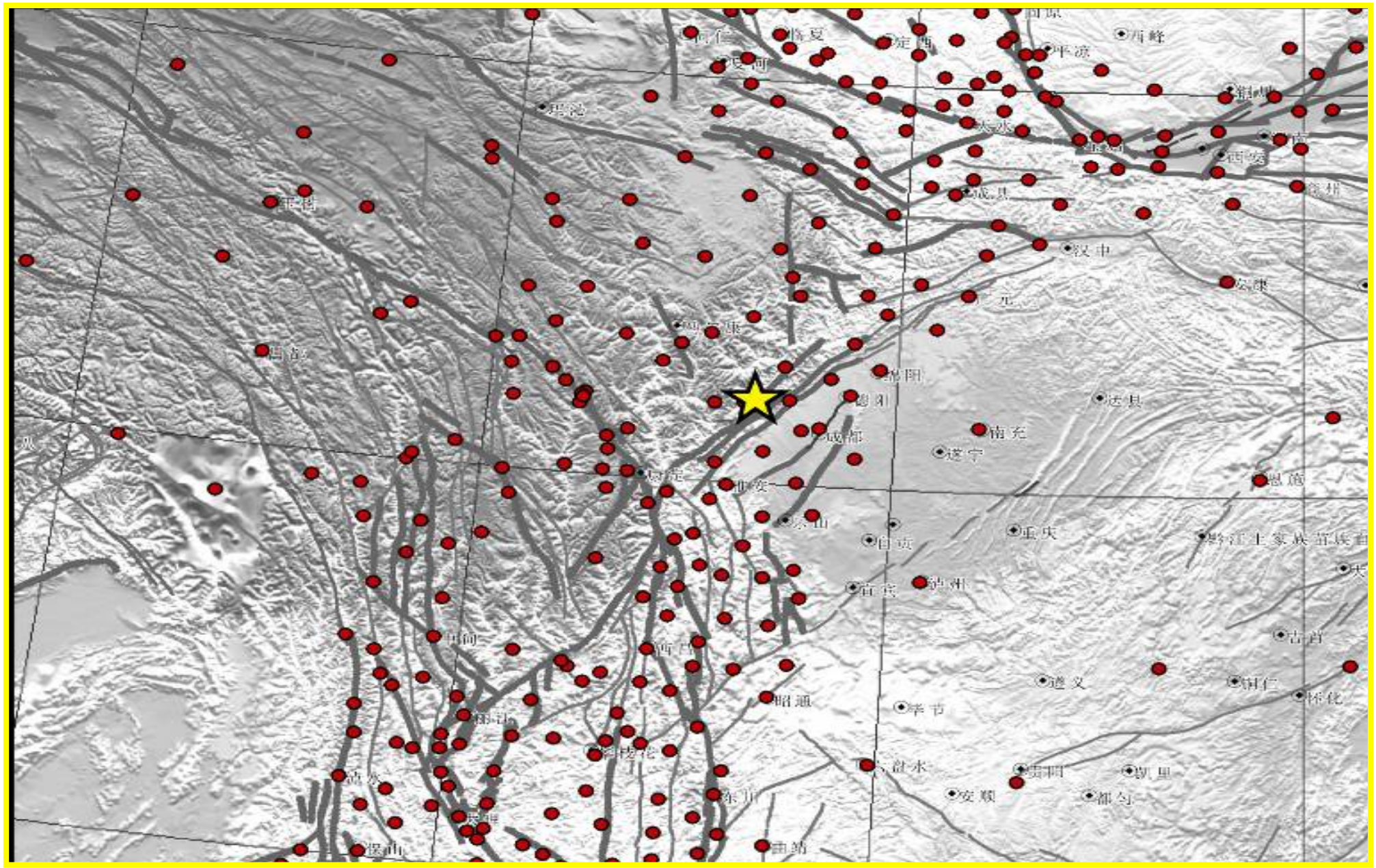

Gan et al. 2007, JGR


Eurasia Plate
Tibetan Plateau
India Plate
Philippine Plate
Legend
Holocene
Quaternary


Eurasia
Tianshan Mnt.
Tarim Basin
Tibetan Plateau
N. China
S. China
Pacific O.
Himalayas
India
20 mm/yr
45
40
35
30
25
20

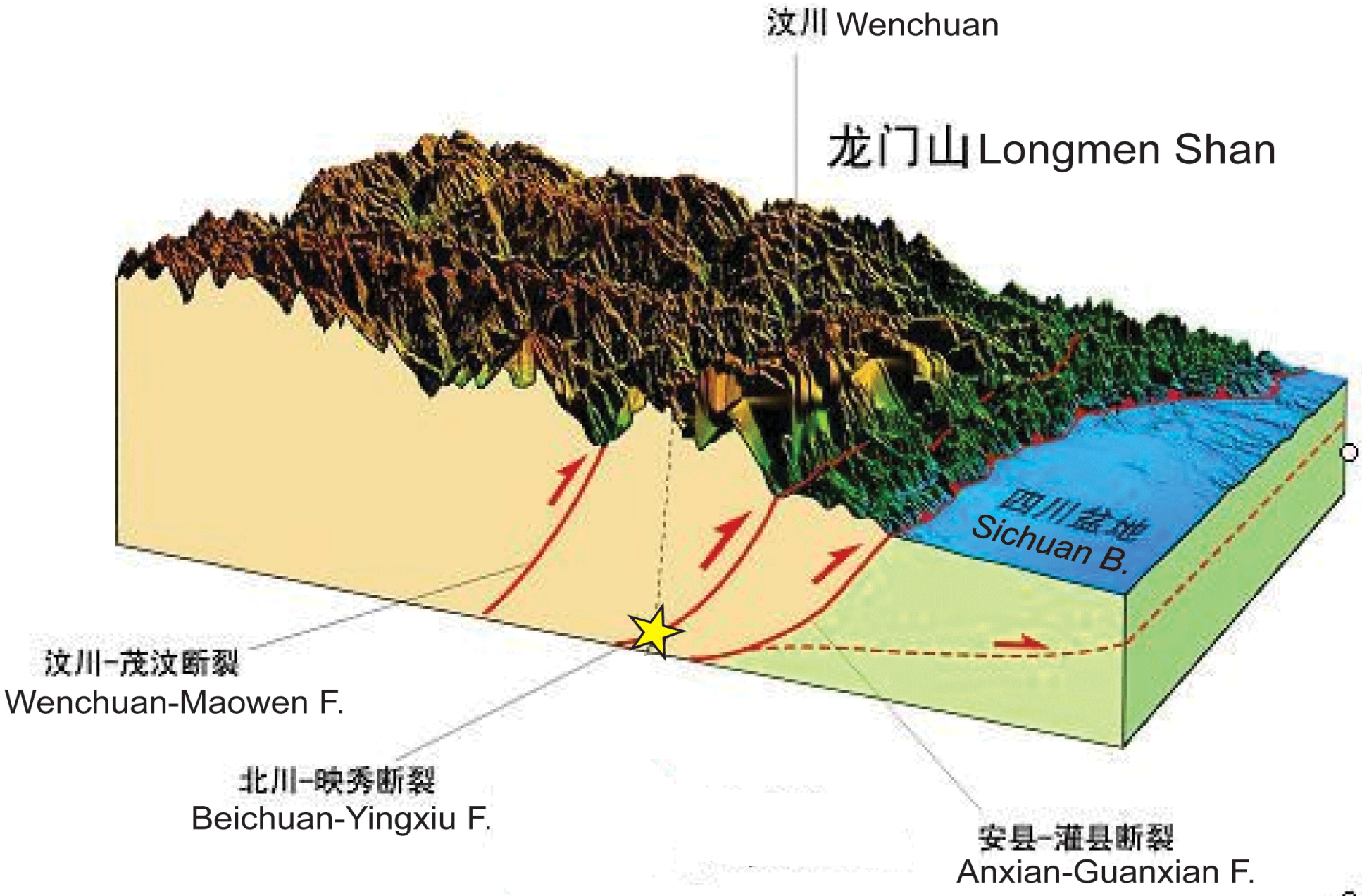

Crustal Movement Observation Network of China (CMONOC)
CORS of Phase I
Campaign-mode sta.of Phase I
CORS of phase II
Campaign-mode sta.of Phase II

# GPS Stations near 2008 Wenchuan M8.0 earthquake

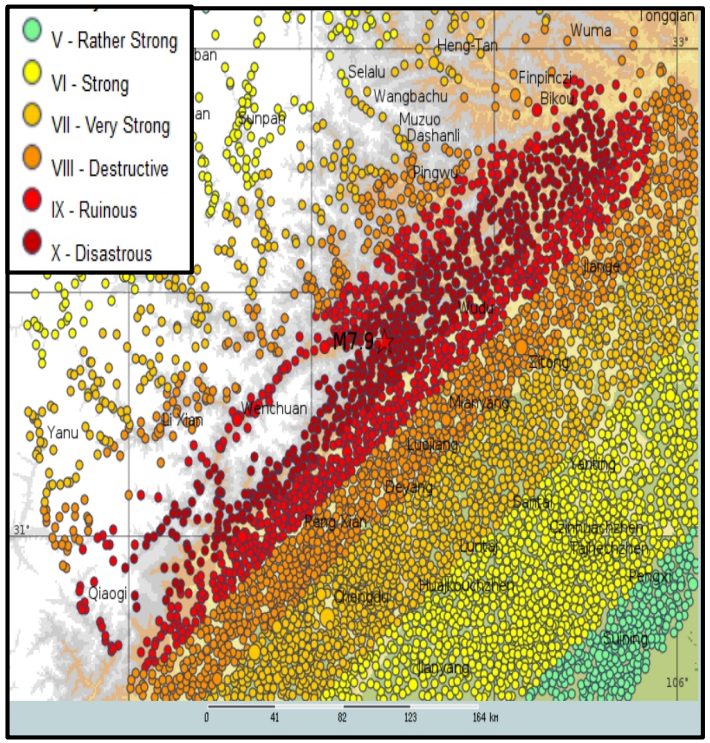


# Wenchuan-Sichuan Earthquake 12.05.2008

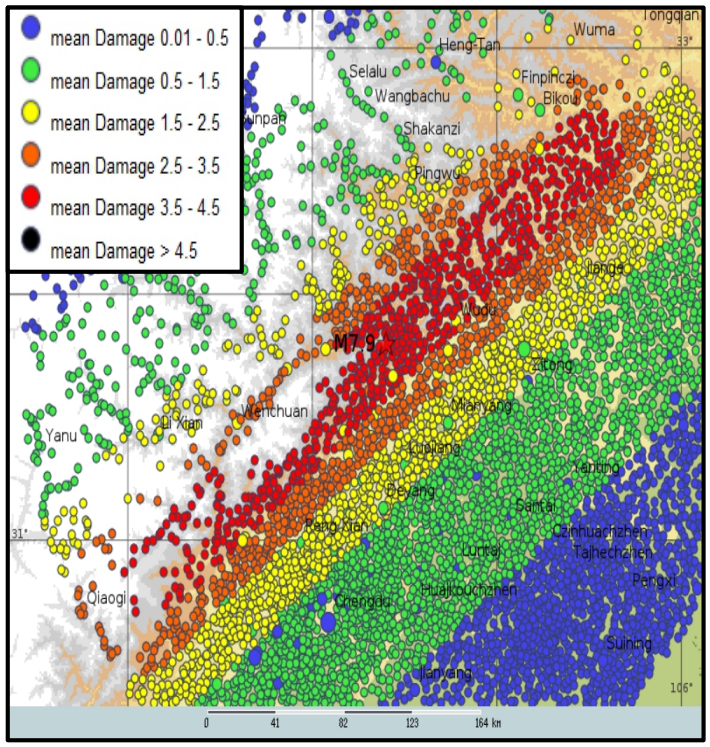
# Active Faults along Longmen Shan



Shortly after the M7.9 Wenchuan earthquake of 12 May 2008, a **QLARM fatalities estimate of 55,000 ± 30,000 was publically distributed**. Many days later, fatalities were officially reported as 85,000.

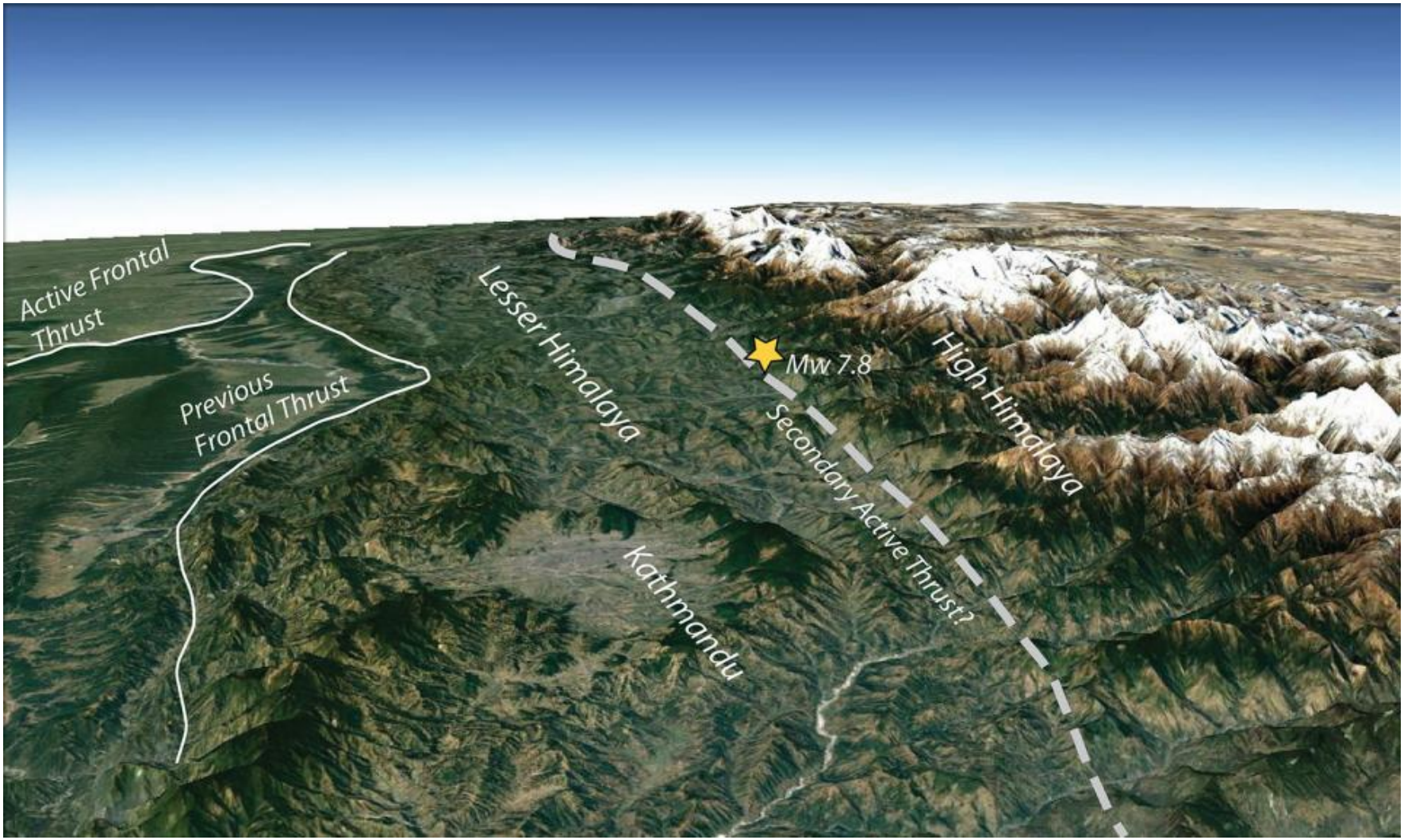



Calculated intensities in settlements near the earthquake epicentre



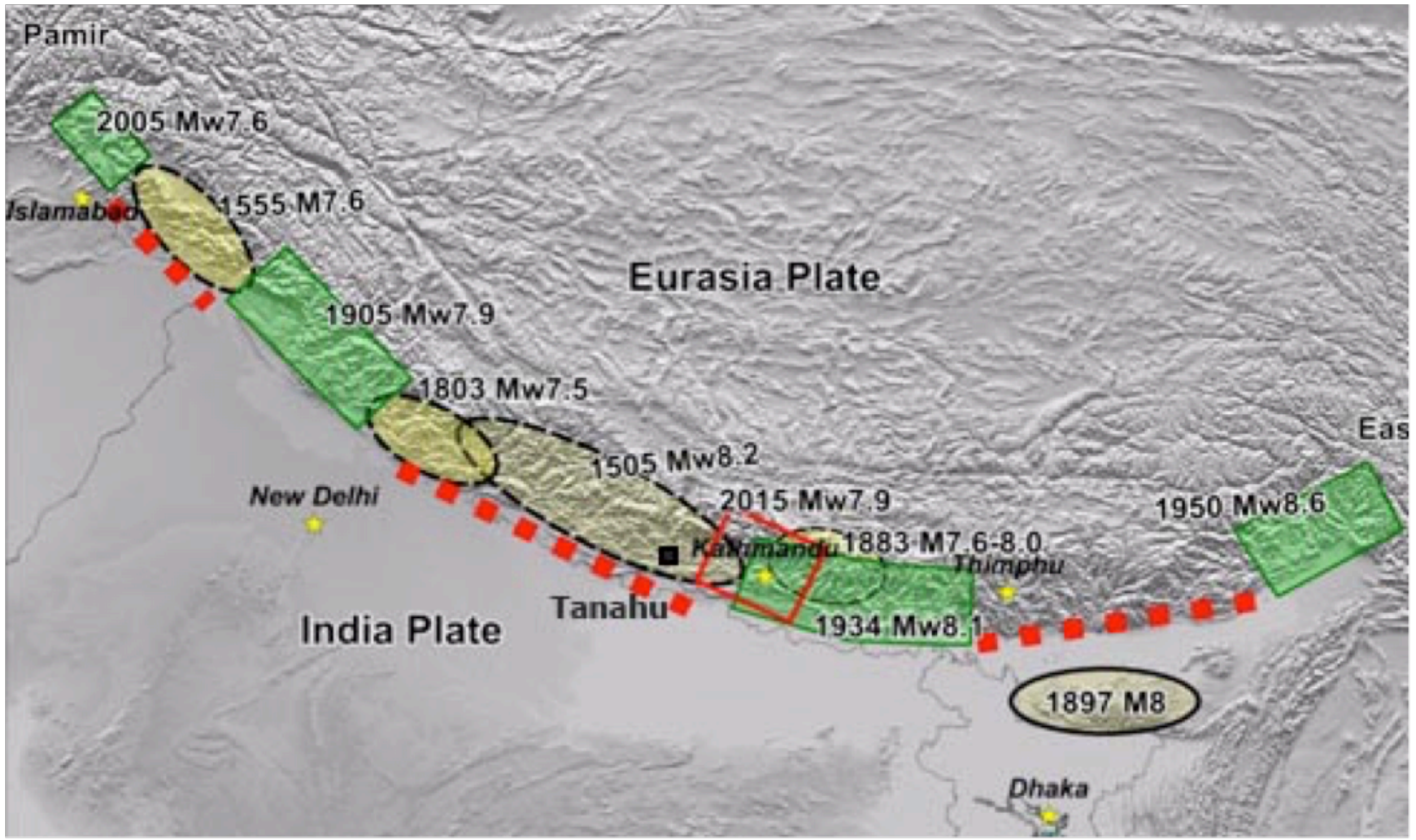

Calculated mean damage in settlements near the earthquake epicentre

# Himalaya thrust is still active – Nepal 2015

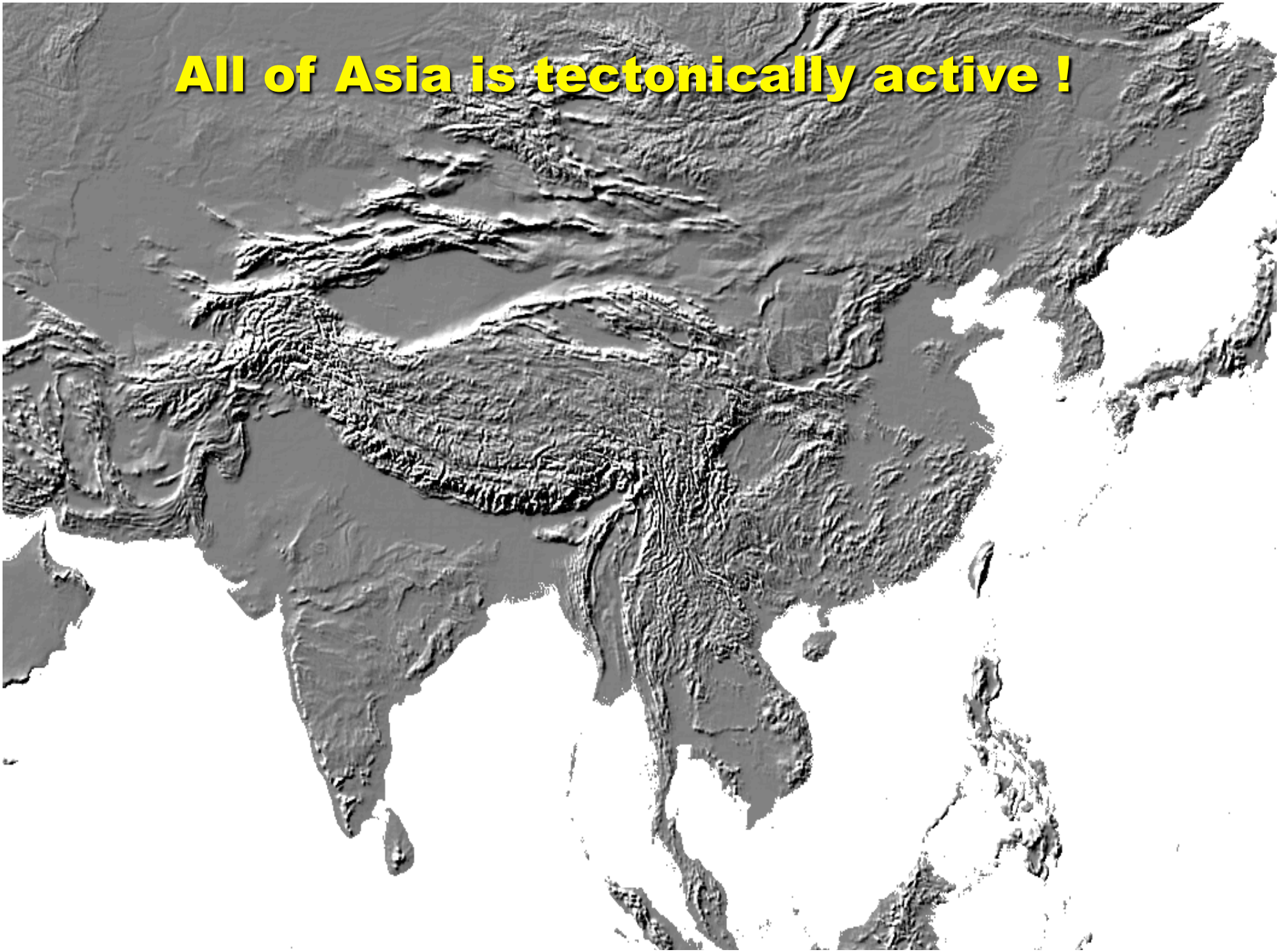


# Nepal-Ghorka was the most recent quake ~ 10,000 deaths

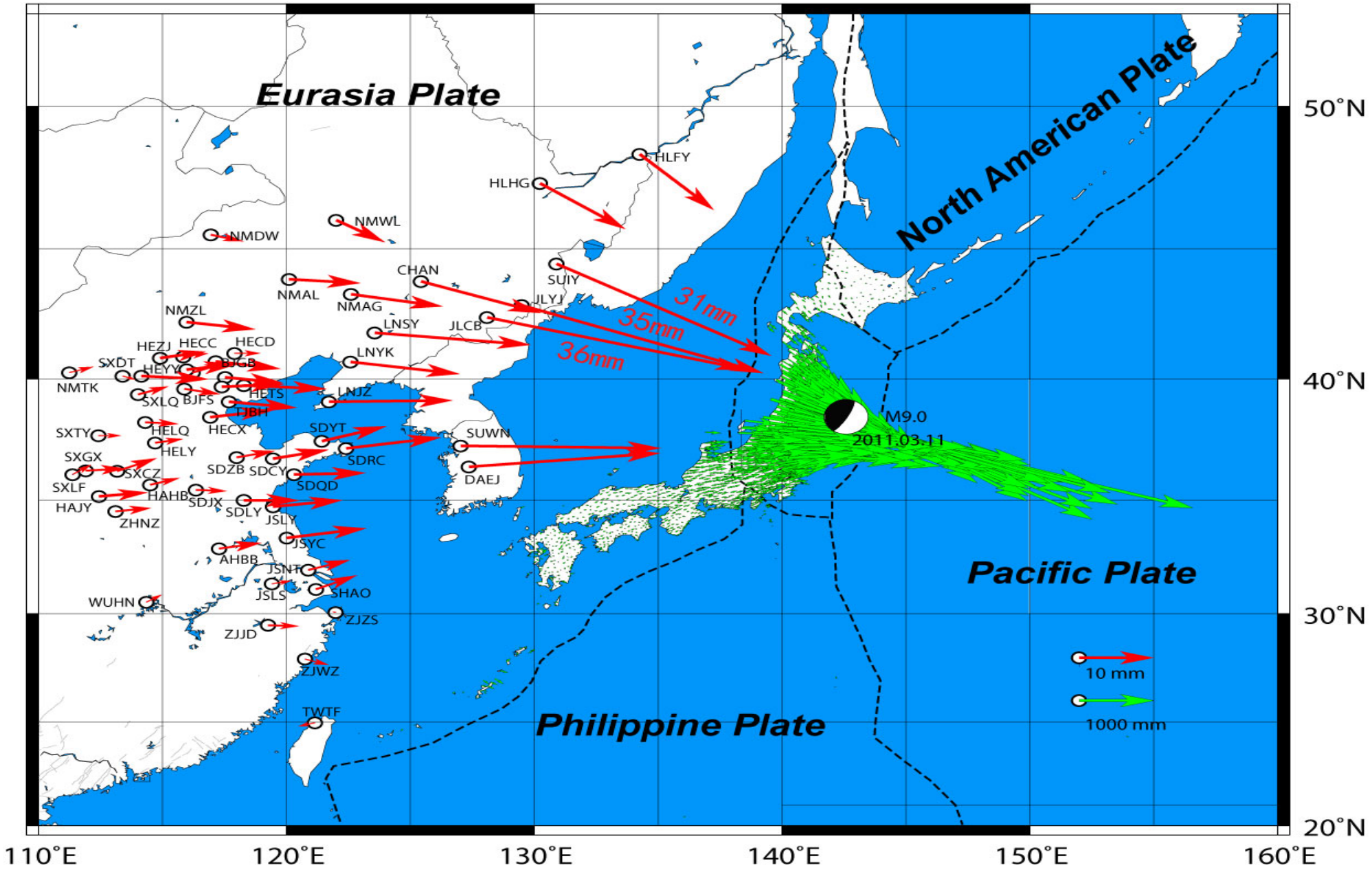
# Historic quakes along the India-Asia collision zone



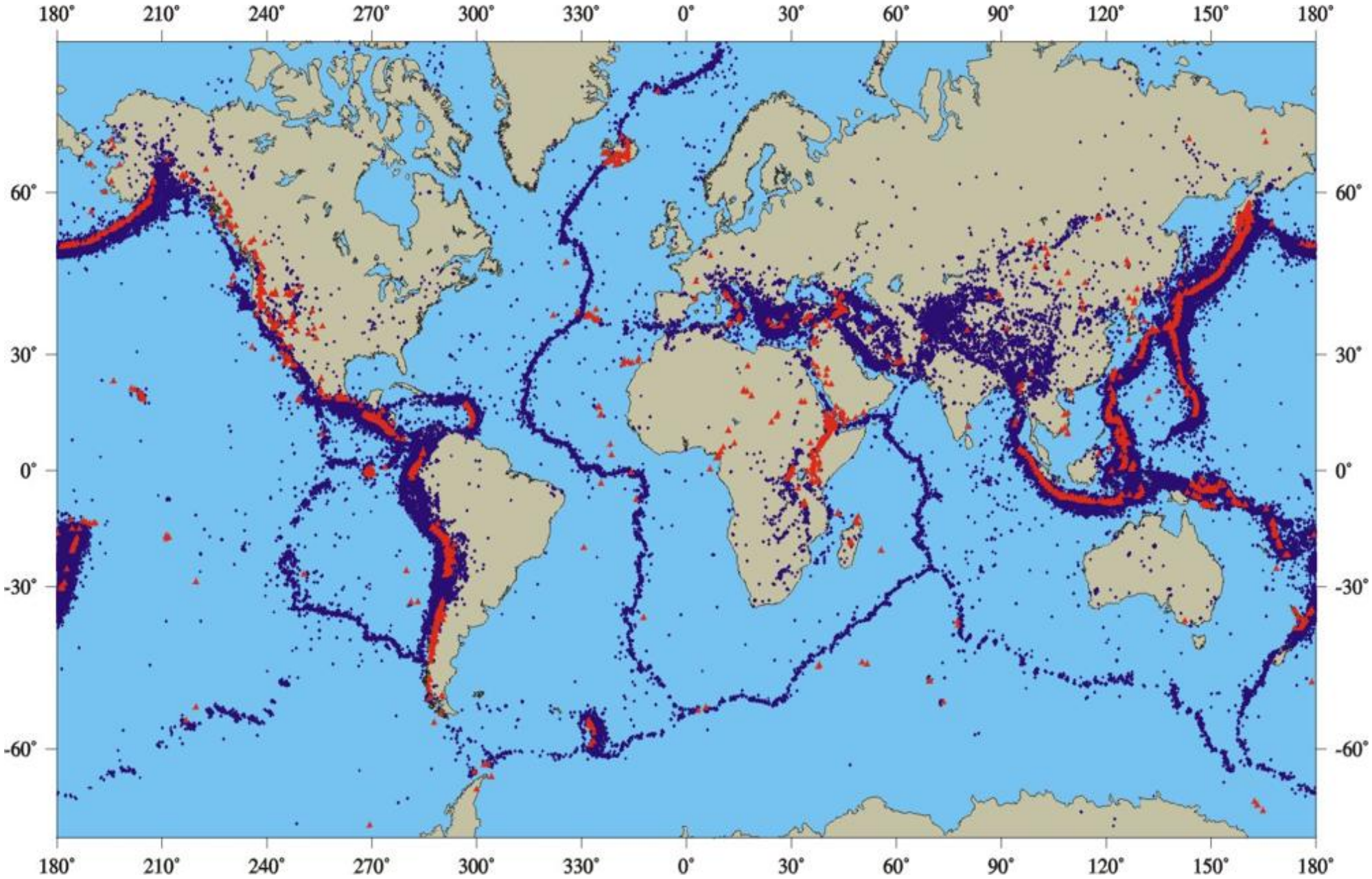

Red squares indicate stress accumulation


All of Asia is tectonically active !

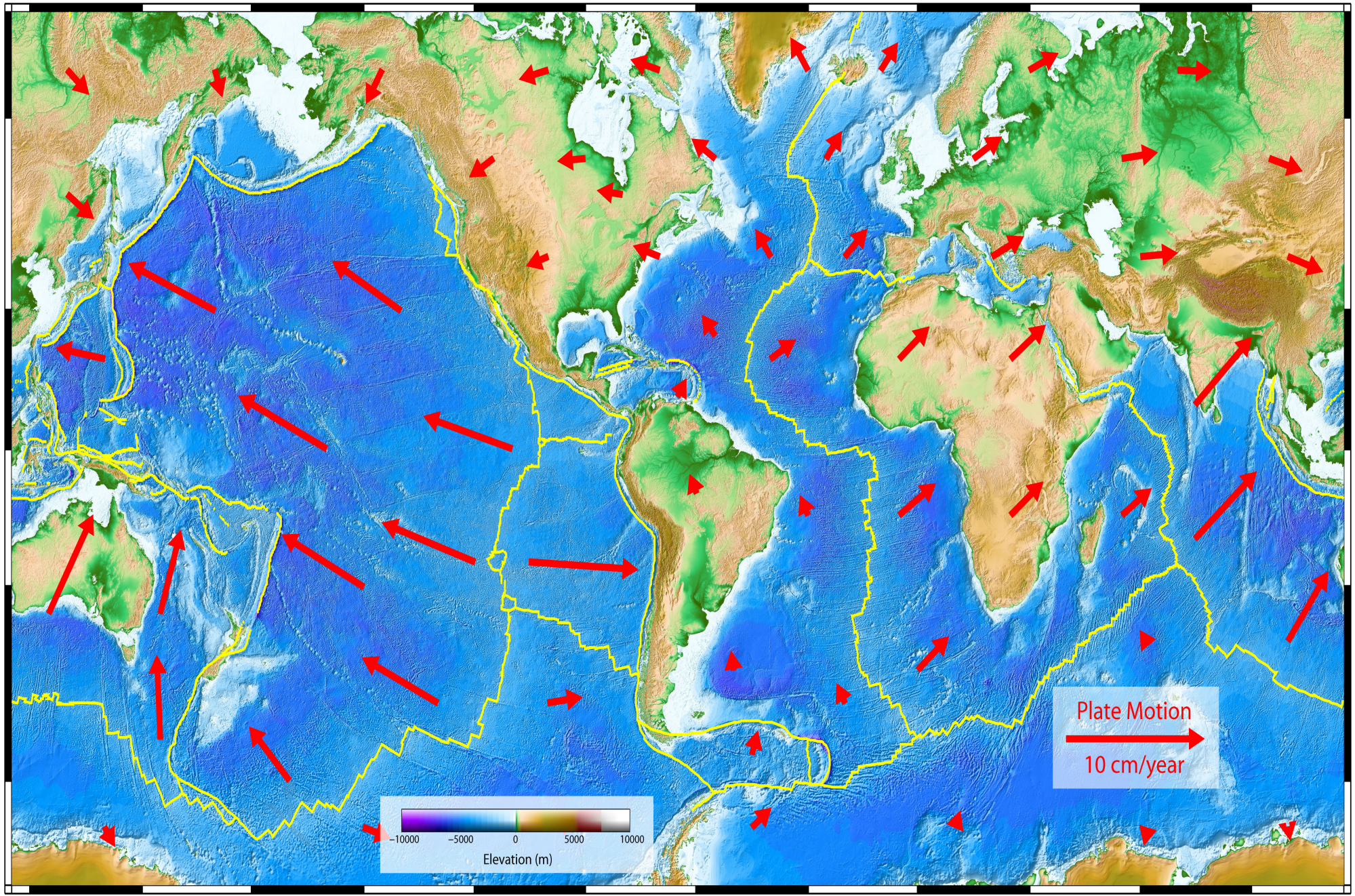
# The Great East Japan Earthquake M9.0 on 11.03.2011

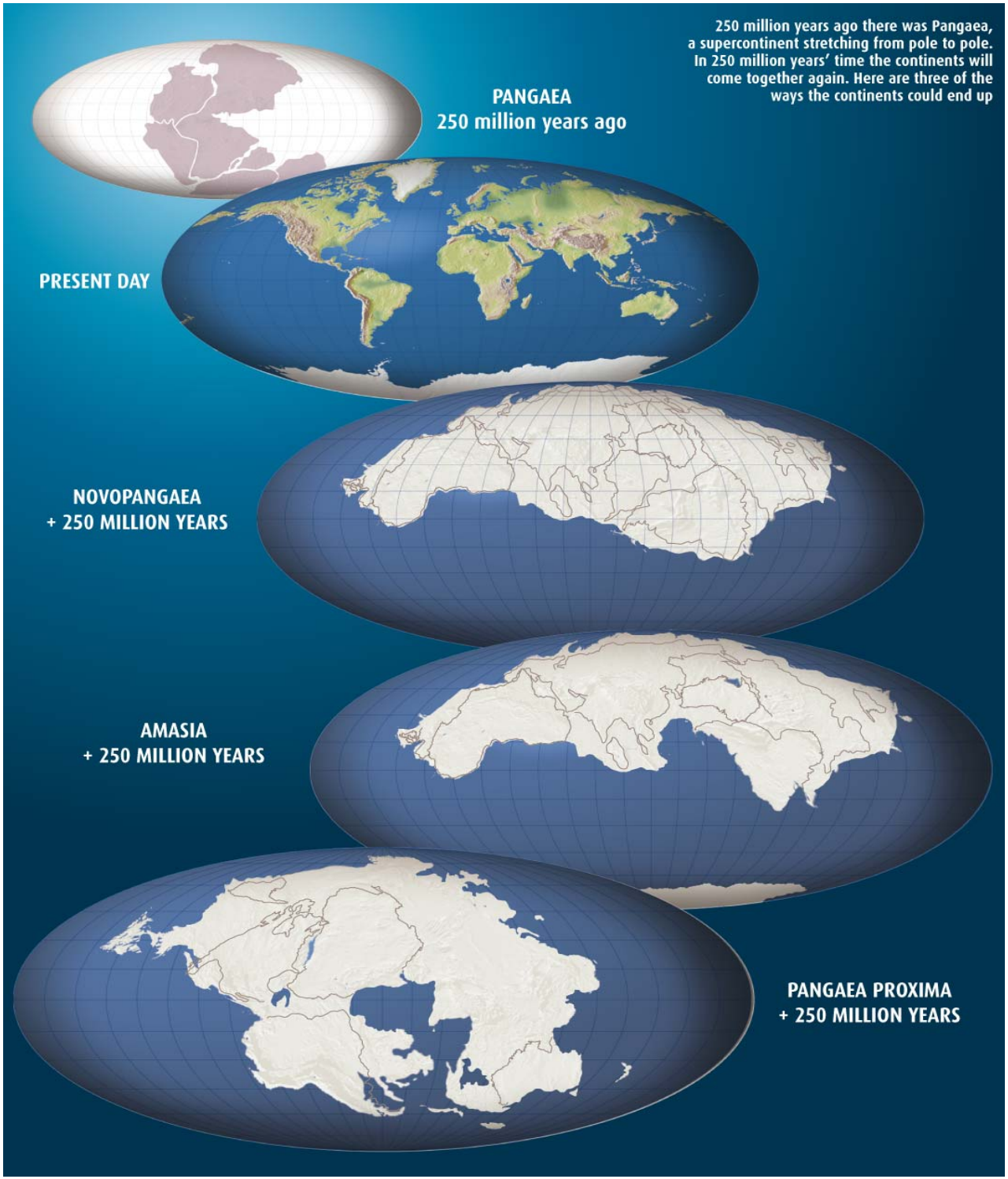


# Quakes are a daily occurrence along all plate boundaries

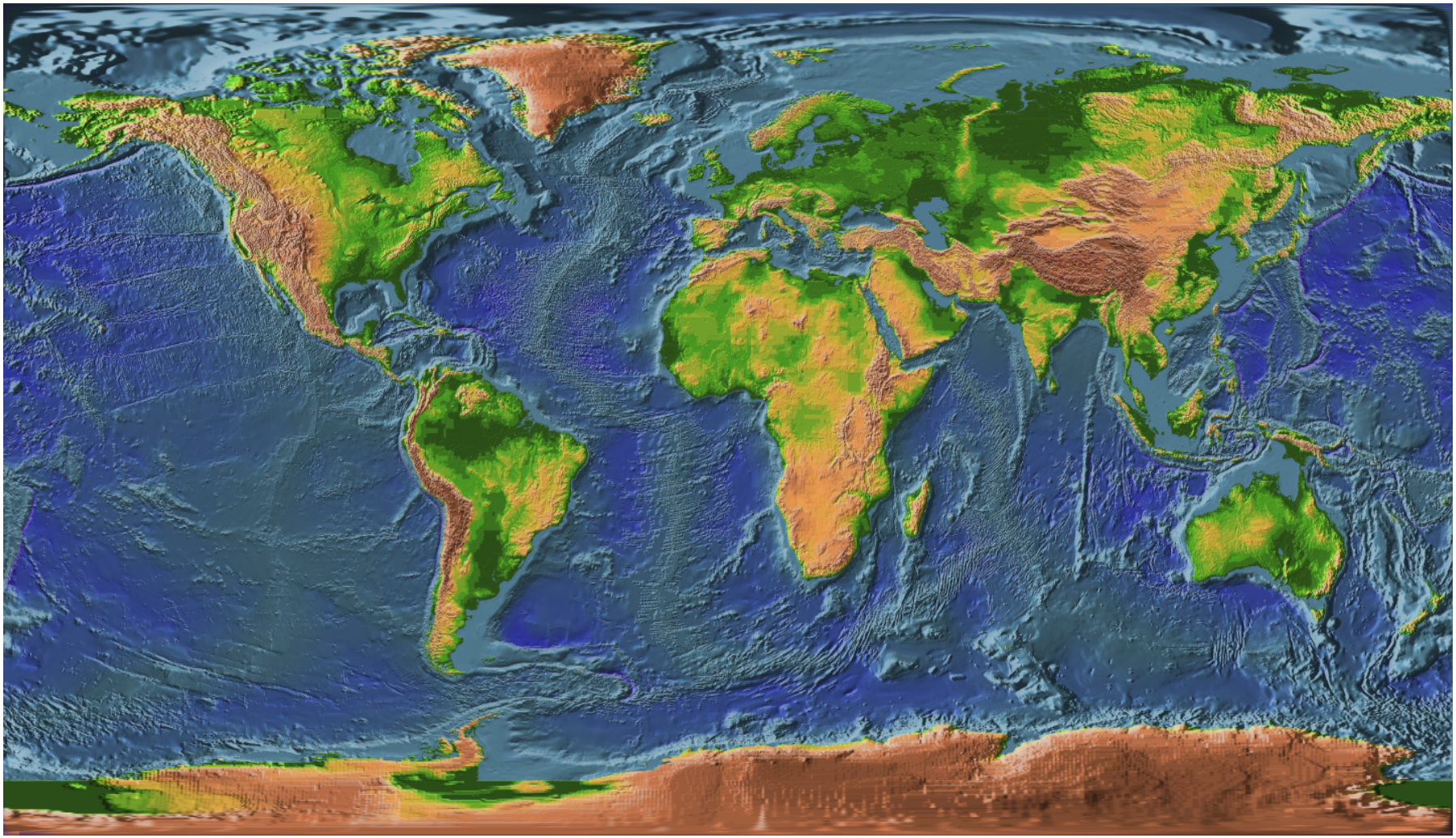


# Continental Drift will create a new supercontinent 250Myf

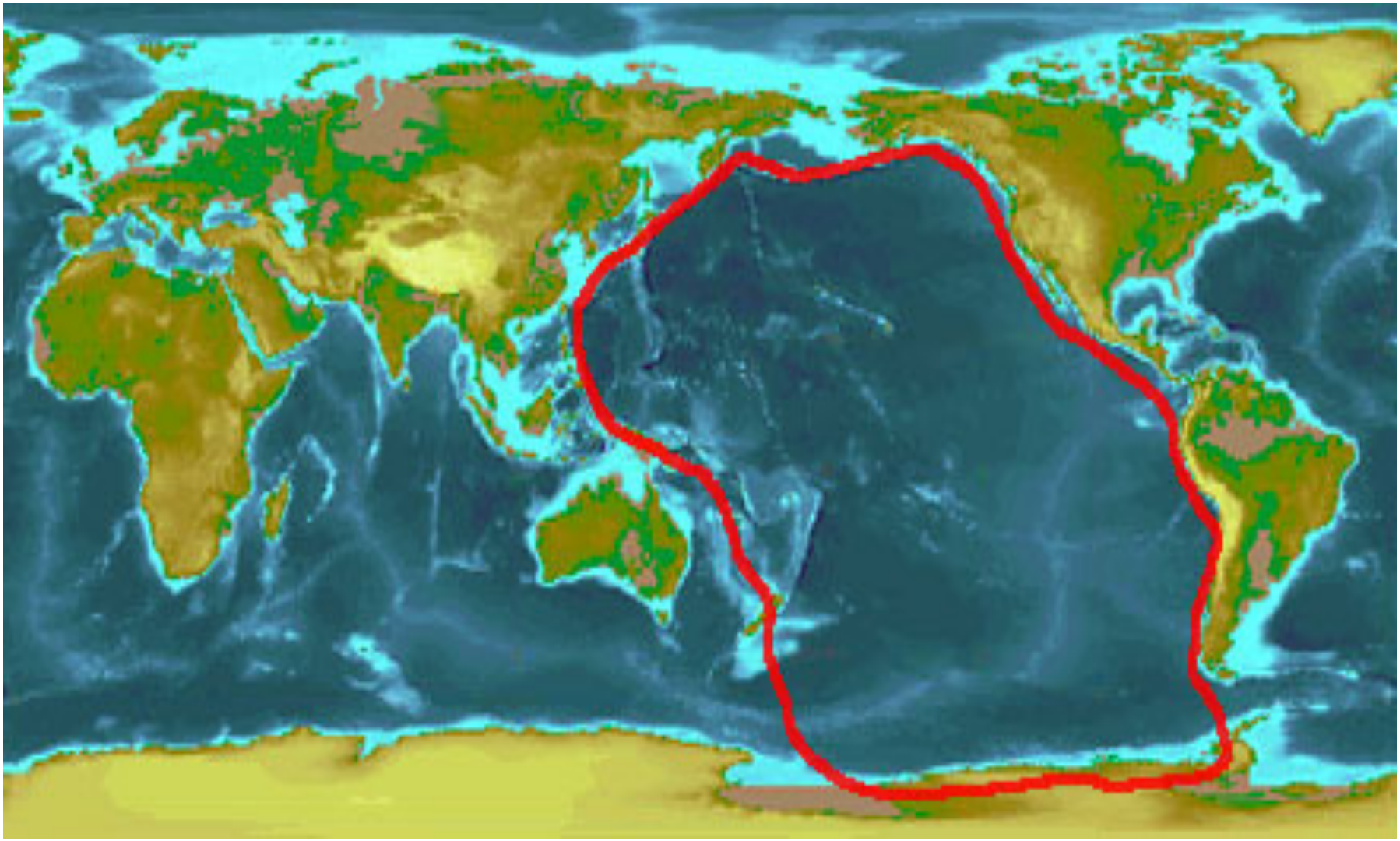



250 million years ago there was Pangaea, a supercontinent stretching from pole to pole. In 250 million years' time the continents will come together again. Here are three of the ways the continents could end up
PANGAEA
250 million years ago
PRESENT DAY
NOVOPANGAEA
+ 250 MILLION YEARS
AMASIA
+ 250 MILLION YEARS
PANGAEA PROXIMA
+ 250 MILLION YEARS

# Bathysphere shows evidence of prior supercontinents

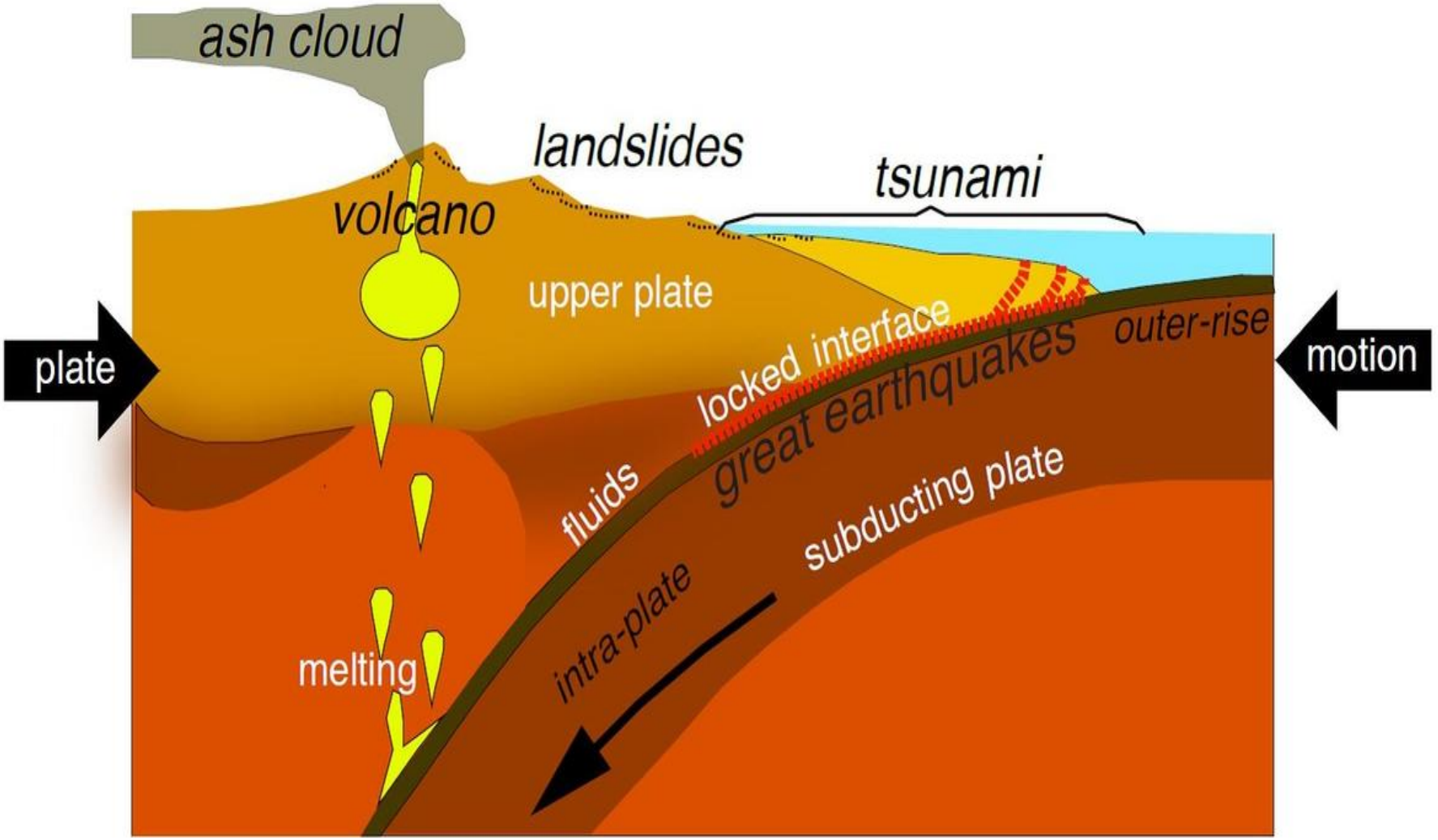


Today, the Ring of Fire includes 452 major volcanoes!

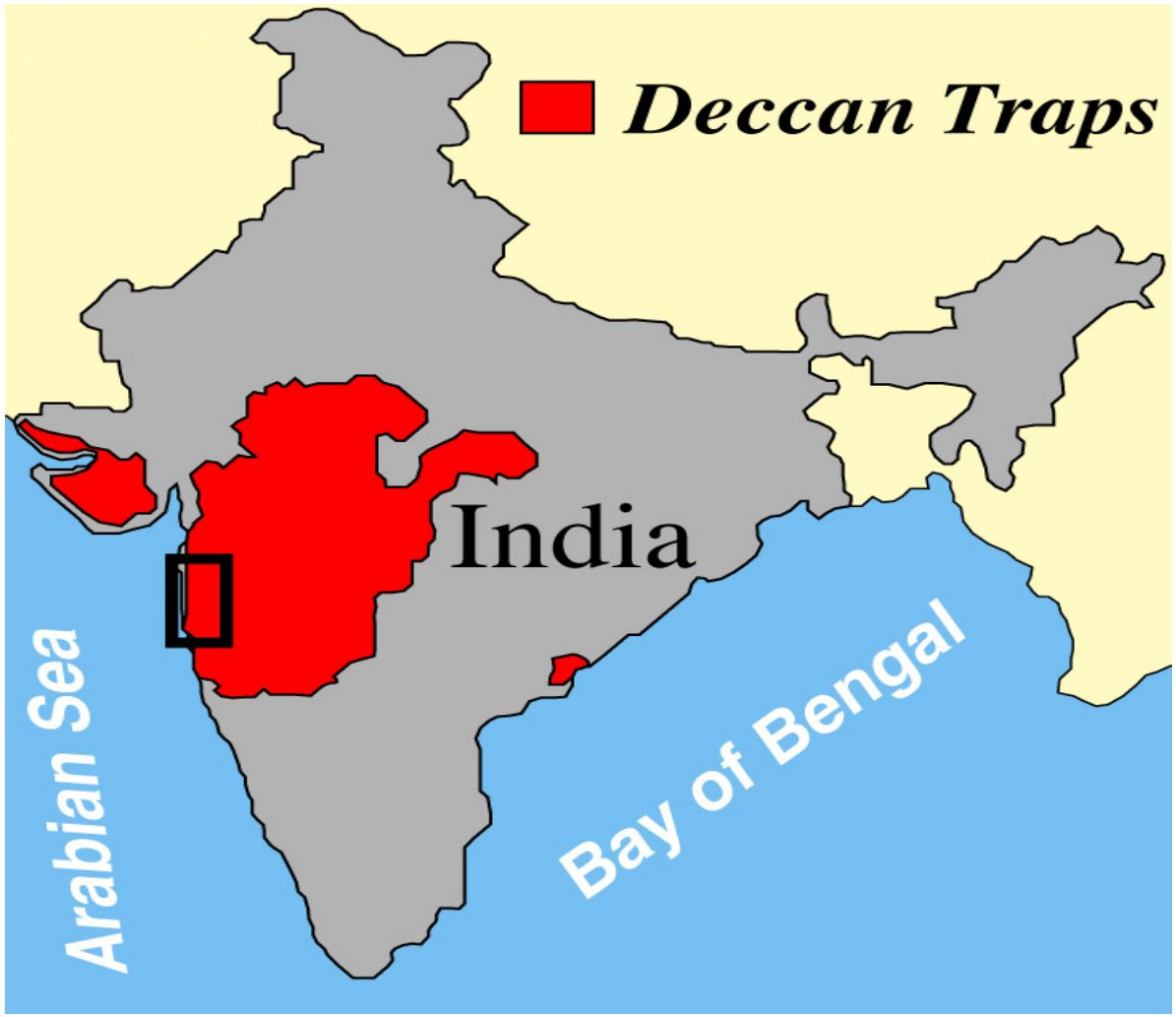



▲ VOLCANOES IN INDONESIA

# Volcanic formation near Subduction Zones

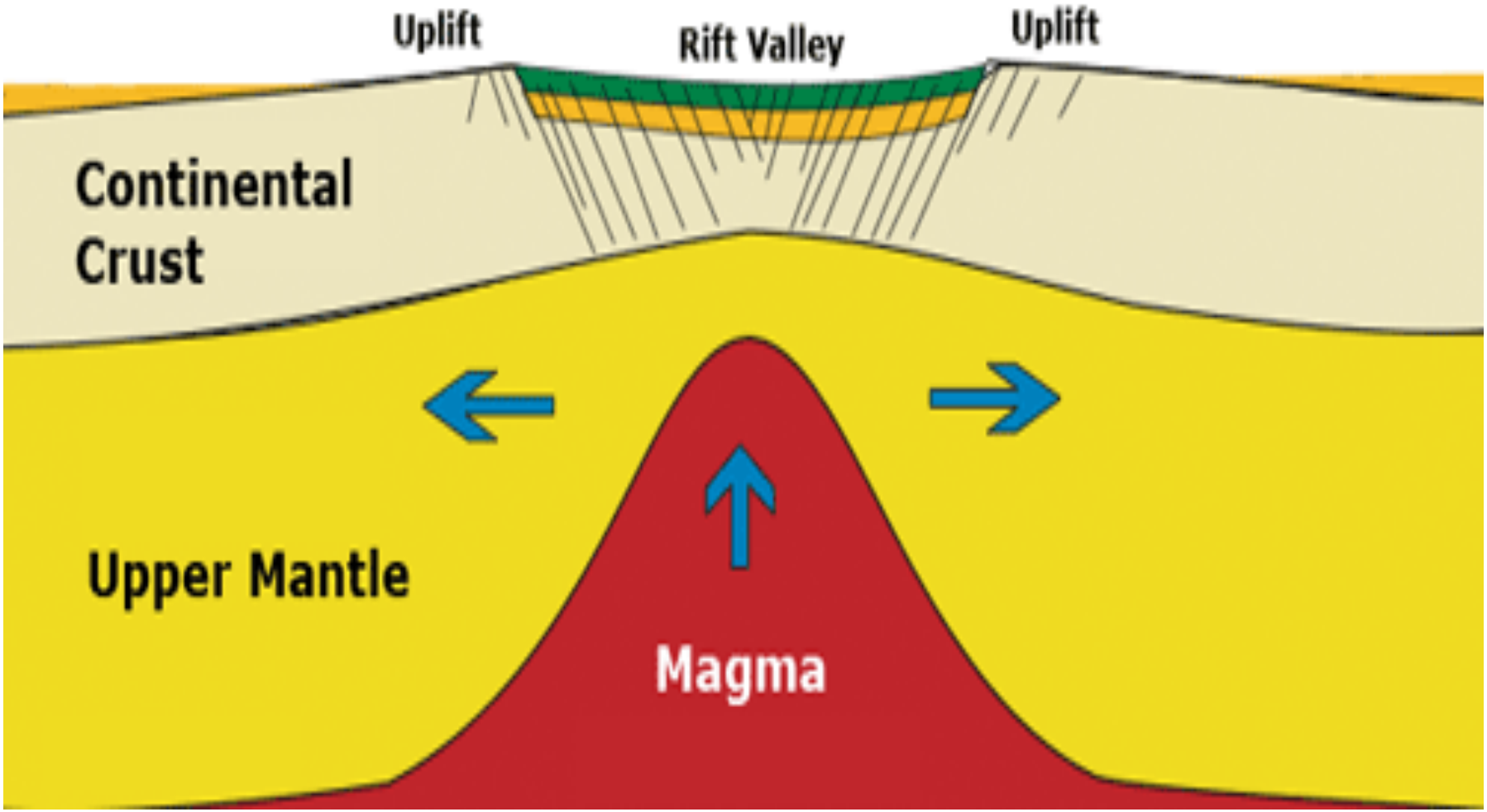


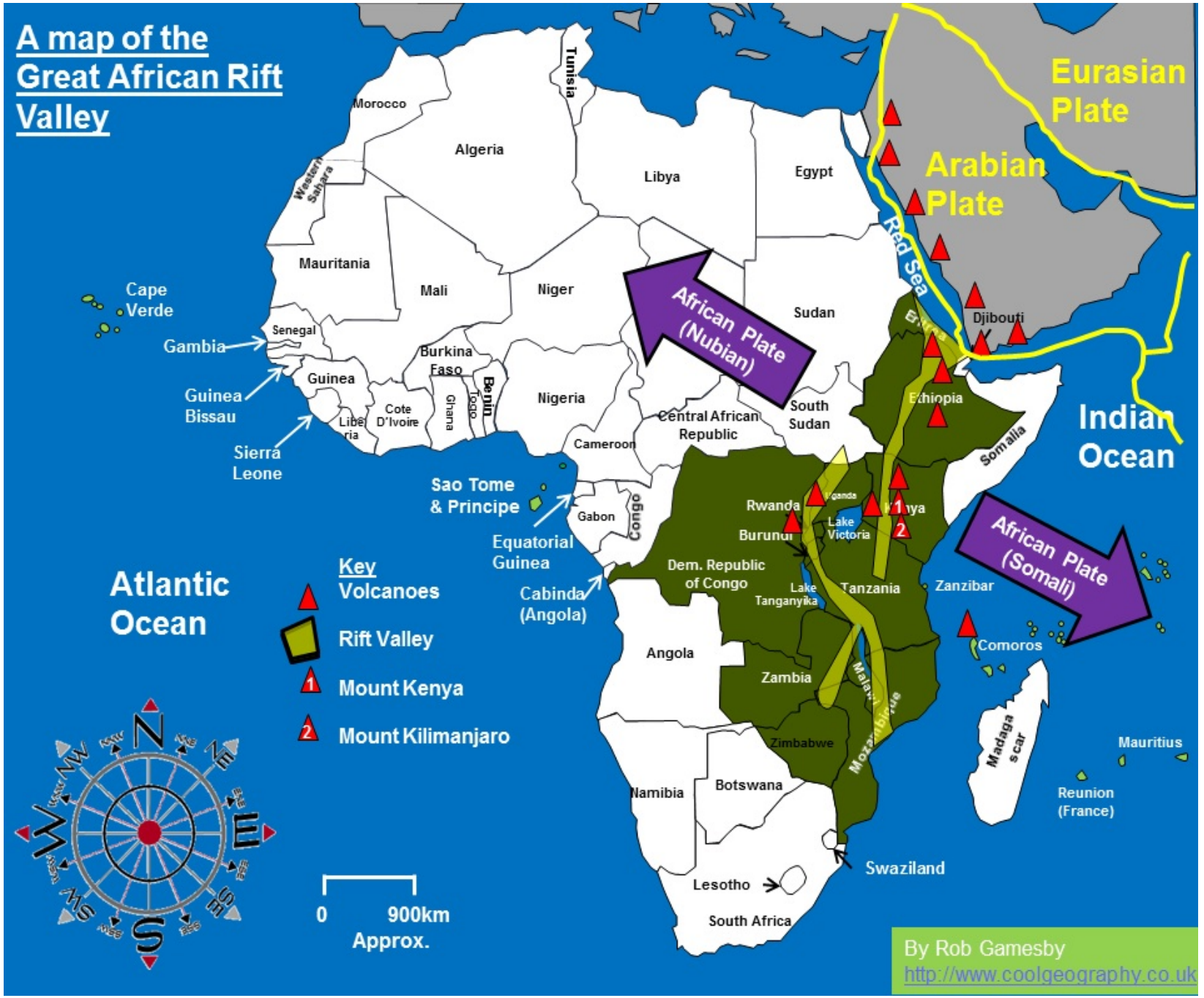
Deccan Traps of India have volume of 1,000,000 $km^3$
They cover 500,000 $km^2$ and are more than 2km deep



# Deccan Traps  (steps) east of Mumbai

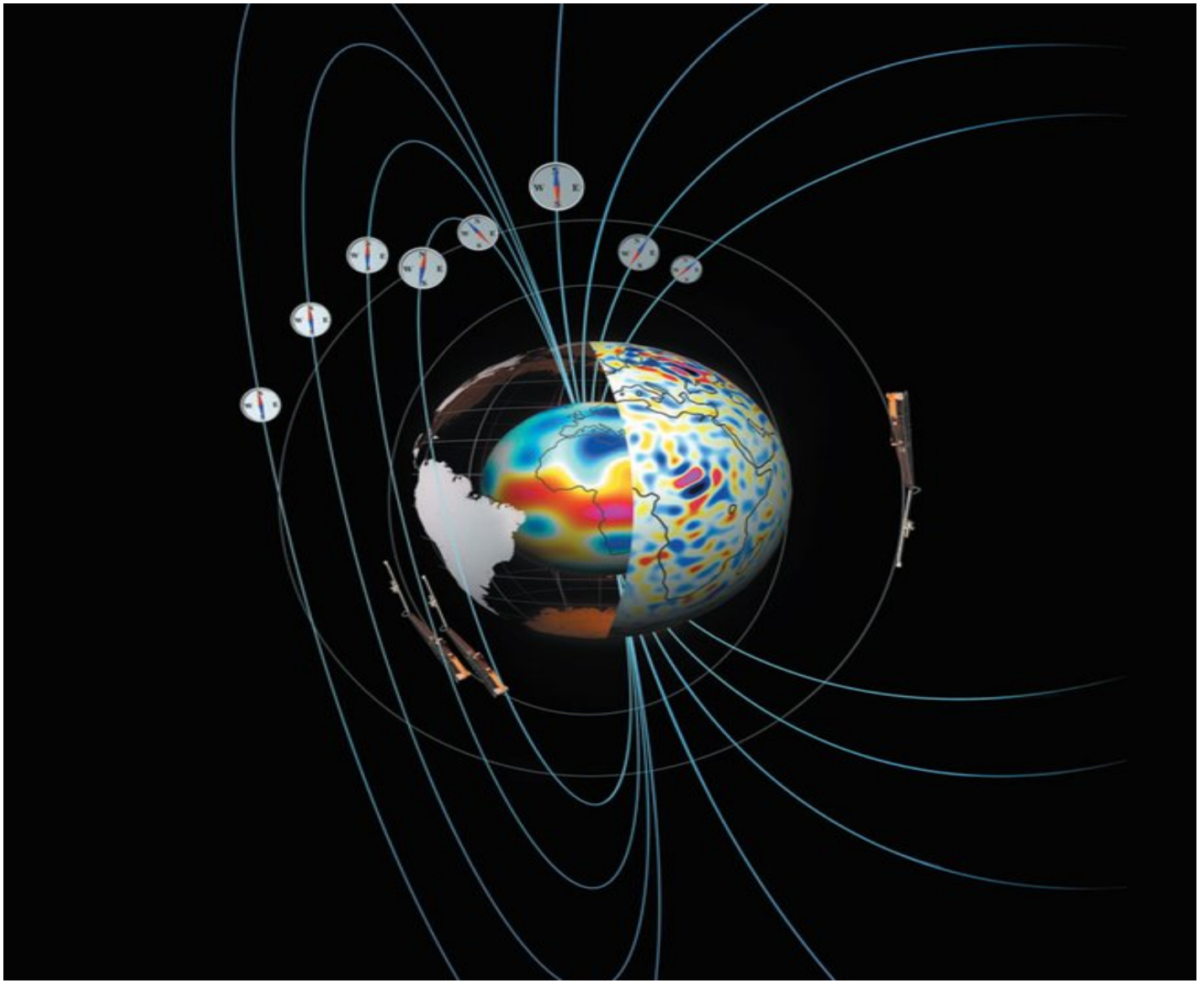
# Continental Rifting



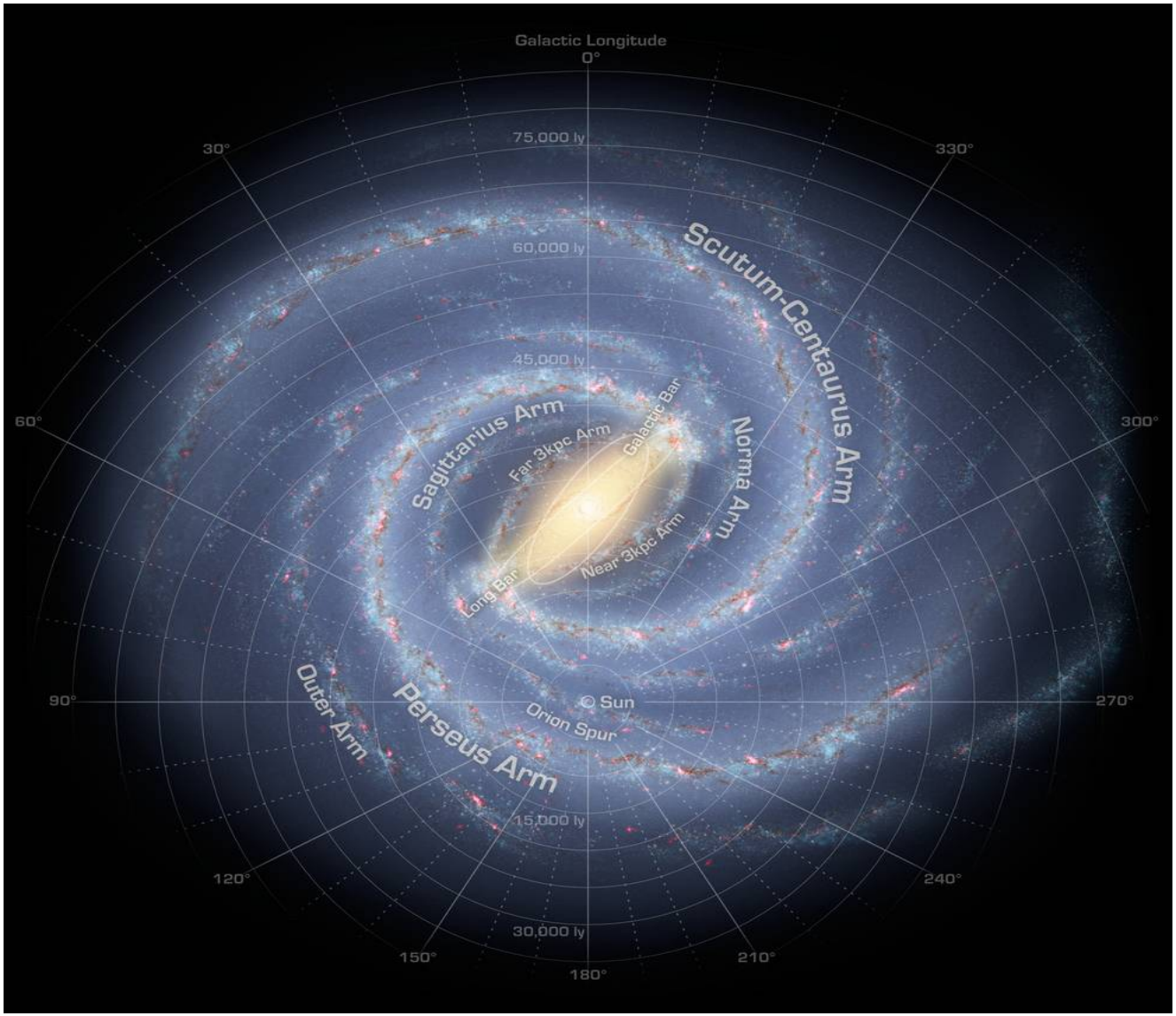

A map of the Great African Rift Valley
Eurasian Plate
Arabian Plate
African Plate (Nubian)
African Plate (Somali)
Indian Ocean
Atlantic Ocean
Red Sea
Tunisia
Morocco
Algeria
Libya
Egypt
Western Sahara
Mauritania
Mali
Niger
Sudan
Cape Verde
Gambia
Senegal
Guinea Bissau
Guinea
Burkina Faso
Benin
Togo
Ghana
Cote D'Ivoire
Liberia
Nigeria
Cameroon
Central African Republic
South Sudan
Ethiopia
Eritrea
Djibouti
Somalia
Sierra Leone
Sao Tome & Principe
Equatorial Guinea
Gabon
Congo
Cabinda (Angola)
Rwanda
Burundi
Uganda
Kenya
Lake Victoria
Dem. Republic of Congo
Lake Tanganyika
Tanzania
Zanzibar
Comoros
Angola
Zambia
Malawi
Mozambique
Zimbabwe
Madagascar
Mauritius
Reunion (France)
Namibia
Botswana
Swaziland
Lesotho
South Africa
Key
Volcanoes
Rift Valley
1 Mount Kenya
2 Mount Kilimanjaro
0 900km Approx.
By Rob Gamesby
http://www.coolgeography.co.uk

# ESA's Envisat, Sentinel and Swarm Missions

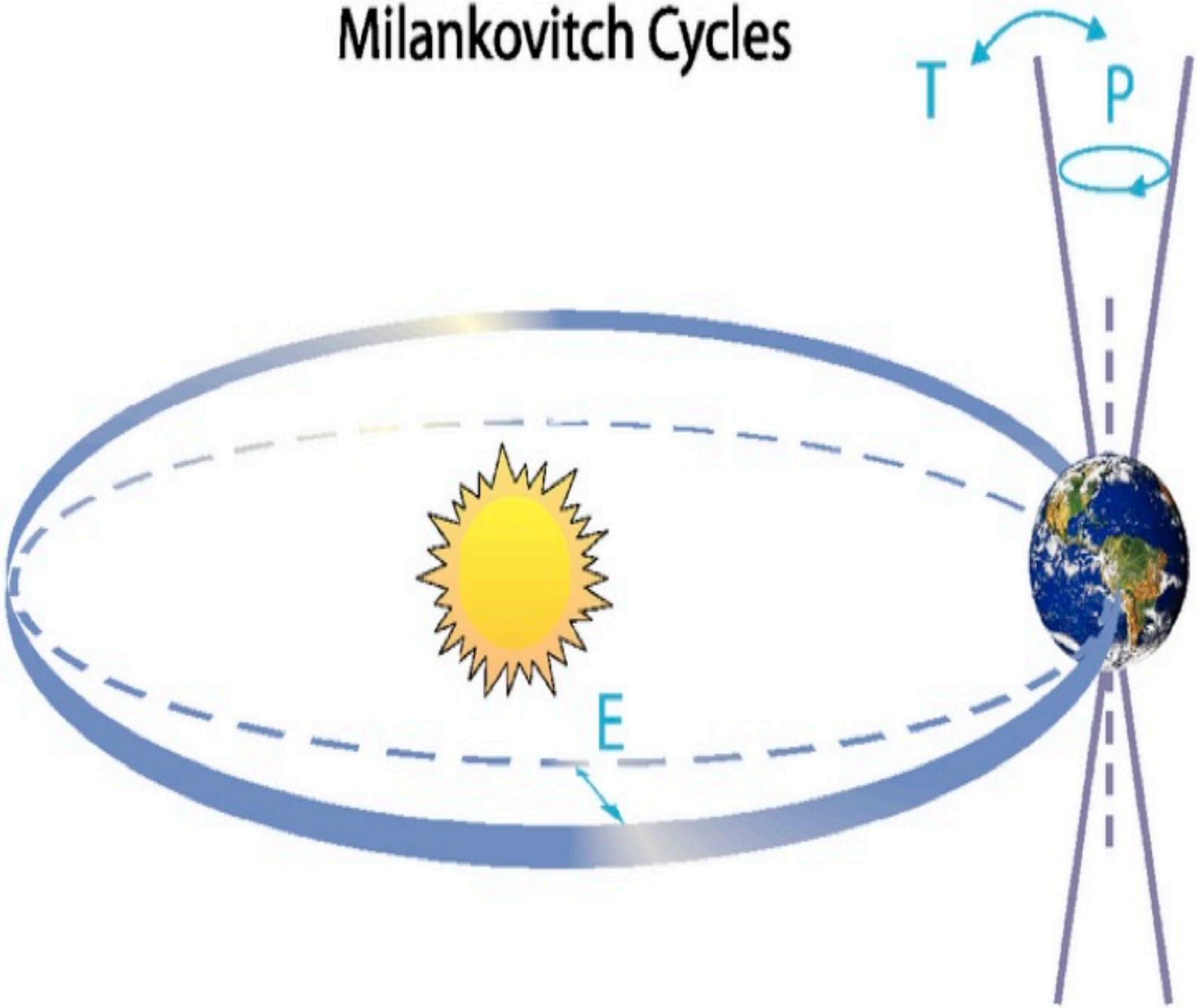
# Core & crust magnetic contribution



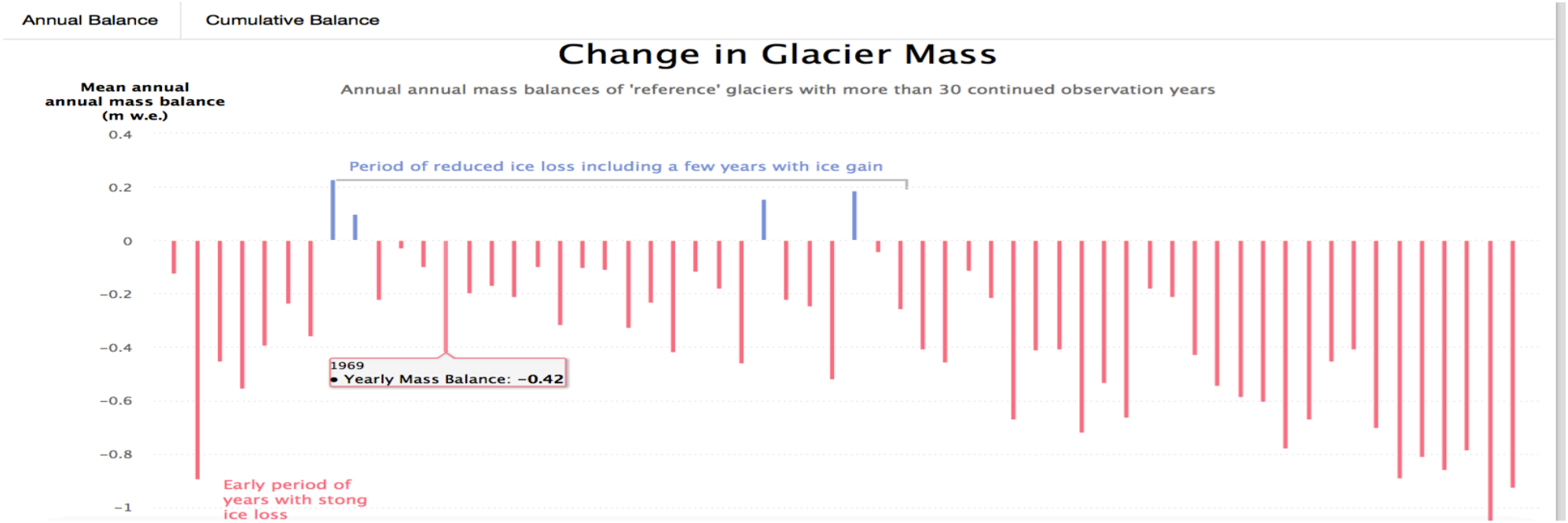
# Other long-period cycles impacting Earth



# Milankovitch Cycles

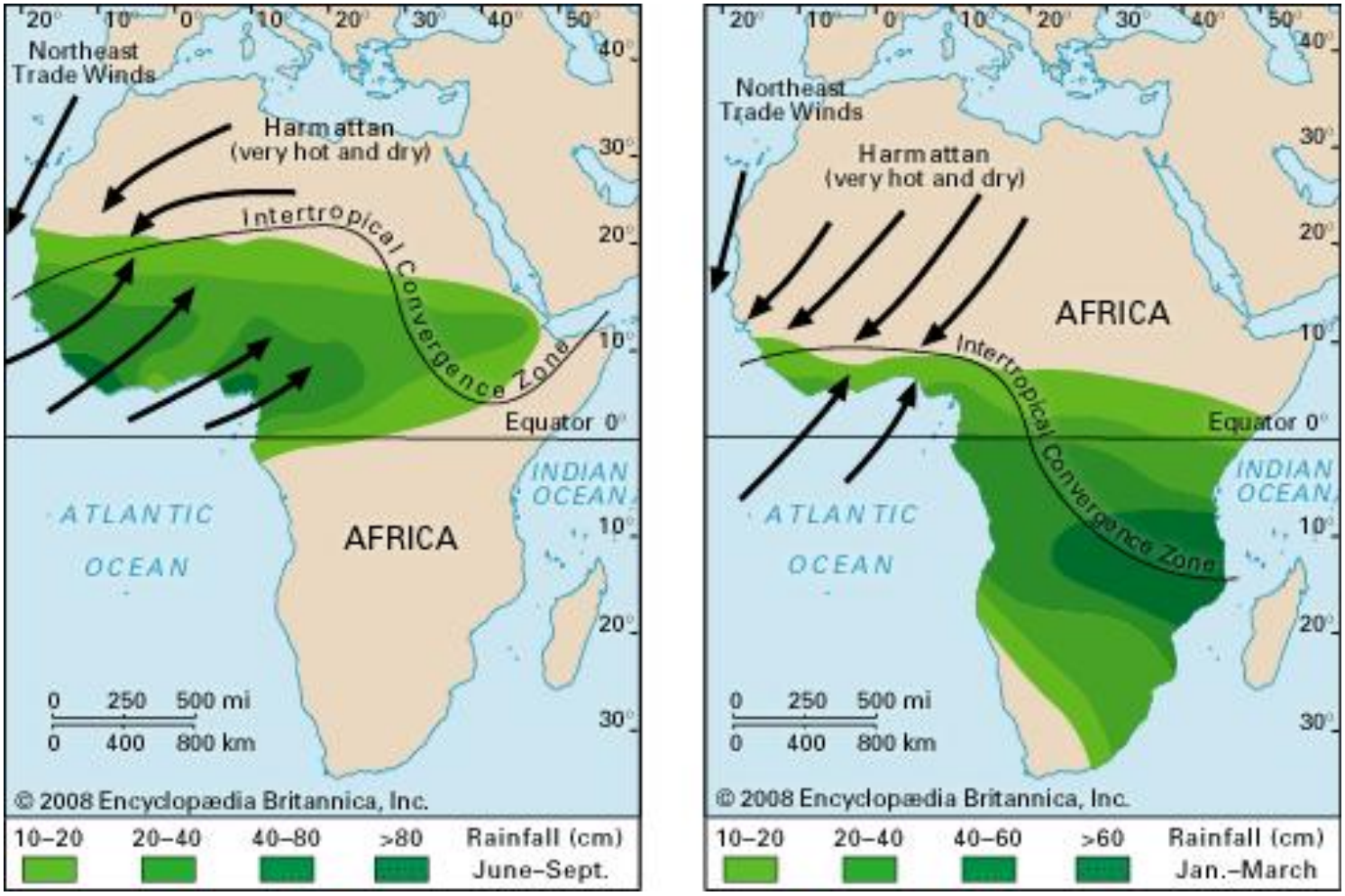


# Interglacials, glacier retreat, natural variability

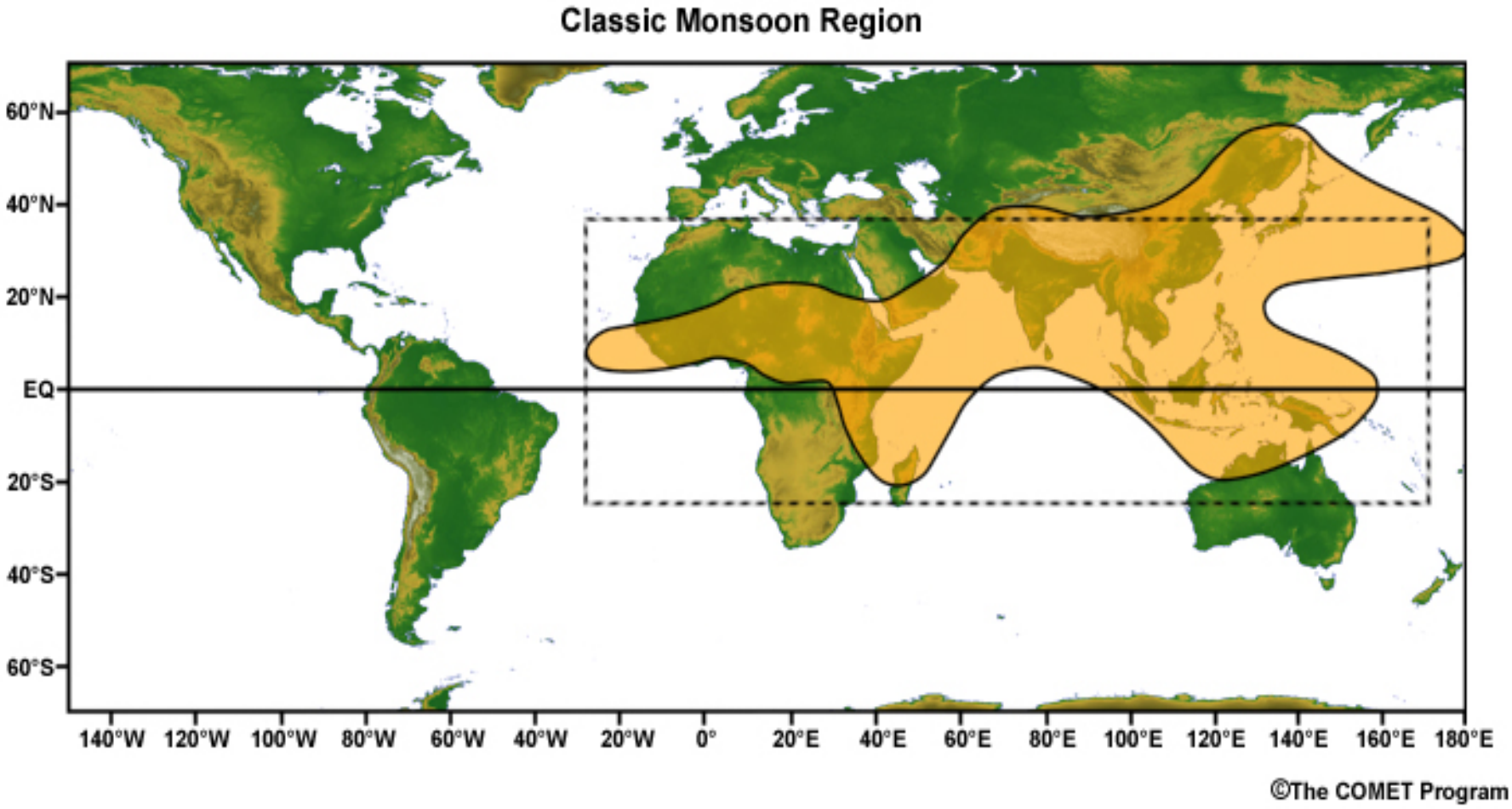

Annual Balance
Cumulative Balance
Change in Glacier Mass
Mean annual annual mass balance (m w.e.)
Annual annual mass balances of 'reference' glaciers with more than 30 continued observation years
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
Period of reduced ice loss including a few years with ice gain
1969
Yearly Mass Balance: −0.42
Early period of years with stong ice loss

# Glacial lake outburst flooding

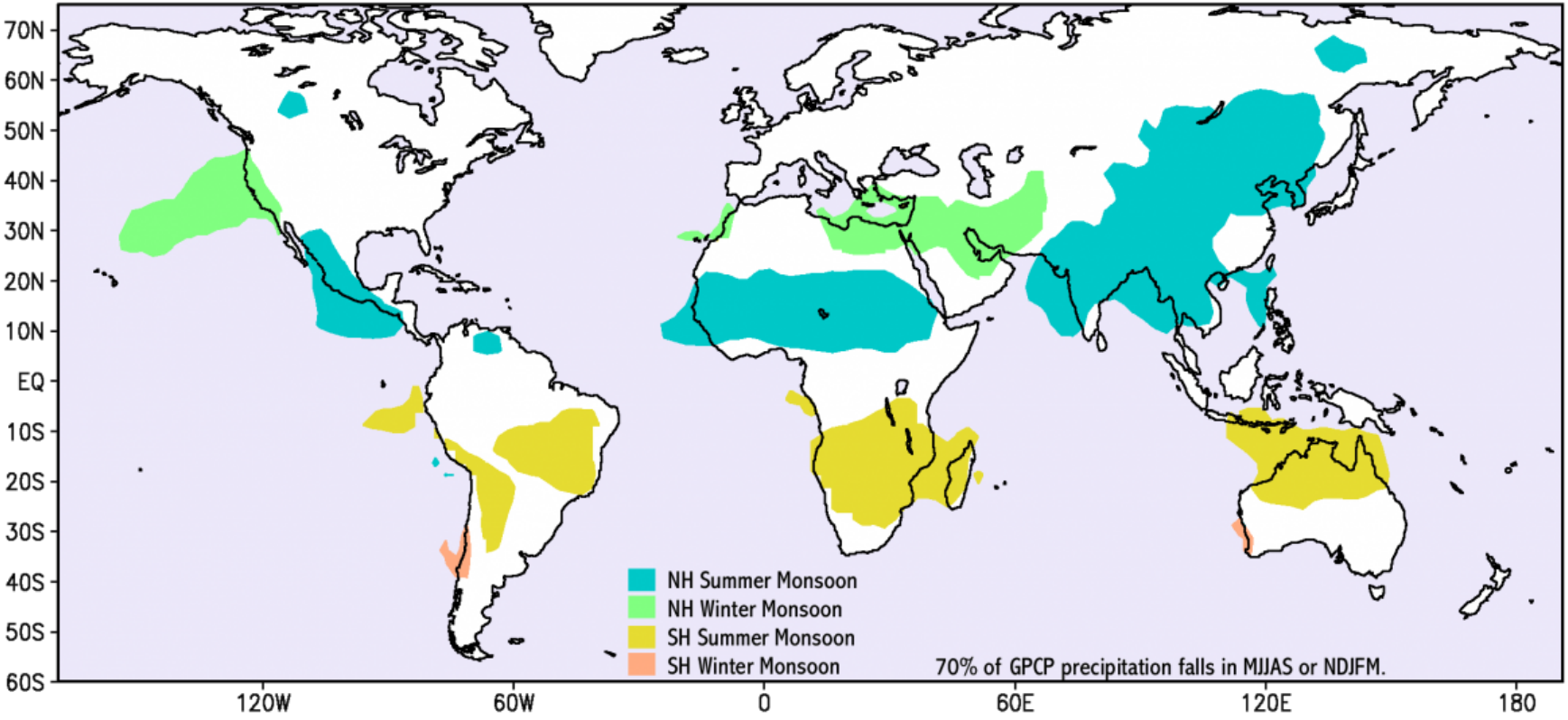
# West African Monsoon



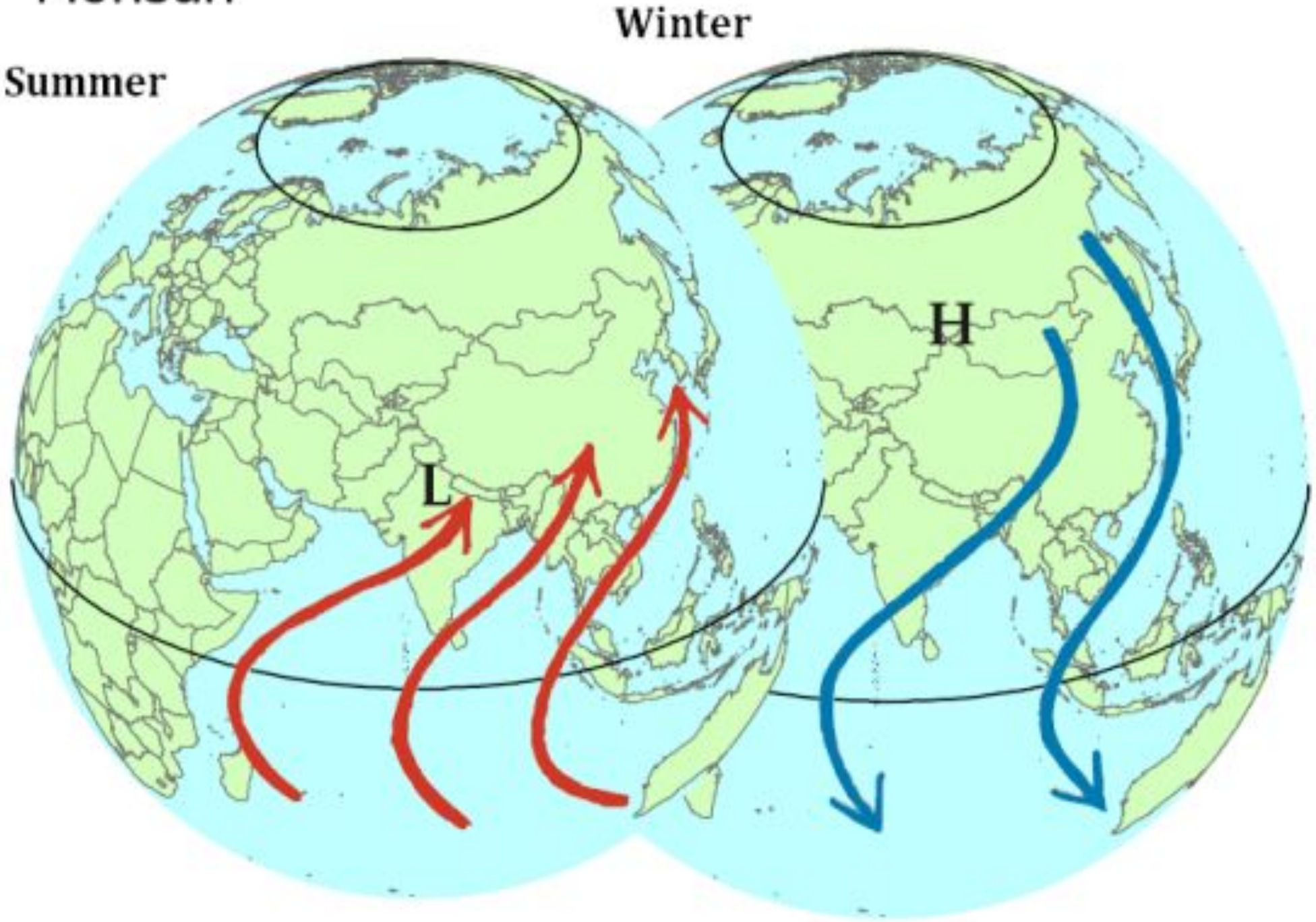
# Old description of Monsoon

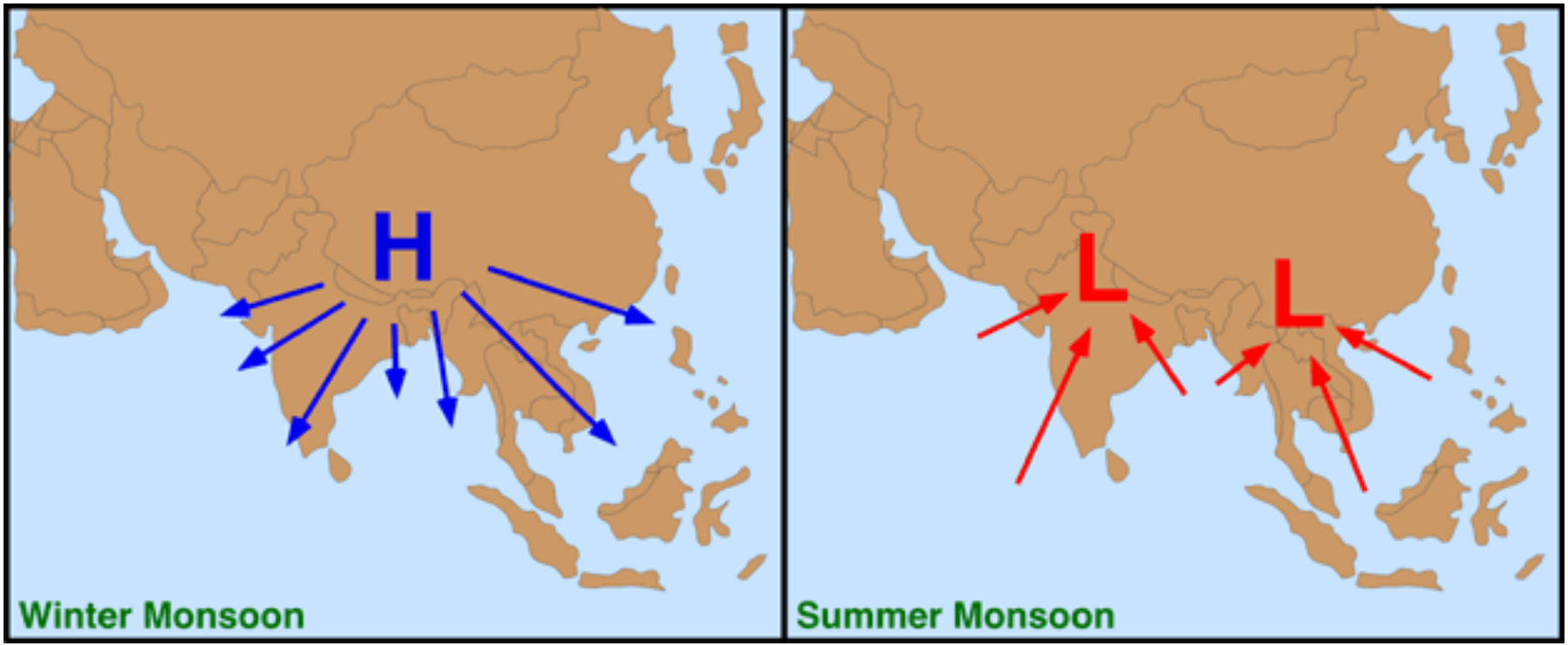


# Extended Monsoon systems



# Monsun




H
Winter Monsoon
L
L
Summer Monsoon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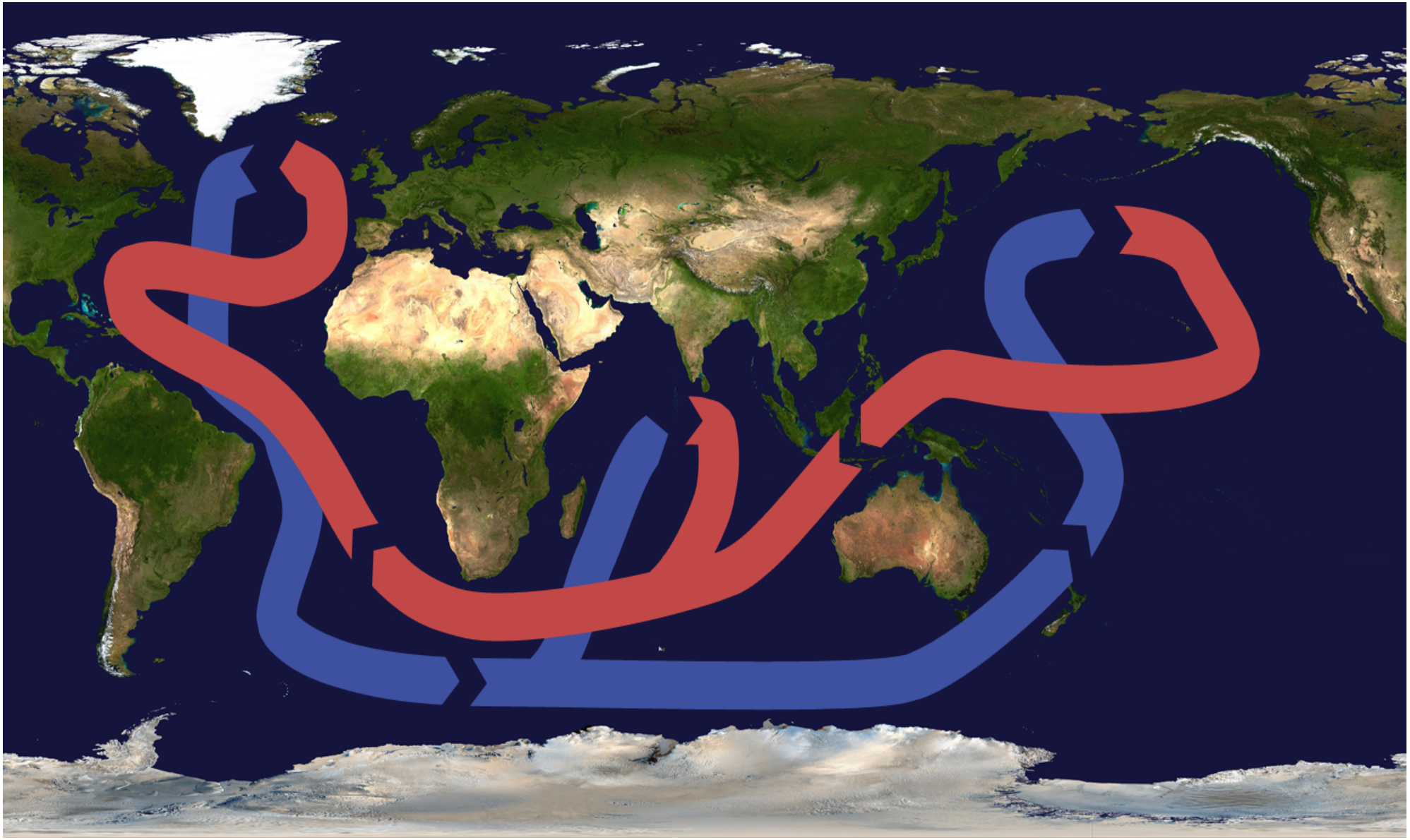
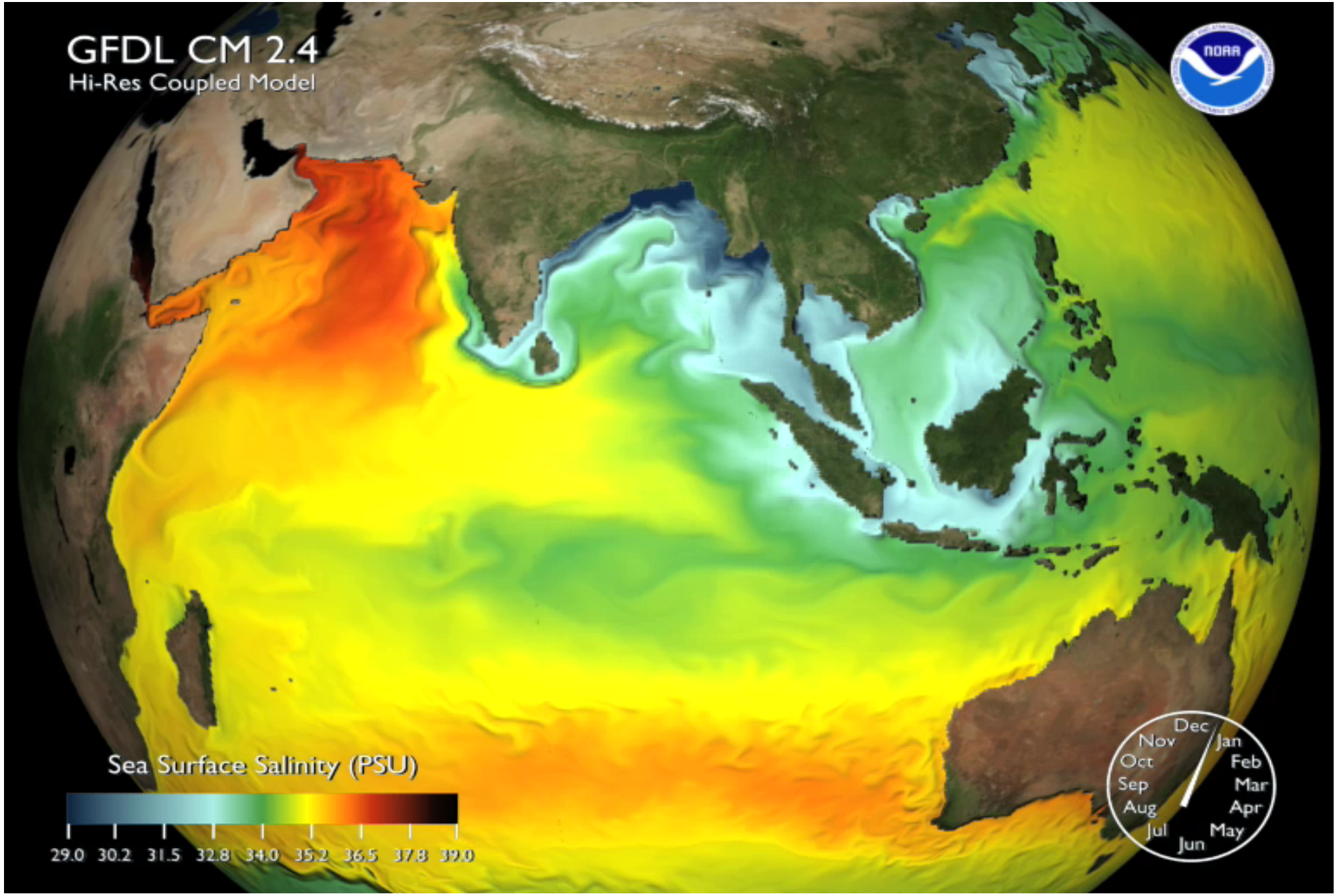
# The Ocean Conveyor Belt links all regions of the world



# Sea Surface Salinity & Temperature affect evaporation



# Chlorophyll & phytoplankton are the base of ocean life