
Welcome To Geography

# Prelims Syllabus

**Physical Geography**

**Social Geography**

**Economic Geography**

# SYLLABUS – MAINS

1. Salient features of *WORLD'S PHYSICAL GEOGRAPHY.*

2. **Distribution of key *NATURAL RESOURCES* across the world. Factors responsible for the location of primary, secondary, and tertiary sector *INDUSTRIES* in various parts of the world**

3. Important *GEOPHYSICAL PHENOMENA* such as Earthquakes, Tsunami, Volcanic activity, Cyclone etc. *GEOGRAPHICAL FEATURES* and their *LOCATION – CHANGES* in critical geographical features and in flora and fauna and the *EFFECTS* of such changes.

# Sources for Geography

## Prelims and Mains

- NCERT- World Physical Geography- Class XI
- NCERT- India Physical Environment- Class XI
- NCERT- Fundamentals of Human Geography- Class XI
- NCERT- India People and Economy-Class XII
- Oxford School Atlas- Latest Edition (36th Edition)
- Indian and World Geography, Majid Husain

Prioritizing ACS Study Plan

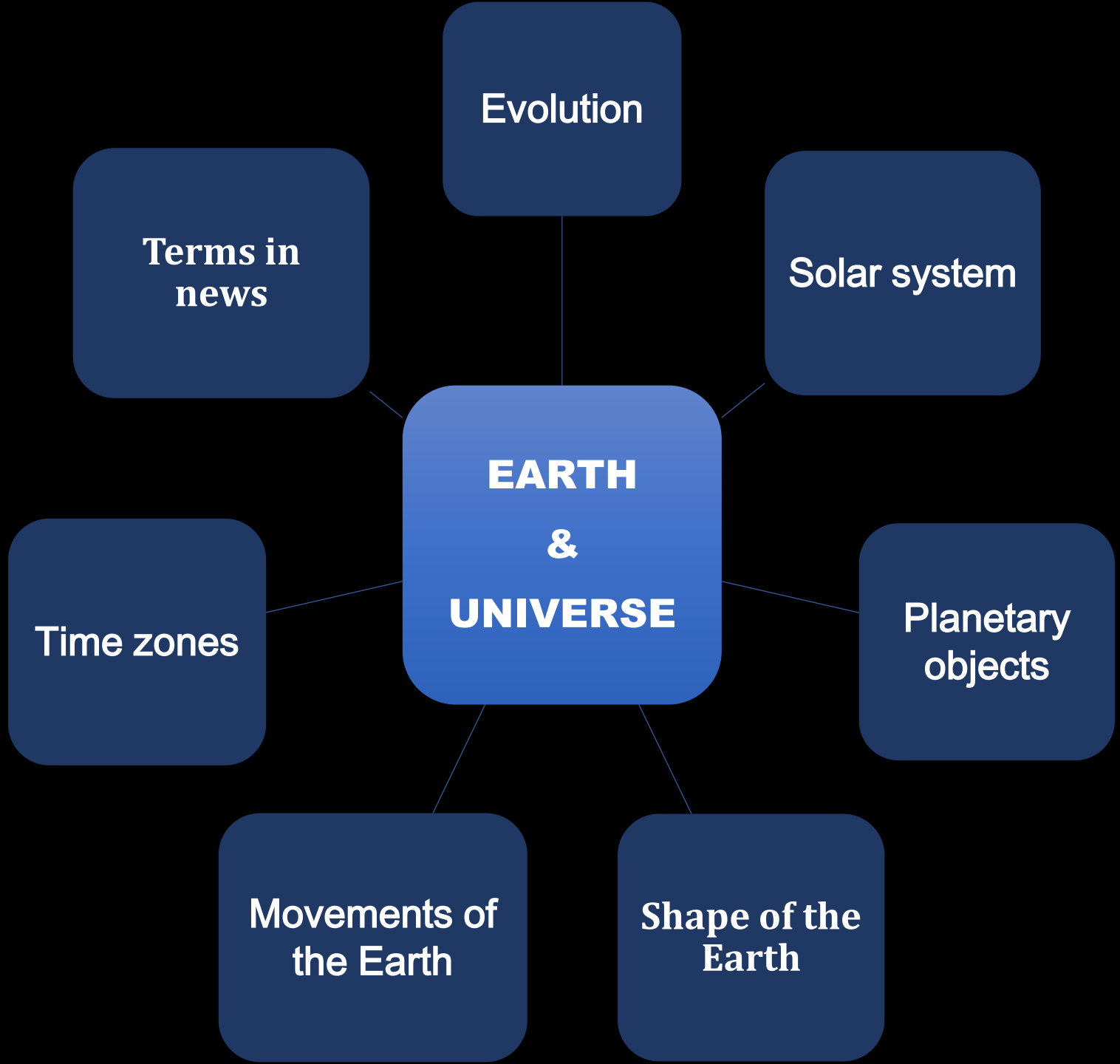
Understand and relate with surrounding

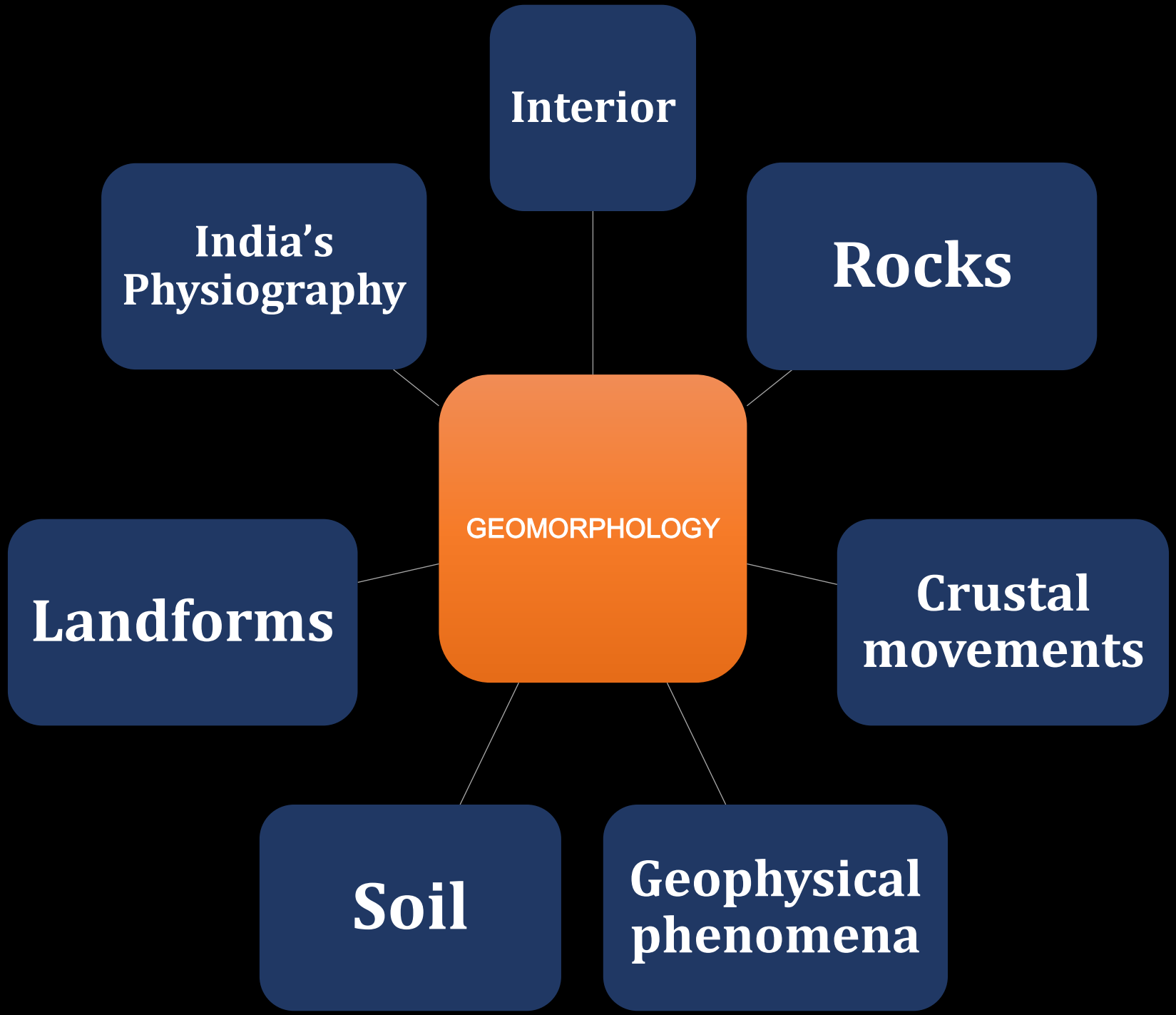
Solving questions

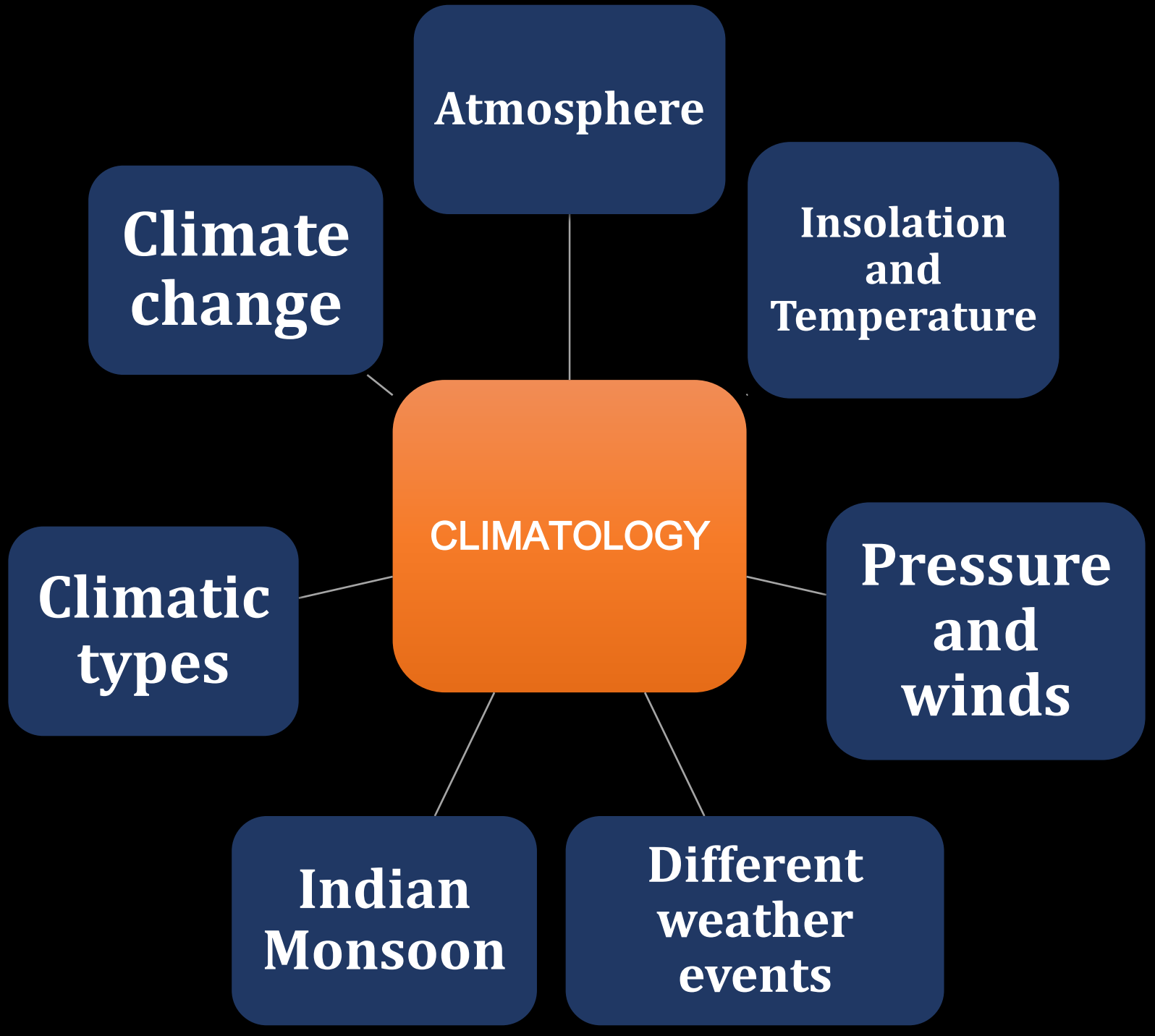
Facts to memorize with concept

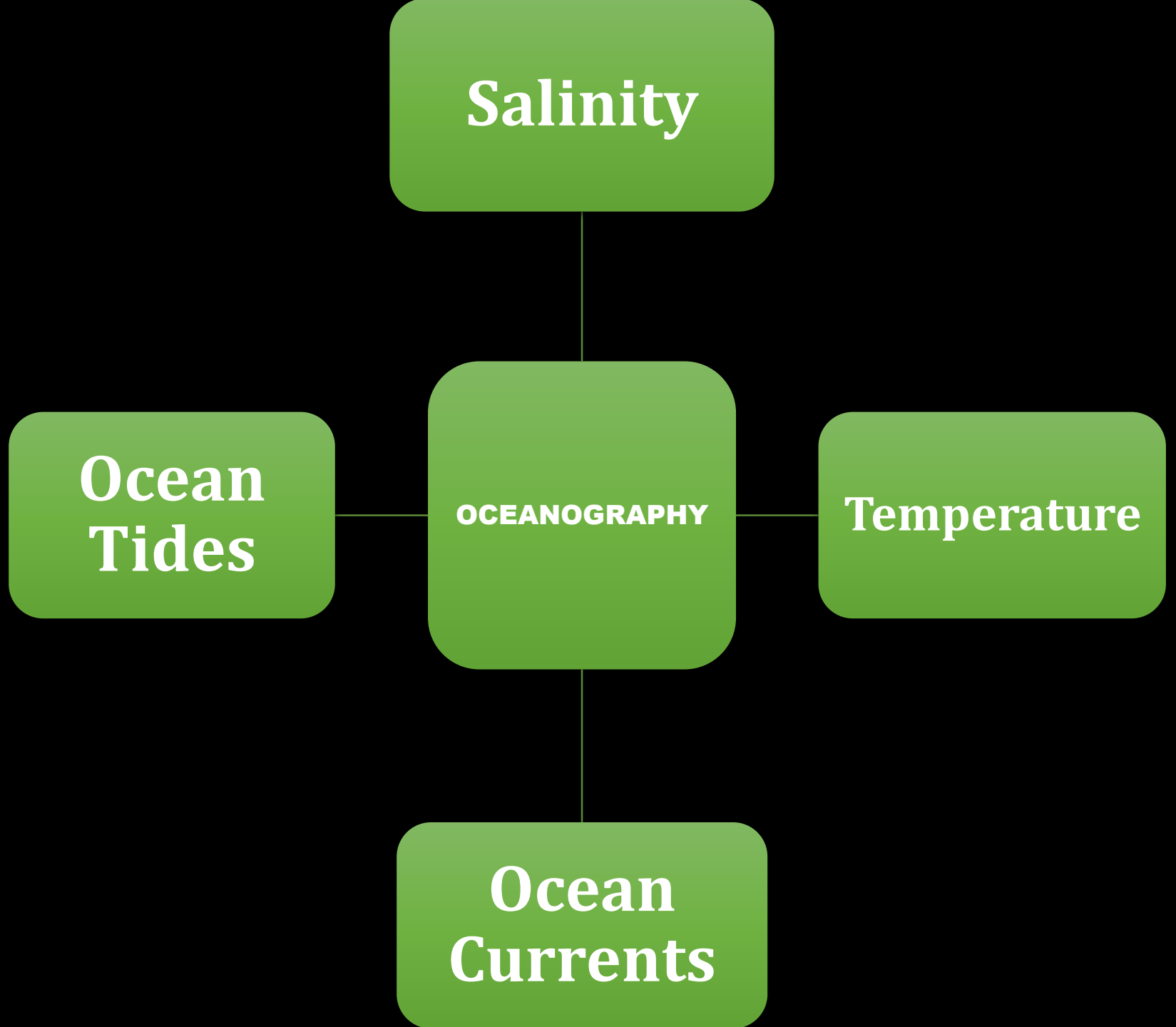
Repeated revision

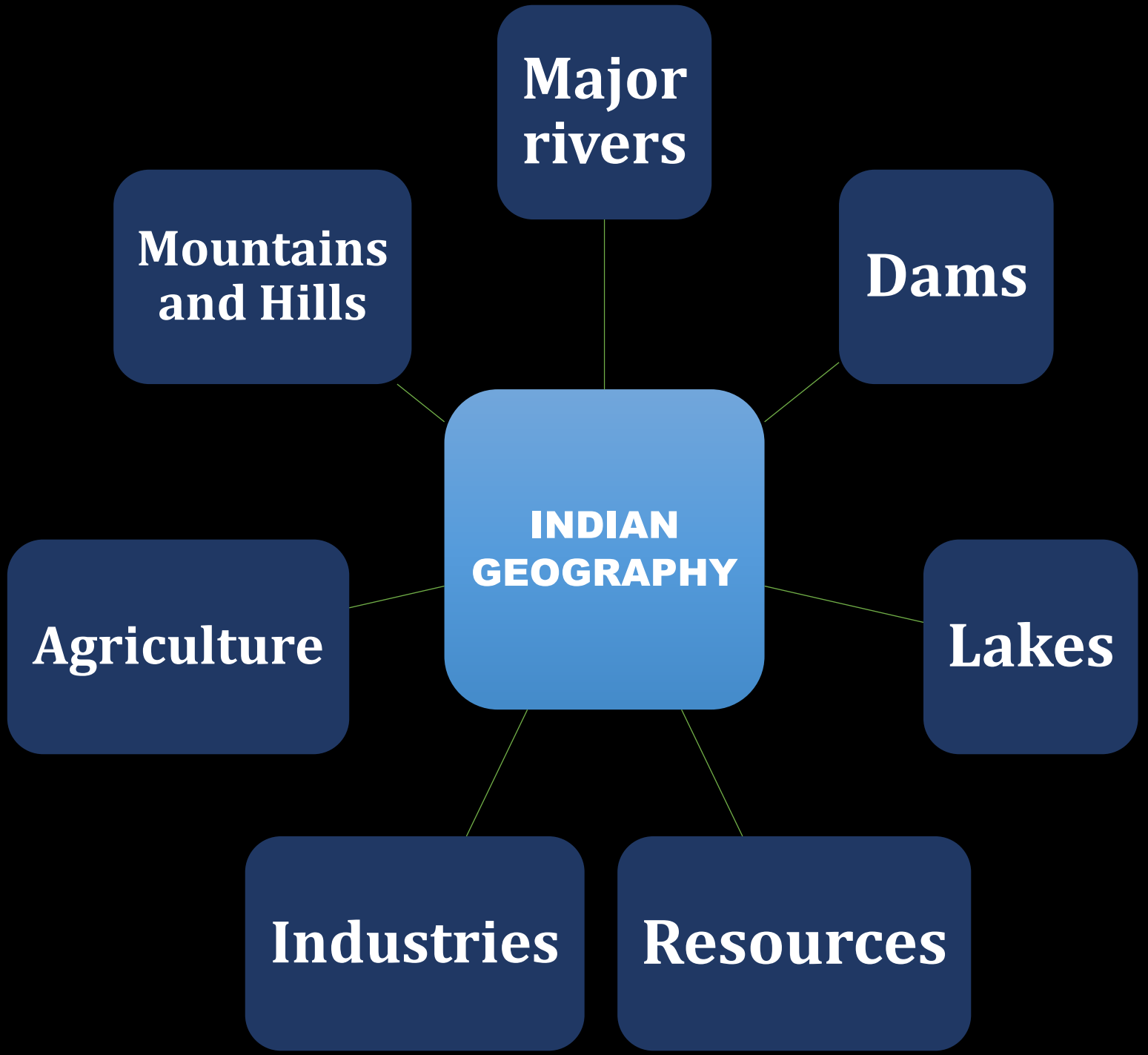
Short-notes


Evolution
Terms in news
Solar system
EARTH & UNIVERSE
Time zones
Planetary objects
Movements of the Earth
Shape of the Earth


Interior
India's Physiography
Rocks
GEOMORPHOLOGY
Landforms
Crustal movements
Soil
Geophysical phenomena


Atmosphere
Climate change
Insolation and Temperature
CLIMATOLOGY
Climatic types
Pressure and winds
Indian Monsoon
Different weather events

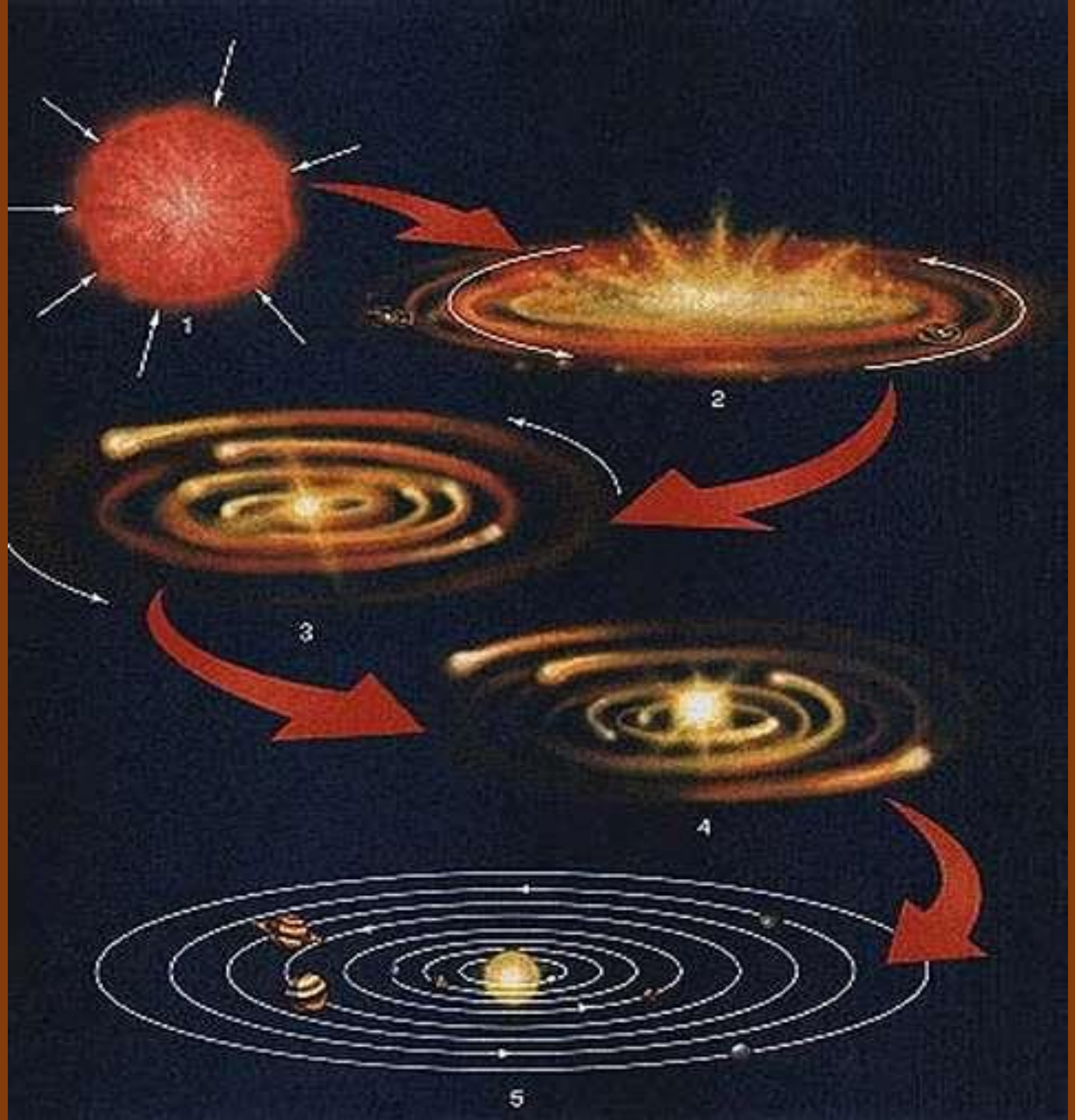

Salinity
Ocean Tides
OCEANOGRAPHY
Temperature
Ocean Currents


Major rivers
Mountains and Hills
Dams
INDIAN GEOGRAPHY
Agriculture
Lakes
Industries
Resources

# EARTH & UNIVERSE

## PHYSICAL GEOGRAPHY






# The Nebular Hypothesis

Marquis Laplace in 1796

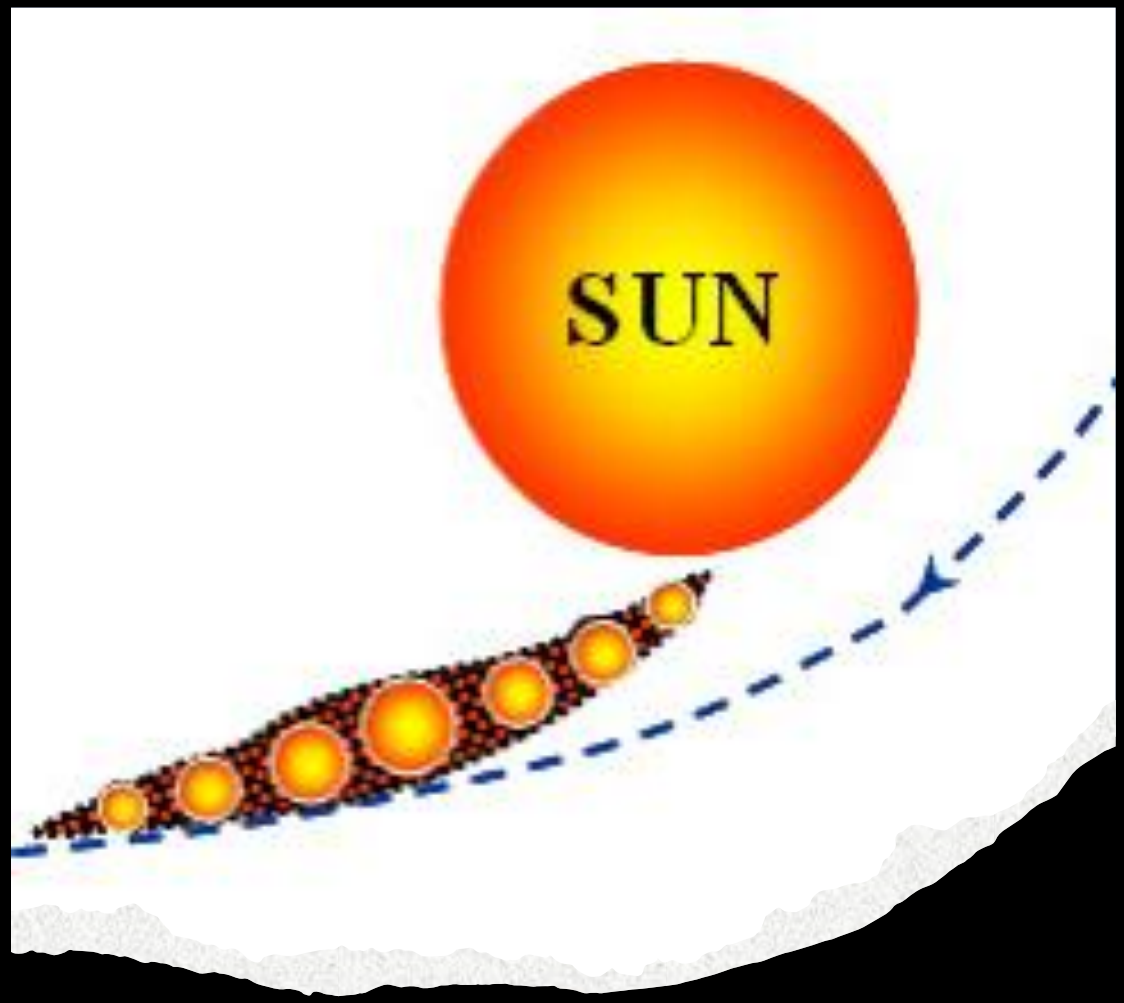
Failed to explain distribution of Angular Momentum

Reasons for differentiation of size and mass of planetary bodies

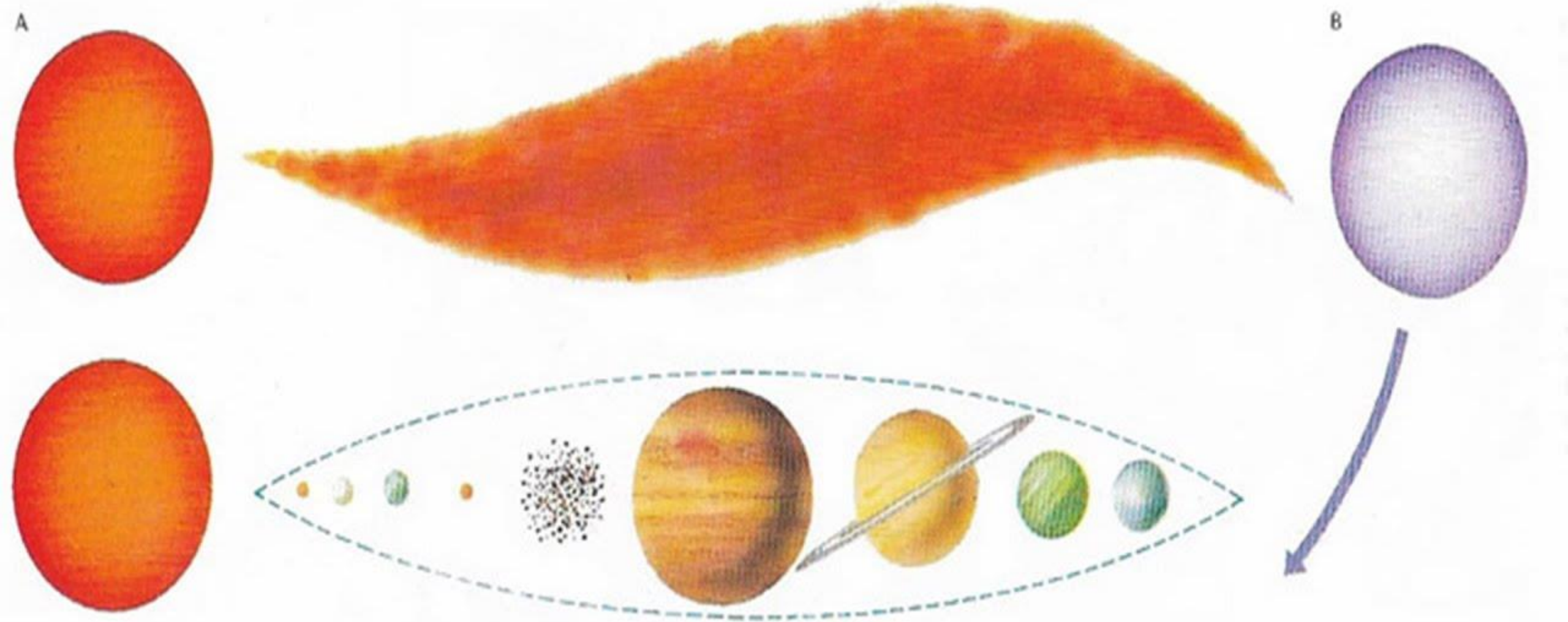
# The Planetesimal Hypothesis

Chamberlin & Moulton in 1904)

- The greatest flaw in the theory is the assumption that the material drawn out of the stars would condense.
- Before condensation could take place, the gases would have almost entirely disappear.

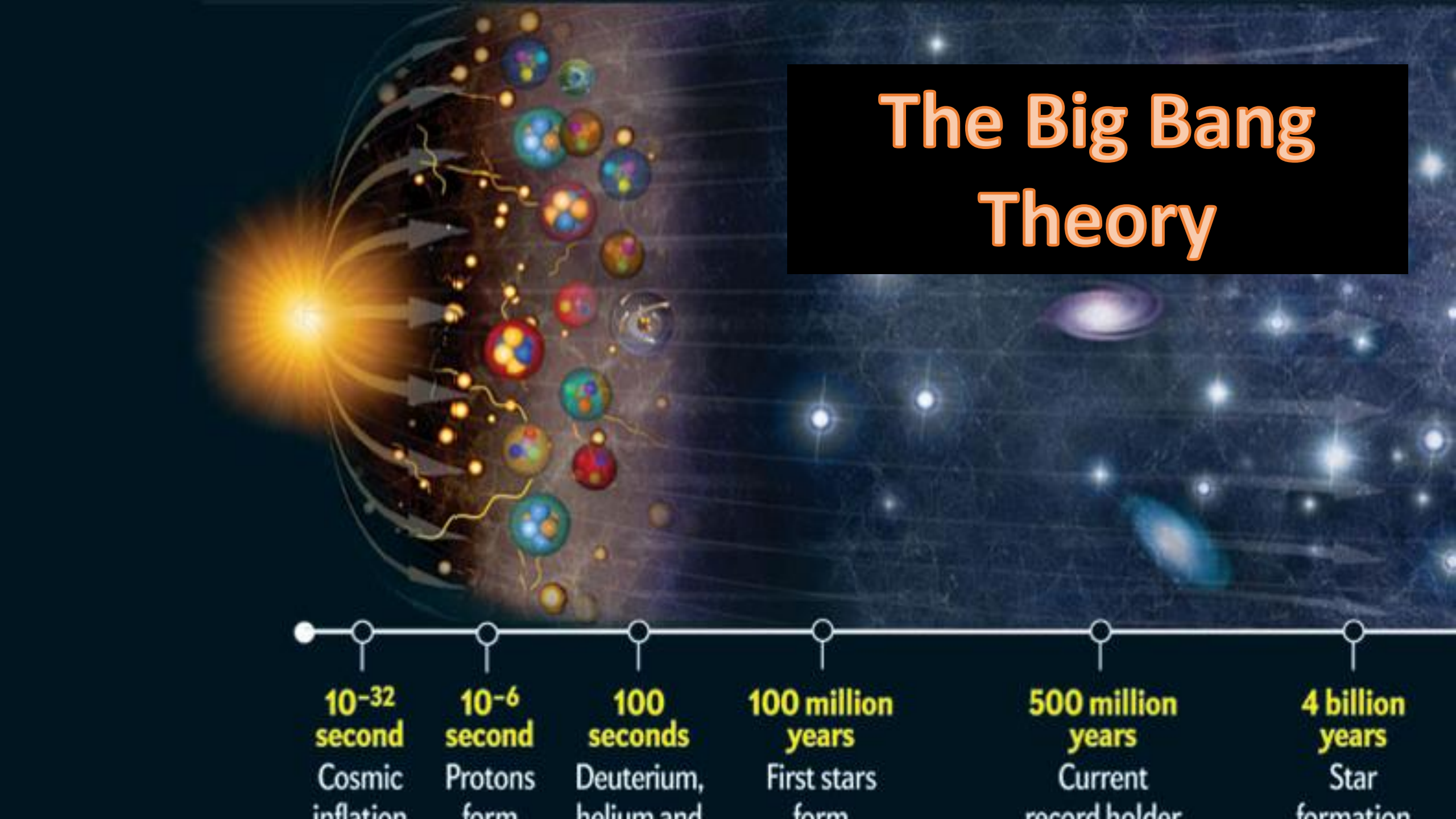


# Tidal Hypothesis of James Jeans



1. The Gaseous Hypothesis of Immanuel Kant in 1755
2. The Nebular Hypothesis of Marquis Laplace in 1796
3. Alfven's Electromagnetic Theory of Hannes Alfven in 1942
4. Planetesimal Hypothesis of Chamberlin & Moulton in 1904
5. The Tidal theory of Sir James Jeans & Sir Harold Jeffreys in 1919 & 1926
6. The Binary Star Hypothesis of H N Russell
7. The Nova Hypothesis of F Hoyle in 1939
8. The Interstellar Dust Hypothesis of Otto Schimdt
9. The Protoplanet Hypothesis of Gerald Kuiper in 1951

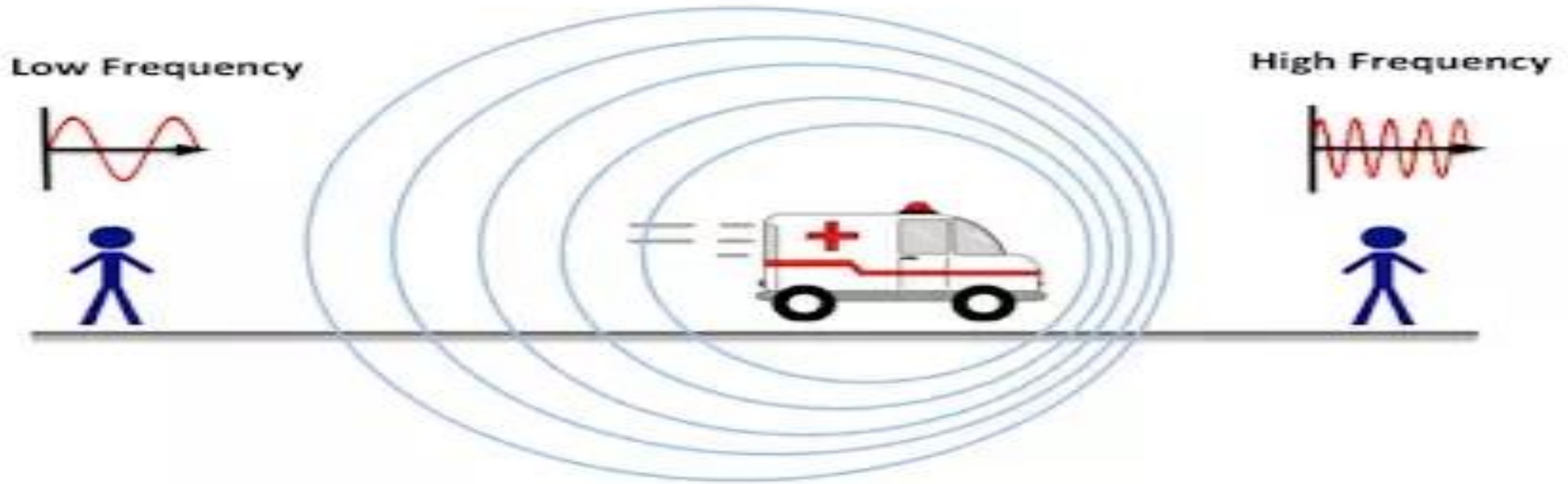
# The Big Bang Theory

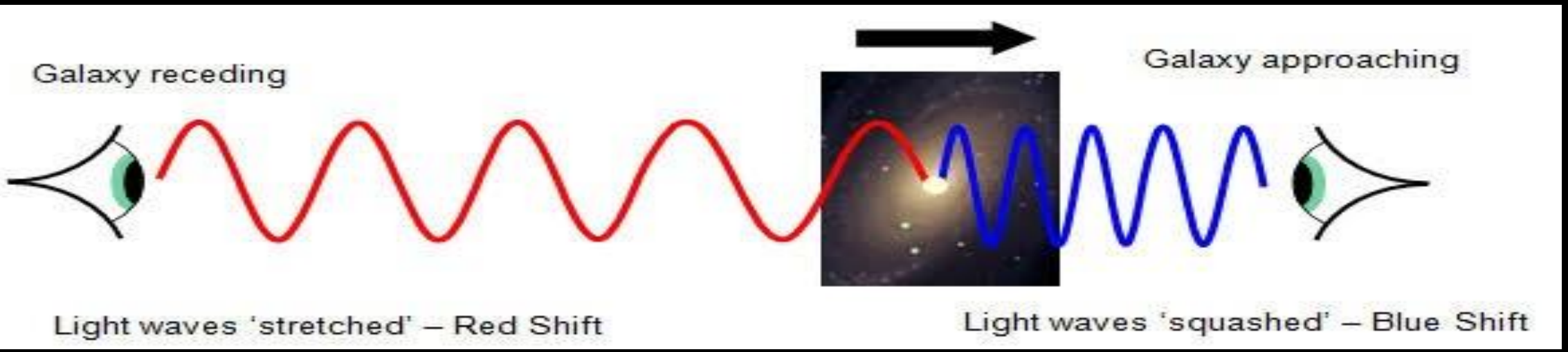


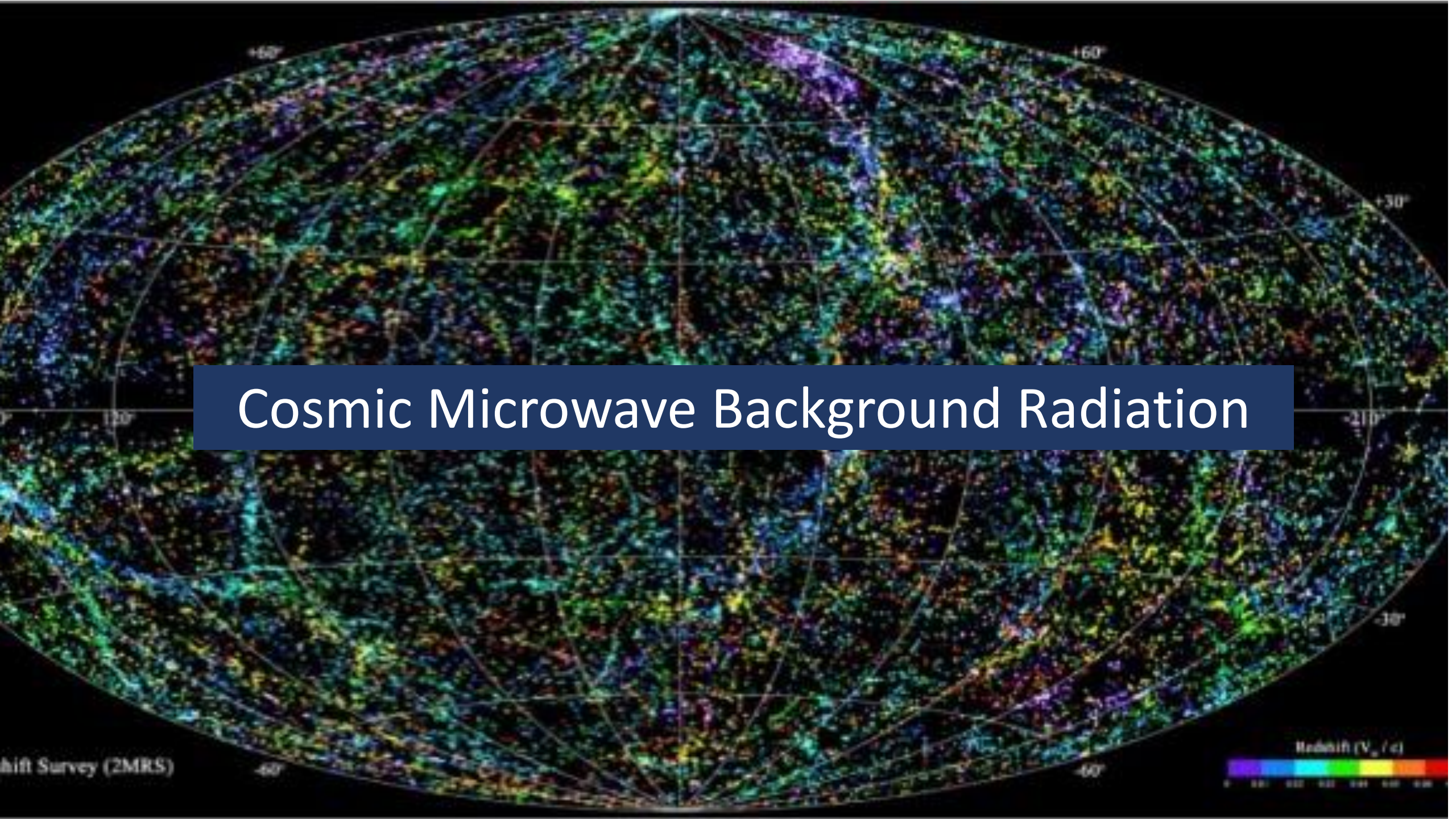
1. The Big Bang Explosion took place 13.7 billion years ago
2. Matter and Energy were released from the expansion
3. Helium & Hydrogen were the first elements to be formed by recombination of particles after cooling down of the Universe.
4. Gradually, the Galaxies or Milky way was formed by the clusters of atoms and inside the Galaxies the stars were originated.
5. These stars released a ripple/wave effect and helped form almost all the remaining elements of the Universe.
6. Those elements were like the building materials of Planets, Moons, Life and everything in the eco system.

7. The Big Bang Theory was first suggested by Edwin Hubble in 1920.

# Doppler Effect




Cosmic Microwave Background Radiation

# Previous Year 2 (2012)

Which of the following is/are cited by the scientists as evidence/evidences for the continued expansion of universe?

I. Detection of microwaves in space
II. Observation of red shift phenomenon in space
III. Movement of asteroids in space
IV. Occurrence of supernova explosions in space

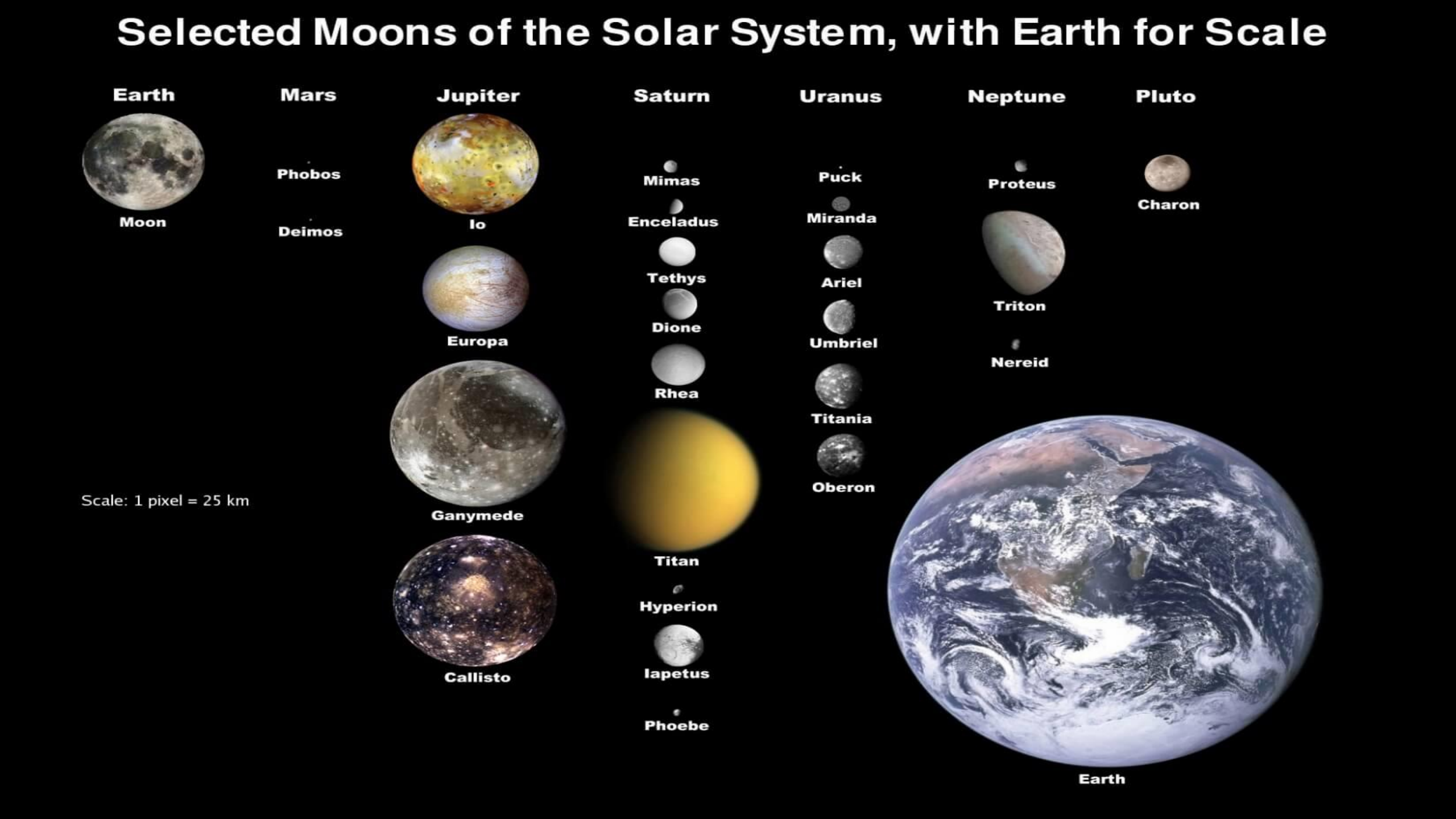
Select the correct answer using the codes given below:

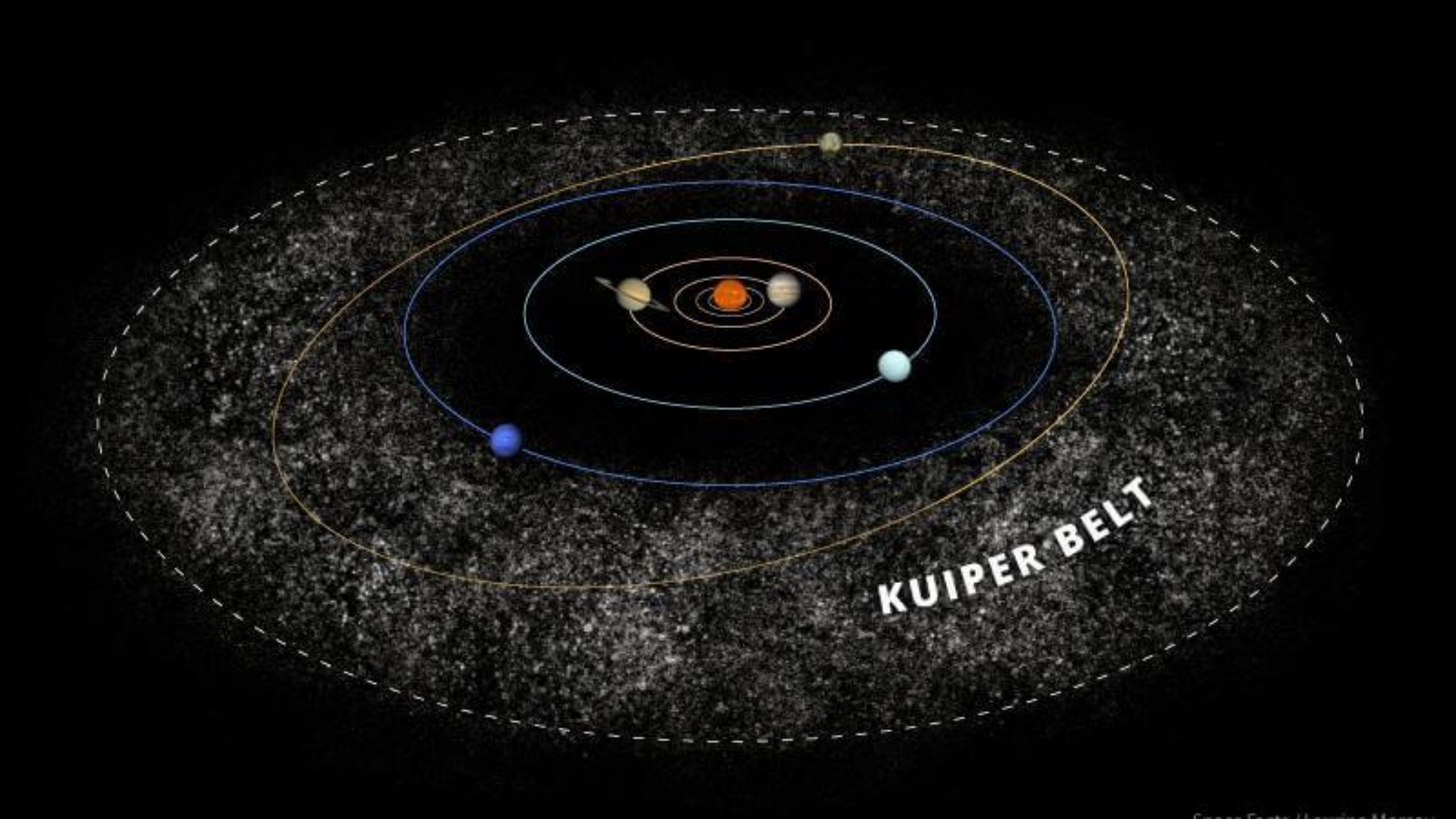
a. I and II
b. II only
c. I, III and IV
d. None of the above can be cited as evidence

Mercury
Venus
Earth
Mars
Asteroid Belt
Jupiter
Saturn
Uranus
Neptune
Eris
Kuiper Belt Objects
Pluto
Makemake
Ceres
Comets

| Sl. No. | Planets | Distance from Sun (million kms) | Orbital Period (Earth Days) | Atmosphere | Moons |
|---|---|---|---|---|---|
| 1. 1 | Mercury | 58 | 88 Days | | No Moon |
| 1. 2 | Venus | 108 | 225 Days | Carbon Dioxide | No Moon |
| 1. 3 | Earth | 150 | 365.25 Days | Nitrogen, Oxygen, and other gases (Argon, Carbon dioxide ,Neon etc). | 1 |
| 1. 4 | Mars | 228 | 687 Days | Carbon Dioxide, Nitrogen, and Argon gases | 2 |
| 1. 5 | Jupiter | 778 | 4,333 Days | Hydrogen and Helium gas | 53 |
| 1. 6 | Saturn | 1427 | 10,759 Days | Hydrogen and Helium gas with traces of other substances(Methane & Water ice) | 53 |
| 1. 7 | Uranus | 2870 | 30,687 Days | Hydrogen and Helium, with a small amount of Methane, traces of Water and Ammonia | 27 |
| 1. 8 | Neptune | 4497 | 60,190 Days | Hydrogen and Helium with just a little bit of Methane | 14 |

# Selected Moons of the Solar System, with Earth for Scale




KUIPER BELT







Canis Major Dwarf.

# Expected Question 2

Read the following statements:

I. Spiral Galaxies are large rotating disks of stars and nebulae, surrounded by a shell of dark matter.
II. Spiral Galaxy is a type of Irregular Galaxies.
III. The Milky Way Galaxy is an irregular Galaxy.

Choose the correct statement(s) using the codes given below:

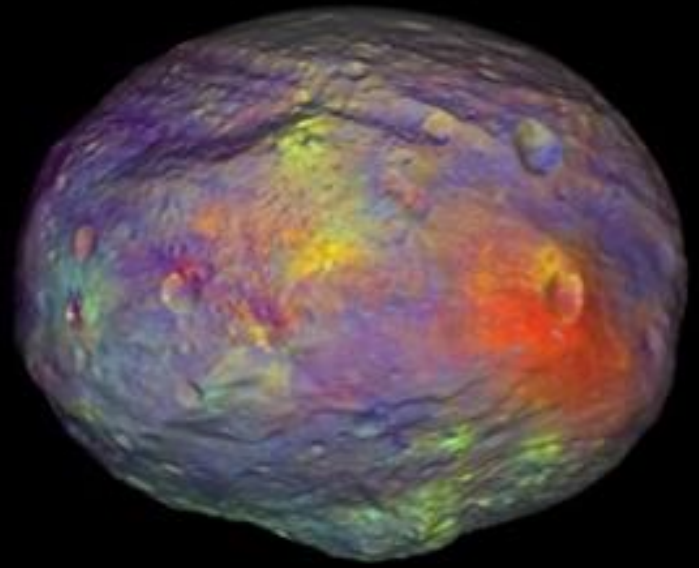
a. I Only
b. II Only
c. III Only
d. All of the above.

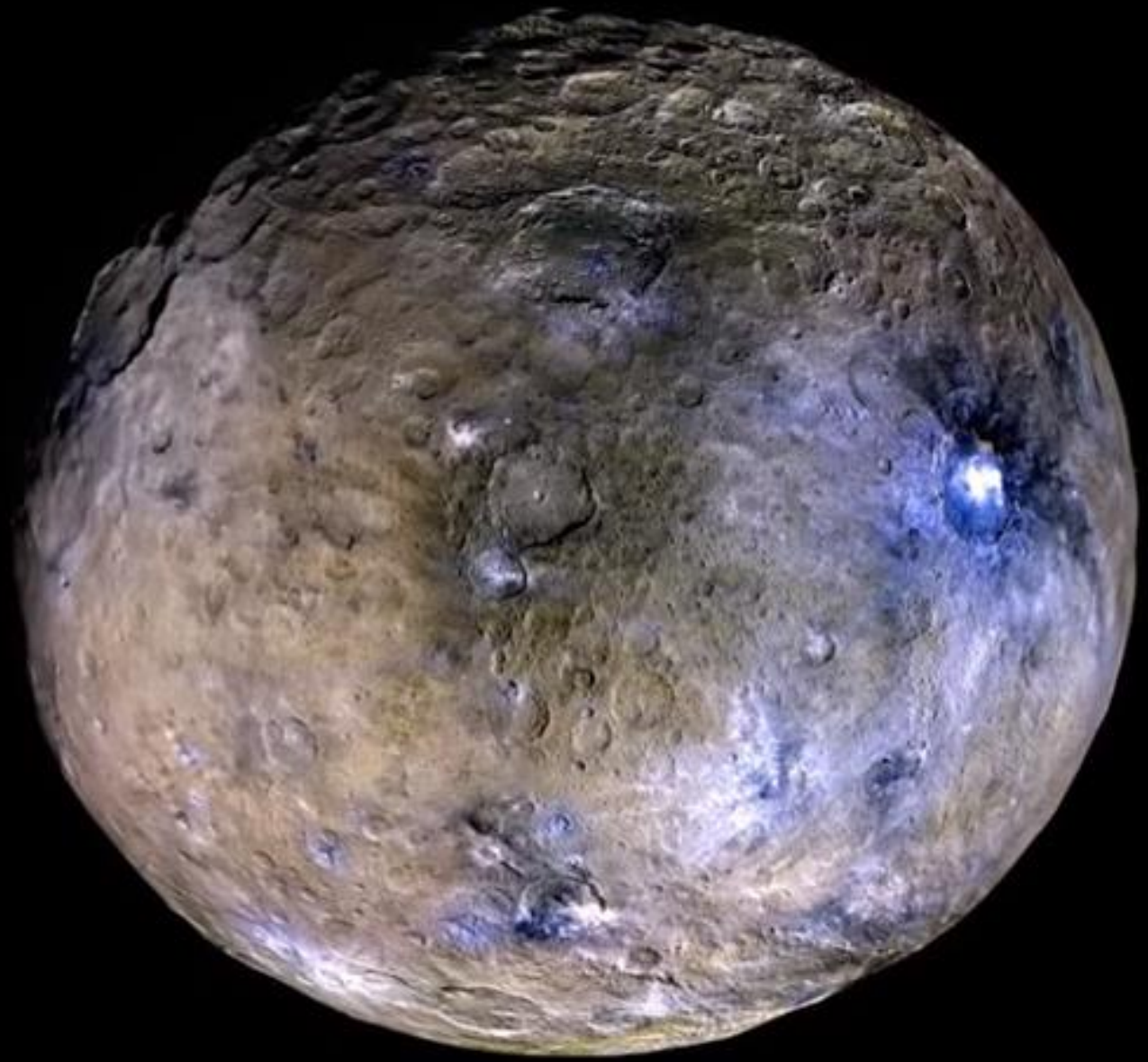
# ASTREOIDS



Mercury
Venus
Earth
Mars
Asteroid Belt
Jupiter
Saturn
Uranus
Neptune
Eris
Kuiper Belt Objects
Pluto
Makemake
Ceres
Comets

Enhanced color highlights mineral variations





Vesta

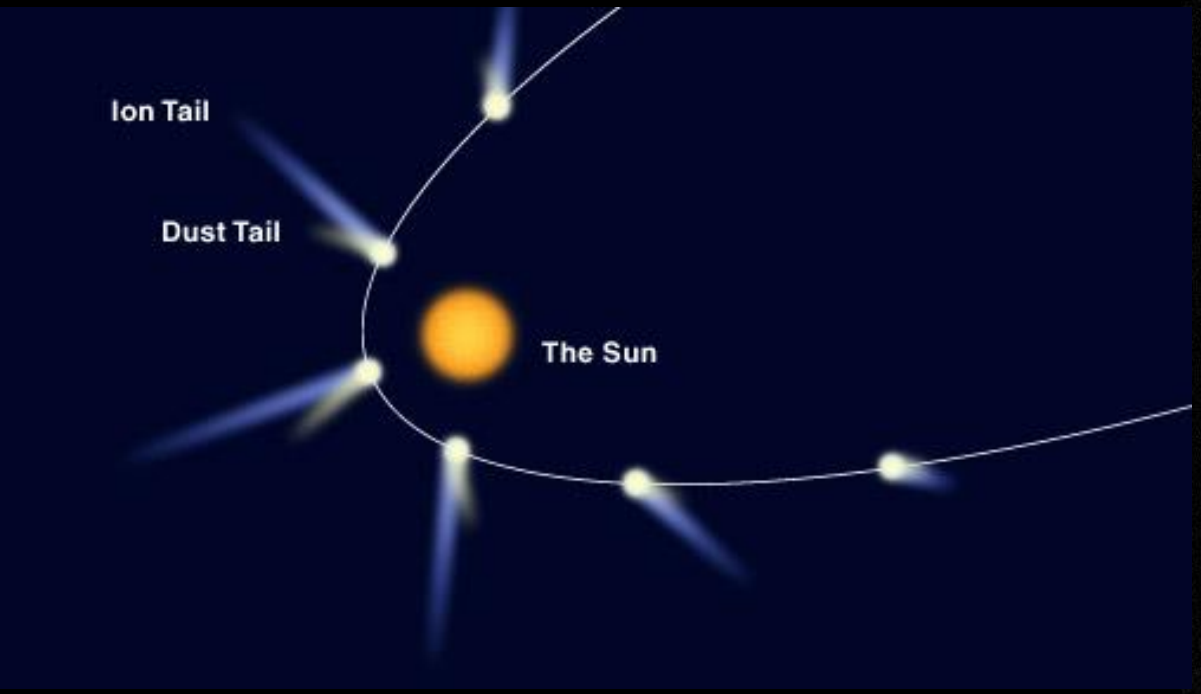
Credit: NASA / JPL-Caltech / MPS / DLR / IDA / PSI

Ceres

Credit: NASA / JPL-Caltech / UCLA / MPS / DLR / IDA


COMETS

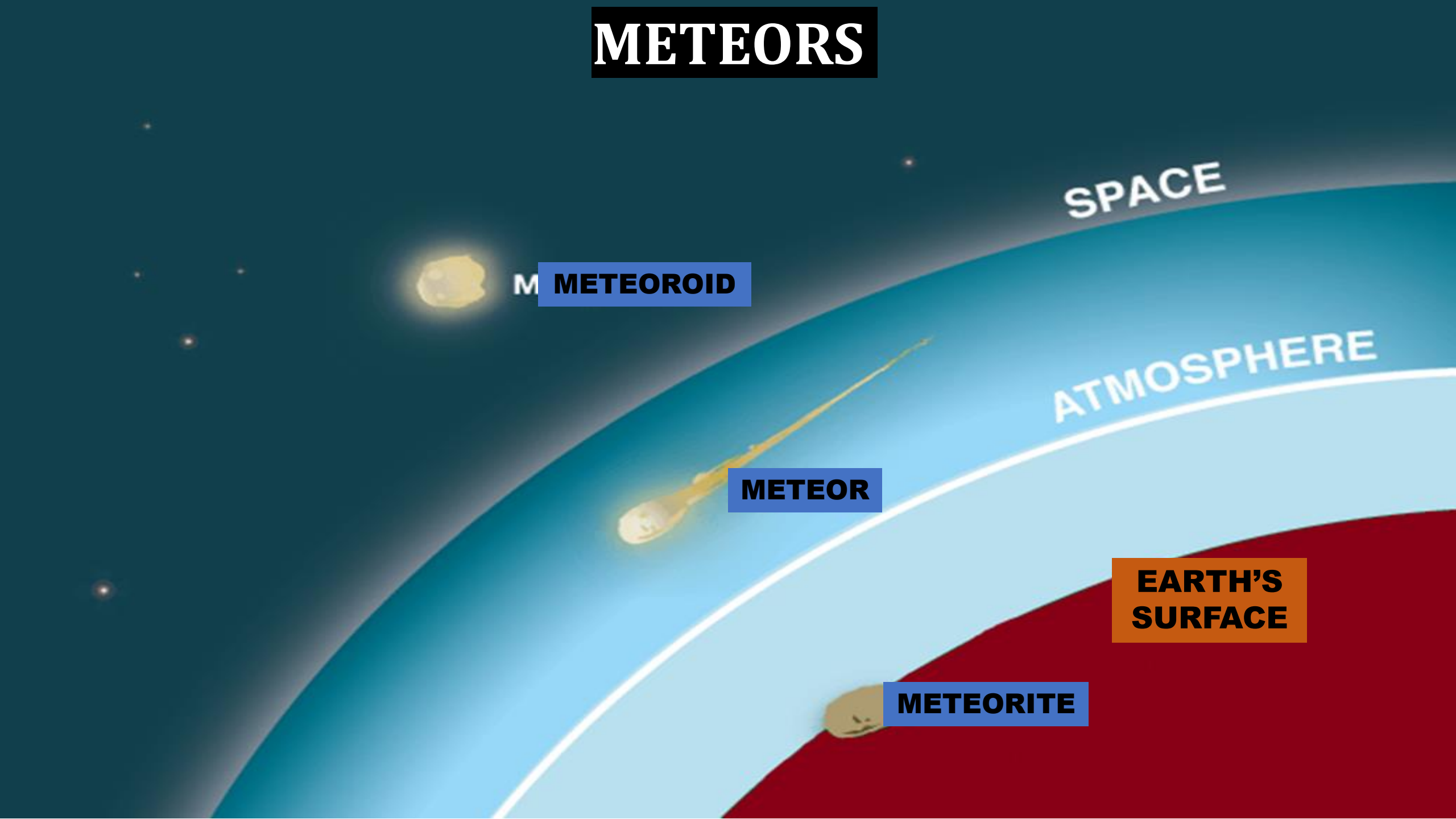
# COMETS





# Meteor, Meteoroid, and Meteorite?

# METEORS


SPACE
METEOROID
ATMOSPHERE
METEOR
EARTH'S SURFACE
METEORITE

# Previous Year (2011)

**What is the difference between asteroids and comets?**

I. Asteroids are small rocky planetoids, while comets are formed of frozen gases held together by rocky and metallic material

II. Asteroids are found mostly between the orbits of Jupiter and Mars, while comets are found mostly between Venus and Mercury.

III. Comets show a perceptible glowing tail, while asteroids do not.

**Which of the statements given above is/are correct?**

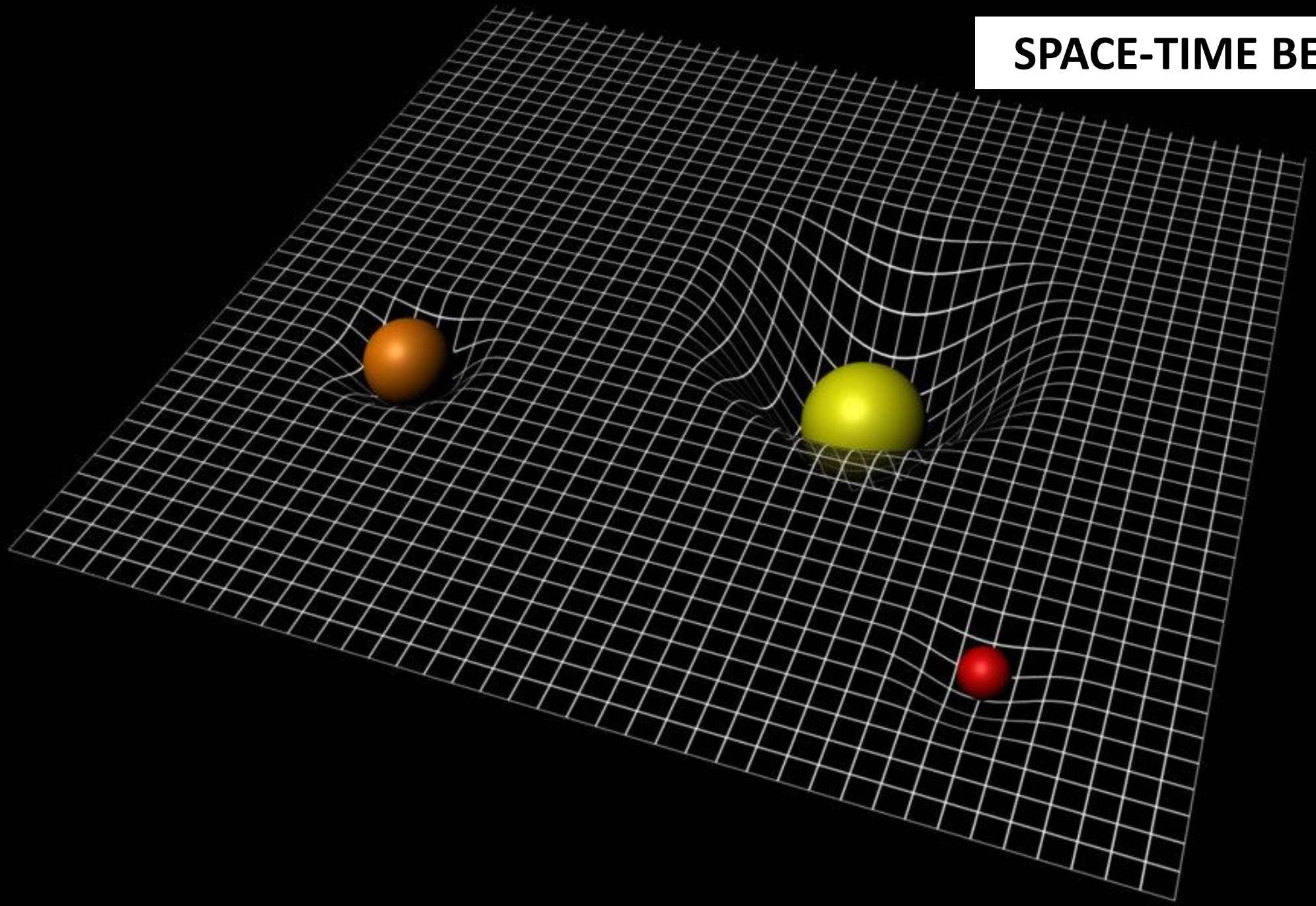
a. I and II only

**b. I and III only**

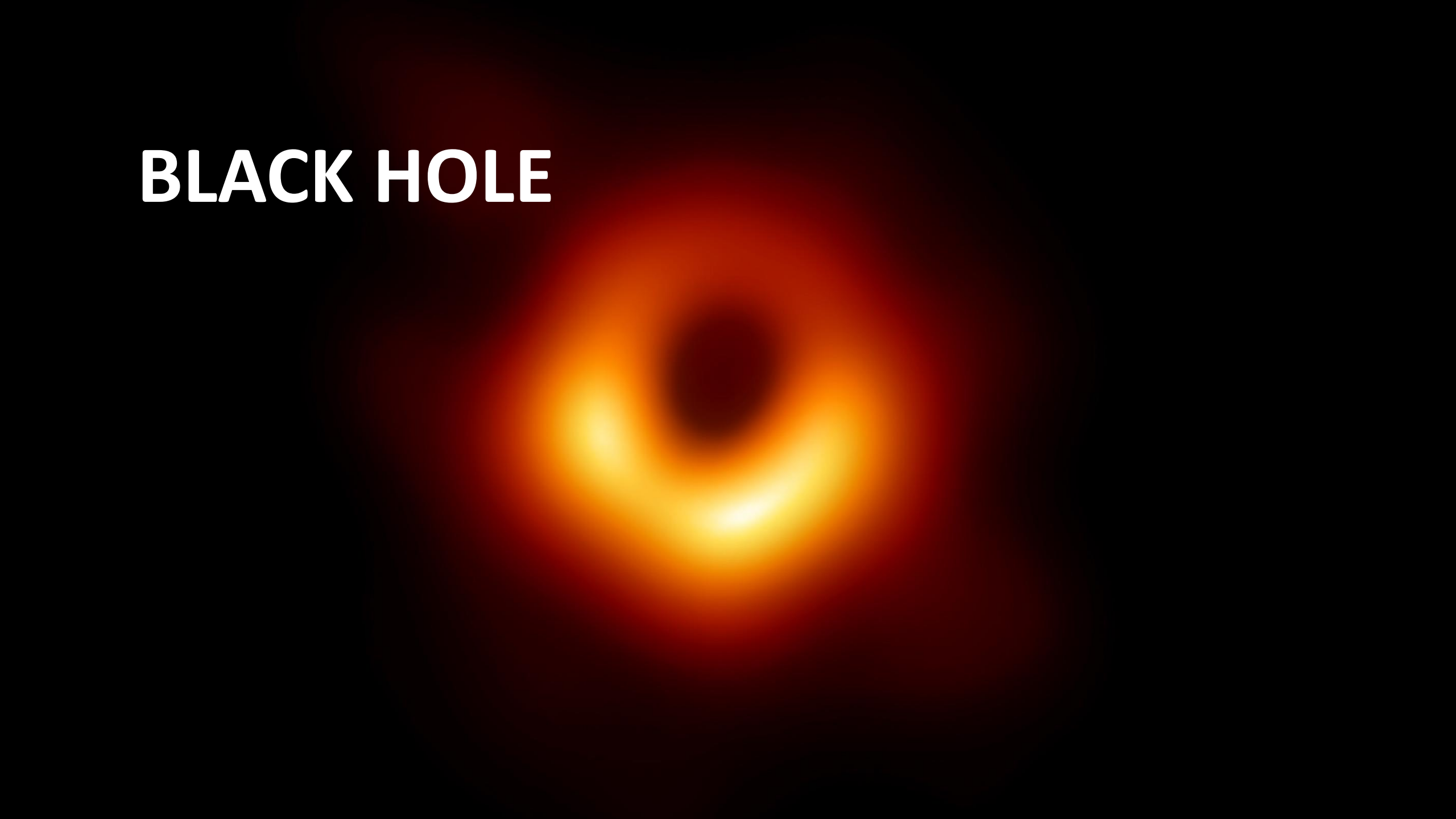
c. III only

d. I, II and III

# SPACE-TIME BENDING

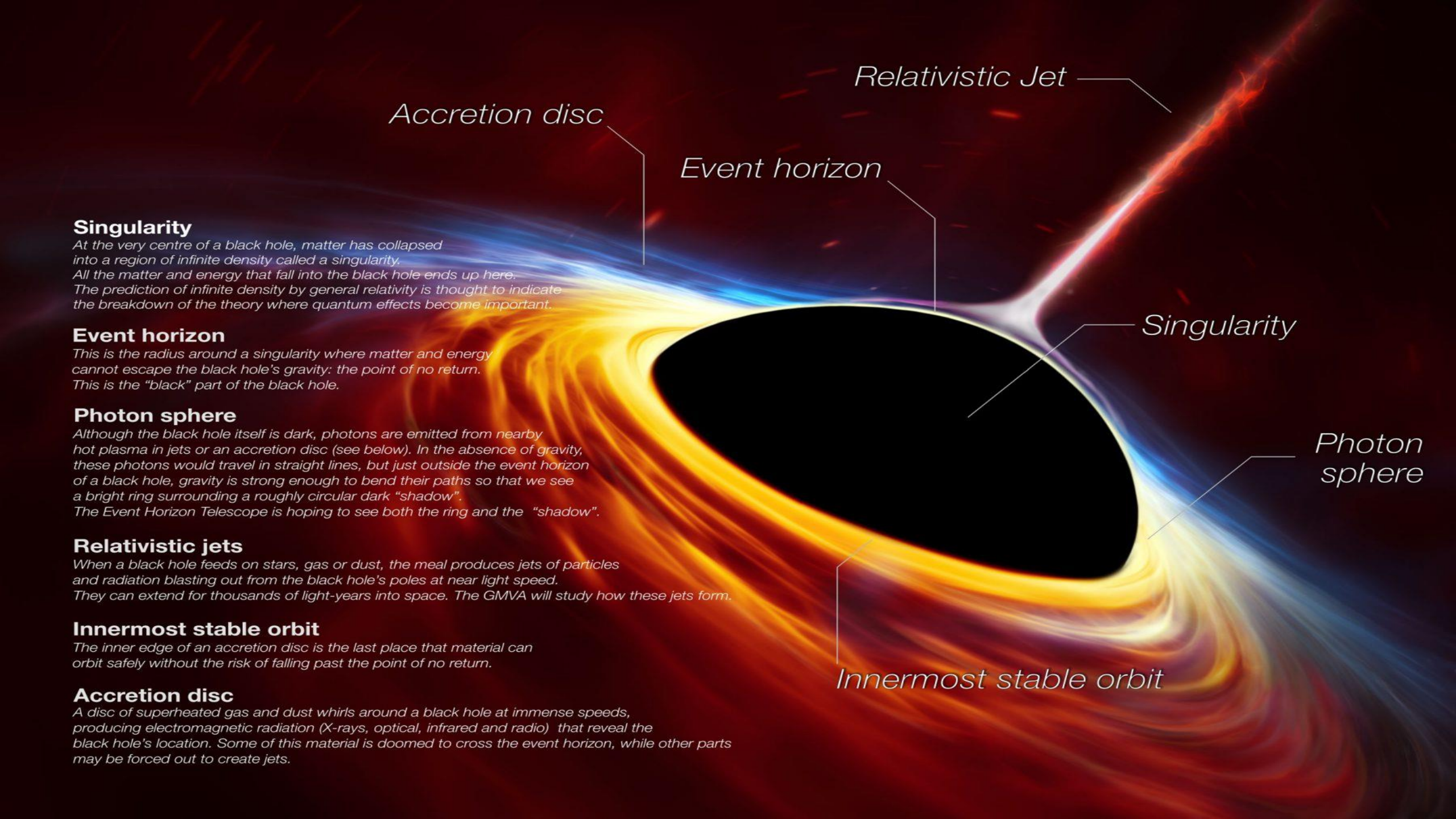


# BLACK HOLE



Mini

1. Miniature Blackhole
2. Stellar Blackhole
3. Intermediate Blackhole
4. Supermassive Blackhole




## Singularity

*At the very centre of a black hole, matter has collapsed into a region of infinite density called a singularity. All the matter and energy that fall into the black hole ends up here. The prediction of infinite density by general relativity is thought to indicate the breakdown of the theory where quantum effects become important.*

## Event horizon

*This is the radius around a singularity where matter and energy cannot escape the black hole's gravity: the point of no return. This is the "black" part of the black hole.*

## Photon sphere

*Although the black hole itself is dark, photons are emitted from nearby hot plasma in jets or an accretion disc (see below). In the absence of gravity, these photons would travel in straight lines, but just outside the event horizon of a black hole, gravity is strong enough to bend their paths so that we see a bright ring surrounding a roughly circular dark "shadow". The Event Horizon Telescope is hoping to see both the ring and the "shadow".*

## Relativistic jets

*When a black hole feeds on stars, gas or dust, the meal produces jets of particles and radiation blasting out from the black hole's poles at near light speed. They can extend for thousands of light-years into space. The GMVA will study how these jets form.*

## Innermost stable orbit

*The inner edge of an accretion disc is the last place that material can orbit safely without the risk of falling past the point of no return.*

## Accretion disc

*A disc of superheated gas and dust whirls around a black hole at immense speeds, producing electromagnetic radiation (X-rays, optical, infrared and radio) that reveal the black hole's location. Some of this material is doomed to cross the event horizon, while other parts may be forced out to create jets.*

# Expected Question

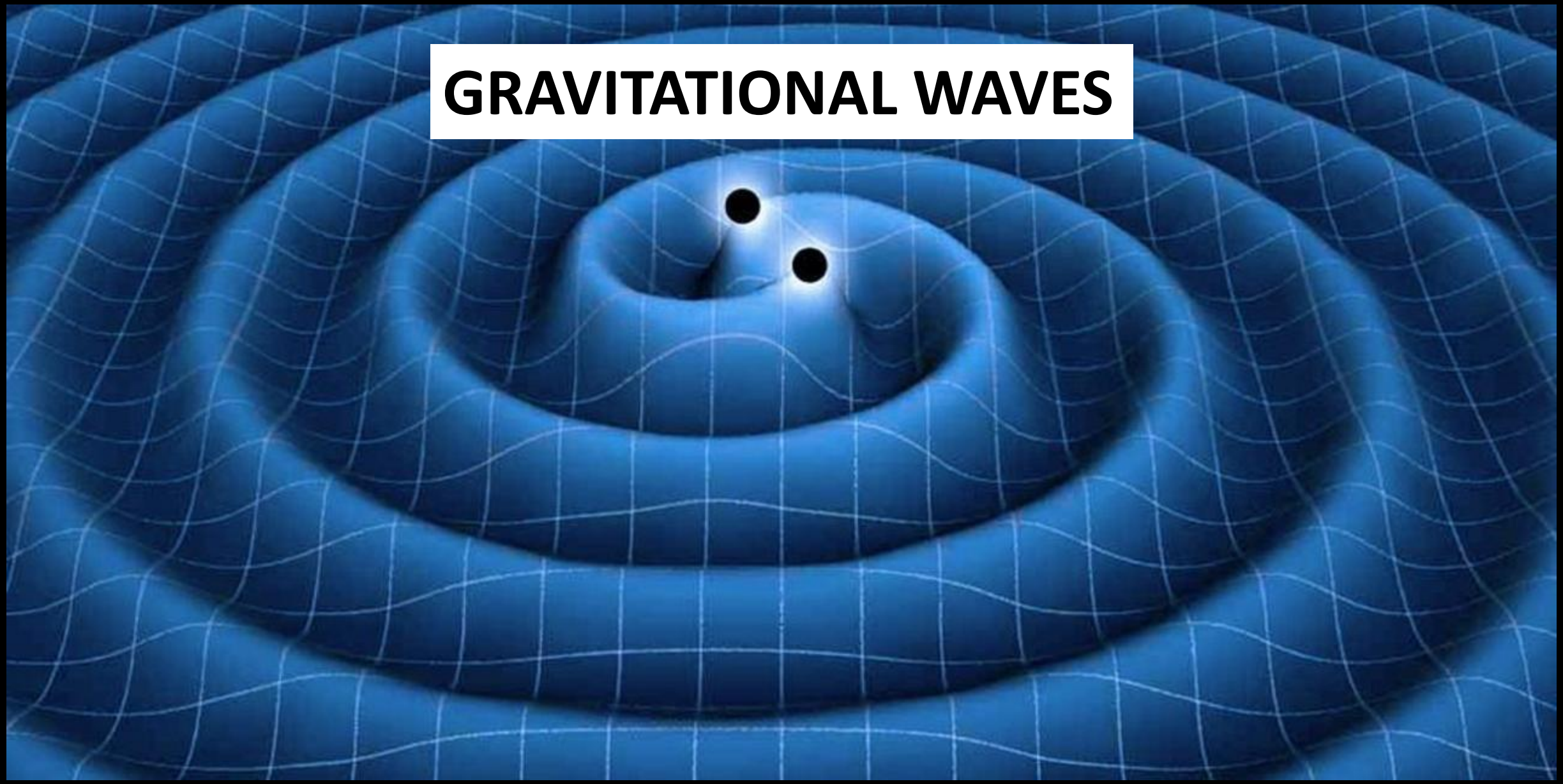
**Choose the correct statement:**

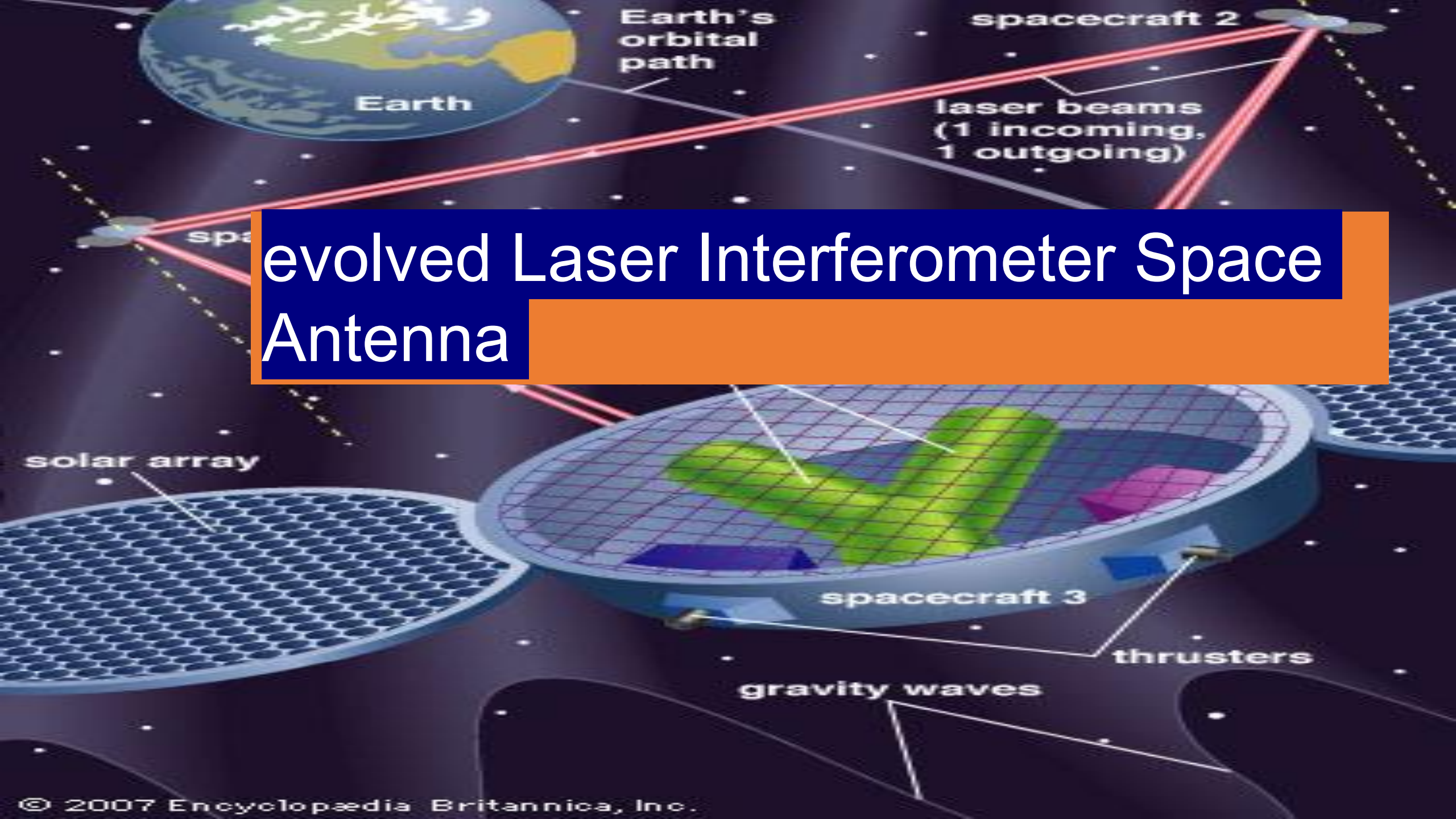
I. Miniature Blackhole have the same mass as Mt. Everest.
II. When a massive star collapses it forms a Stellar Blackhole.
III. There is a Supermassive Blackhole at the centre of the milky way galaxy.

**Select the correct statement(s) using the codes given below:**

a. I & II
b. I & III
c. II & III
d. All of the above.

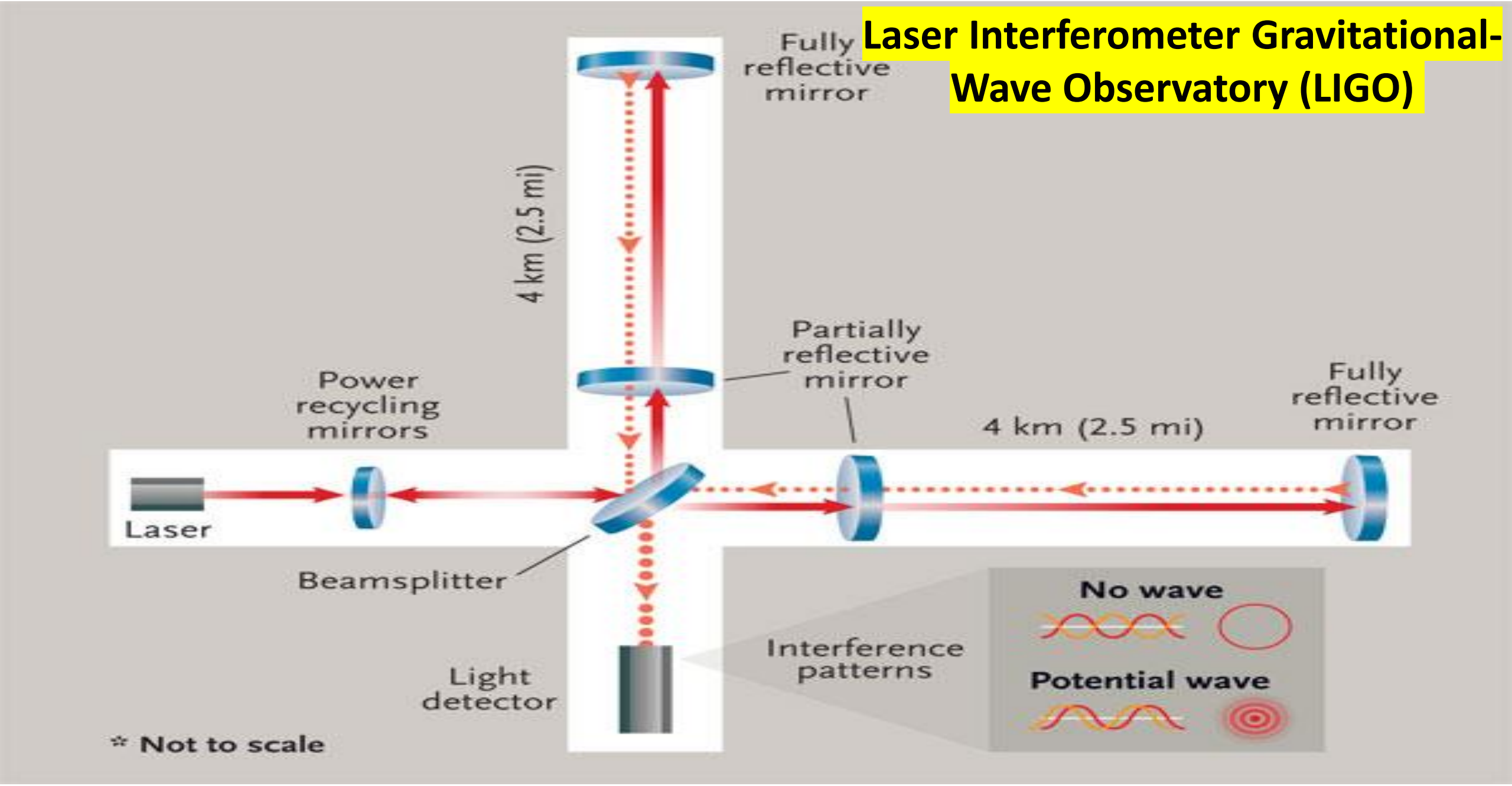
# GRAVITATIONAL WAVES






# evolved Laser Interferometer Space Antenna

# Laser Interferometer Gravitational-Wave Observatory (LIGO)





# LIGO India Project

Located near Aundha Nagnath, Hingoli District, Maharashtra

# Previous Year (2017)

What is the purpose of ‘evolved Laser Interferometer Space Antenna (eLISA)’ project?

a. To detect neutrinos
b. To detect gravitational waves
c. To detect the effectiveness of missile defence system
d. To study the effect of solar flares on our communication systems

# Expected Question

**Which of the following statement(s) is/are true:**

I. **Evolved Laser Interferometry Space Antenna comprises of two enormous laser interferometers located thousands of kilometres apart which exploits the physical properties of light and space to detect and understand the origins of Gravitational Waves.**

II. **Laser Interferometer Gravitational-Wave Observatory's primary objective is to detect and examine the gravitational waves emitted by the super-massive black holes.**

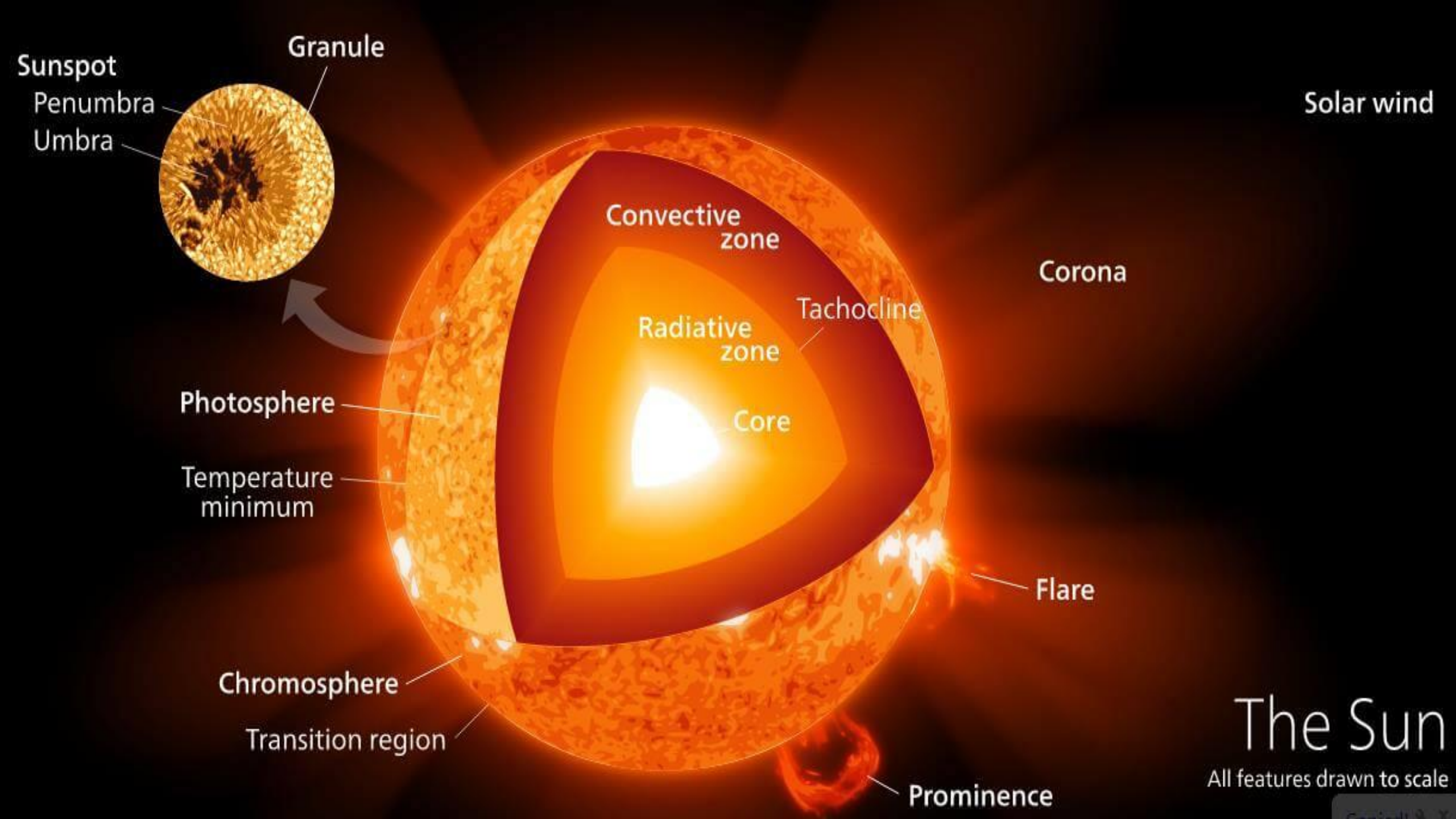
Choose the correct statement(s) using the codes given below:

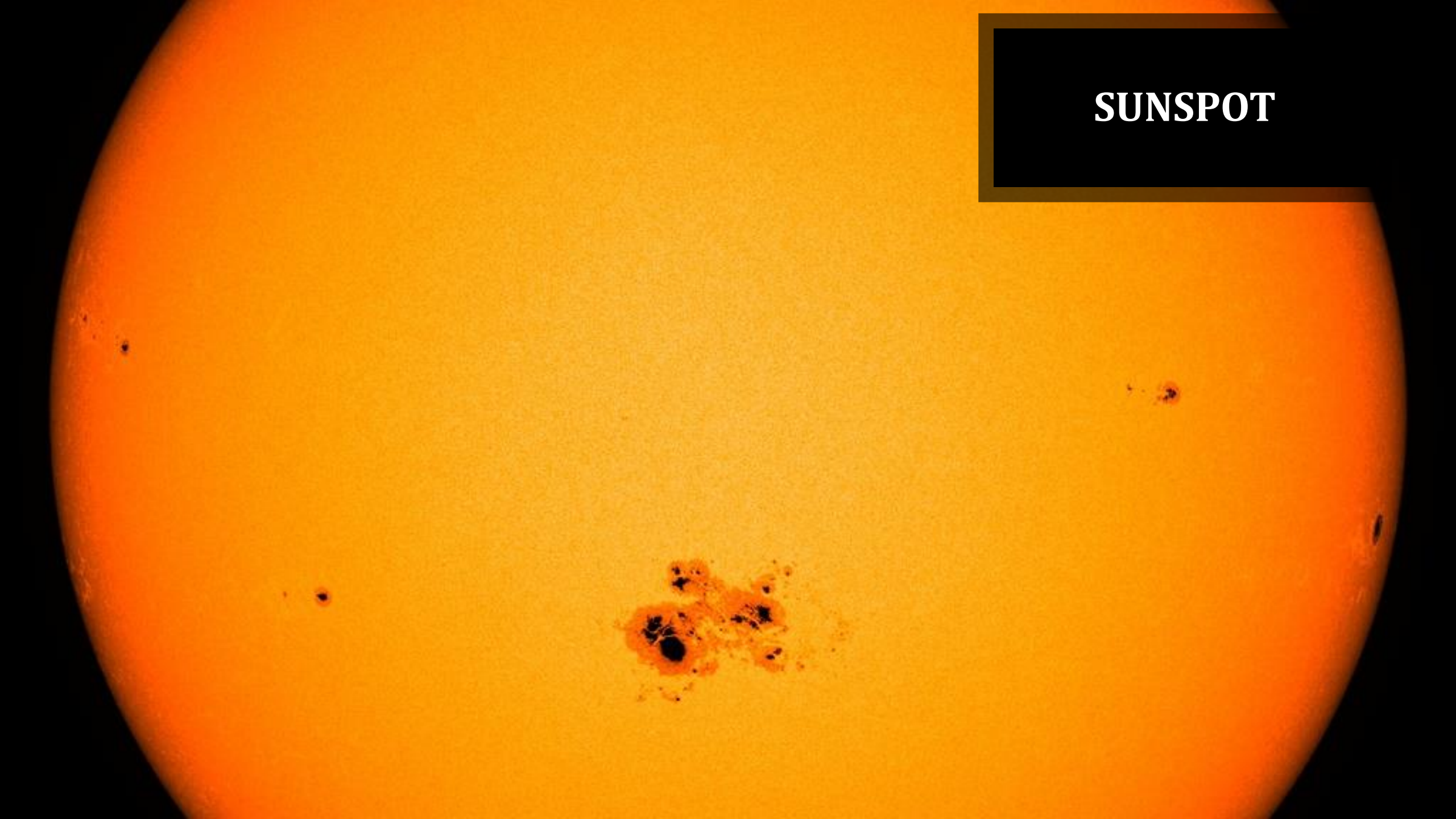
a. I Only
b. II Only
c. Both I & II
d. None of the above.

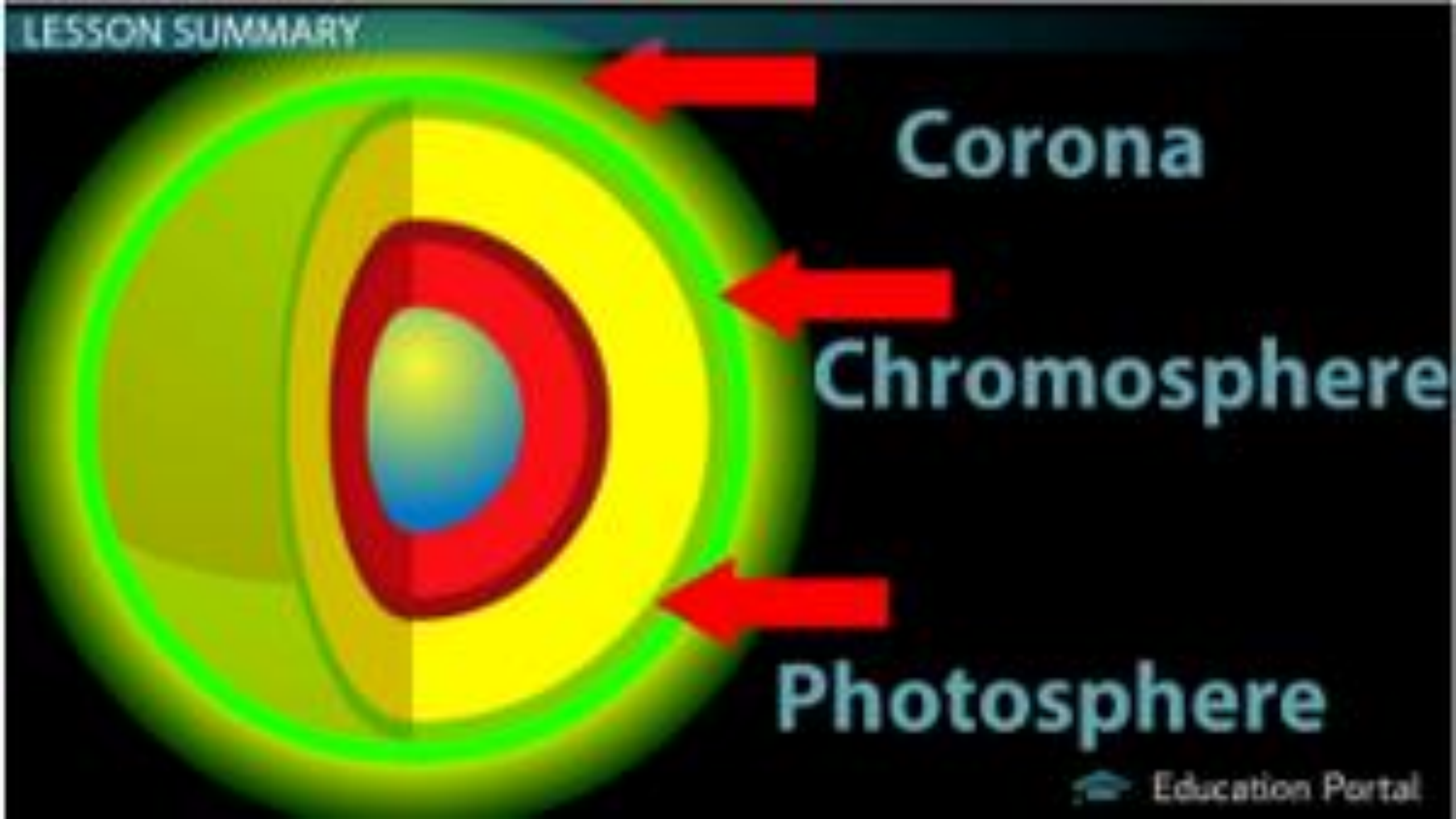
# HABITABLE ZONE

Habitable-Zone Planet Finder(HPF)



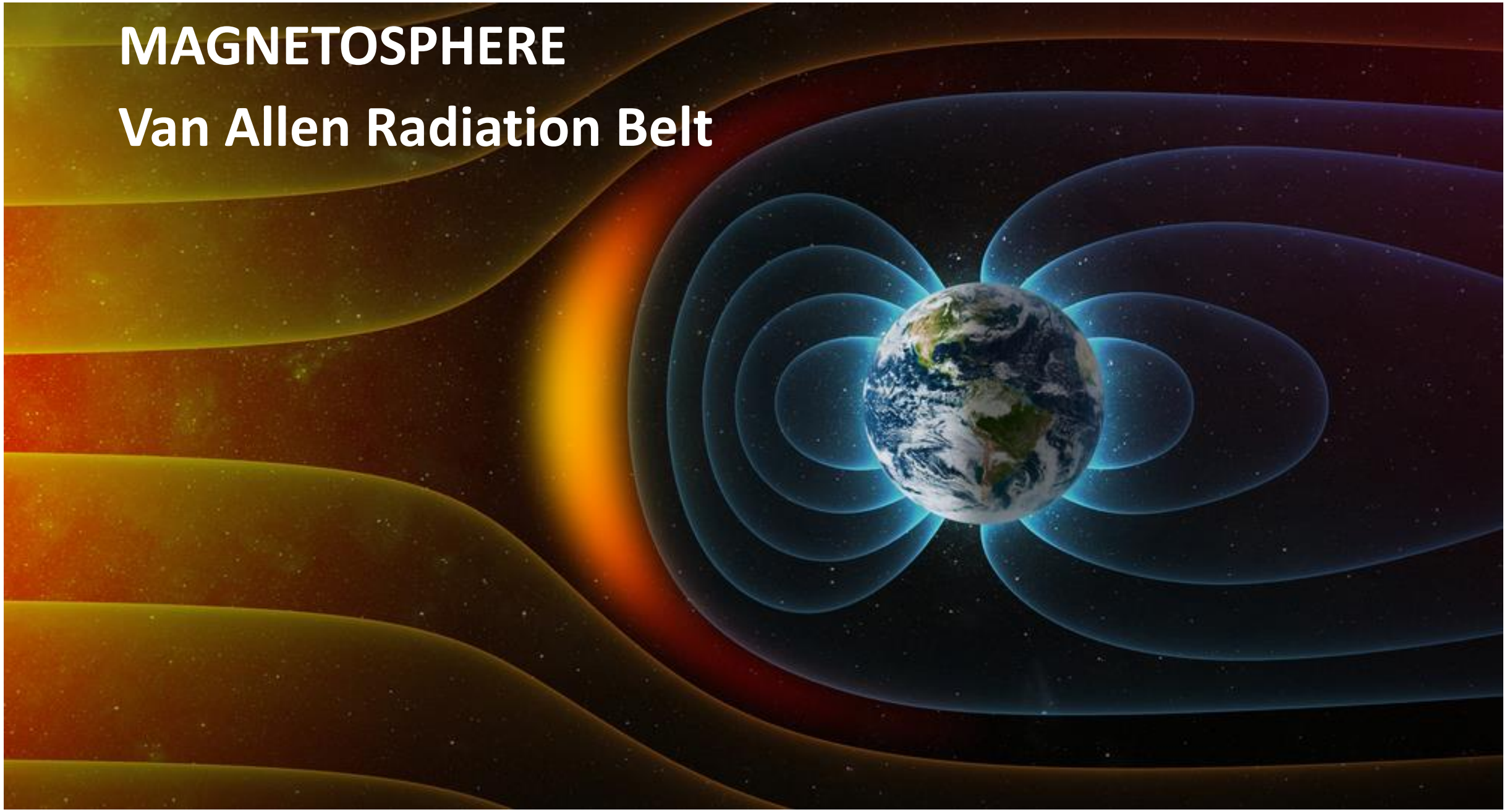

Sunspot
Granule
Penumbra
Umbra
Solar wind
Convective zone
Corona
Tachocline
Radiative zone
Photosphere
Core
Temperature minimum
Flare
Chromosphere
Transition region
Prominence
The Sun
All features drawn to scale


SUNSPOT


LESSON SUMMARY
Corona
Chromosphere
Photosphere
Education Portal

# MAGNETOSPHERE

## Van Allen Radiation Belt



**1. Dynamo theory: Generation of Earth's Magnetic Field and Sustaining it, flow of liquid iron** generates **electric currents**, which in turn produce **magnetic fields**.

**2. Magnetosphere:** the region above the ionosphere, **protecting the Earth from the charged particles of the solar wind and cosmic rays**

**3. Sun's magnetosphere called heliosphere**

**4. Van Allen radiation belt: zone of energetic charged particles**, most of which originate from the solar wind, that are **captured by and held around a planet by that planet's magnetic field**.

**5. Geo Magnetic Storms:** when a **coronal mass ejection erupts** above the Sun and sends a shock wave through the Solar System.

**6.Auroras:** Positive ions slowly drift westward, and negative ions drift eastward, giving rise to a **ring current**.

**7: Helioseismology**: By tracking sound waves that course through the center of the sun

# Expected Question

Which of the following statement(s) is/are true regarding Sun spots:

I. Each spot has a black centre called umbra, and a lighter region called penumbra.
II. Sun Spots decreases the solar winds.
III. Sun Spots form due to magnetic anomalies of the interior of the Sun.

Select the correct code:

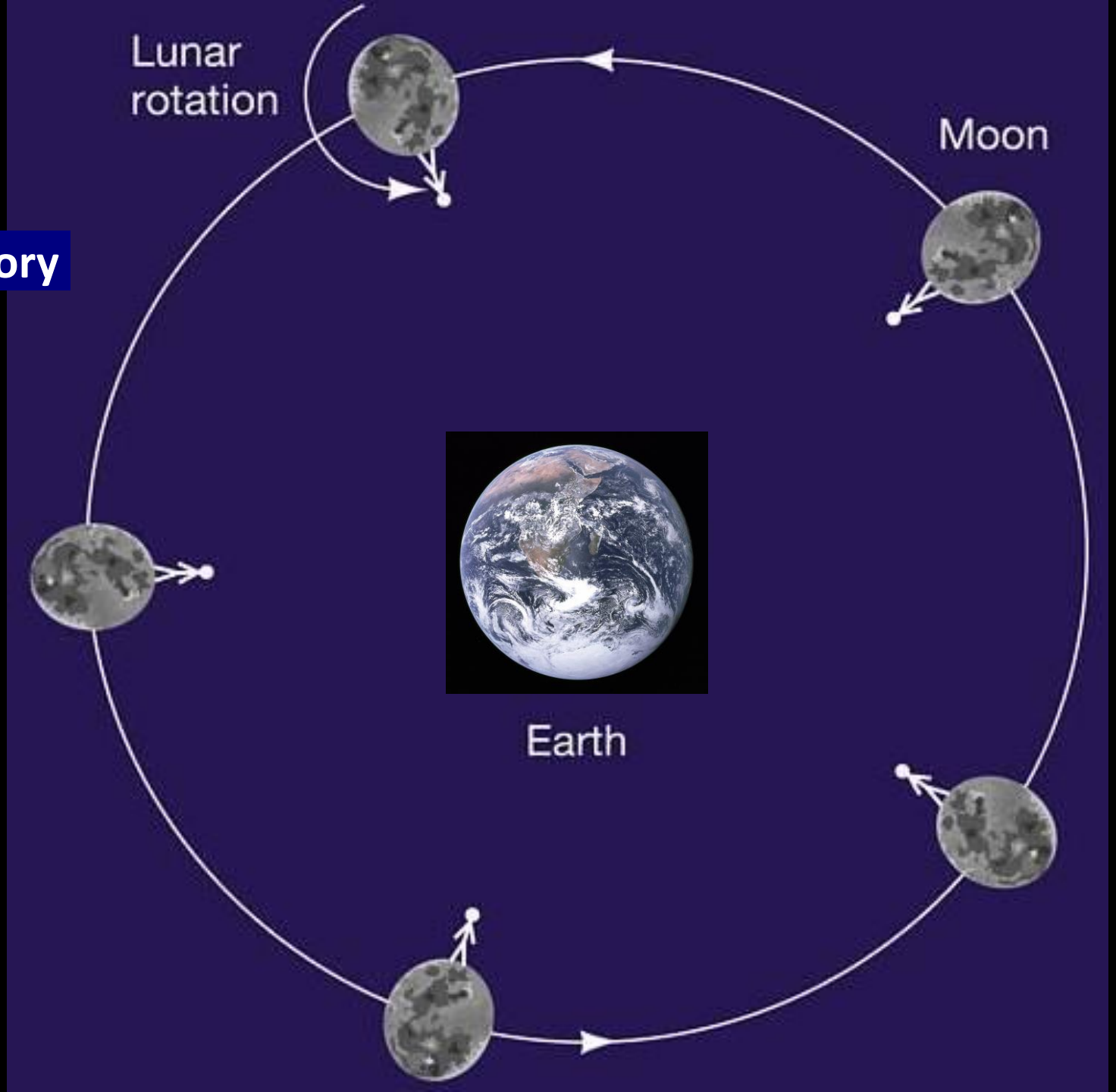
a. I & II
b. II & III
c. I & III
d. All of the above

# The MOON

**Giant impact theory**

**Tidal Locking**

**Apogee**
**Perigee**





- Fission Theory
- spinning so fast that part of our planet spun off into space but was kept tethered by Earth's gravity.
- the Pacific Ocean might be the site where the would-be moon material came off of Earth
- after moon rocks were analyzed,  the moon rock compositions differed from those in the Pacific Ocean.

## 2. Capture Theory

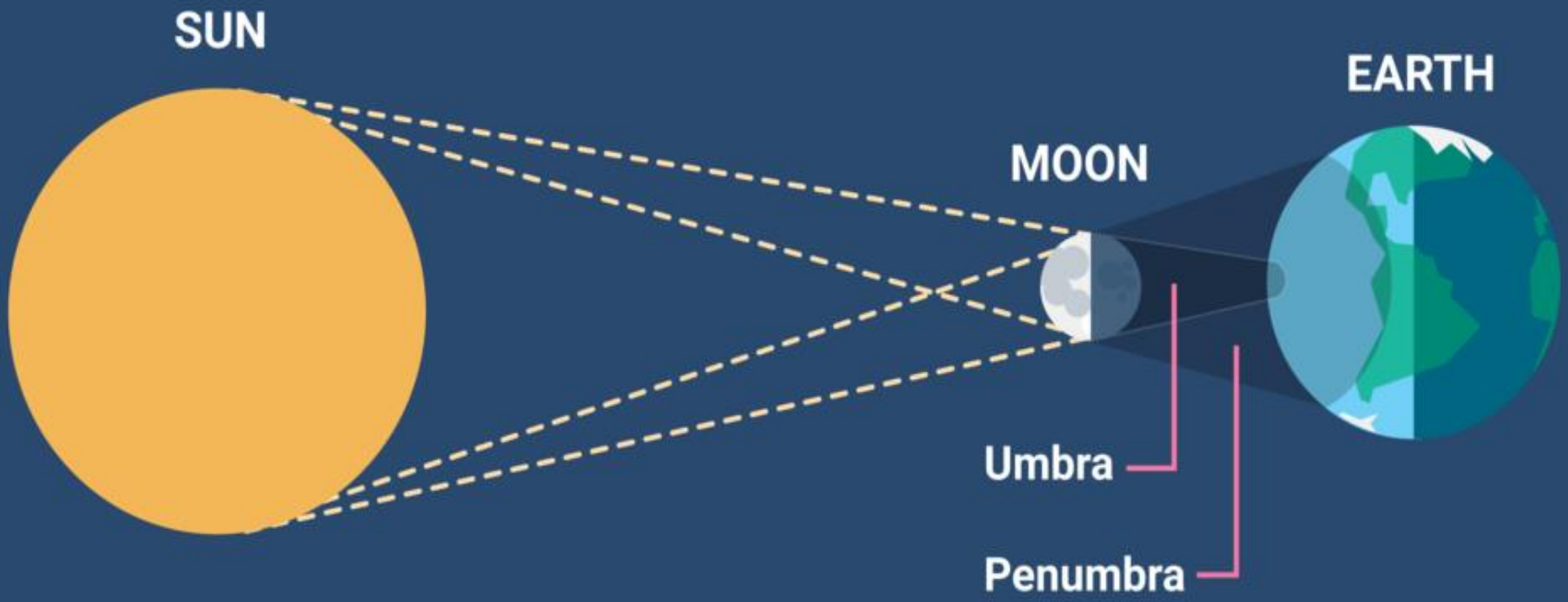
- the moon originated elsewhere in the Milky Way, completely independent of Earth
- while traveling past Earth, the moon got trapped in our planet's gravity.
- the moon would have eventually broken free from Earth's gravity because Earth's gravity would have been massively altered by catching the moon.



## 3. Co-Accretion Theory

- Also known as the condensation theory
- the moon and the Earth formed together while orbiting a black hole.
- neglects an explanation of why the moon orbits the Earth

# SOLAR ECLIPSE




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# Types of Solar Eclipses

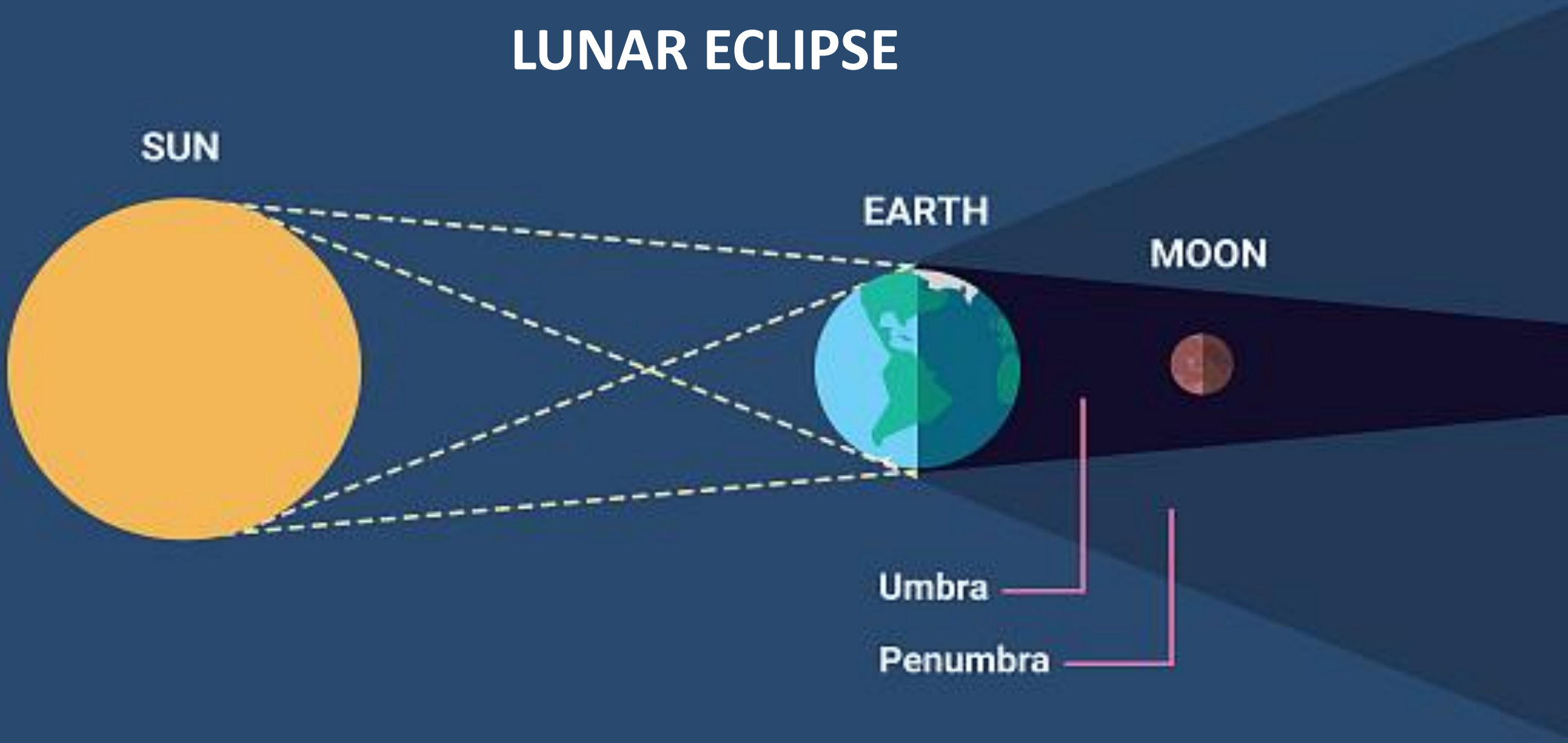


PARTIAL

ANNULAR

TOTAL

# LUNAR ECLIPSE



# 3 TYPES OF LUNAR ECLIPSES



TOTAL



PARTIAL



PENUMBRAL

# Expected Question

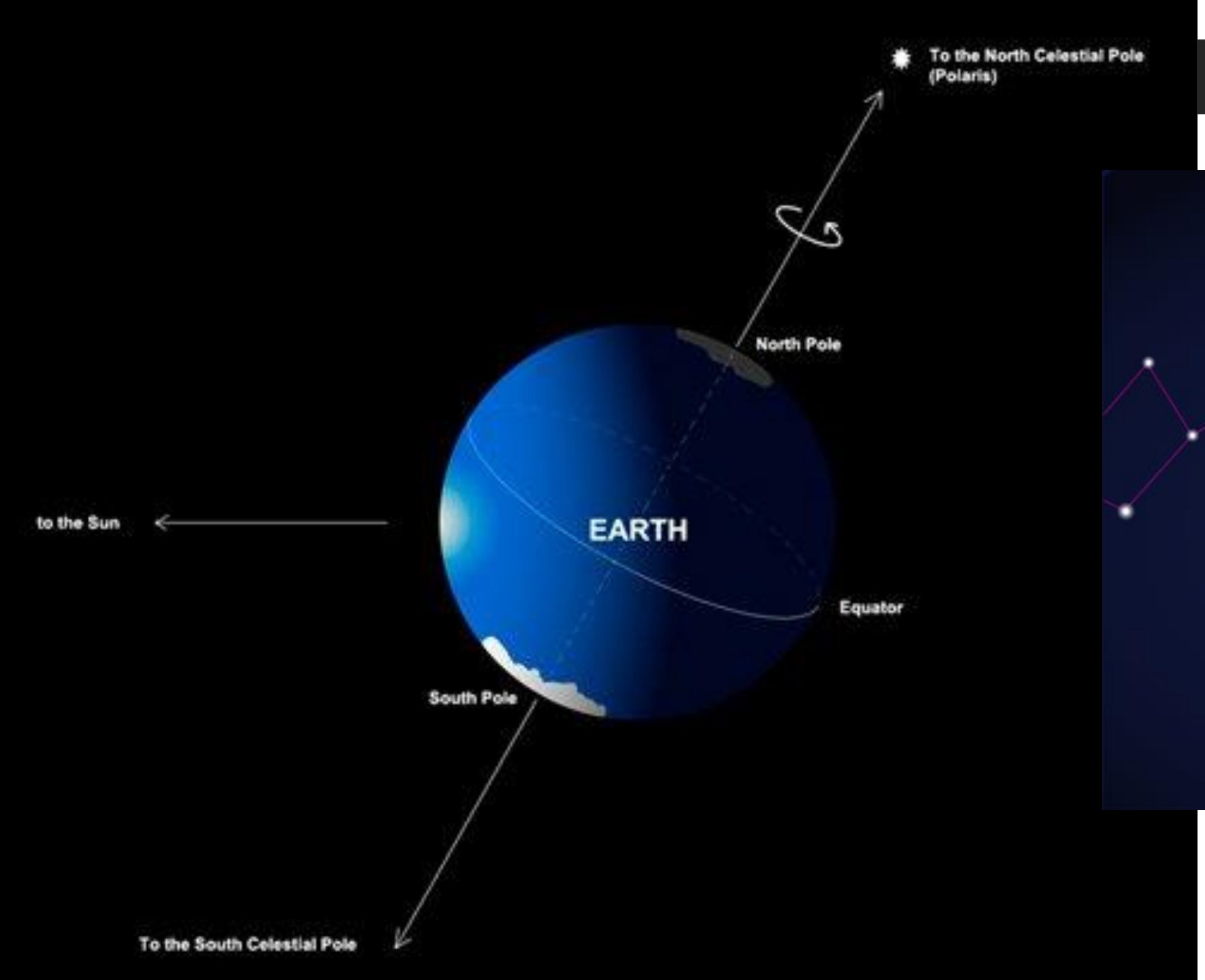
Consider the following statements:

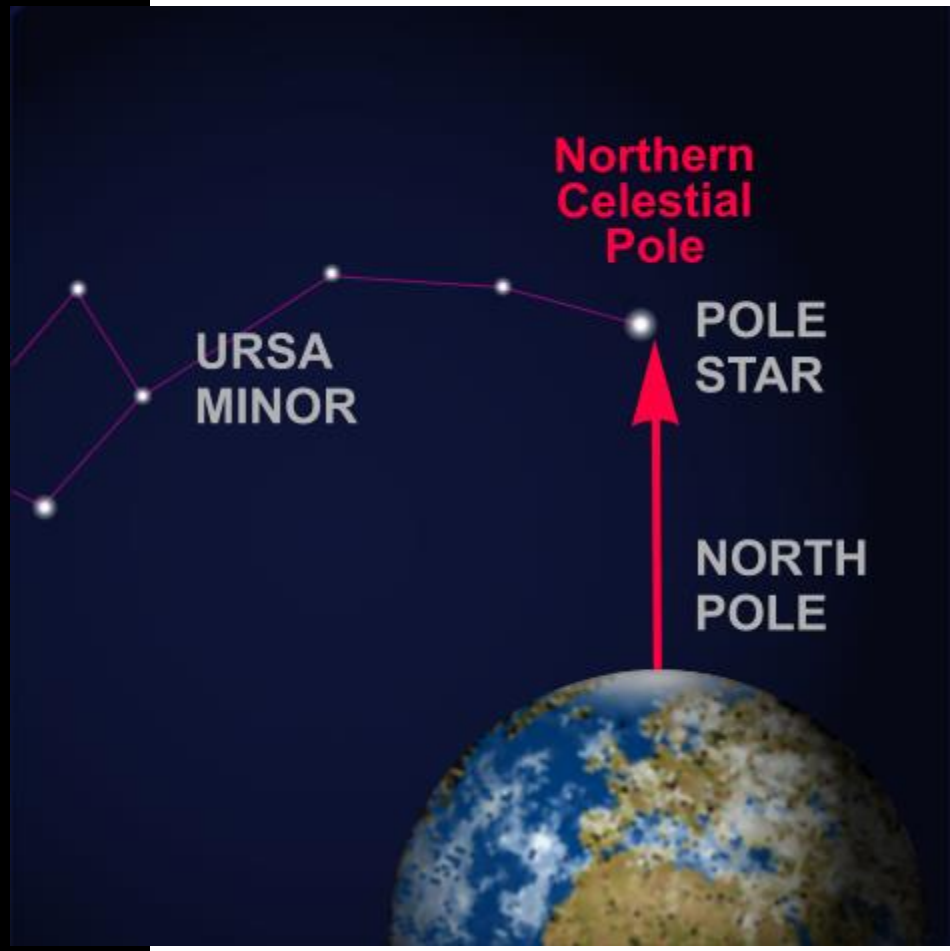
I. The same face of the Moon is always presented to the Earth.
II. The Moon rotates about its own axis in 27 days.
III. The moon is tidally locked to the earth.
IV. When Moon's orbit closest to Earth is called apogee and the point farthest away is the perigee.

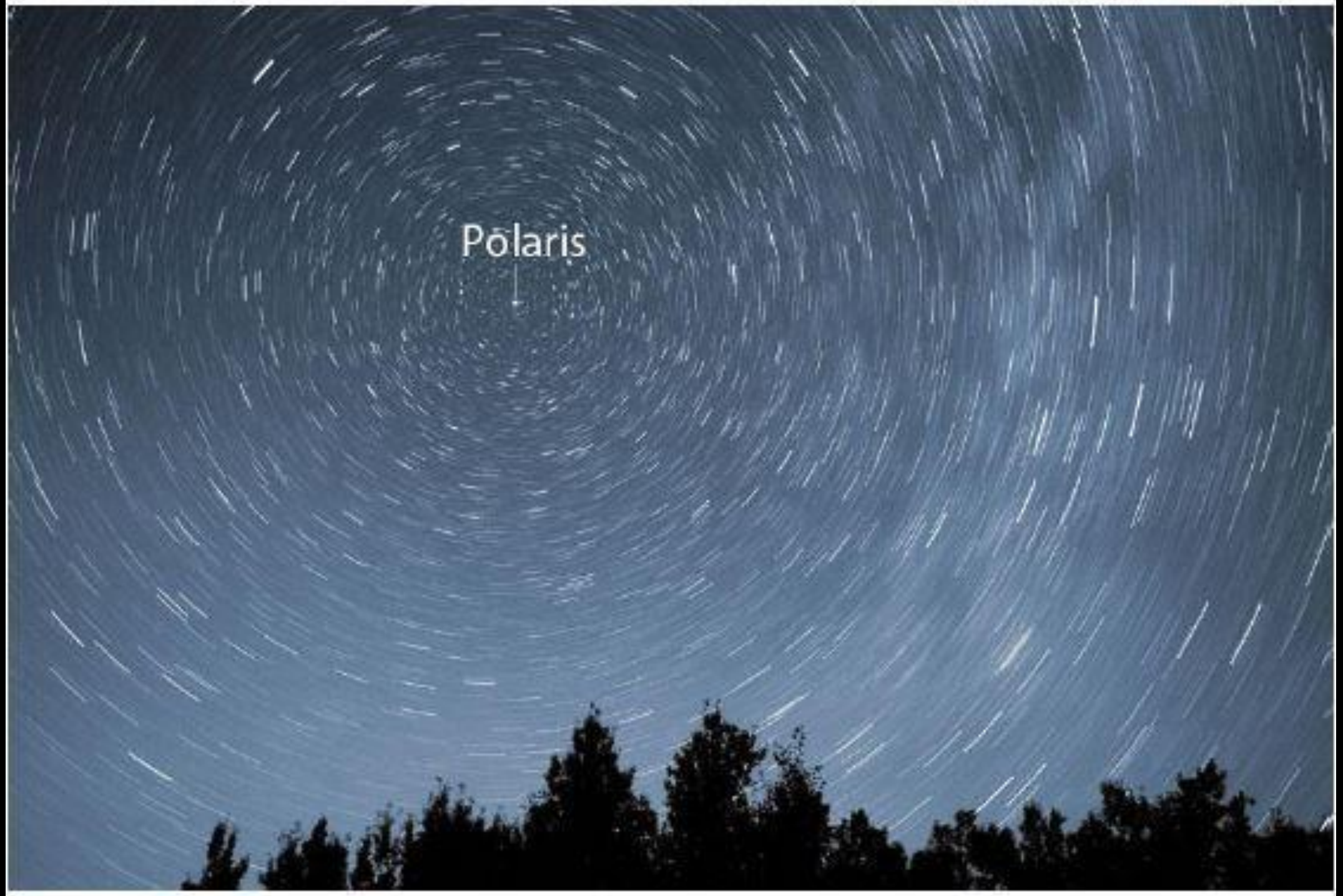
Choose the correct statement(s) using the codes given below:

a. I & II
b. III & IV
c. I, II & III
d. All of the above.

# POLE STAR


To the North Celestial Pole
(Polaris)
North Pole
to the Sun
EARTH
Equator
South Pole
To the South Celestial Pole


Northern
Celestial
Pole
URSA
MINOR
POLE
STAR
NORTH
POLE

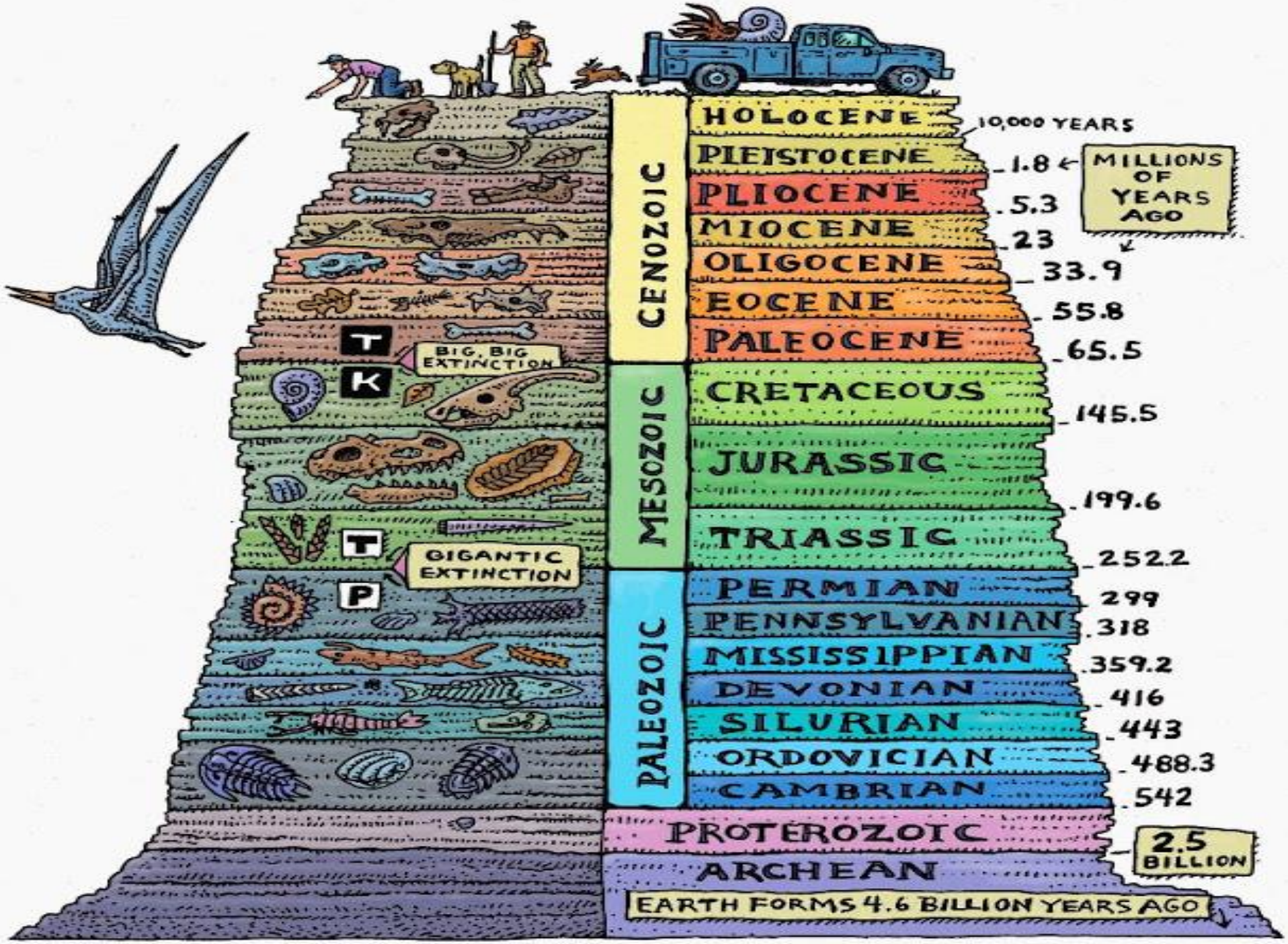

Polaris

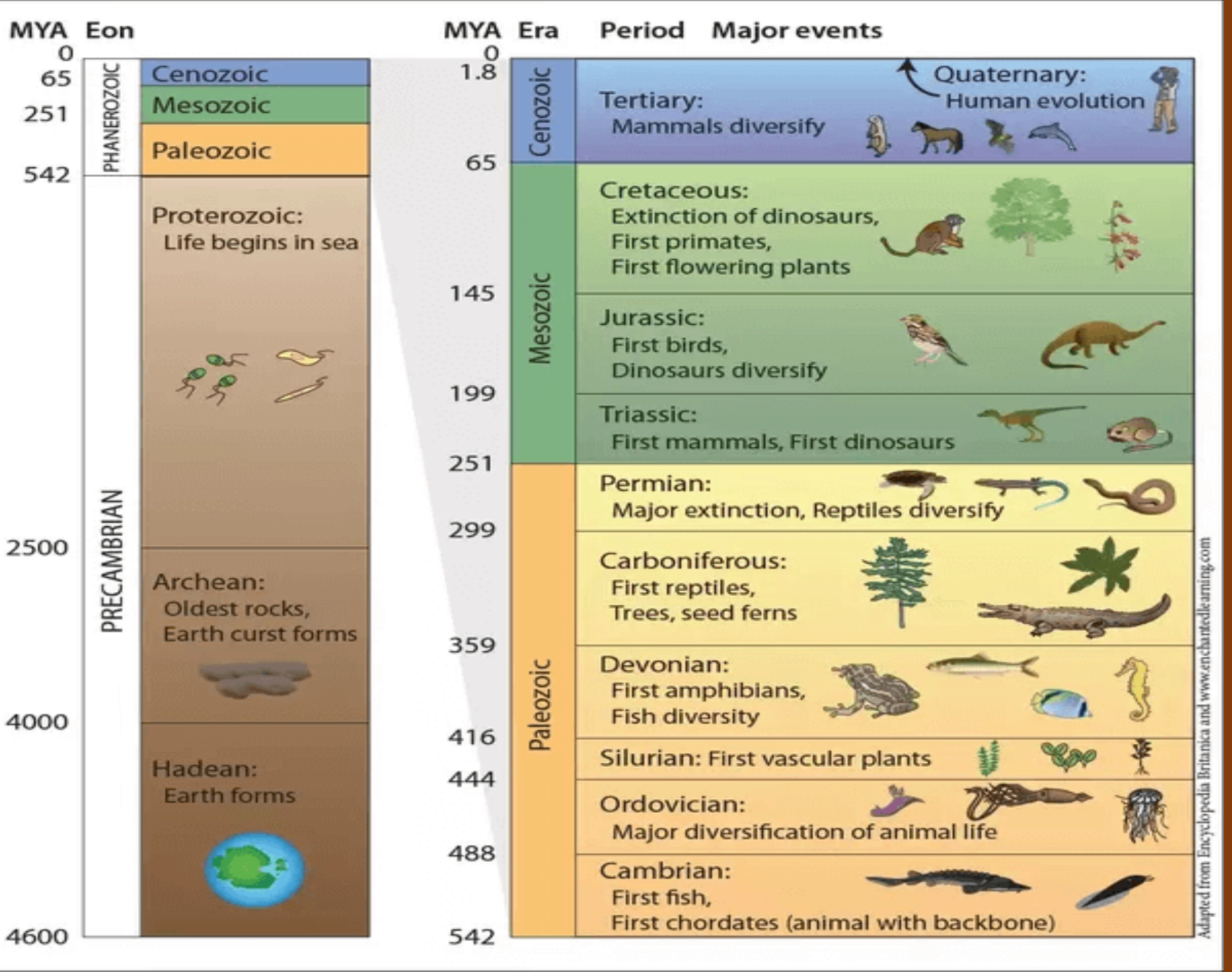
# PREVIOUS YEAR QUESTION 2012

A person stood alone in a desert on a dark night and wanted to reach his village which was situated 5 km east of the point where he was standing. He had no instruments to find the direction, but he located the polestar. The most convenient way now to reach his village is to walk in the (2012)

(a) direction facing the polestar
(b) direction opposite to the polestar
(c) direction keeping the polestar to his left
(d) direction keeping the polestar to his right

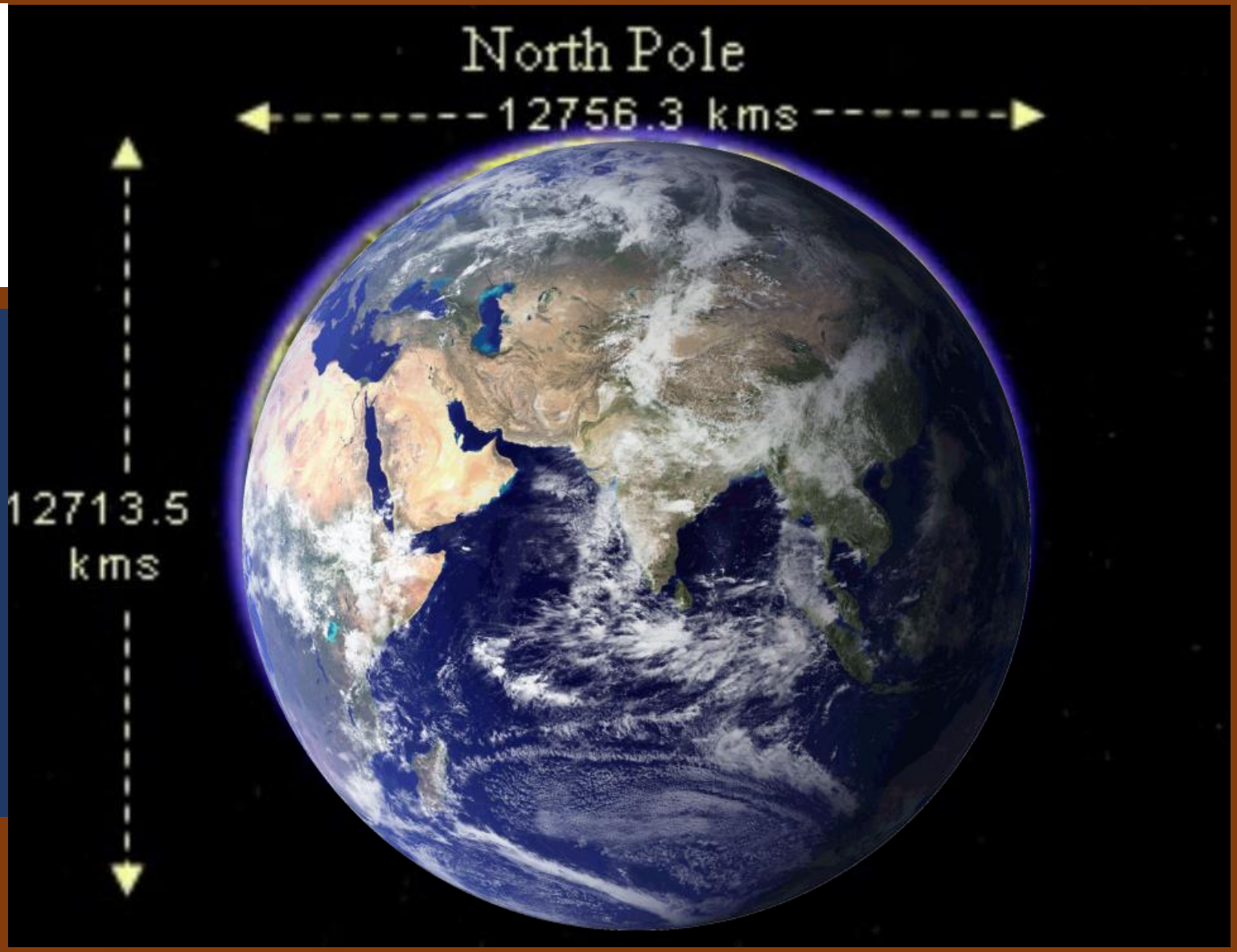

ORIGIN AND
EVOLUTION
OF EARTH


HOLOCENE
10,000 YEARS
PLEISTOCENE
1.8
MILLIONS OF YEARS AGO
PLIOCENE
5.3
MIOCENE
23
OLIGOCENE
33.9
EOCENE
55.8
PALEOCENE
65.5
CENOZOIC
T
K
BIG, BIG EXTINCTION
CRETACEOUS
145.5
JURASSIC
199.6
TRIASSIC
252.2
MESOZOIC
T
P
GIGANTIC EXTINCTION
PERMIAN
299
PENNSYLVANIAN
318
MISSISSIPPIAN
359.2
DEVONIAN
416
SILURIAN
443
ORDOVICIAN
488.3
CAMBRIAN
542
PALEOZOIC
PROTEROZOIC
2.5 BILLION
ARCHEAN
EARTH FORMS 4.6 BILLION YEARS AGO


MYA
Eon
0
65
251
542
2500
4000
4600
PHANEROZOIC
PRECAMBRIAN
Cenozoic
Mesozoic
Paleozoic
Proterozoic:
Life begins in sea
Archean:
Oldest rocks,
Earth curst forms
Hadean:
Earth forms
MYA
Era
Period
Major events
0
1.8
65
145
199
251
299
359
416
444
488
542
Cenozoic
Mesozoic
Paleozoic
Tertiary:
Mammals diversify
Quaternary:
Human evolution
Cretaceous:
Extinction of dinosaurs,
First primates,
First flowering plants
Jurassic:
First birds,
Dinosaurs diversify
Triassic:
First mammals, First dinosaurs
Permian:
Major extinction, Reptiles diversify
Carboniferous:
First reptiles,
Trees, seed ferns
Devonian:
First amphibians,
Fish diversity
Silurian: First vascular plants
Ordovician:
Major diversification of animal life
Cambrian:
First fish,
First chordates (animal with backbone)
Adapted from Encyclopedia Britanica and www.enchantedlearning.com

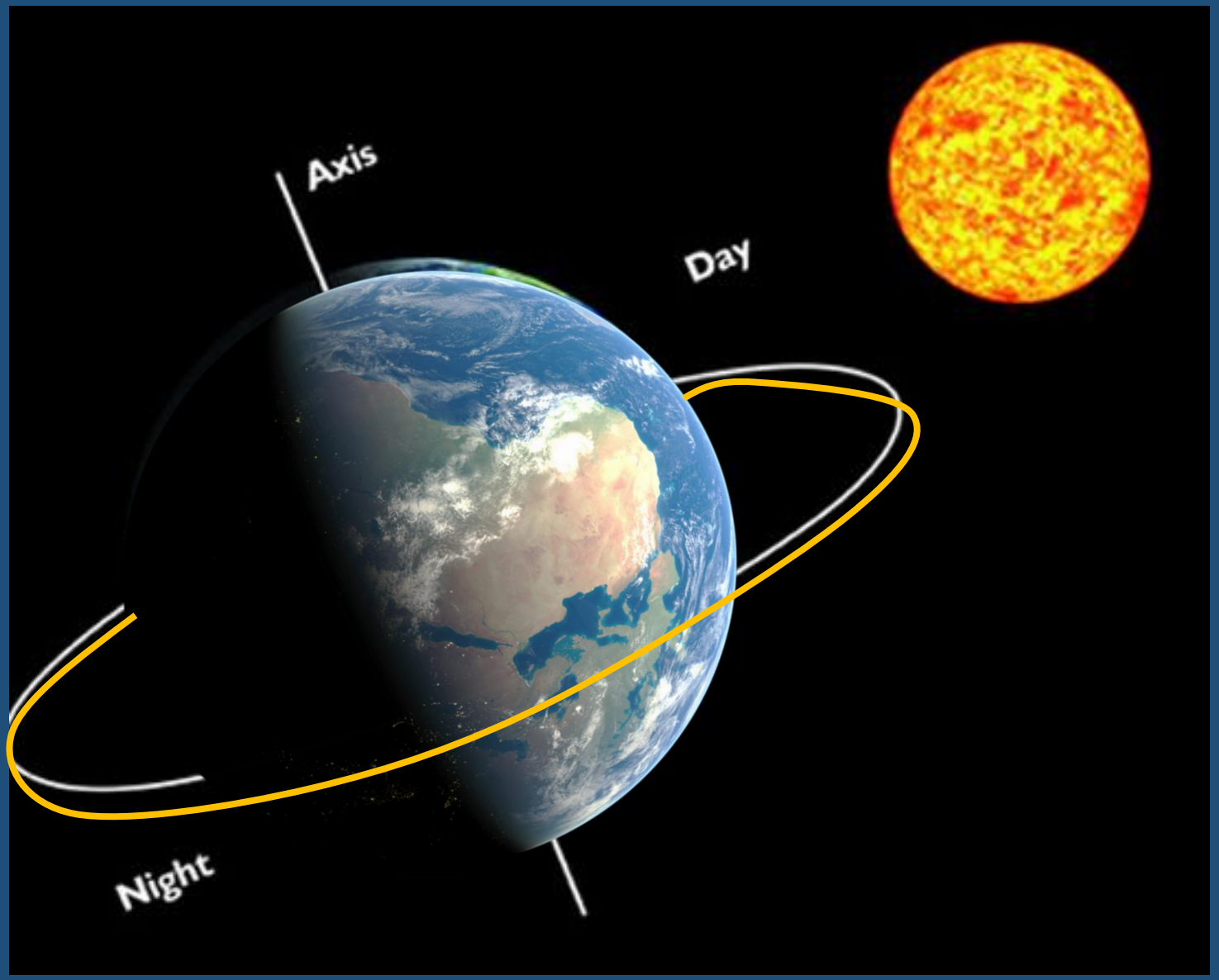
# SHAPE OF THE EARTH

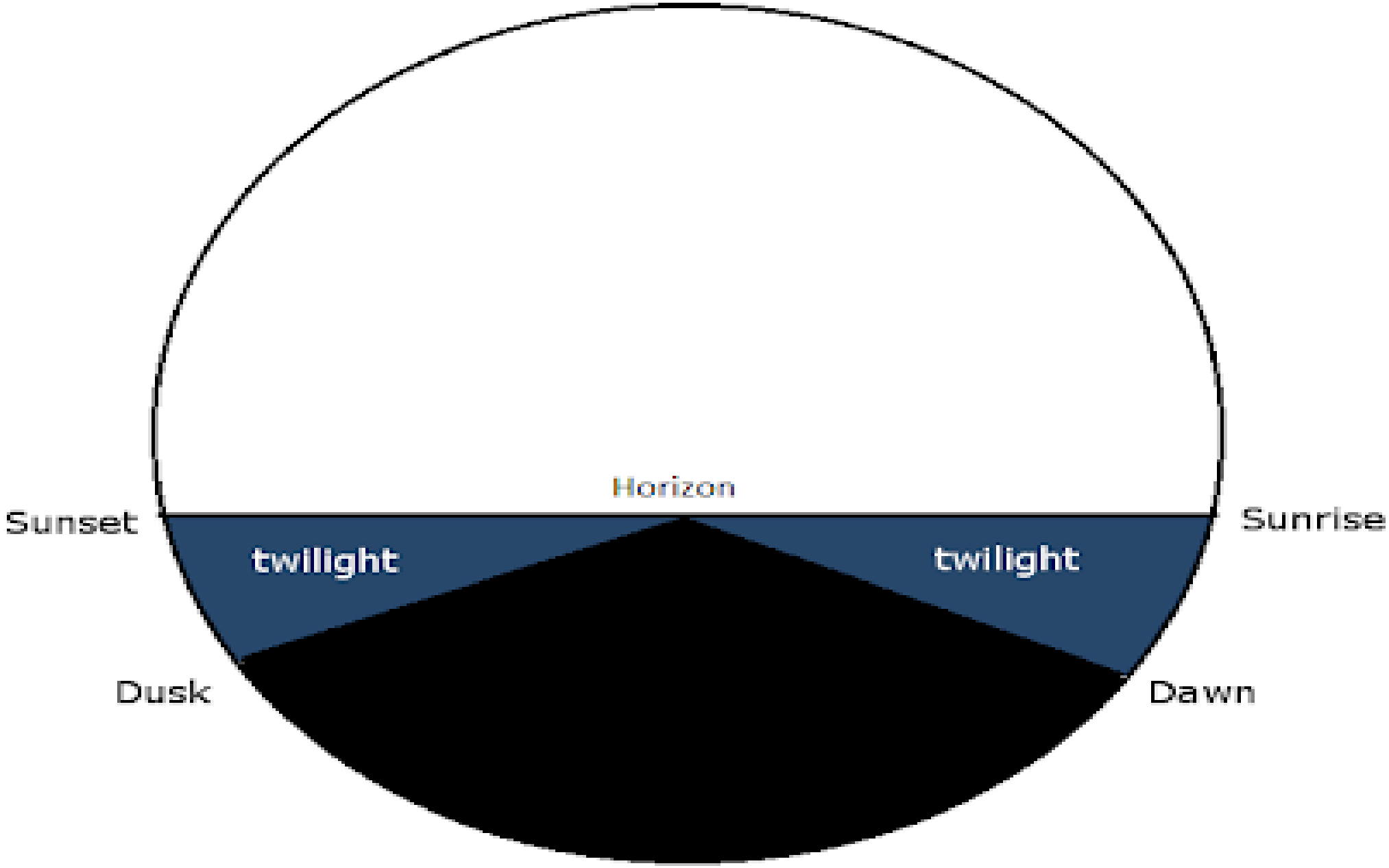
- Oblate Spheroid
- Ellipsoid
- Geoid
- Sphere
- Pear shape



# THE EARTH'S ROTATION

- West to east
- 24 hours
- Daylight and darkness
- Sunrise and Sunset
- Axial tilt




Horizon
Sunset
Sunrise
twilight
twilight
Dusk
Dawn

# Previous Year (2018)

Consider the following statements:

I. The Earth's magnetic field has reversed every few hundred thousand years.

II. When the Earth was created more than 4000 million years ago, there was 54% oxygen and no carbon dioxide.

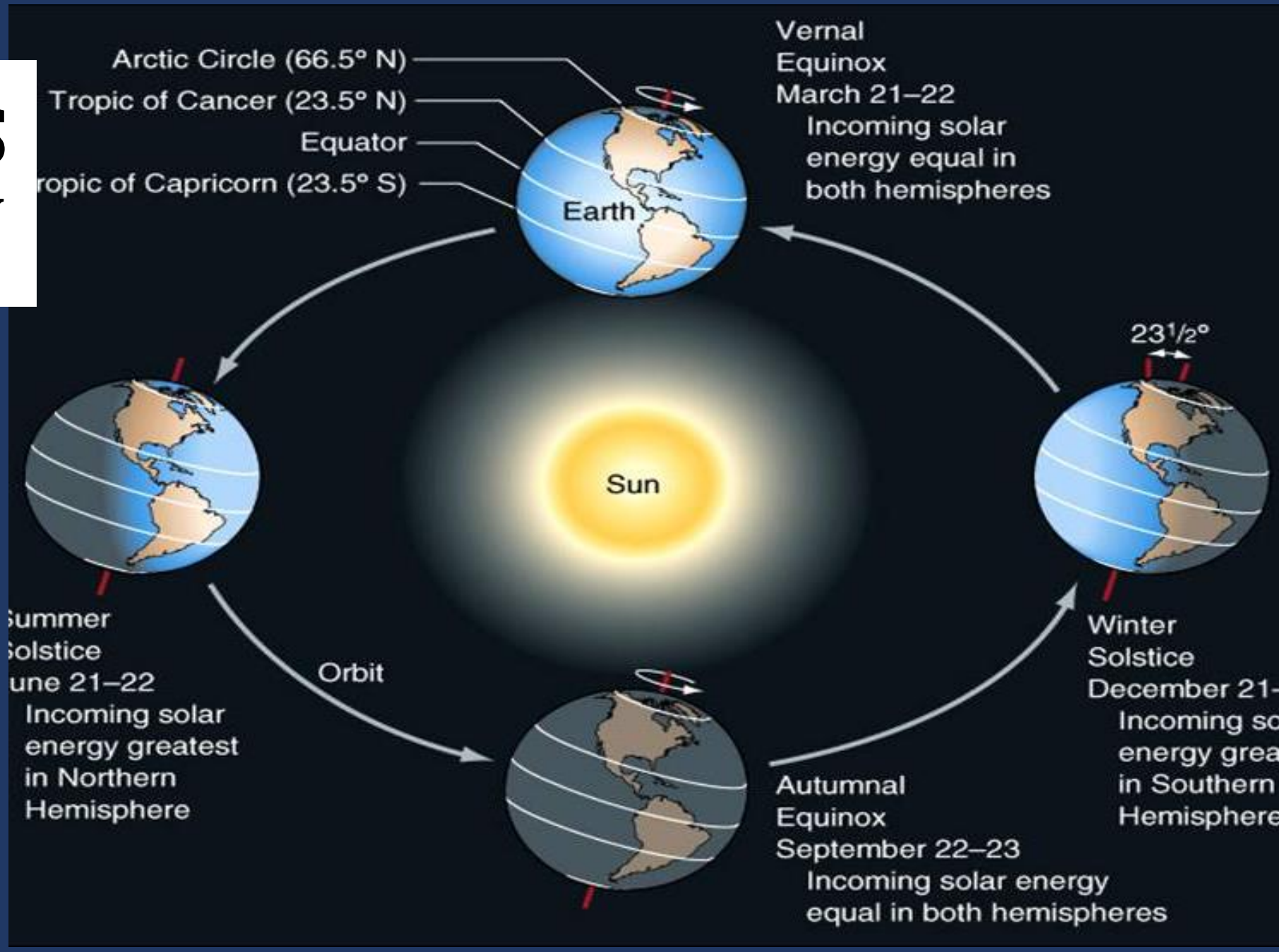
III. When living organisms originated, they modified the early atmosphere of the Earth.

Which of the statements given above is/are correct?

(a) I only (b) II and III only (c) I and III only (d) I, II and III

# THE EARTH'S REVOLUTION

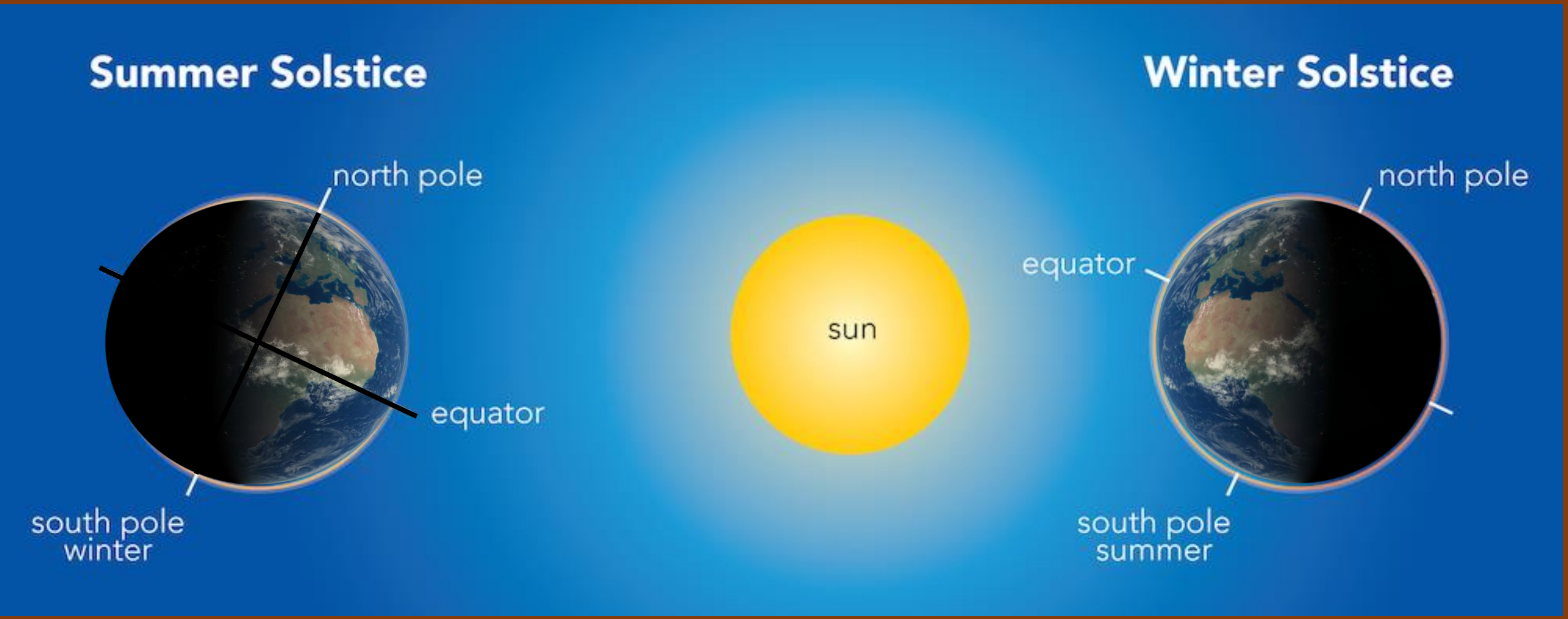
- Elliptical orbit
- Speed - 29.8 km/s
- 365 ¼ days - Leap Year



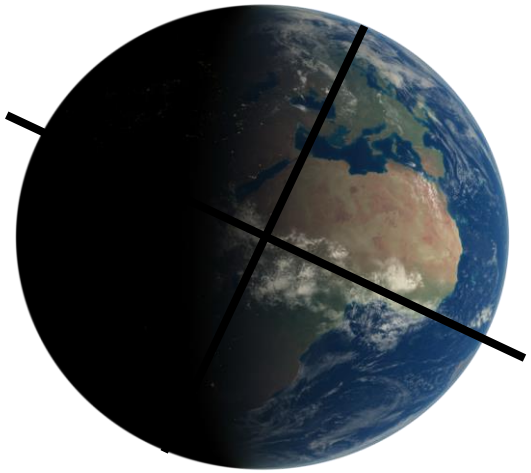
**Kepler’s Law of Planetary Motion:**

**1 : a statement in astronomy: The orbit of each planet is an ellipse that has the sun at one focus.**

**2 : a statement in astronomy: The radius vector from the sun to each planet generates equal orbital areas in equal times.**


Summer Solstice
north pole
equator
south pole
winter
sun
Winter Solstice
north pole
equator
south pole
summer

**In the northern hemisphere, the longest day of the year normally occurs in the:**



(a) First half of the month of June

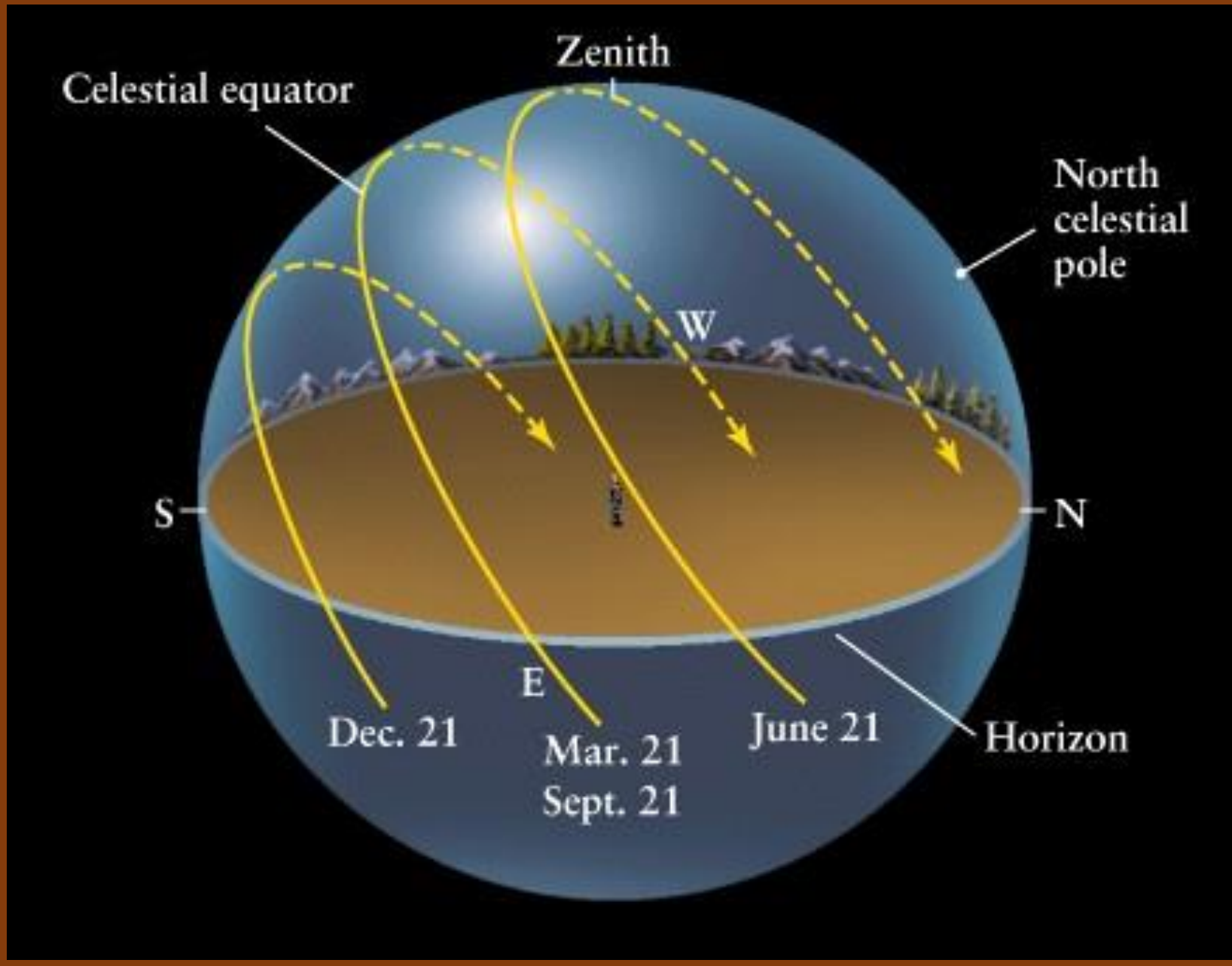
(b) Second half of the month of June

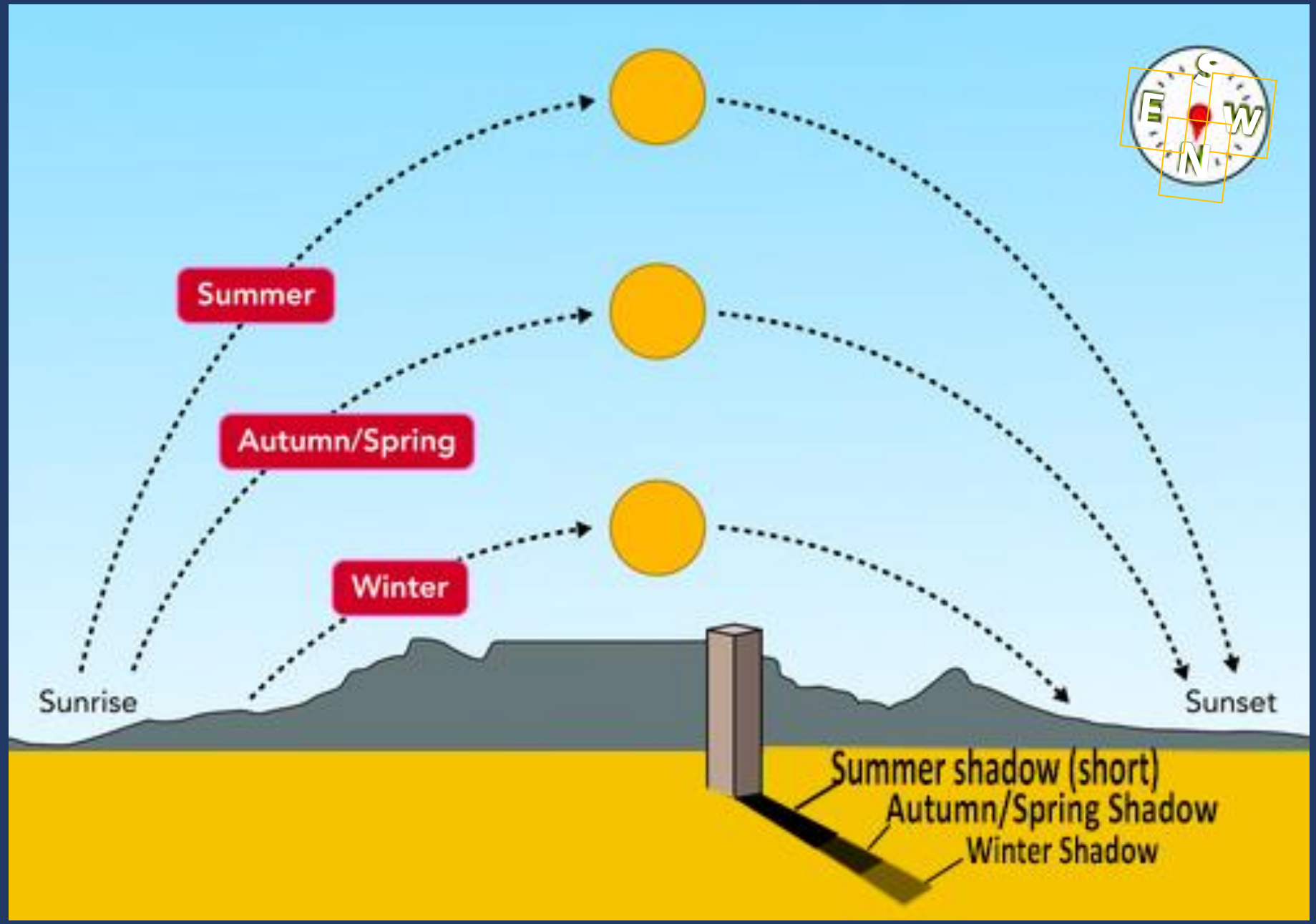
(c) First half of the month of July

(d) Second half of the month of July



# VARYING ALTITUDE OF MID-DAY SUN




Summer
Autumn/Spring
Winter
Sunrise
Sunset
Summer shadow (short)
Autumn/Spring Shadow
Winter Shadow
S
E
W
N

# Expected Question

What is/are the major cause(s) for faster movement of the Earth in its Orbit in Perihelion and comparatively slower motion of the Earth in Aphelion:

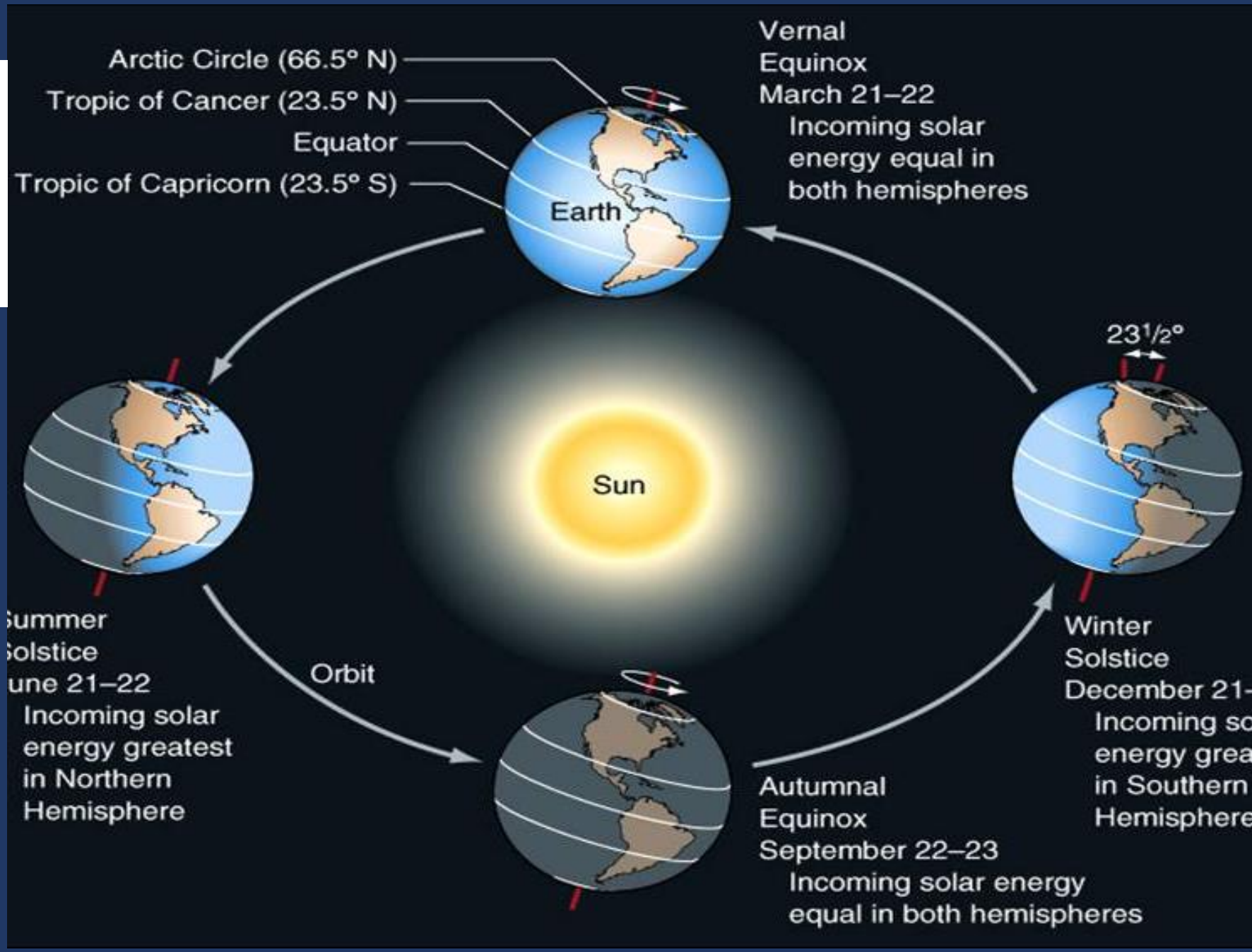
I. Effect of Kinetic energy and Potential energy.
II. Kepler's law of Planetary motion.
III. Elliptical orbit of the Earth.

Select the correct statement(s) using the codes given below:

a. I & II
b. II & III
c. II Only
d. All of the above.

# THE EARTH'S REVOLUTION

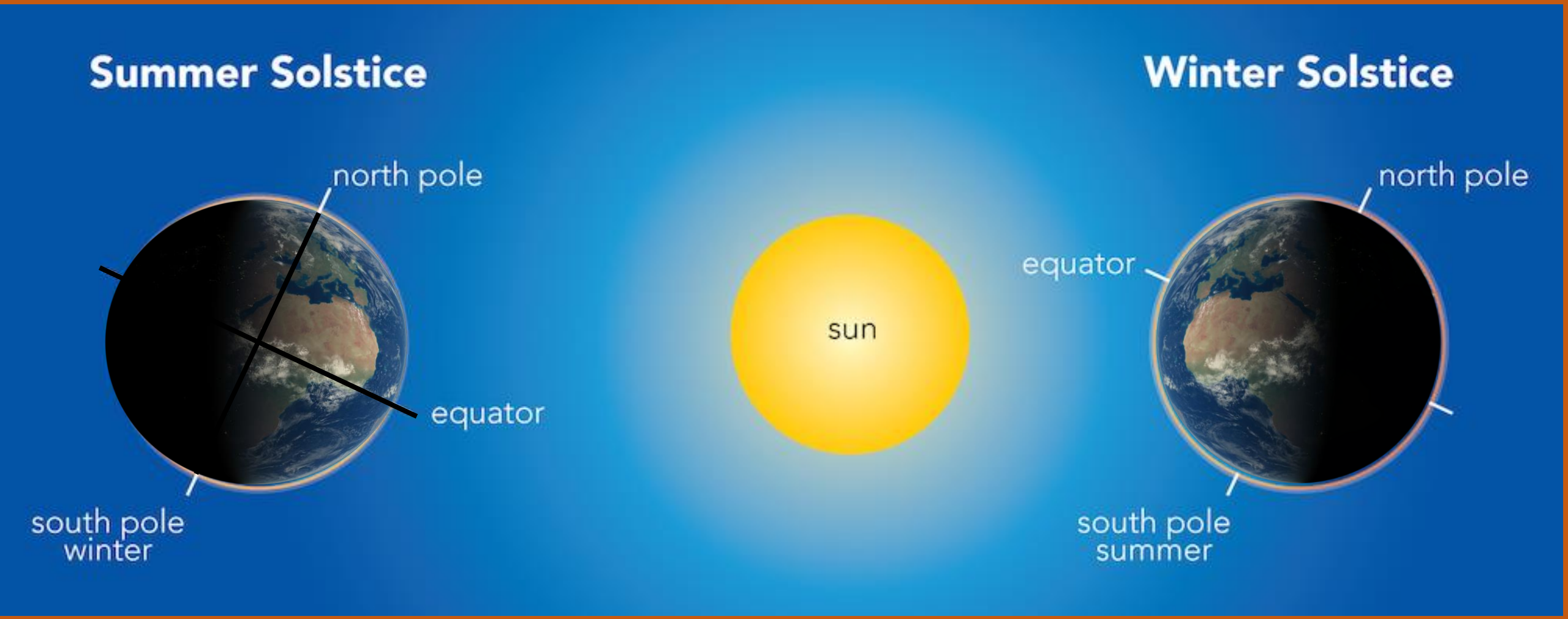
- Elliptical orbit
- Speed - 29.8 km/s
- 365 ¼ days - Leap Year



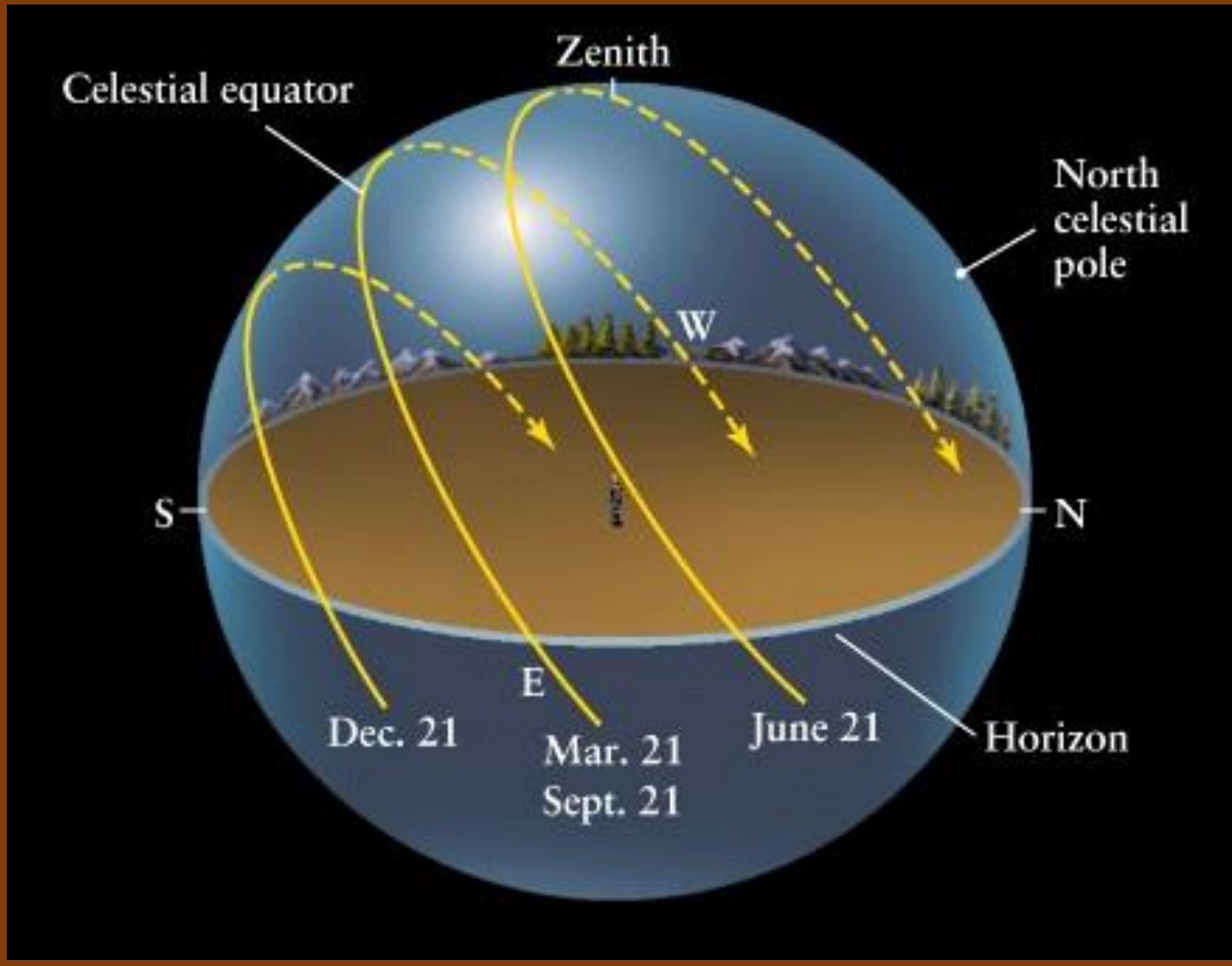
**Kepler’s Law of Planetary Motion:**

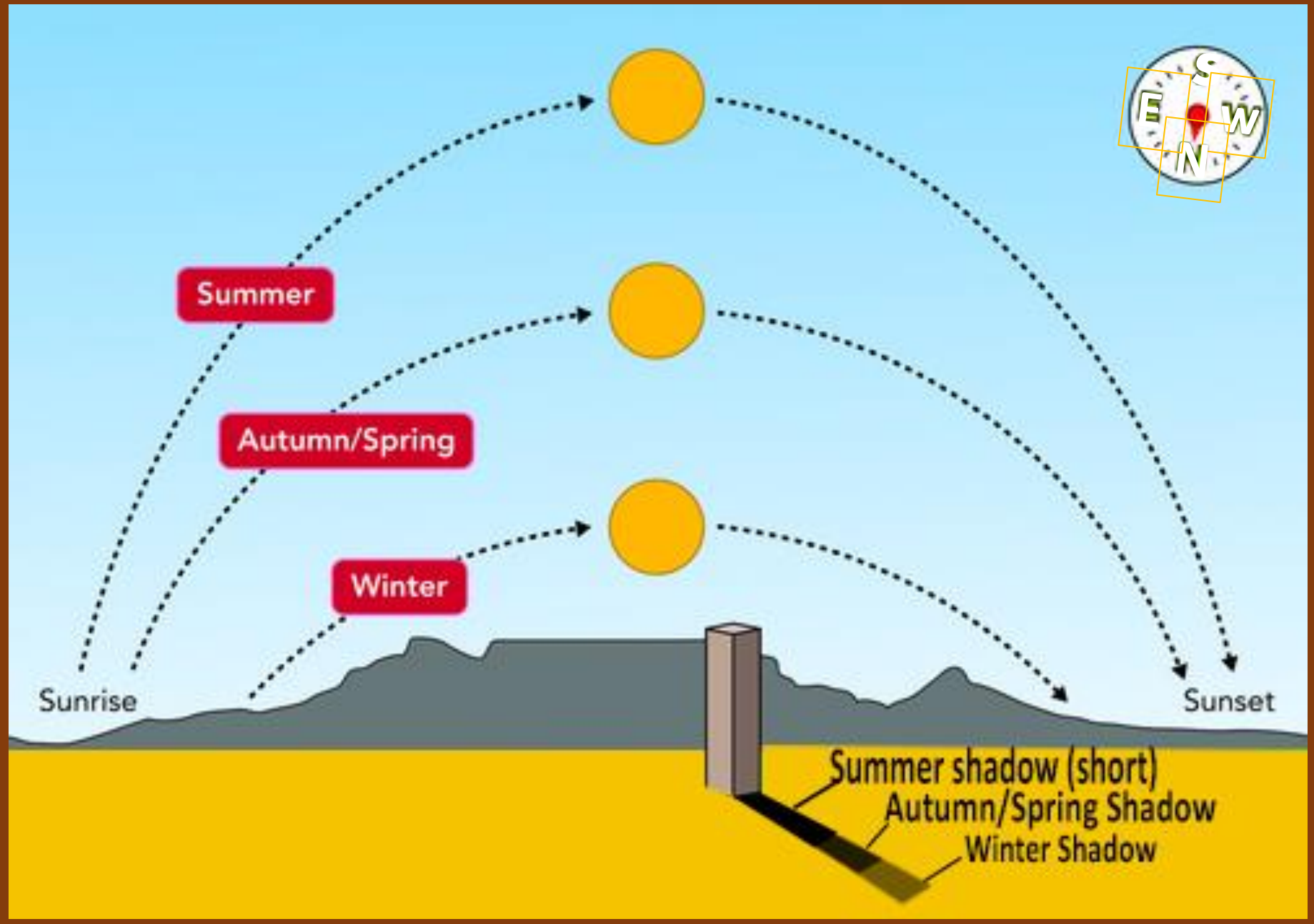
**1 : a statement in astronomy: The orbit of each planet is an ellipse that has the sun at one focus.**

**2 : a statement in astronomy: The radius vector from the sun to each planet generates equal orbital areas in equal times.**


Summer Solstice
north pole
equator
south pole
winter
sun
Winter Solstice
north pole
equator
south pole
summer

# VARYING ALTITUDE OF MID-DAY SUN




Summer
Autumn/Spring
Winter
Sunrise
Sunset
Summer shadow (short)
Autumn/Spring Shadow
Winter Shadow

# Expected Question

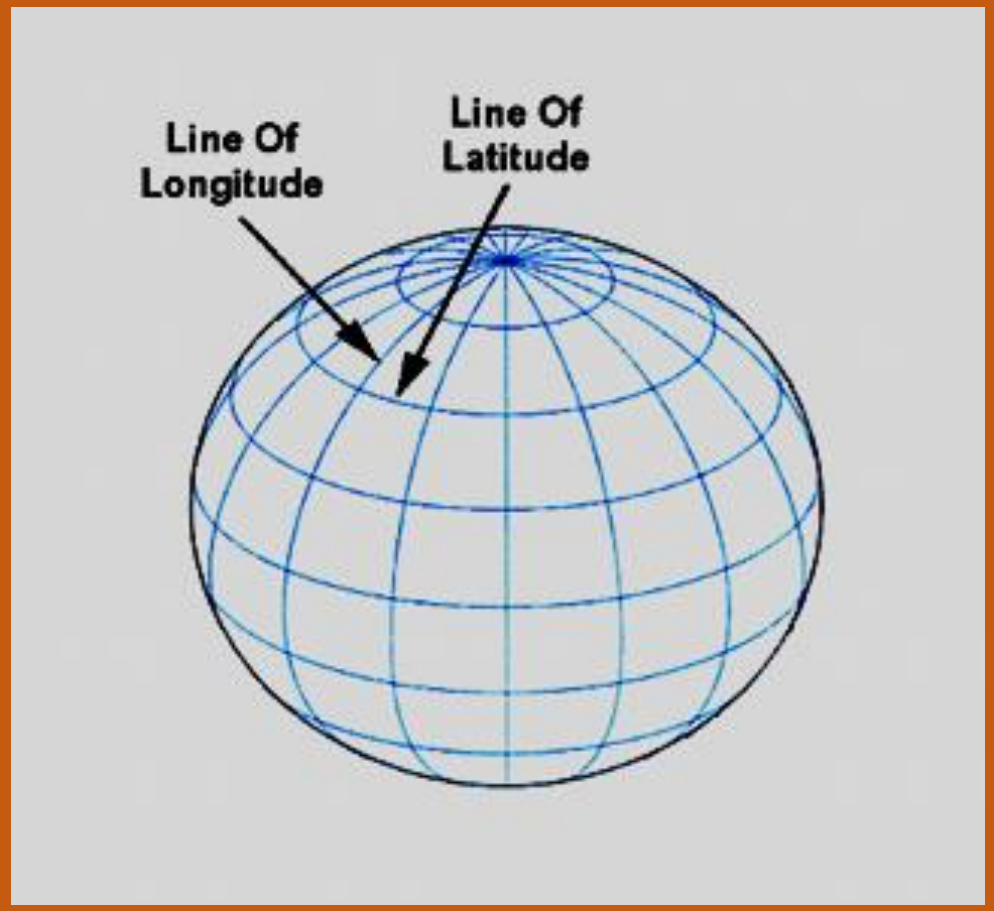
What is/are the major cause(s) for faster movement of the Earth in its Orbit in Perihelion and comparatively slower motion of the Earth in Aphelion:

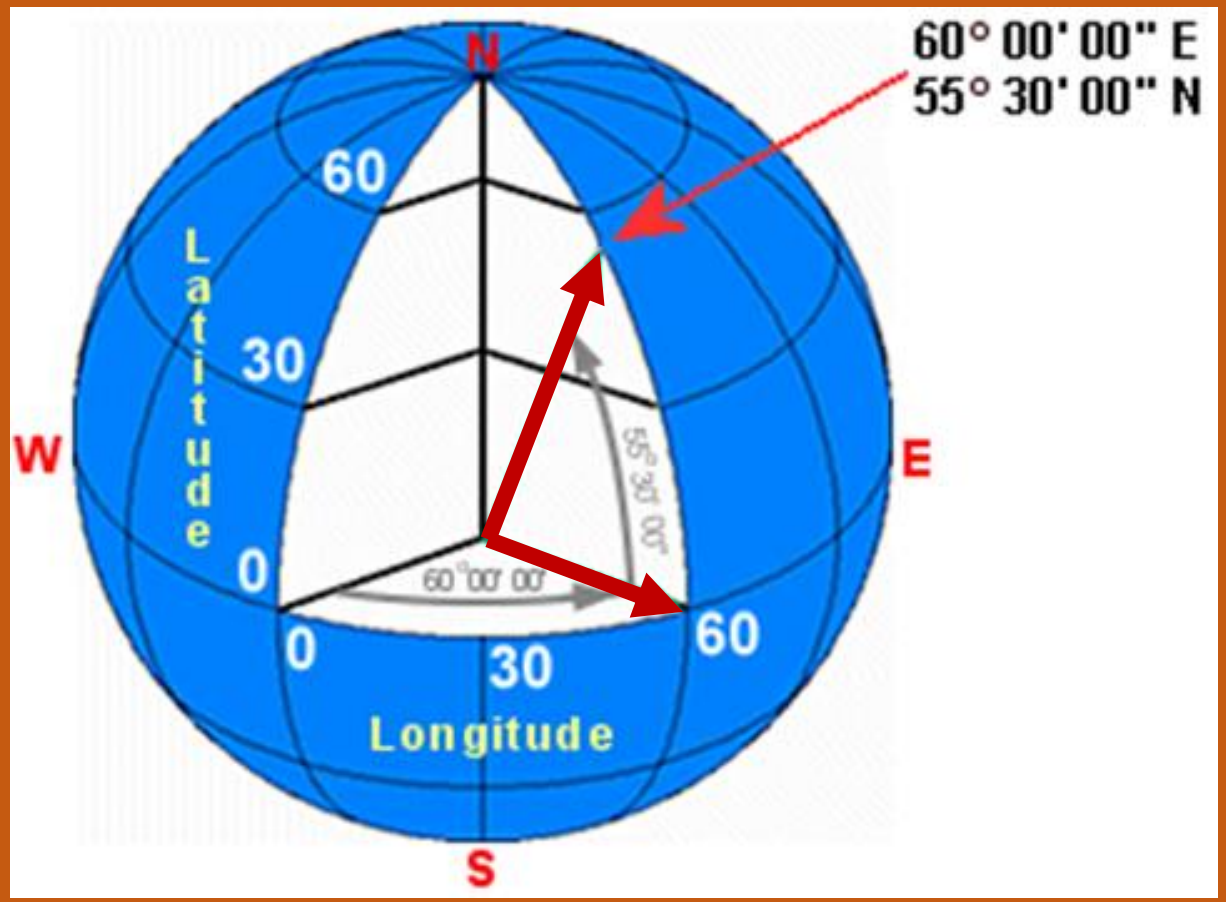
I. Effect of Kinetic energy and Potential energy.
II. Kepler's law of Planetary motion.
III. Elliptical orbit of the Earth.

Select the correct statement(s) using the codes given below:

a. I & II
b. II & III
c. II Only
d. All of the above.

# LATITUDE AND LONGITUDE



## Latitude:

Facts to Remember:

Parallel to each other and increases a little in the Poles

Each $1^0$ = Approximately 111 km apart

Each $1^0$ in Equator= 110.567 km

Each $1^0$ in Tropics = 110.948 km

Each $1^0$ in Poles = 111.699 km

## Longitude:

Facts to Remember:

Not Parallel to each other and meet at poles

IST = GMT + 5 hrs.30 mins

Earth Rotates 24 hours to complete $360^0$




# INTERNATIONAL DATE LINE

A ship sailing from the eastern extremity of the Aleutian Islands to Dutch crosses 180° meridian at 23.30 hrs on January 1, 1999. What time and date will be recorded by the captain of the ship in his diary after one-hour journey from the point of crossing of the meridian?

1. January 1, 0030 hrs
2. January 2, 0030 hrs
3. January 3, 0030 hrs
4. January 4, 0030 hrs



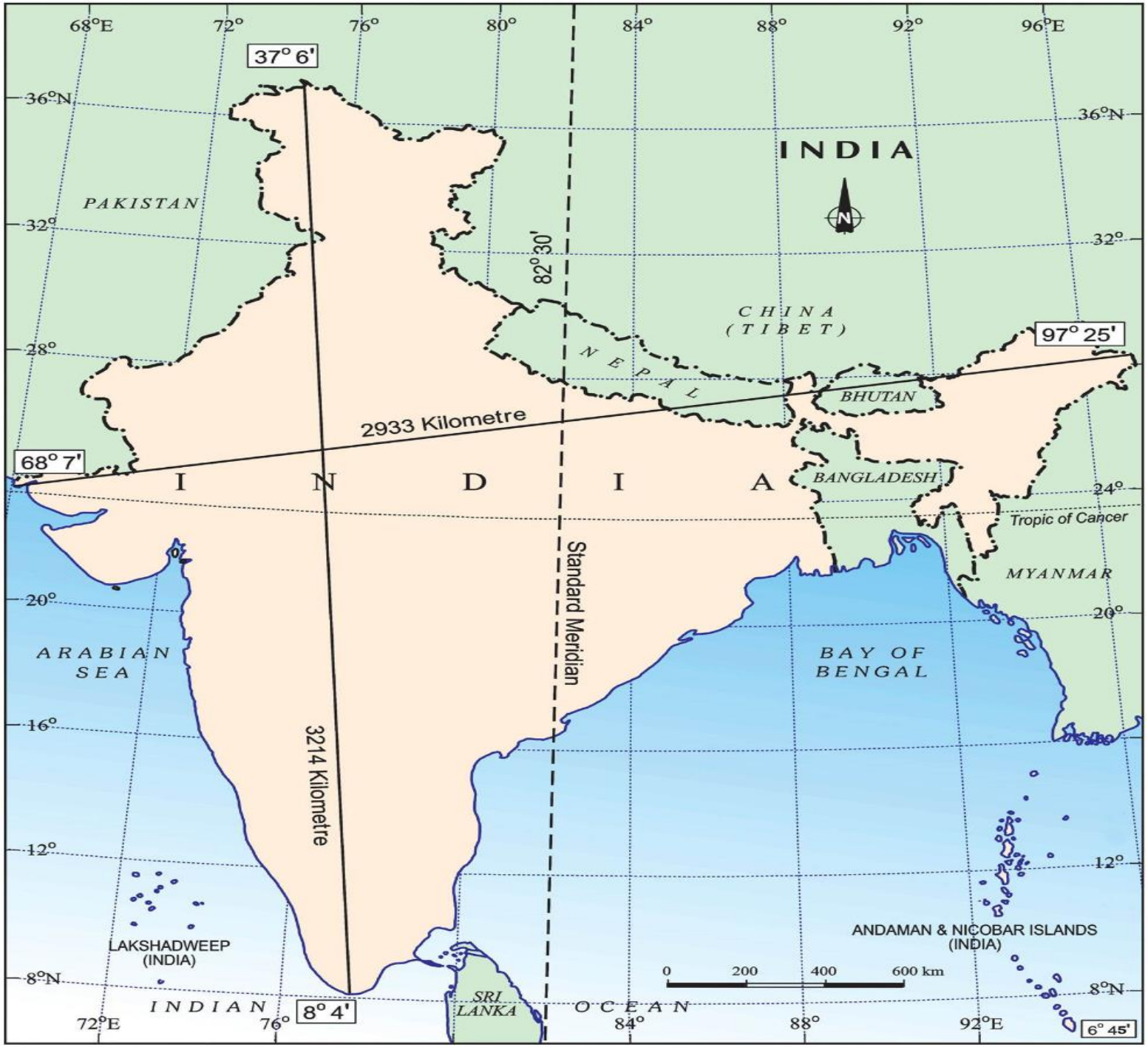

Taveuni Island, one of the most northerly islands of the Fijian archipelago

• Most countries adopt their standard time from the central meridian of their countries.

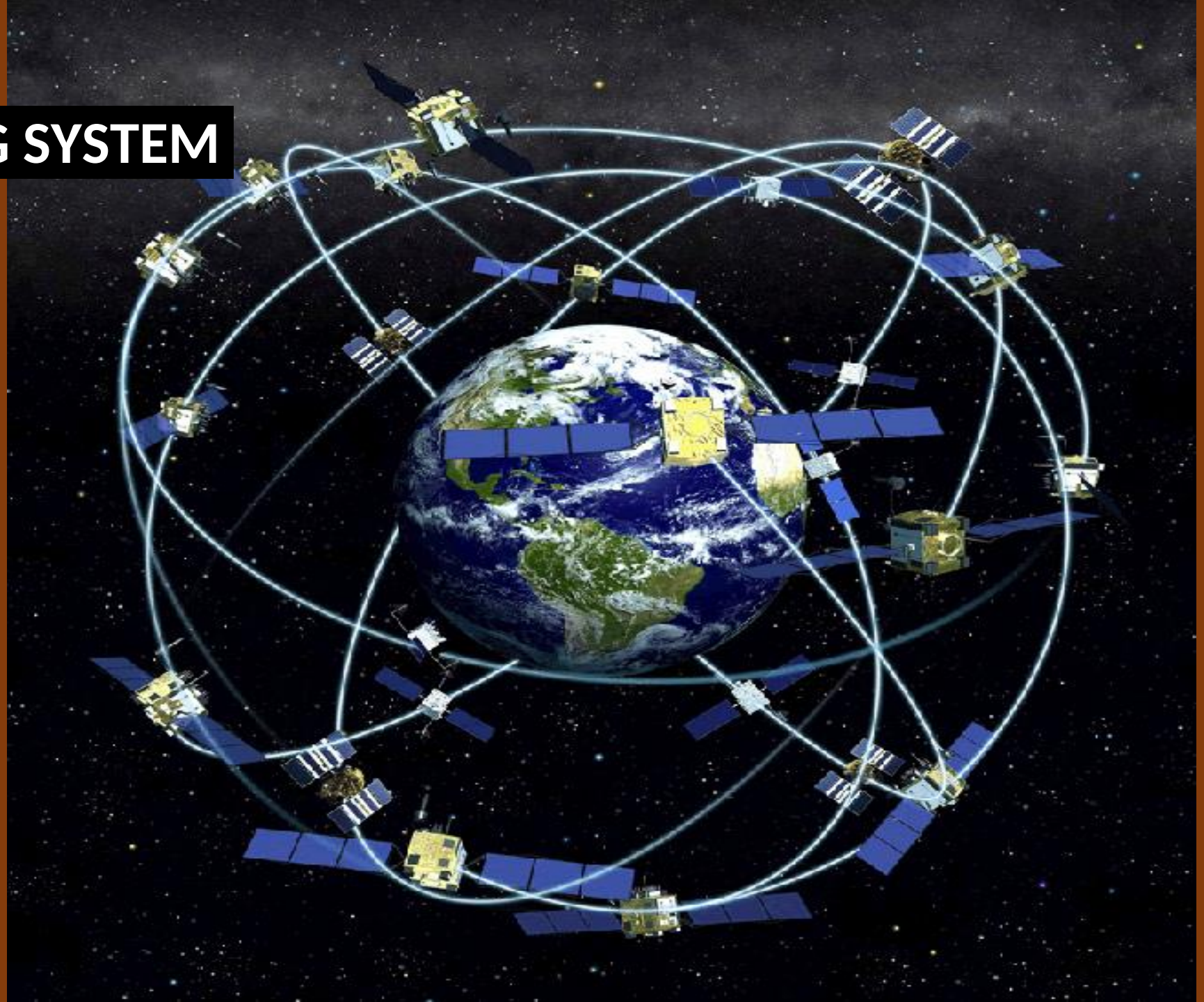
• In larger countries such as **Canada, U.S.A., China, and U.S.S.R**, it would be inconvenient to have single time zone. So these countries have multiple time zones.

• Both **Canada and U.S.A.** have **five time zones**—the Atlantic, Eastern, Central, Mountain and Pacific Time Zones. The difference between the local time of the Atlantic and Pacific coasts is nearly five hours.

• S.S.R had eleven time zones before its


INDIA
PAKISTAN
CHINA (TIBET)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
I N D I A
2933 Kilometre
3214 Kilometre
Standard Meridian
82° 30'
37° 6'
68° 7'
97° 25'
8° 4'
6° 45'
Tropic of Cancer
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
LAKSHADWEEP (INDIA)
ANDAMAN & NICOBAR ISLANDS (INDIA)
SRI LANKA
0 200 400 600 km
68°E
72°
76°
80°
84°
88°
92°
96°E
36°N
32°
28°
24°
20°
16°
12°
8°N

# GPS
# GLOBAL POSITIONING SYSTEM

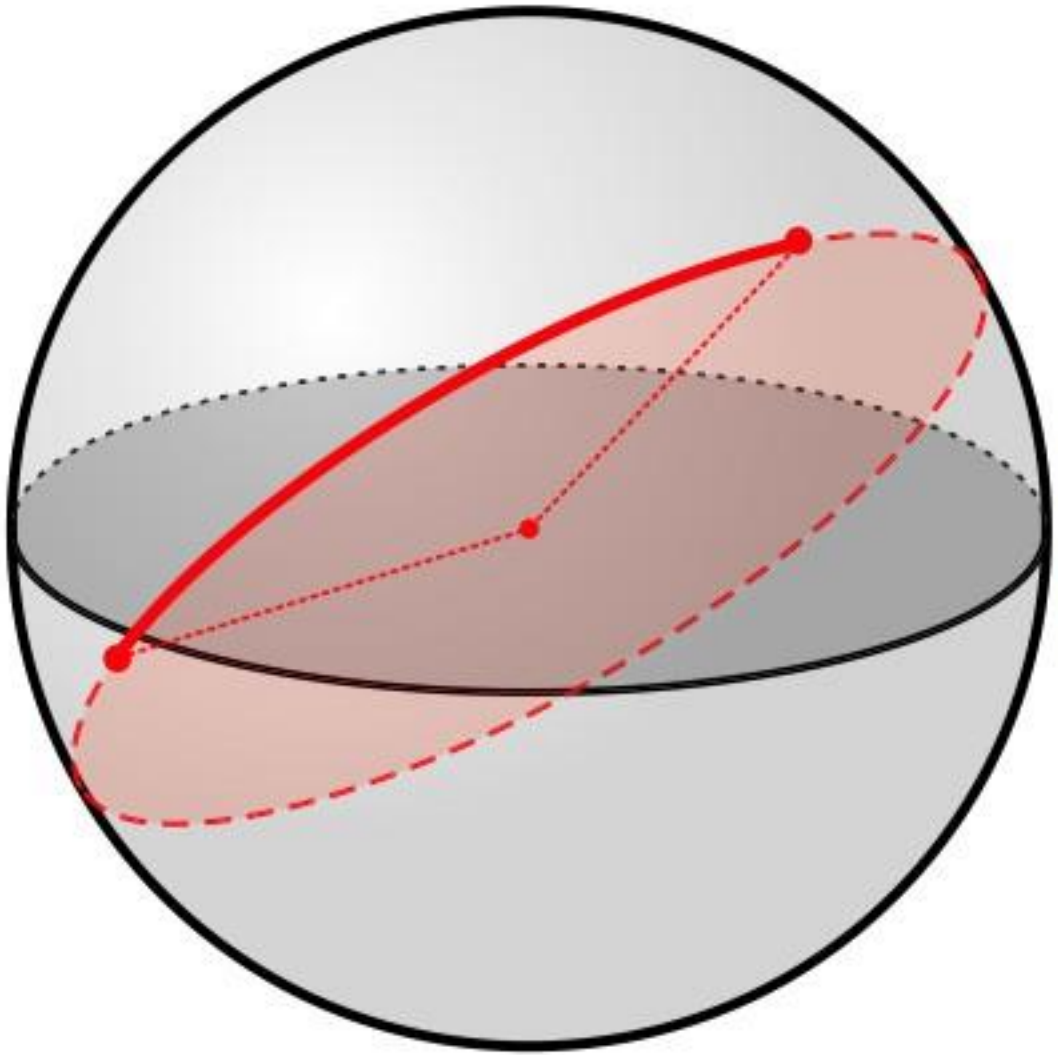


## Sectors used in:

Internet of Things (IoT), Location based services, Emergency and security, Humanitarian services, Scientific research,
Weather and Climate, Transportation, Agriculture, Fisheries, Civil engineering, Communication, Banking, Energy

## Types

- GLONASS(Globalnaya Navigazionnaya Sputnikovaya Sistema )
- GALILEO(European Global Navigation Satellite System)
- INDIAN REGIONAL NAVIGATION SATELLITE SYSTEM (IRNSS)
- GAGAN(GPS Aided GEO Augmented Navigation)



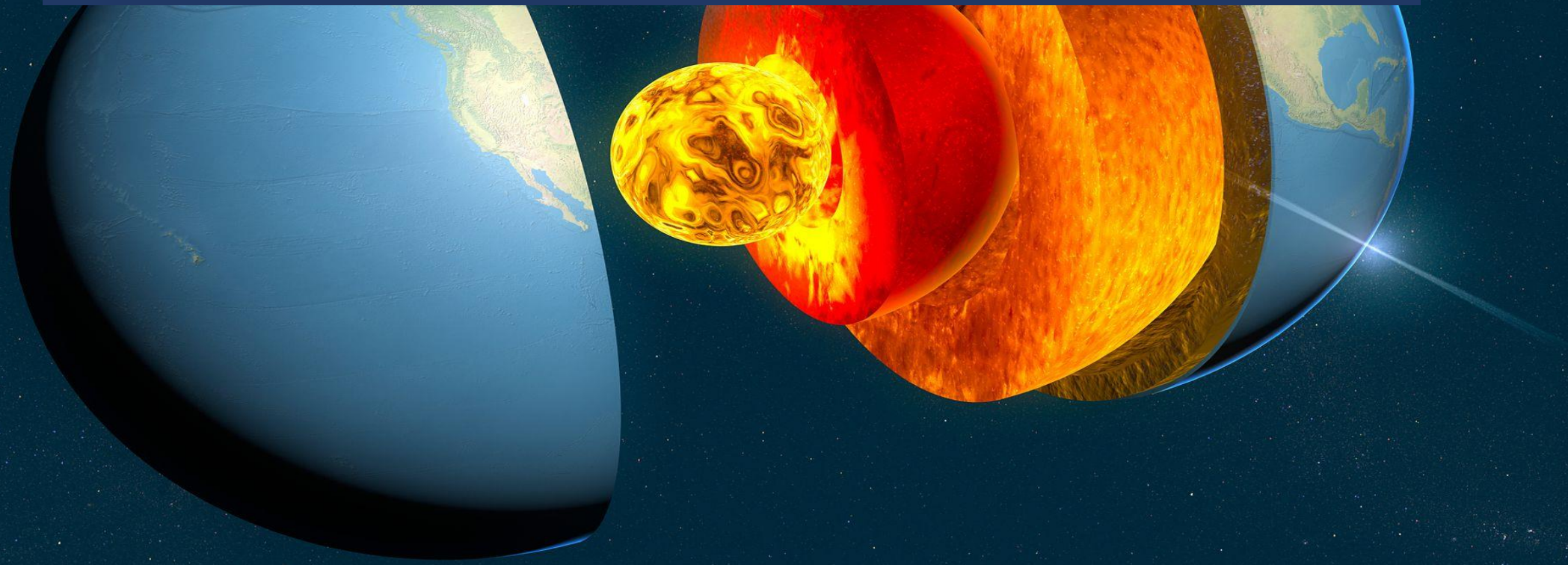


# Test your Understandings

Suppose, You make a call from London on 20th December at 11 AM to your mother who is in Delhi. Then, at what time will she receive your call:

a. 20 th December 04:30 AM
b. 19 th December 11:00 PM
c. 20 th December 04:30 PM
d. 19 th December 11:00 AM

# EARTH'S INTERIOR
# AND MATERIALS OF THE EARTH'S CRUST



# EARTH'S FOUR SPHERES

**Lithosphere** – solid earth



**Atmosphere** – gases (the air)



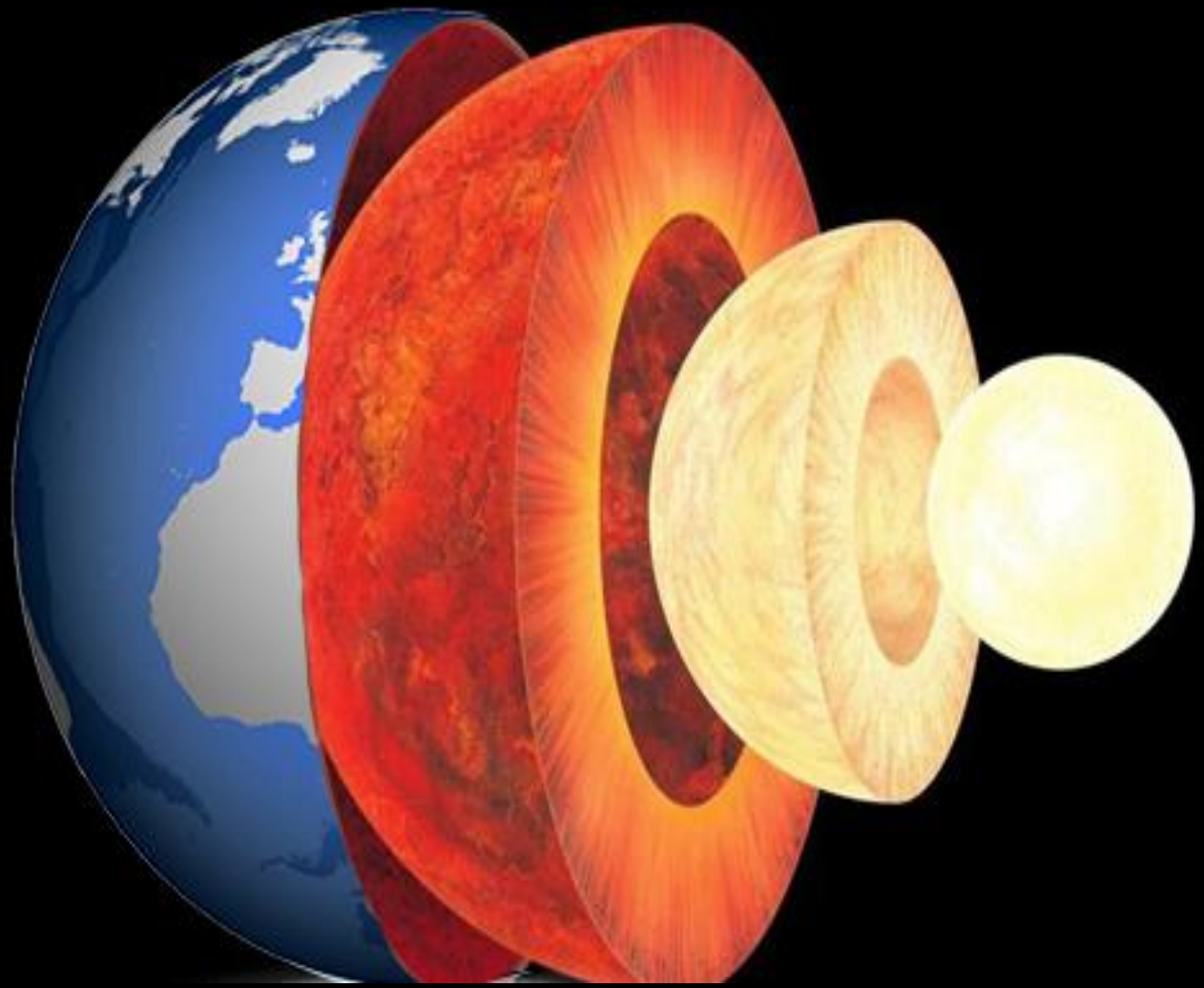


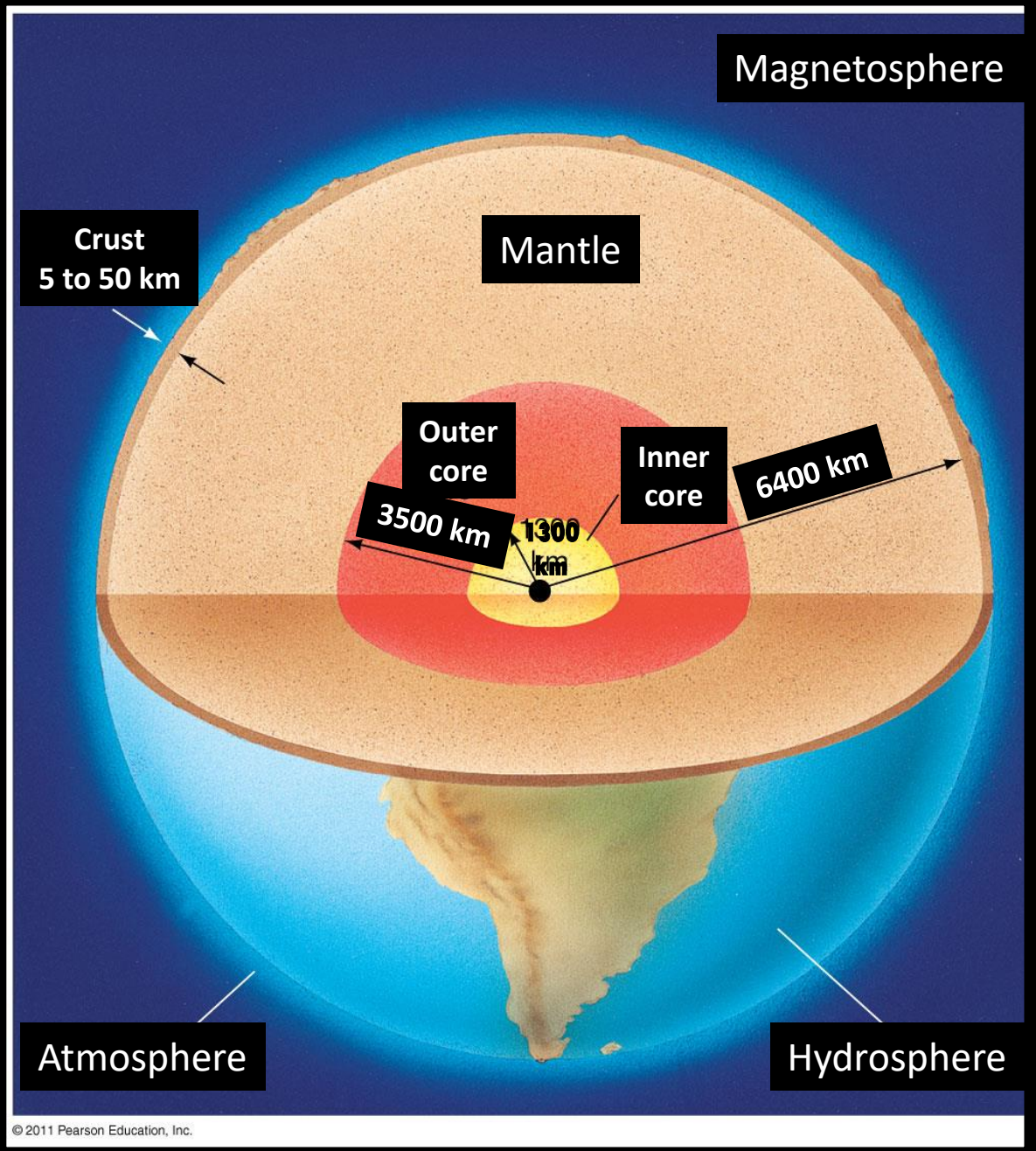


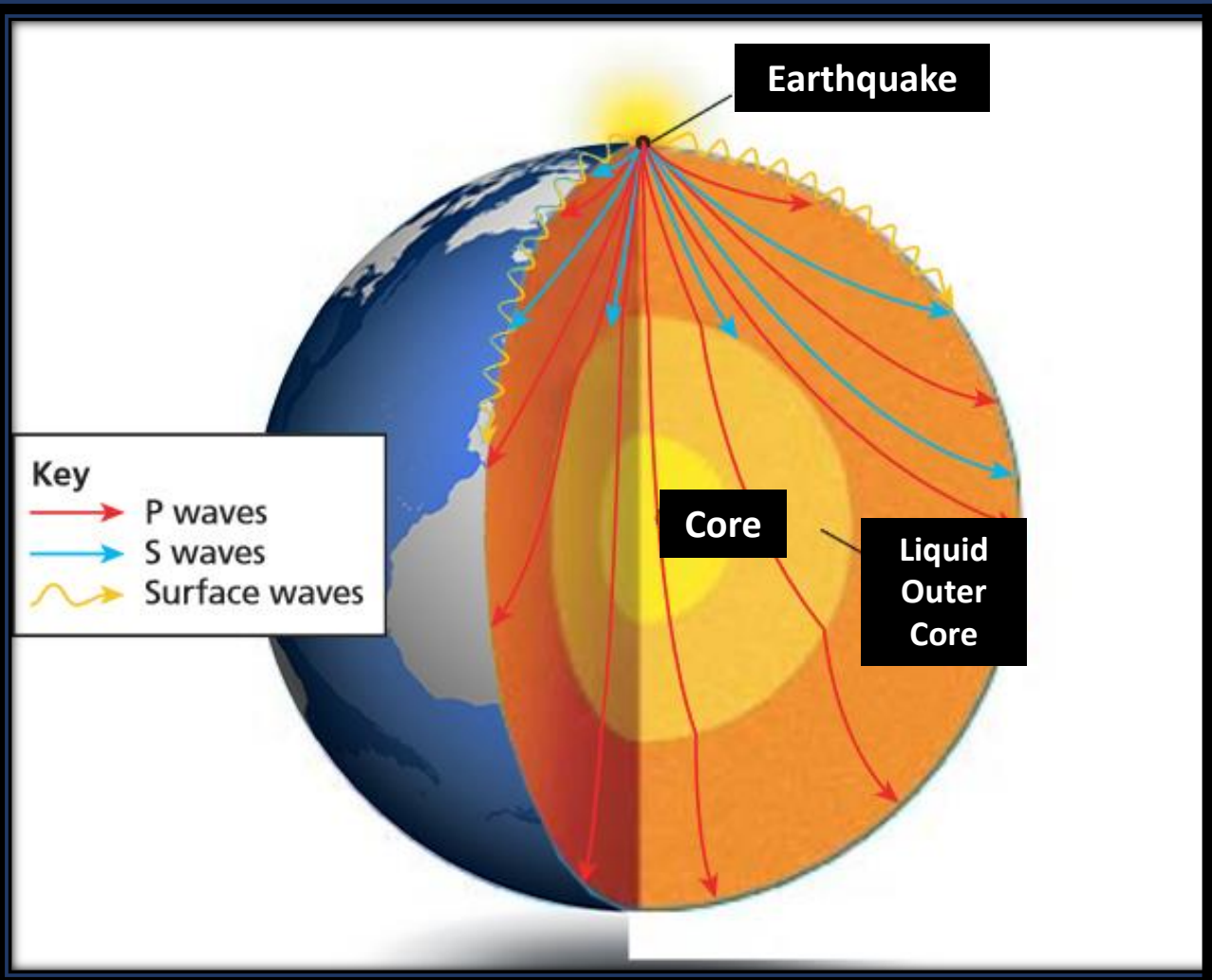
**Hydrosphere** – all water

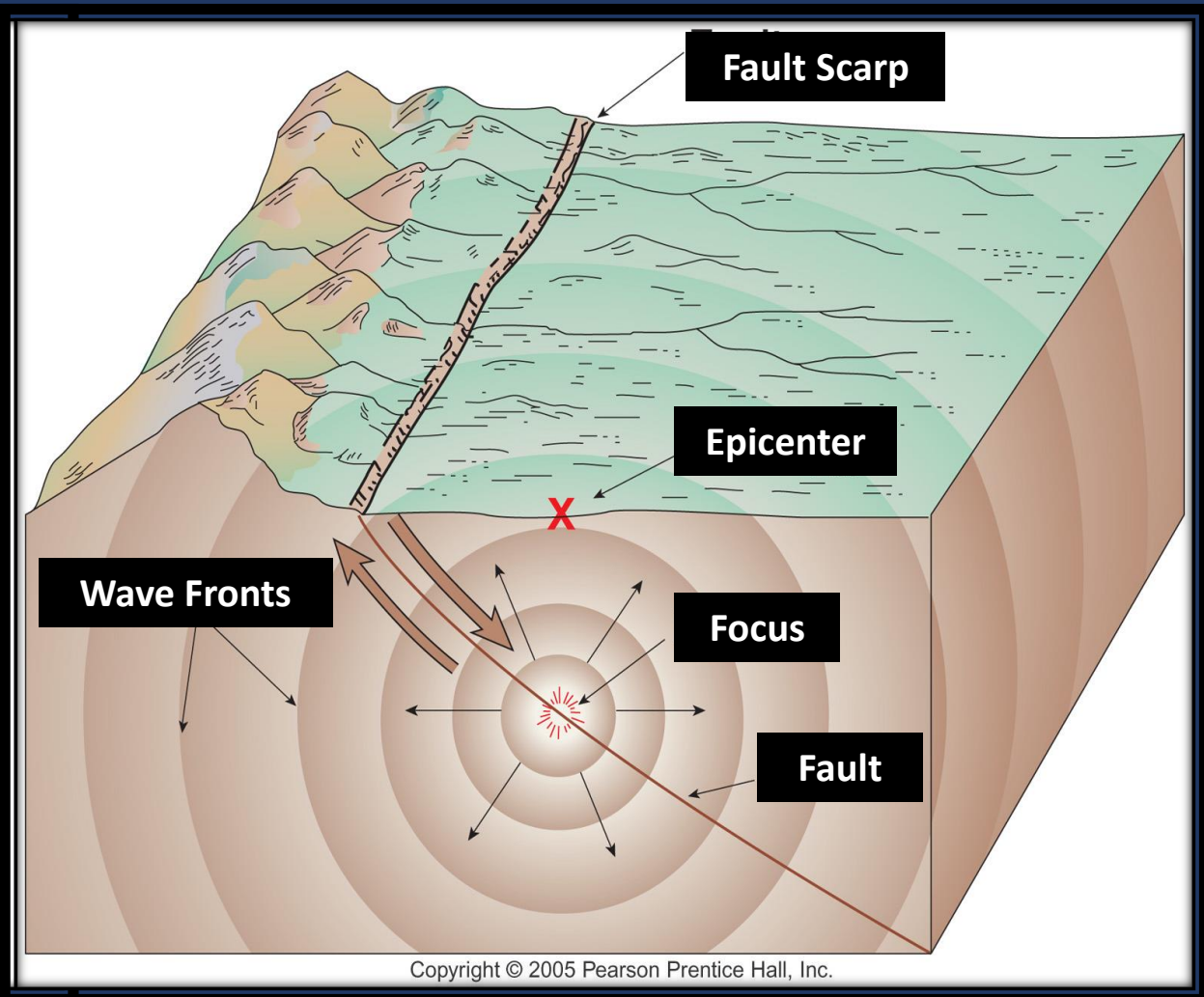


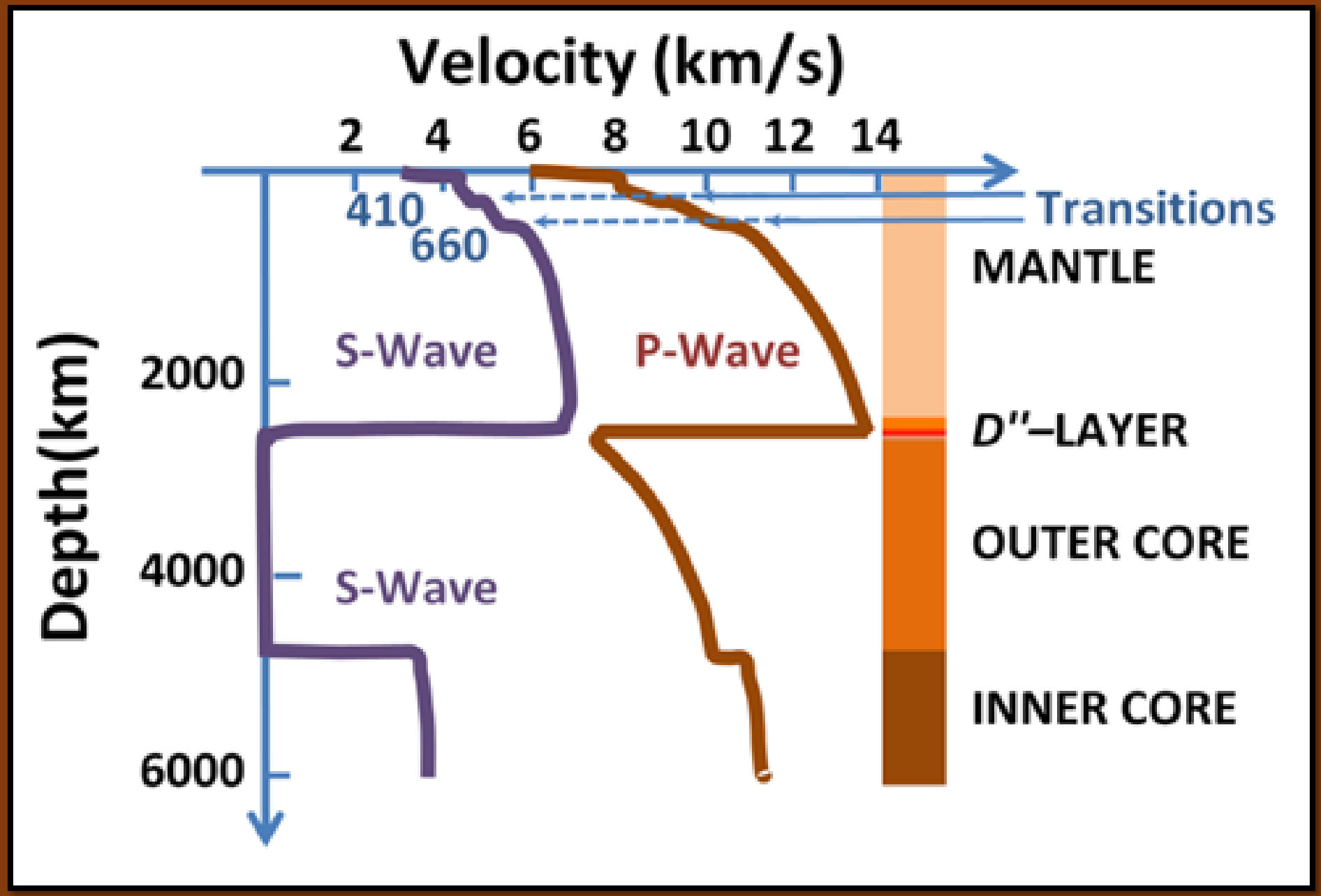
**Biosphere** – all life

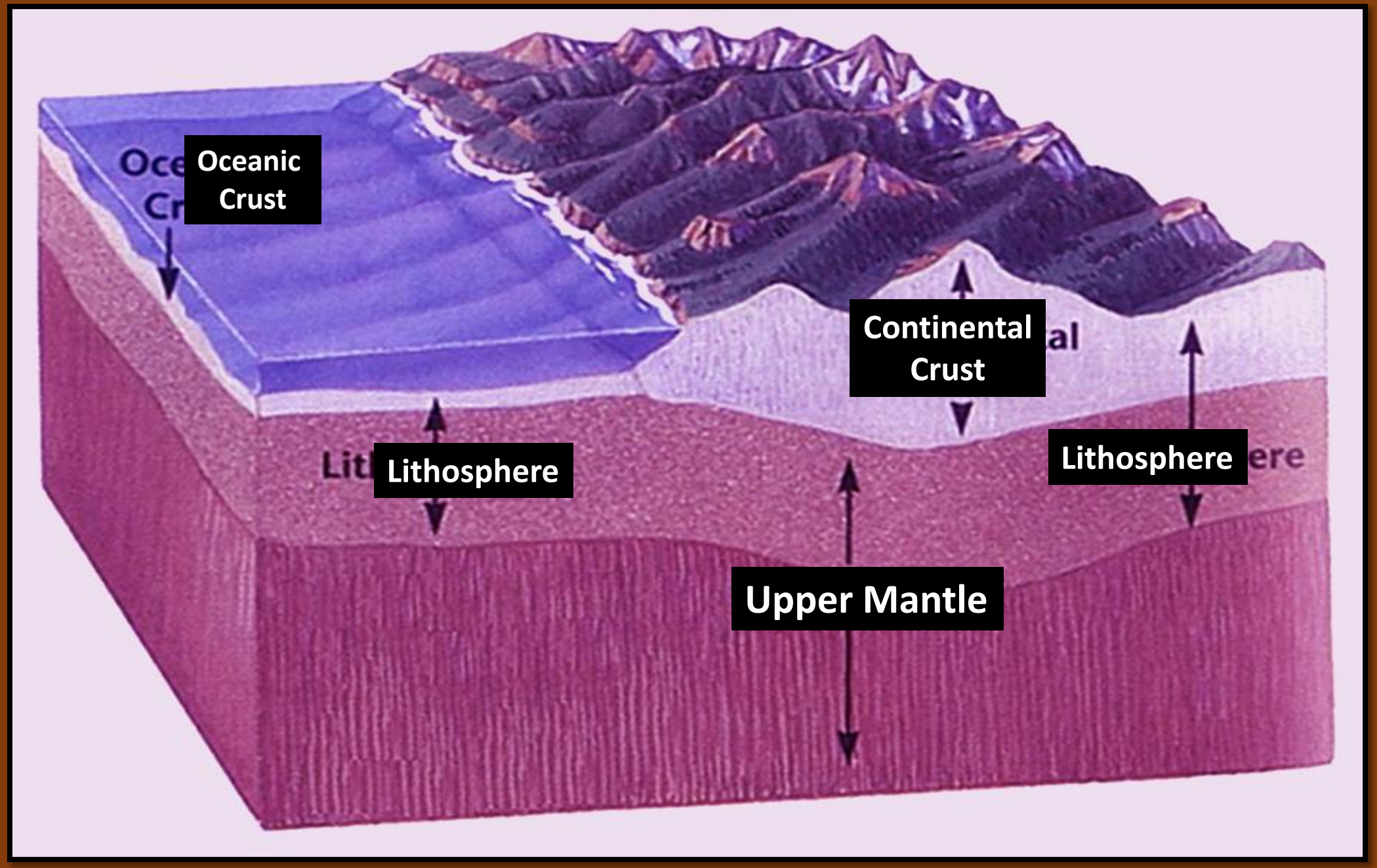



Magnetosphere
Crust
5 to 50 km
Mantle
Outer
core
Inner
core
6400 km
3500 km
1300
km
Atmosphere
Hydrosphere
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Earthquake
Core
Liquid Outer Core
Key
P waves
S waves
Surface waves


Fault Scarp
Epicenter
X
Wave Fronts
Focus
Fault
Copyright © 2005 Pearson Prentice Hall, Inc.


Velocity (km/s)
2
4
6
8
10
12
14
410
660
Transitions
MANTLE
Depth(km)
2000
4000
6000
S-Wave
P-Wave
S-Wave
D''–LAYER
OUTER CORE
INNER CORE


Oceanic Crust
Continental Crust
Lithosphere
Lithosphere
Upper Mantle

# CRUST:

- **5-30 km in case of the oceanic crust** and as **50-70 km in case of the continental crust**.
- **0.5-1.0 per cent of the earth's volume** and **less than 1 per cent of Earth's mass**.
- The continents are composed of lighter silicates — **silica + aluminium** (also called **sial**) while the oceans have the heavier silicates — **silica + magnesium** (also called **sima**)
- The continental crust is composed of lighter (**felsic**) **sodium potassium aluminium silicate** rocks, like **granite**.
- The oceanic crust, on the other hand, is composed of dense (**mafic**) **iron magnesium silicate** igneous rocks, like **basalt**.
- Find the most abundant elements

**Lithosphere**

- rigid outer part of the earth with thickness varying between 10-200 km.
- **crust and the upper part of the mantle**.
- The lithosphere is broken into **tectonic plates (lithospheric plates)**

**Asthenosphere**

- upper portion of the mantle is called as asthenosphere (astheno means weak).
- **just below the lithosphere** extending up to **80-200 km**.
- **main source of magma, aid in plate tectonic movement and isostatic adjustments**

**The Mantle**

- **83 per cent of the earth's volume and holds 67% of the earth's mass**.
- composed of **silicate rocks that are rich in iron and magnesium**
- High-pressure conditions ought to inhibit seismicity in the mantle.
- Find the Elements

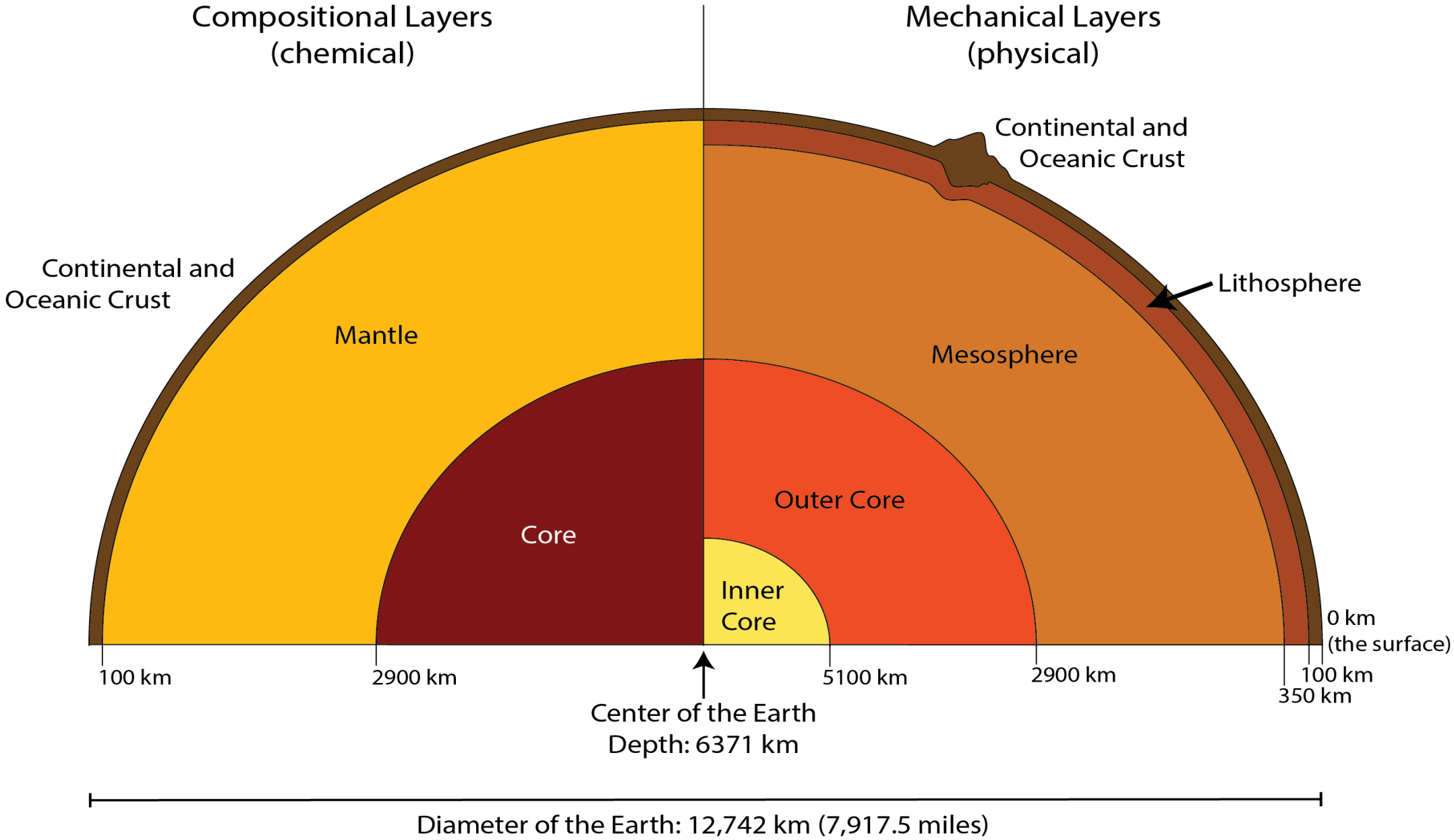
**The Outer Core**

- **iron mixed with nickel** (**nife**) and trace amounts of lighter elements.
- Dynamo theory suggests that **convection in the outer core, combined with the Coriolis effect**, gives rise to **Earth's magnetic field**.

**The Inner Core**

- composed primarily of **iron (80%) and some nickel** (**nife**).
- At 6000°C, this iron core is as hot as the Sun's surface, but the **crushing pressure caused by gravity prevents it from becoming liquid**.

# Two different views of the interior of the Earth



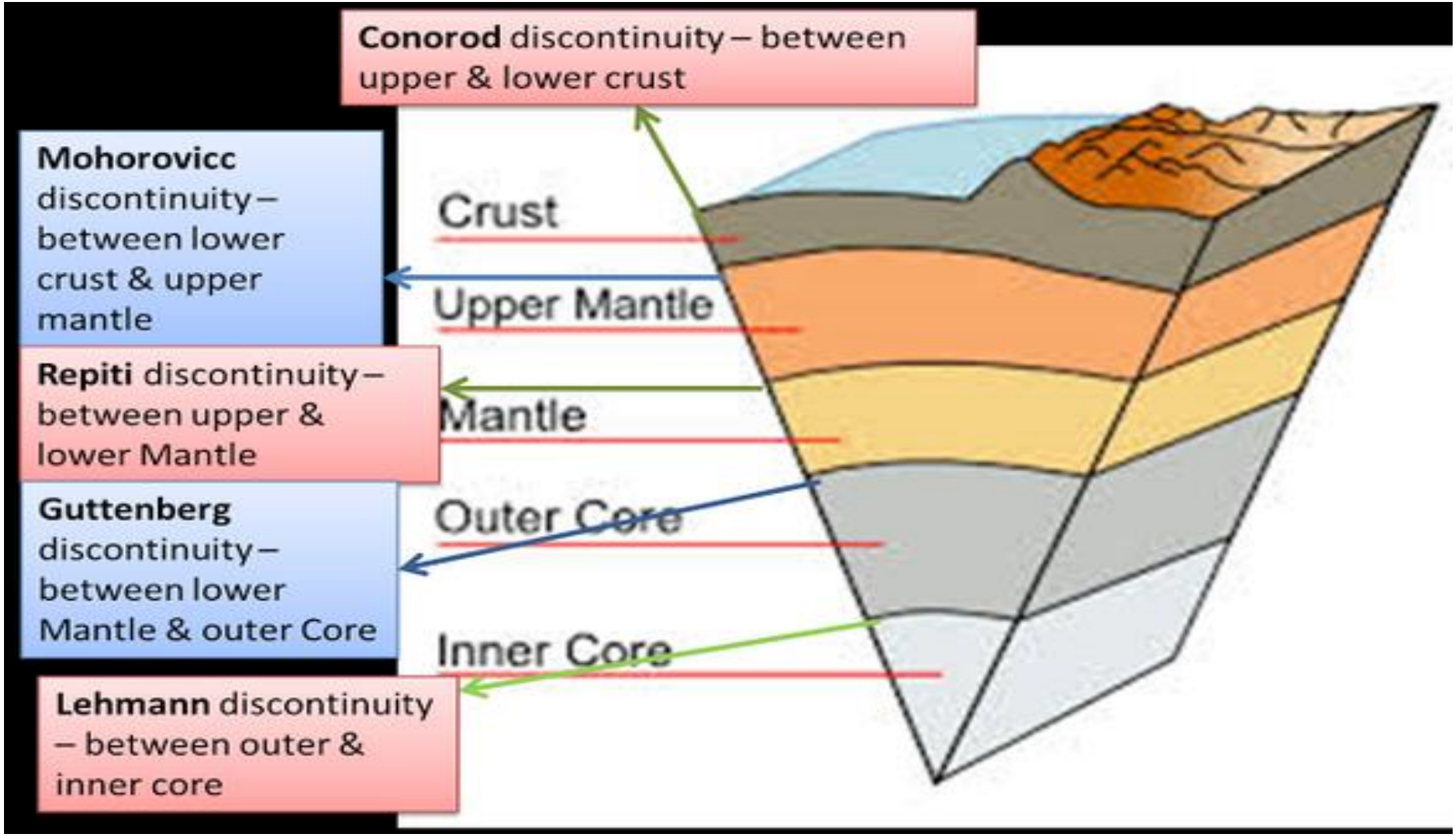
# Expected Question

Consider the following statements with reference to the Earth's crust:

I. The crust is the outermost solid part of the earth.
II. The continental crust is mainly formed by basaltic rocks.
III. The oceanic crust are mainly formed by granitic rocks.

Which of the following statements is/are NOT correct:

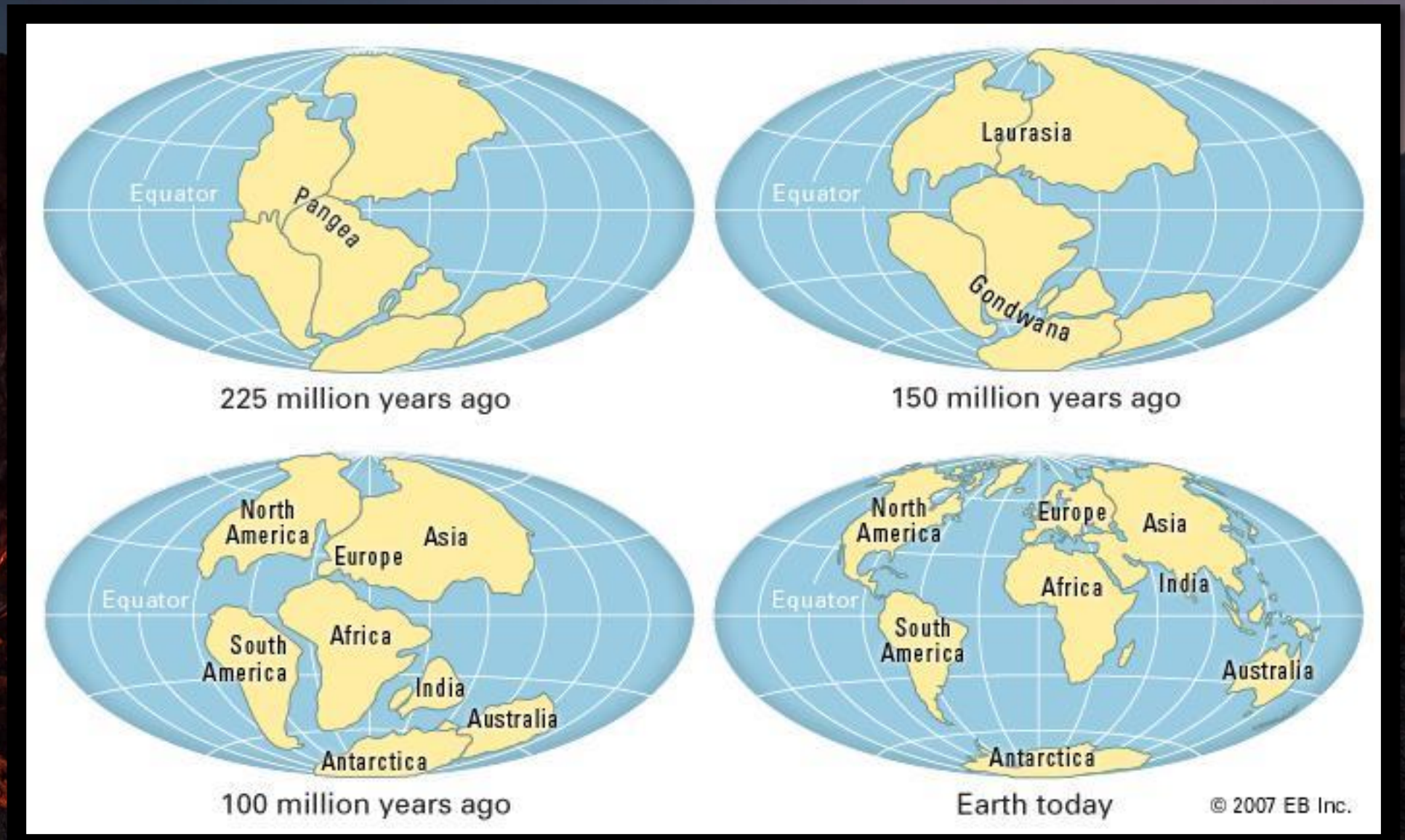
a. I Only
b. II and III
c. I and III
d. I, II and III


**Conorod** discontinuity – between upper & lower crust
**Mohorovicc** discontinuity – between lower crust & upper mantle
**Repiti** discontinuity – between upper & lower Mantle
**Guttenberg** discontinuity – between lower Mantle & outer Core
**Lehmann** discontinuity – between outer & inner core
Crust
Upper Mantle
Mantle
Outer Core
Inner Core

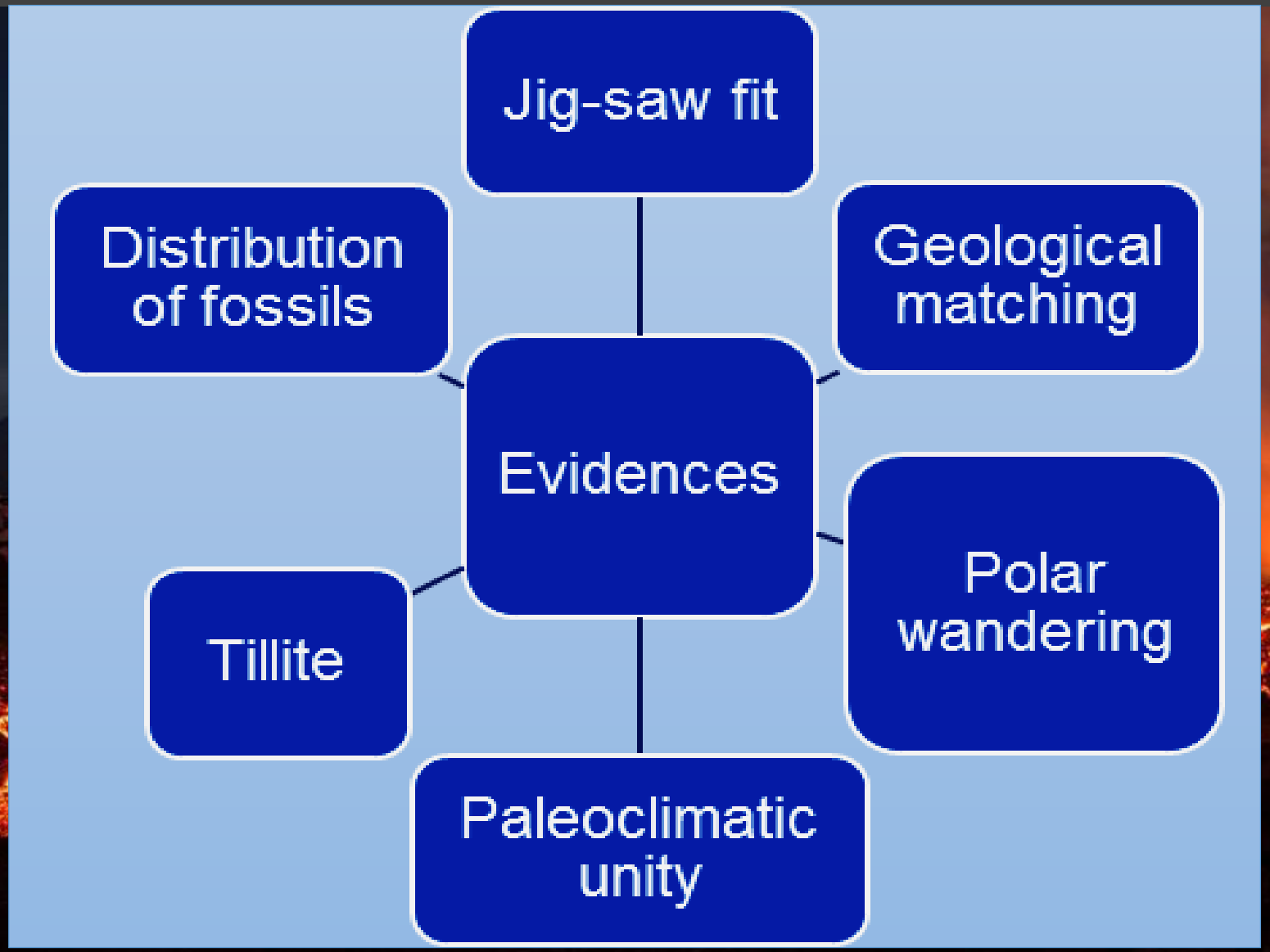
# CONTINENTAL DRIFT THEORY

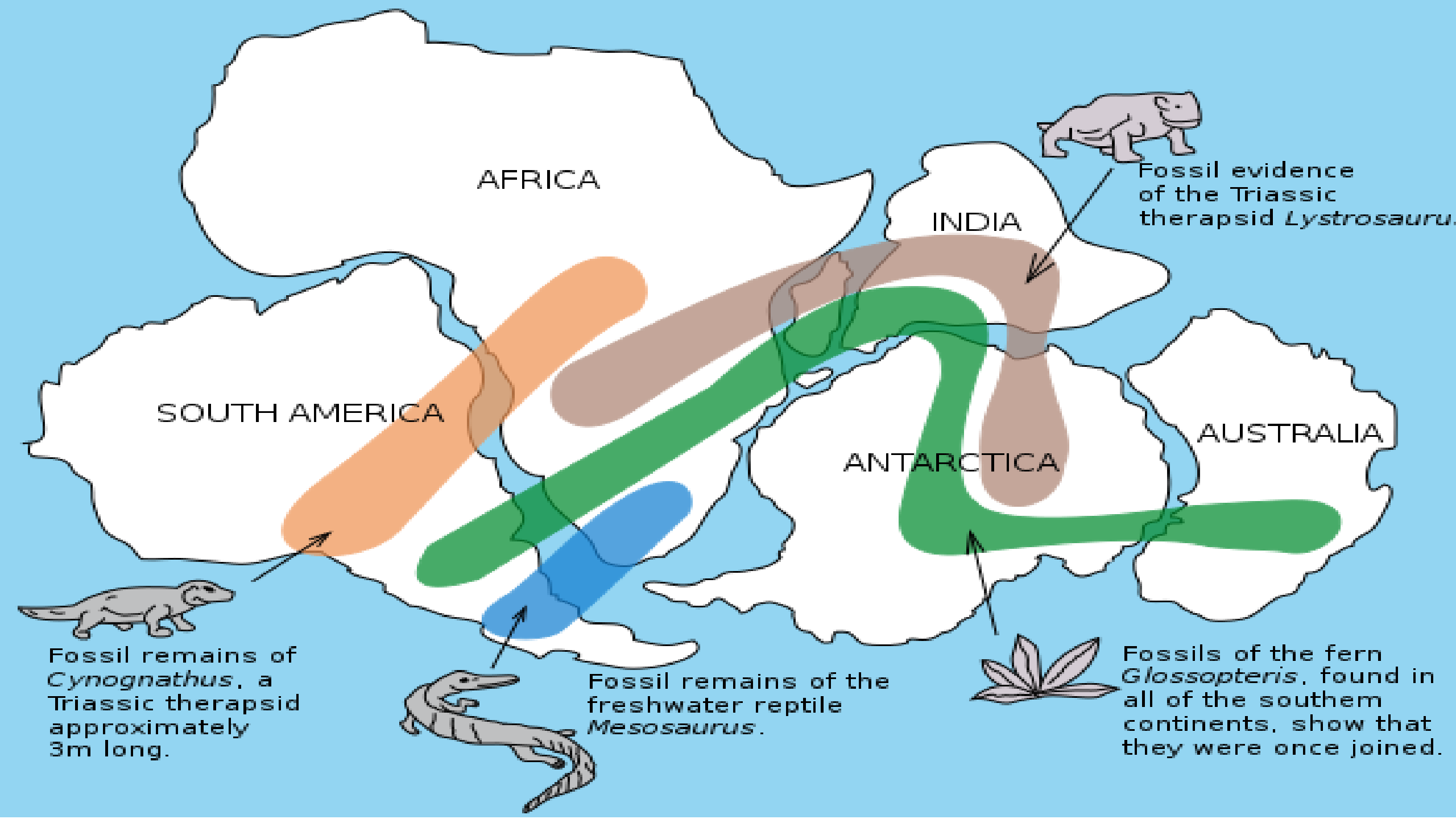


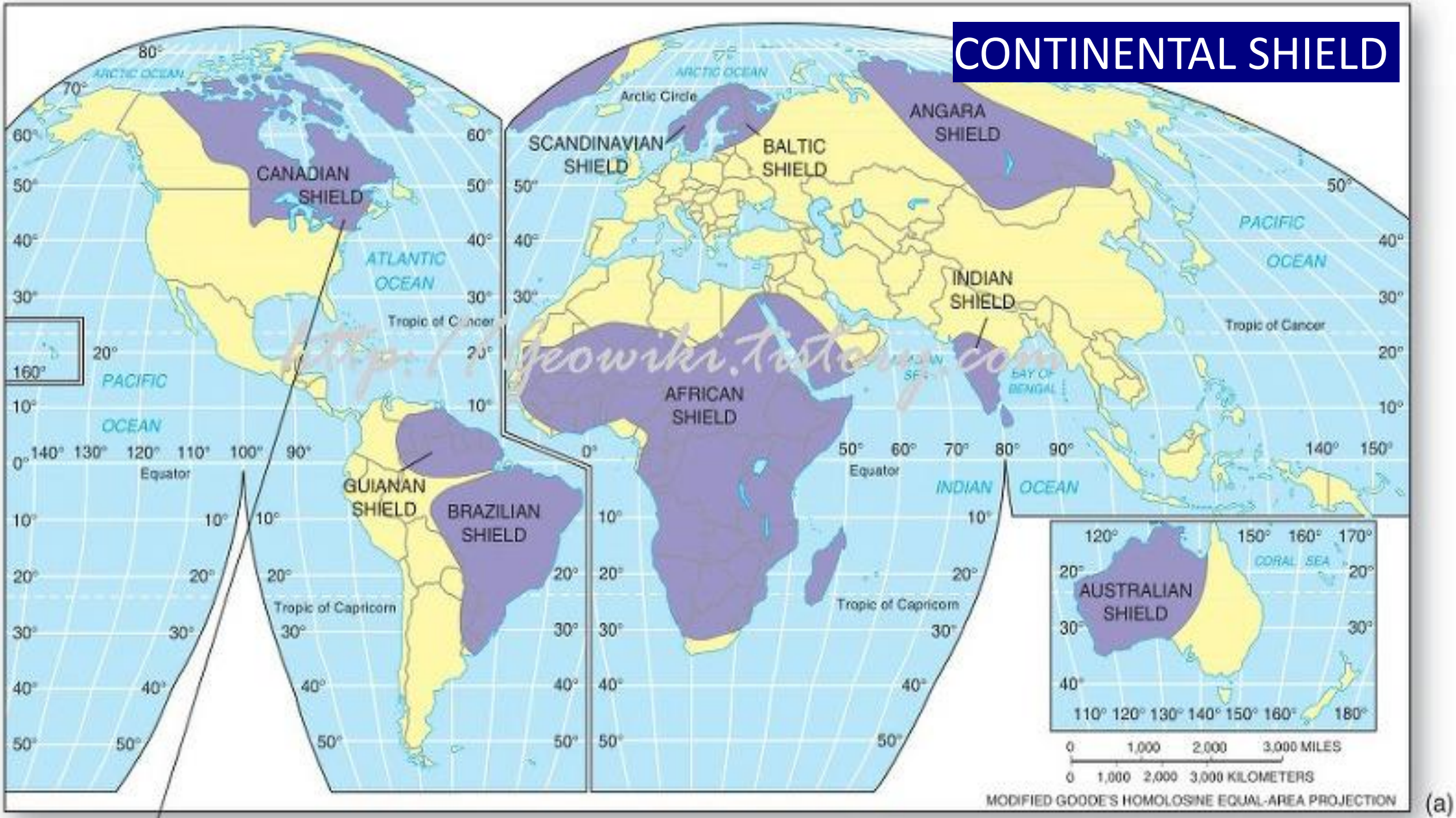
# CONTINENTAL DRIFT THEORY



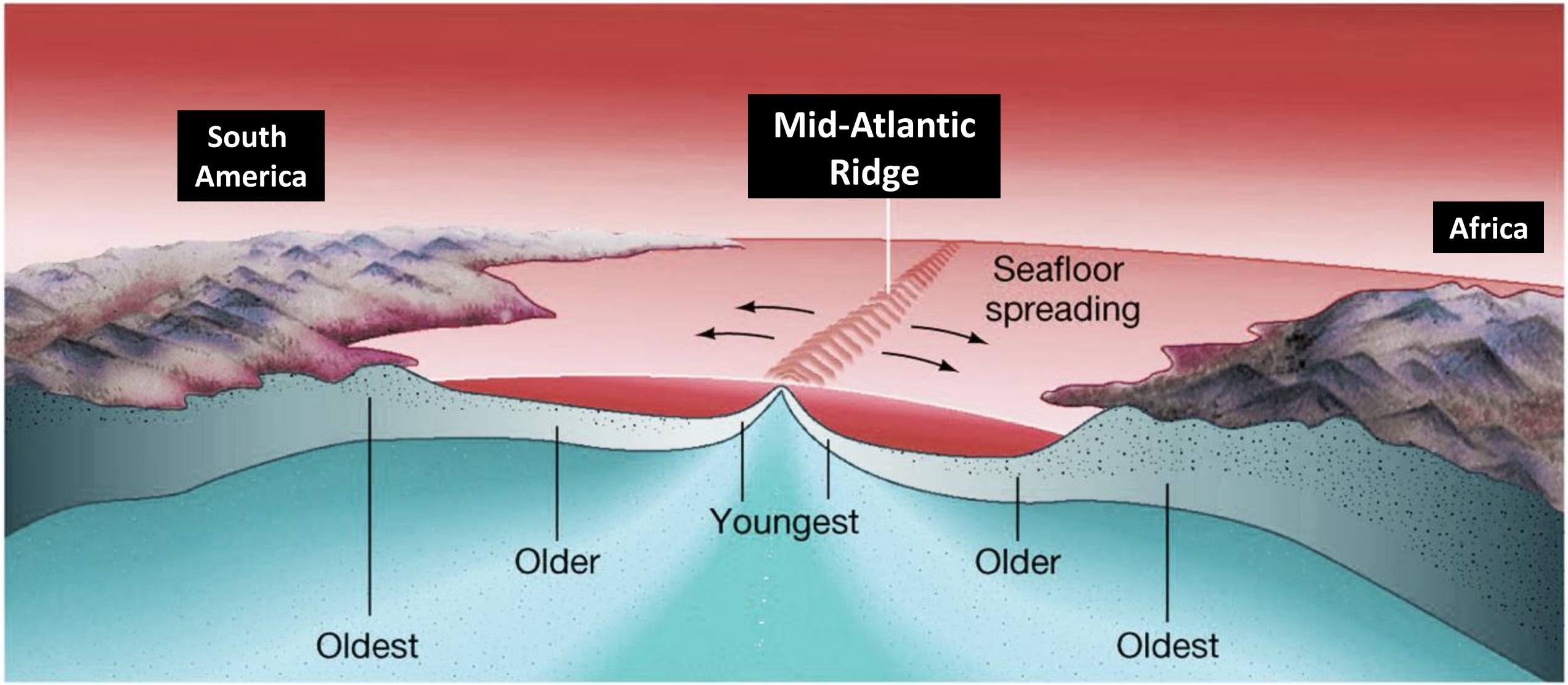
# EVIDENCES OF CDT




AFRICA
INDIA
Fossil evidence of the Triassic therapsid *Lystrosaurus*.
SOUTH AMERICA
ANTARCTICA
AUSTRALIA
Fossil remains of *Cynognathus*, a Triassic therapsid approximately 3m long.
Fossil remains of the freshwater reptile *Mesosaurus*.
Fossils of the fern *Glossopteris*, found in all of the southern continents, show that they were once joined.


CONTINENTAL SHIELD
CANADIAN SHIELD
SCANDINAVIAN SHIELD
BALTIC SHIELD
ANGARA SHIELD
INDIAN SHIELD
AFRICAN SHIELD
GUIANAN SHIELD
BRAZILIAN SHIELD
AUSTRALIAN SHIELD
ARCTIC OCEAN
Arctic Circle
ATLANTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
CORAL SEA
BAY OF BENGAL
Equator
Tropic of Cancer
Tropic of Capricorn
0 1,000 2,000 3,000 MILES
0 1,000 2,000 3,000 KILOMETERS
MODIFIED GOODE'S HOMOLOSINE EQUAL-AREA PROJECTION
(a)

# SEA FLOOR SPREADING




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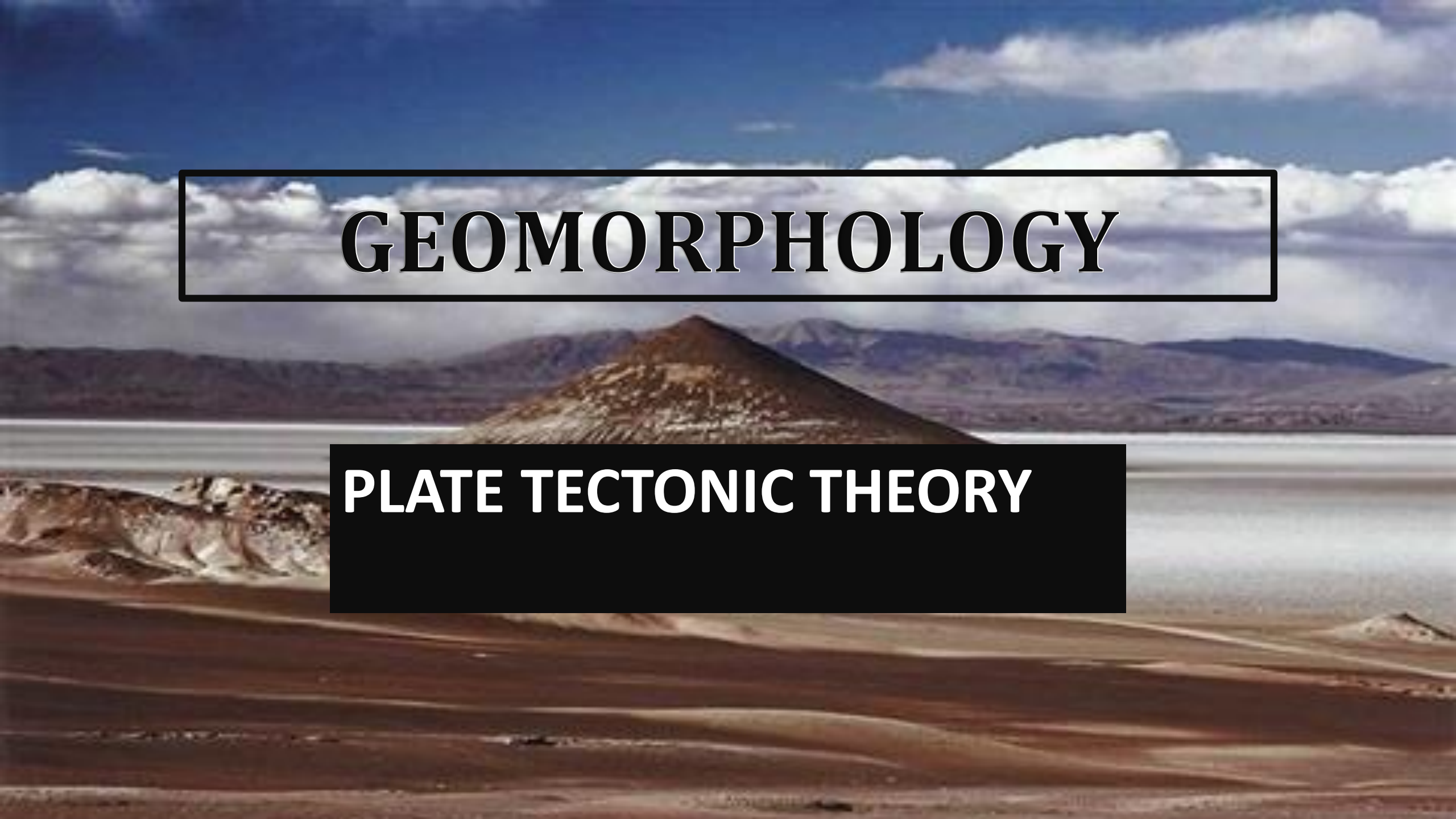
# Expected Question

Consider the following statements with regarding the Continental Drift Theory:

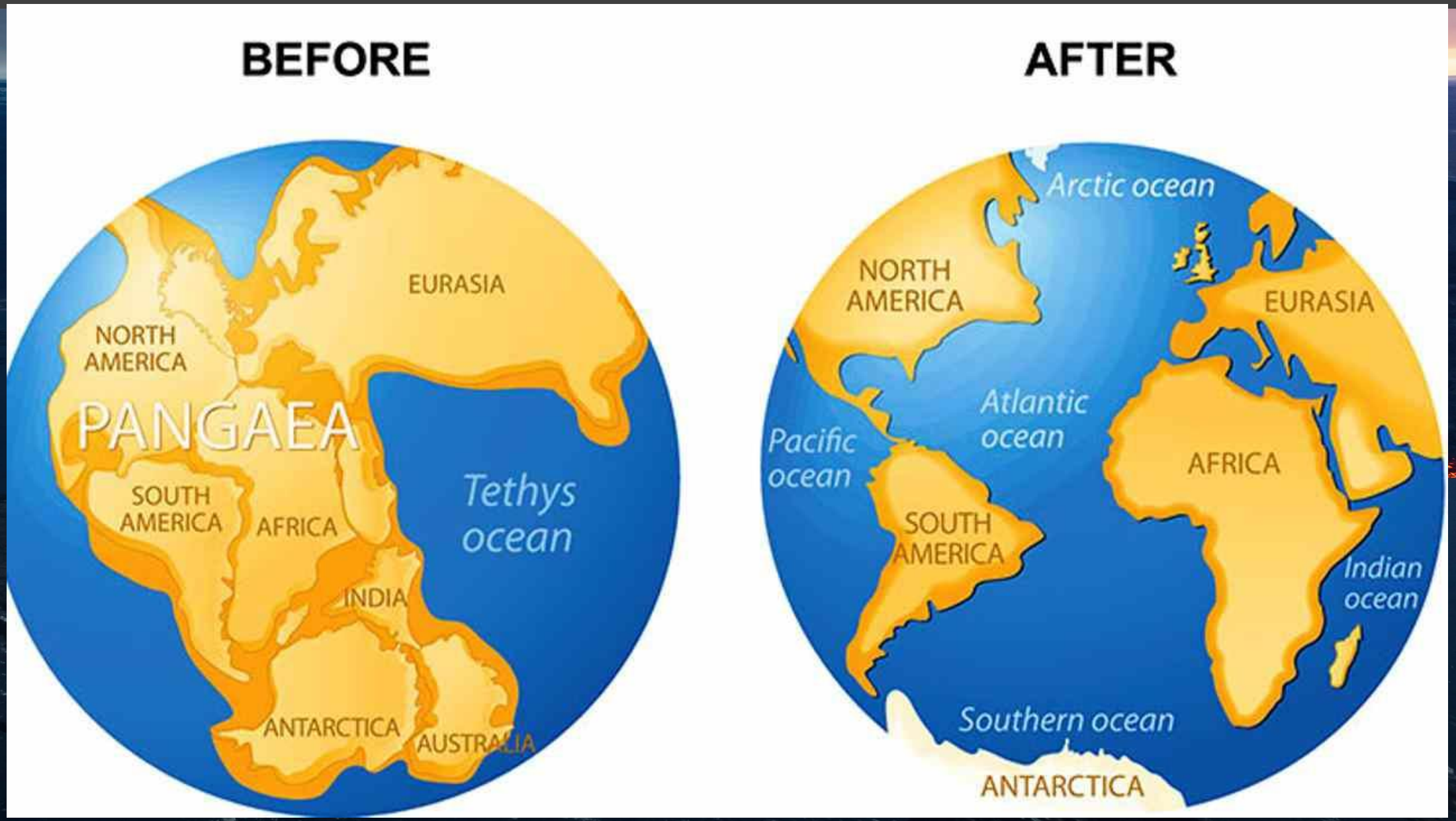
I. Panthalasa was the only ocean that surrounds Pangea.
II. Gondwanaland was the Southern part of Pangea.
III. Tethys sea was the dividing factor between Laurasia and Gondwanaland.

Which of the following statements are NOT true:

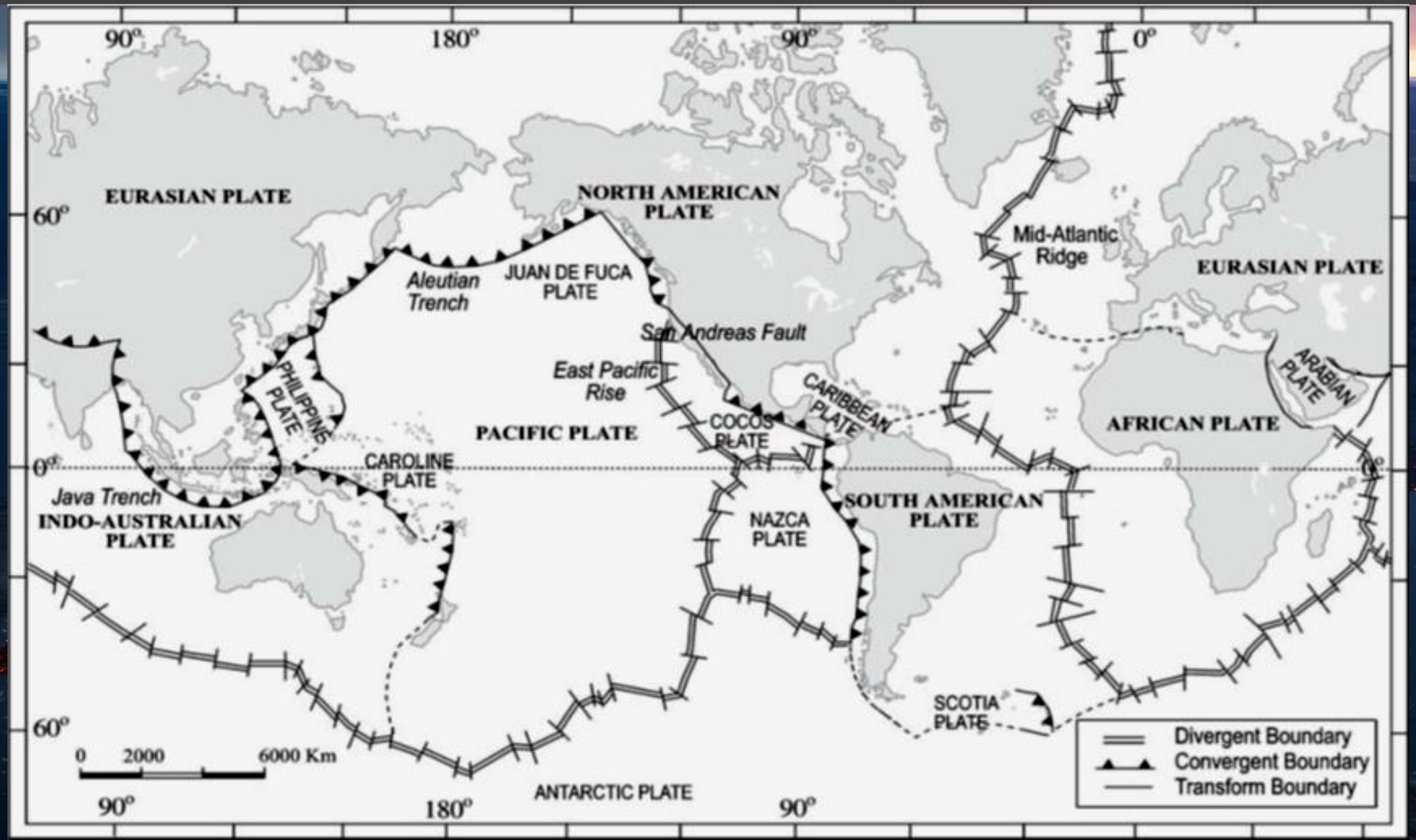
a. II and III
b. I and III
c. All of the above
d. None of the above.

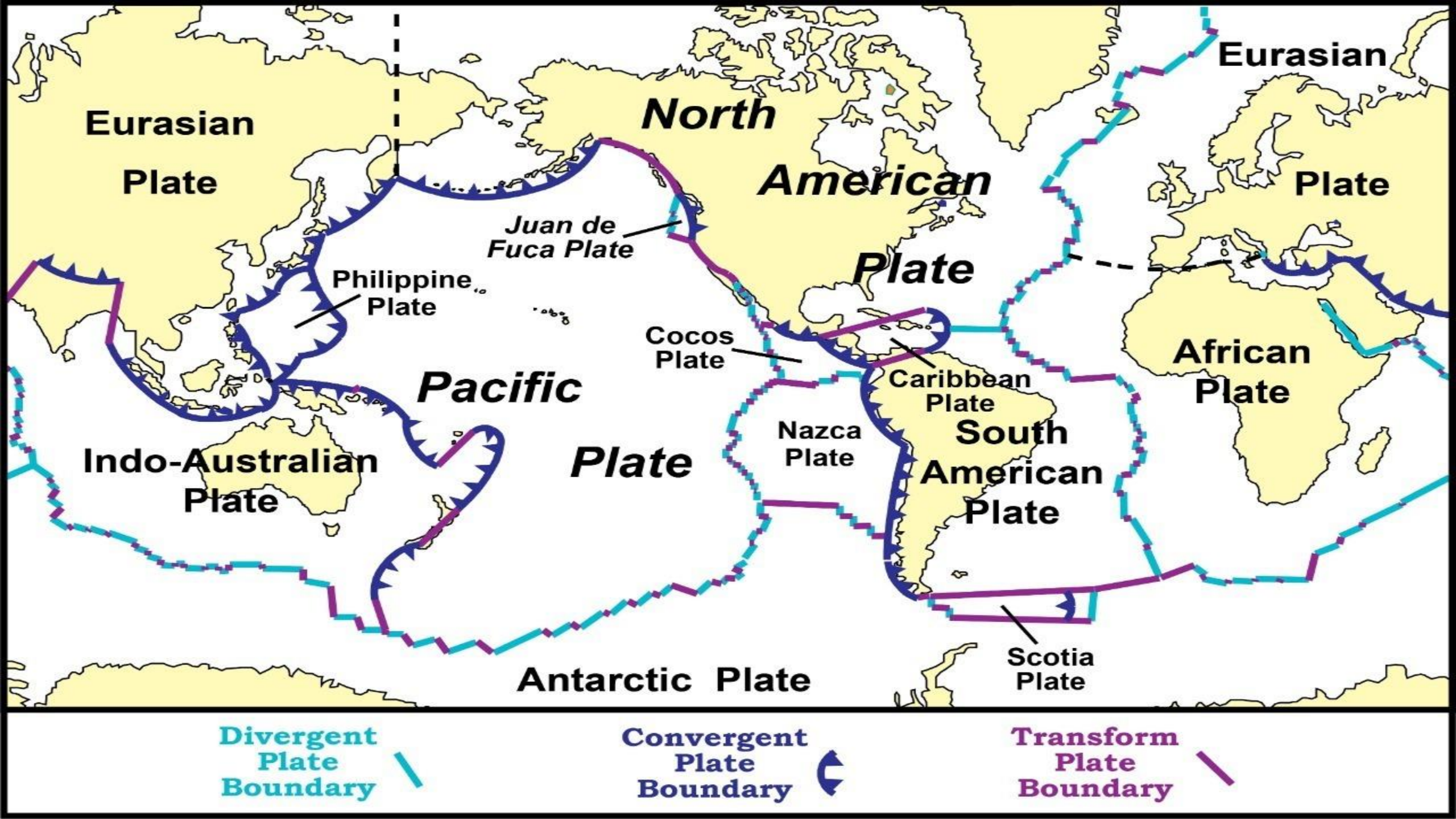

GEOMORPHOLOGY
PLATE TECTONIC THEORY

# PLATE TECTONICS



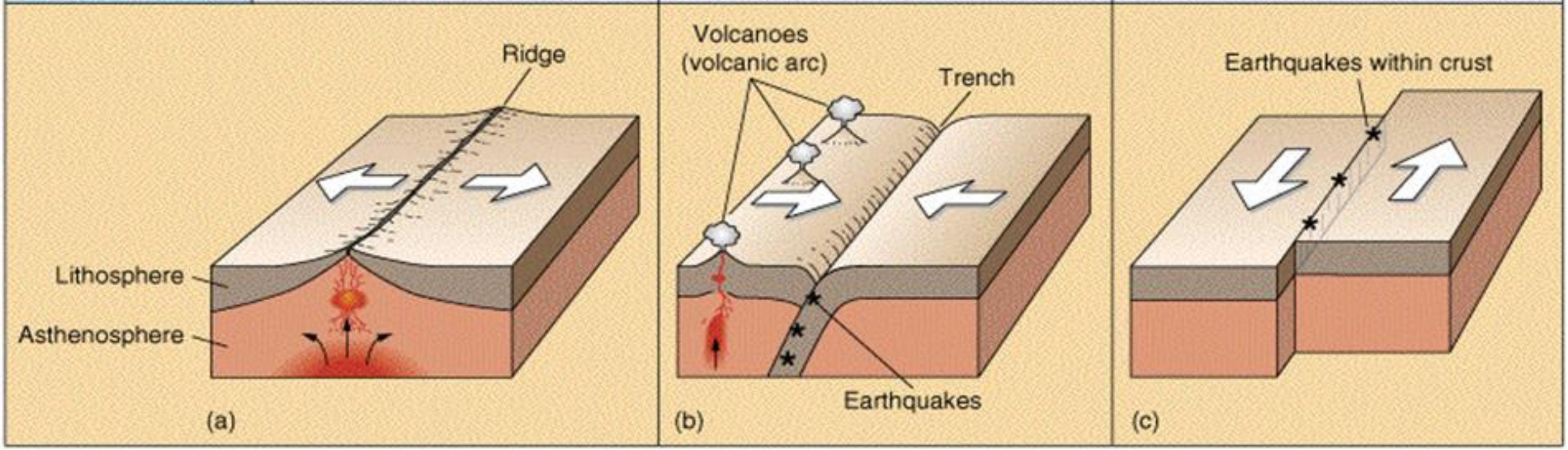
# MAJOR AND MINOR PLATES



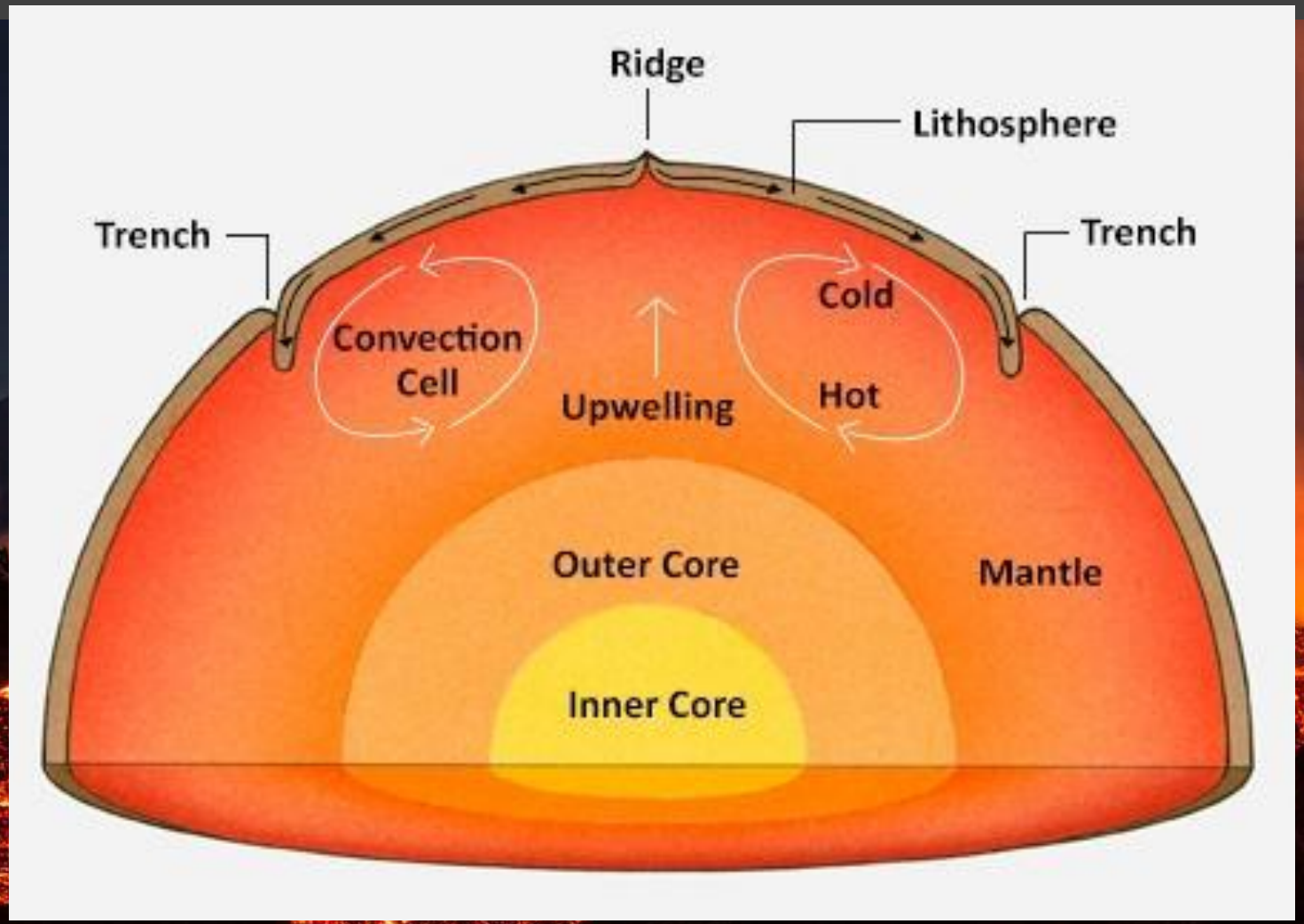

Eurasian
Plate
North
American
Plate
Eurasian
Plate
Juan de
Fuca Plate
Philippine
Plate
Cocos
Plate
Caribbean
Plate
African
Plate
Pacific
Plate
Nazca
Plate
South
American
Plate
Indo-Australian
Plate
Scotia
Plate
Antarctic Plate
Divergent
Plate
Boundary
Convergent
Plate
Boundary
Transform
Plate
Boundary

# PLATE BOUNDARIES

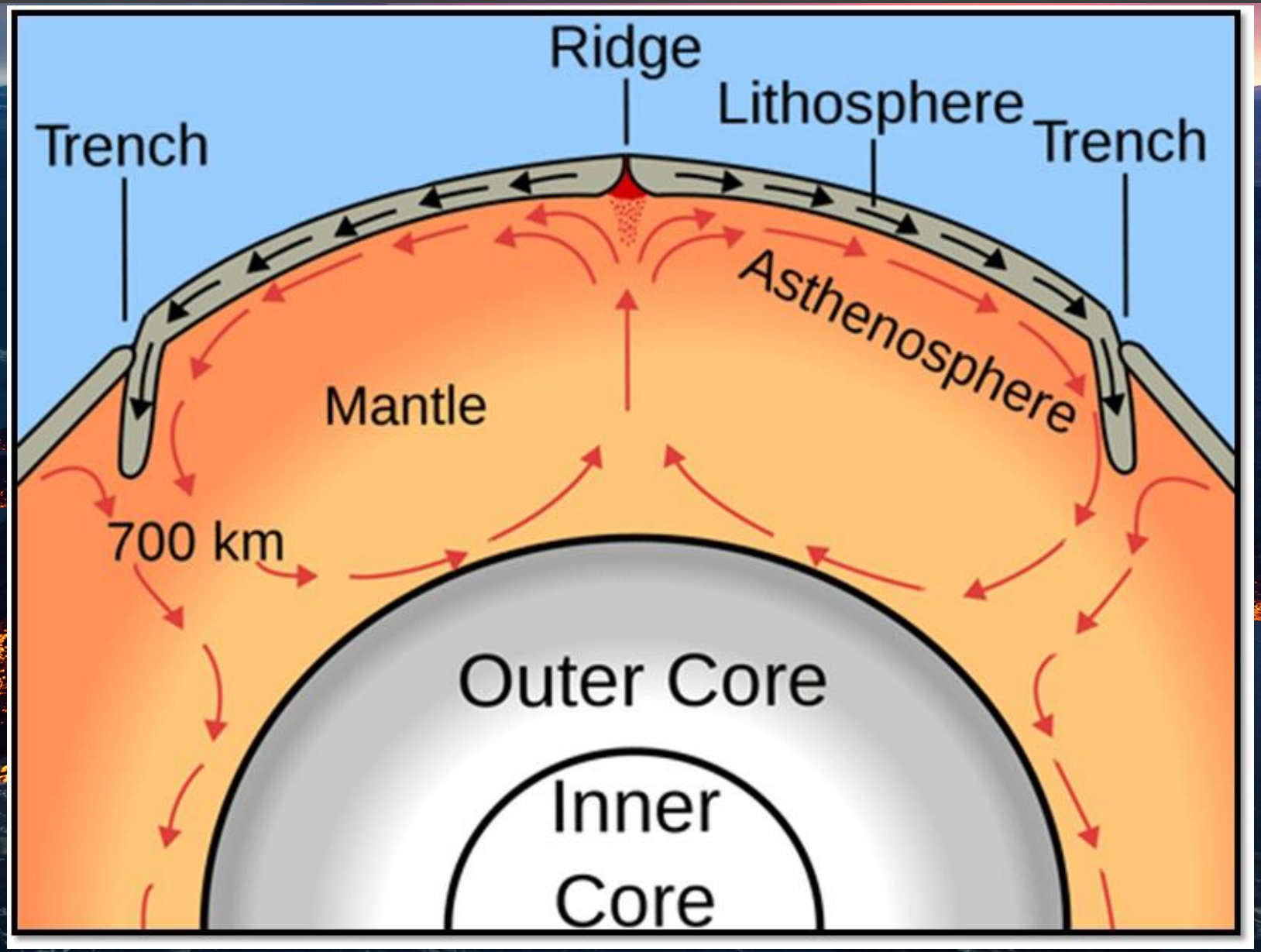
| Type of Margin | Divergent | Convergent | Transform |
|---|---|---|---|
| **Motion** | Spreading | Subduction | Lateral sliding |
| **Effect** | Constructive (oceanic lithosphere created) | Destructive (oceanic lithosphere destroyed) | Conservative (lithosphere neither created or destroyed) |
| **Topography** | Ridge/Rift | Trench | No major effect |
| **Volcanic activity?** | Yes | Yes | No |



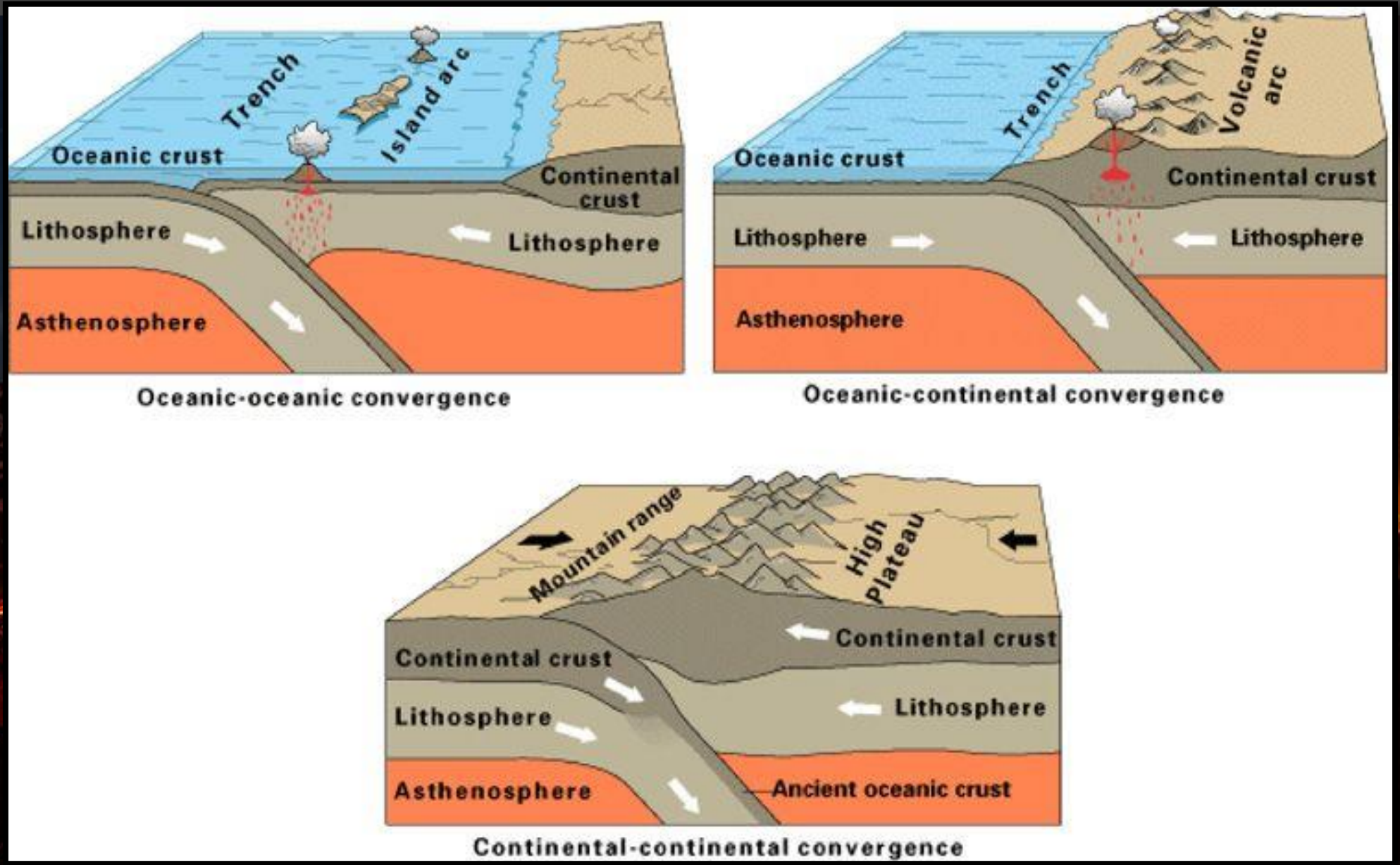
# THERMAL CONVECTION



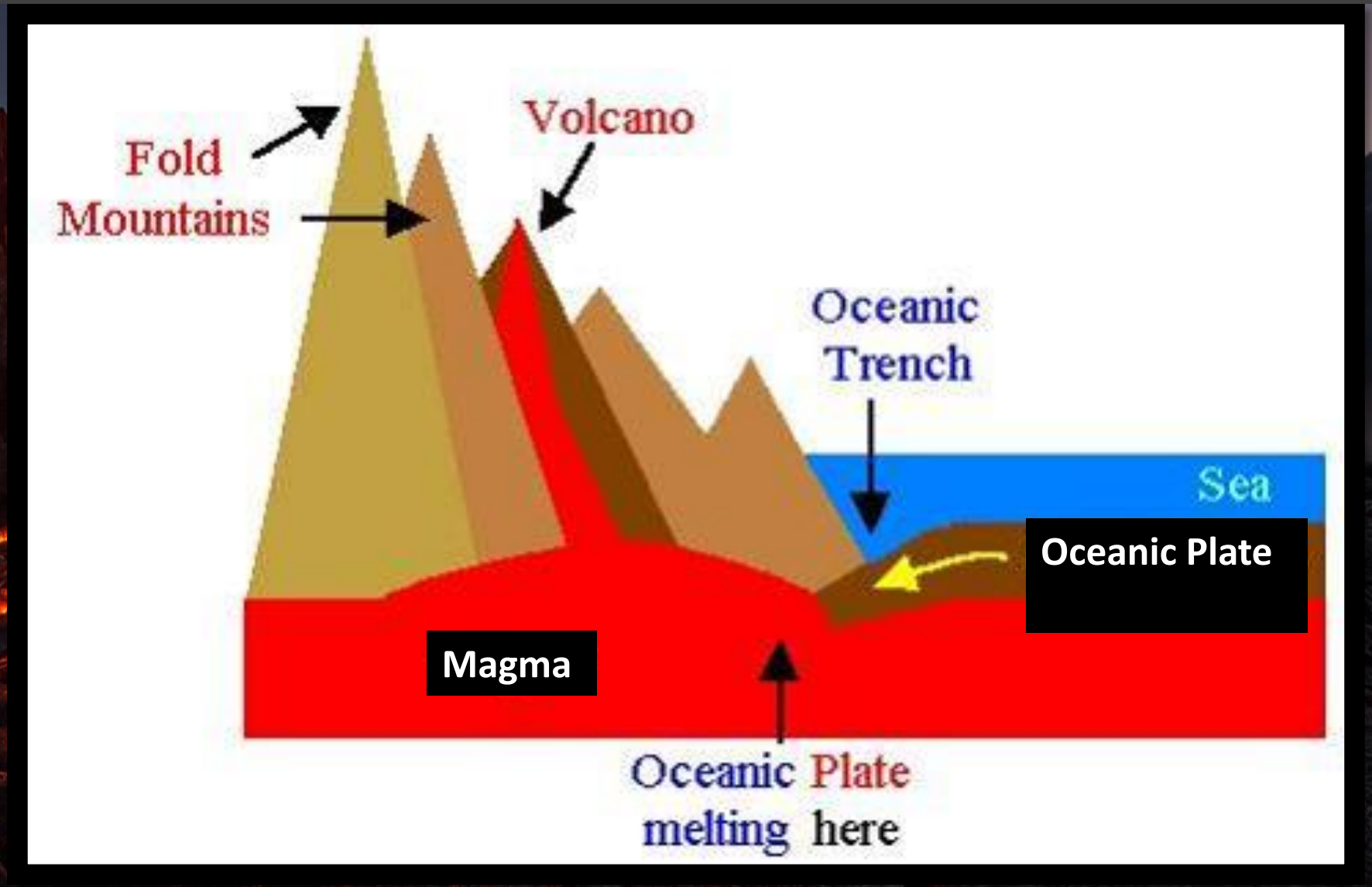
# RIDGES AND TRENCHES



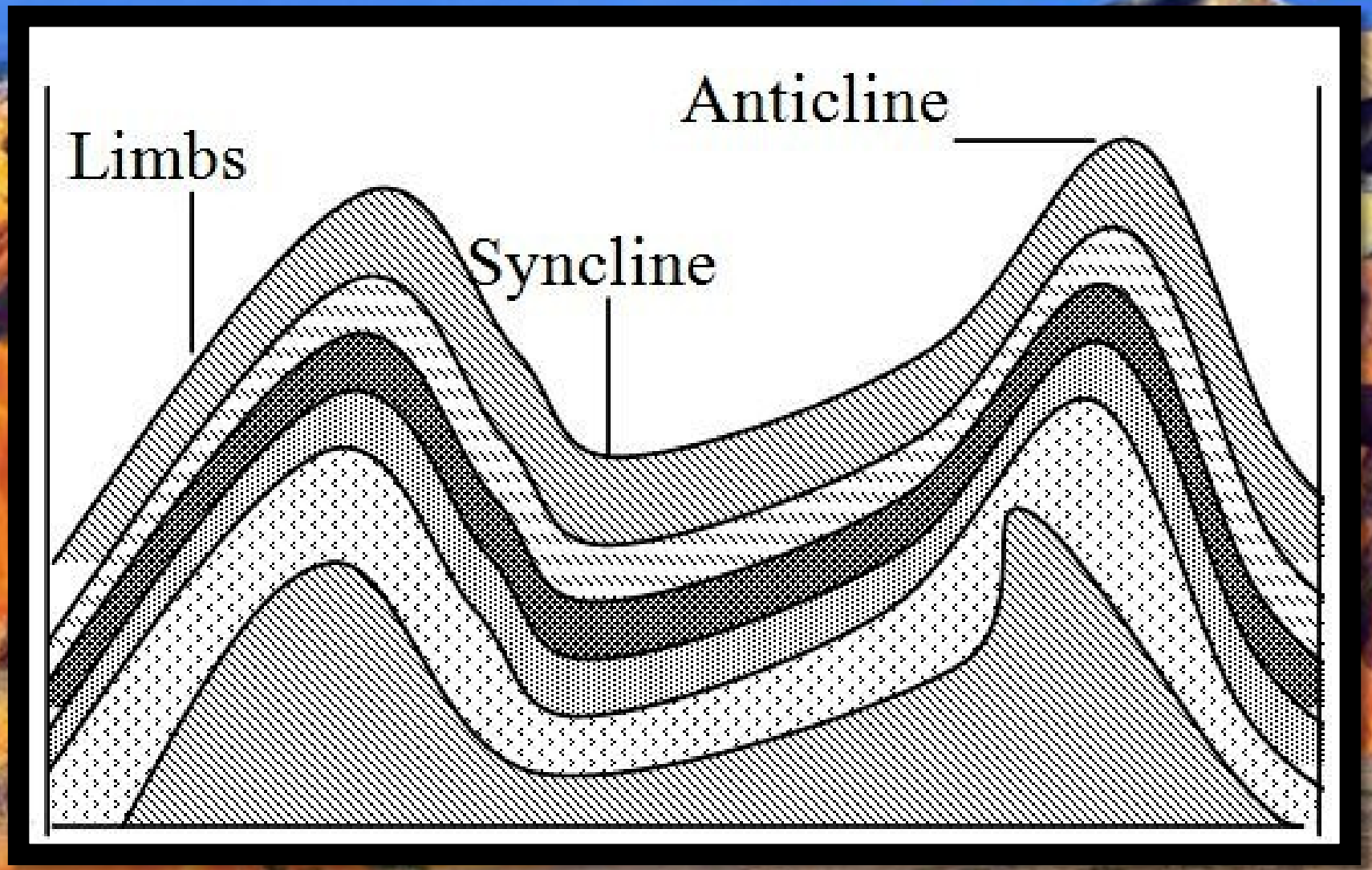
# CONVERGENT BOUNDARY

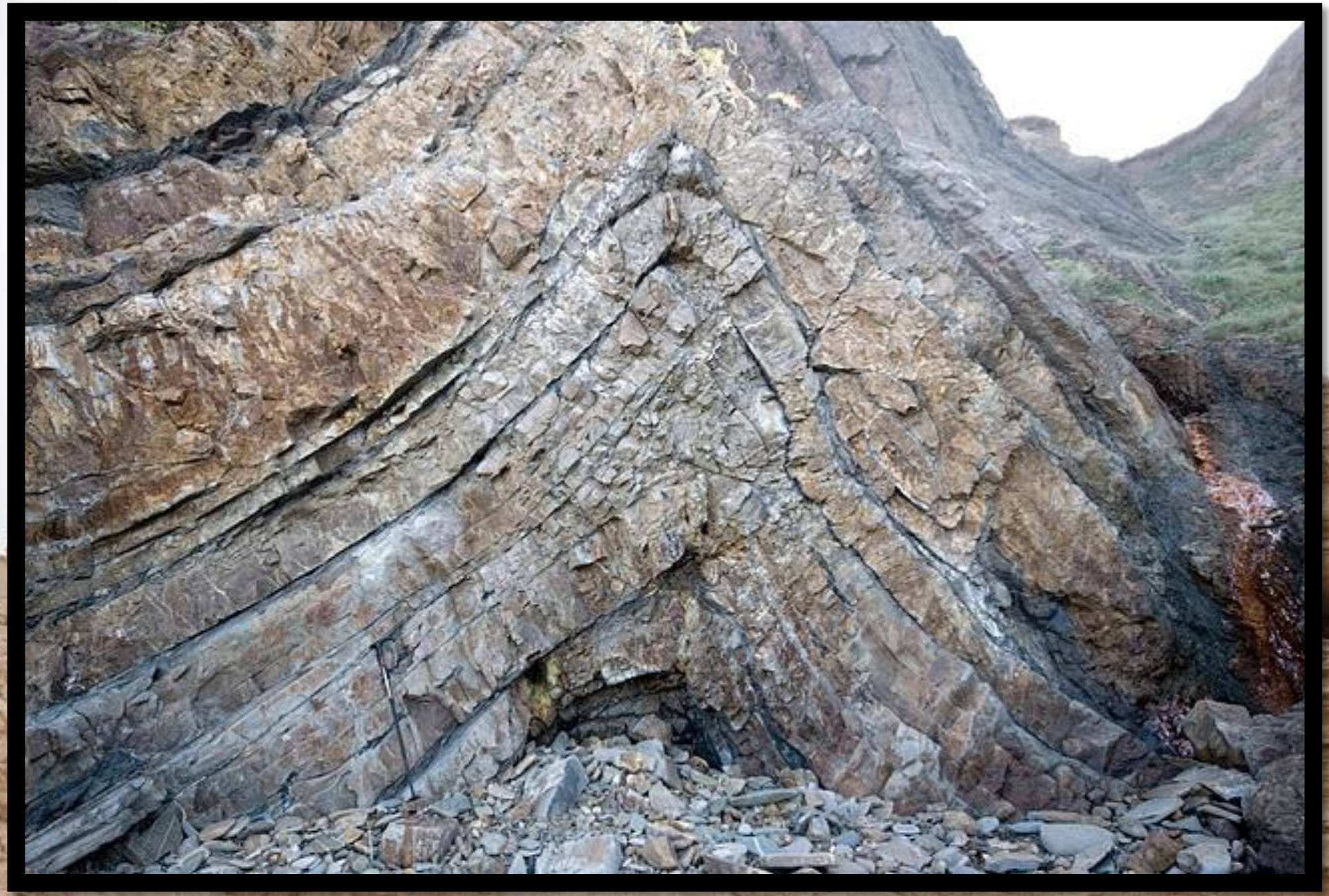


# FOLD MOUNTAINS

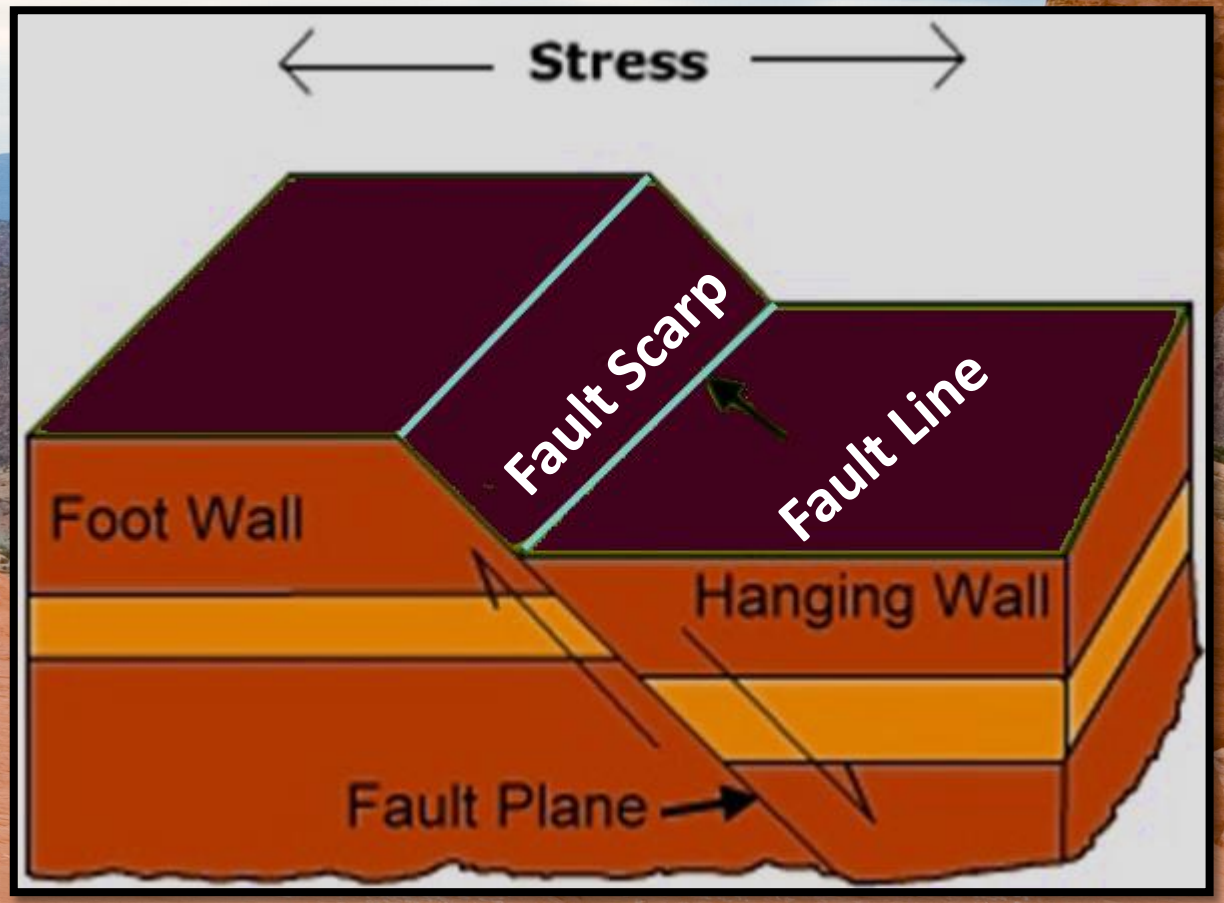


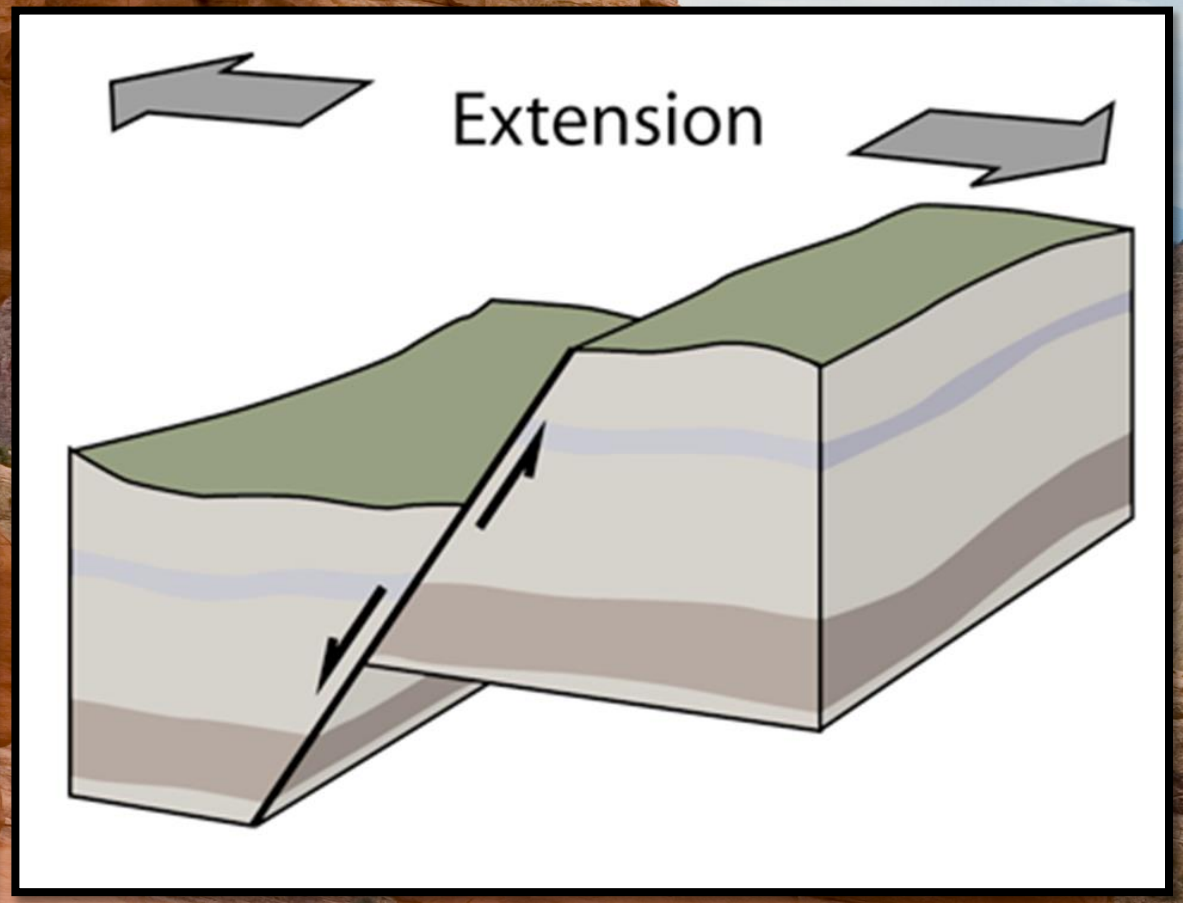
# FOLDING



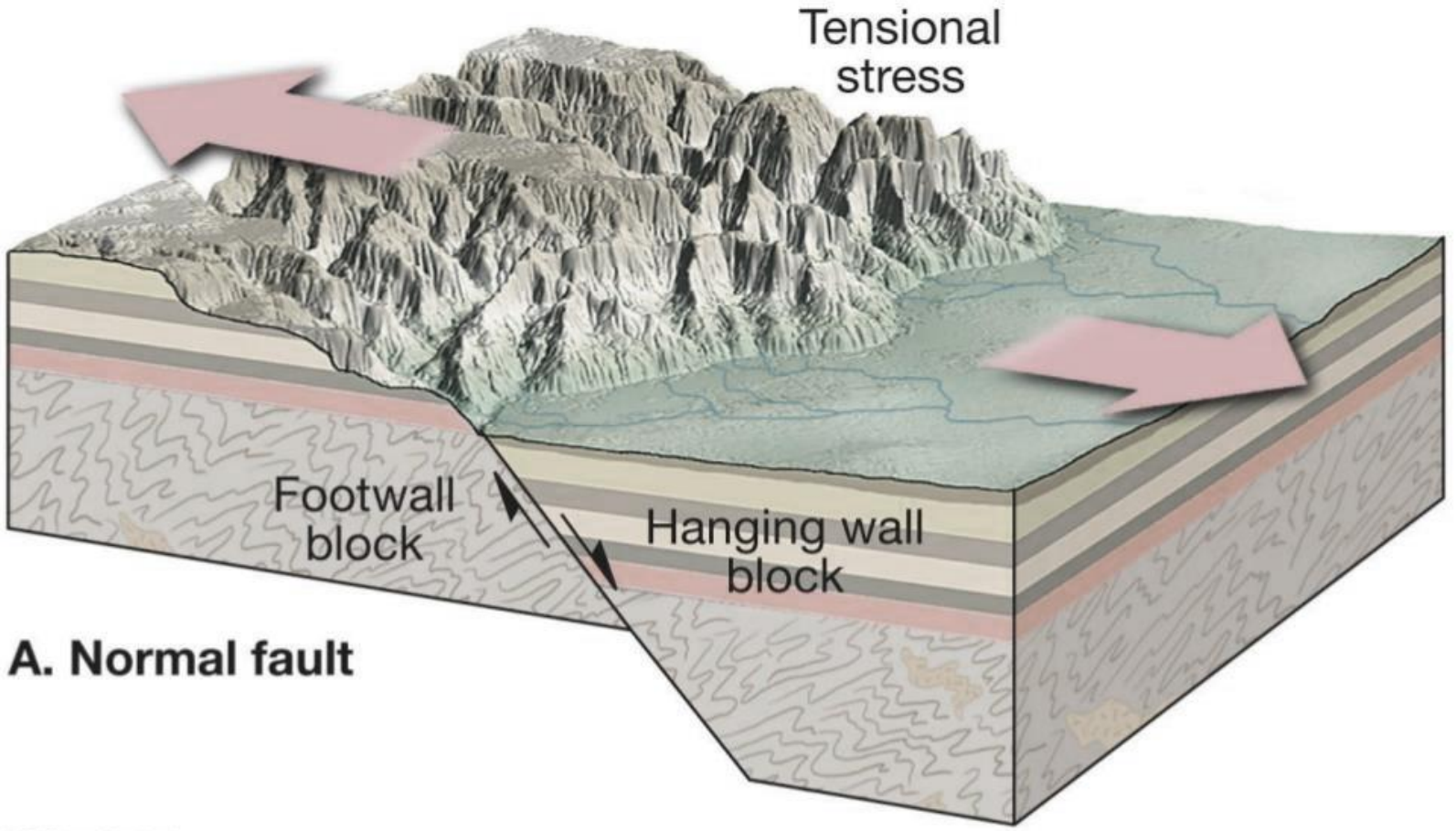


# FAULTING


Stress
Fault Scarp
Fault Line
Foot Wall
Hanging Wall
Fault Plane


Extension

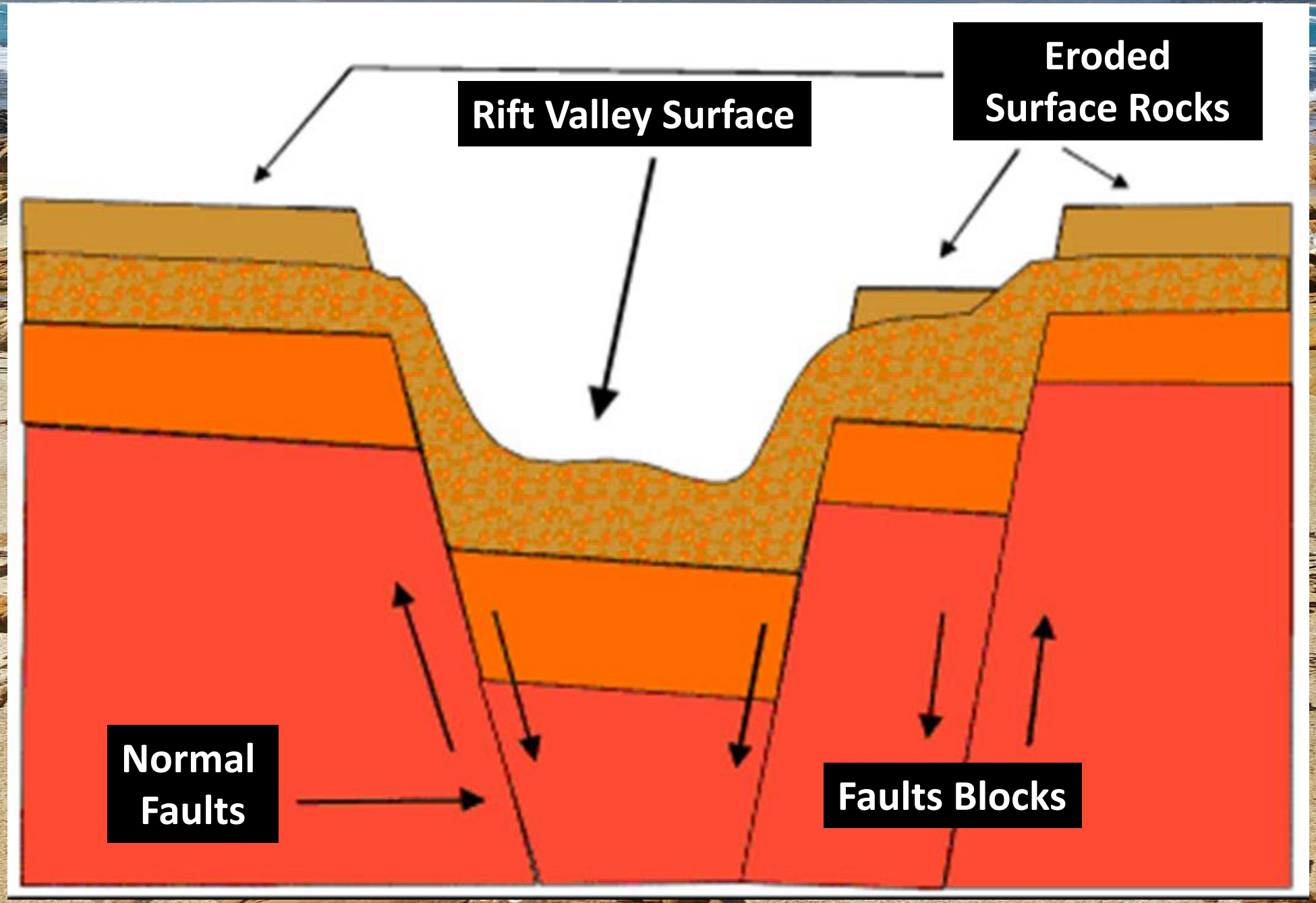
# A normal fault

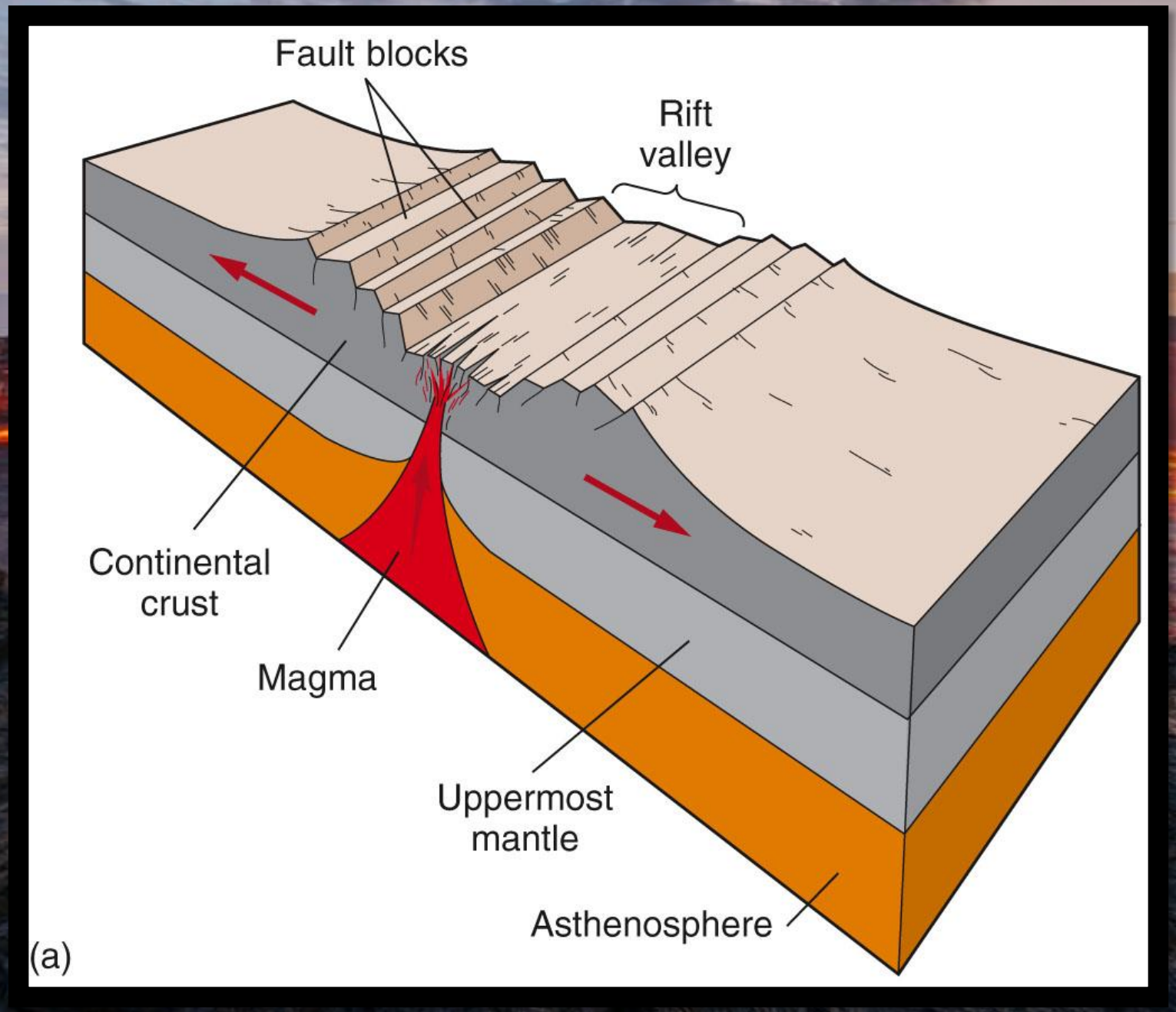



**A. Normal fault**

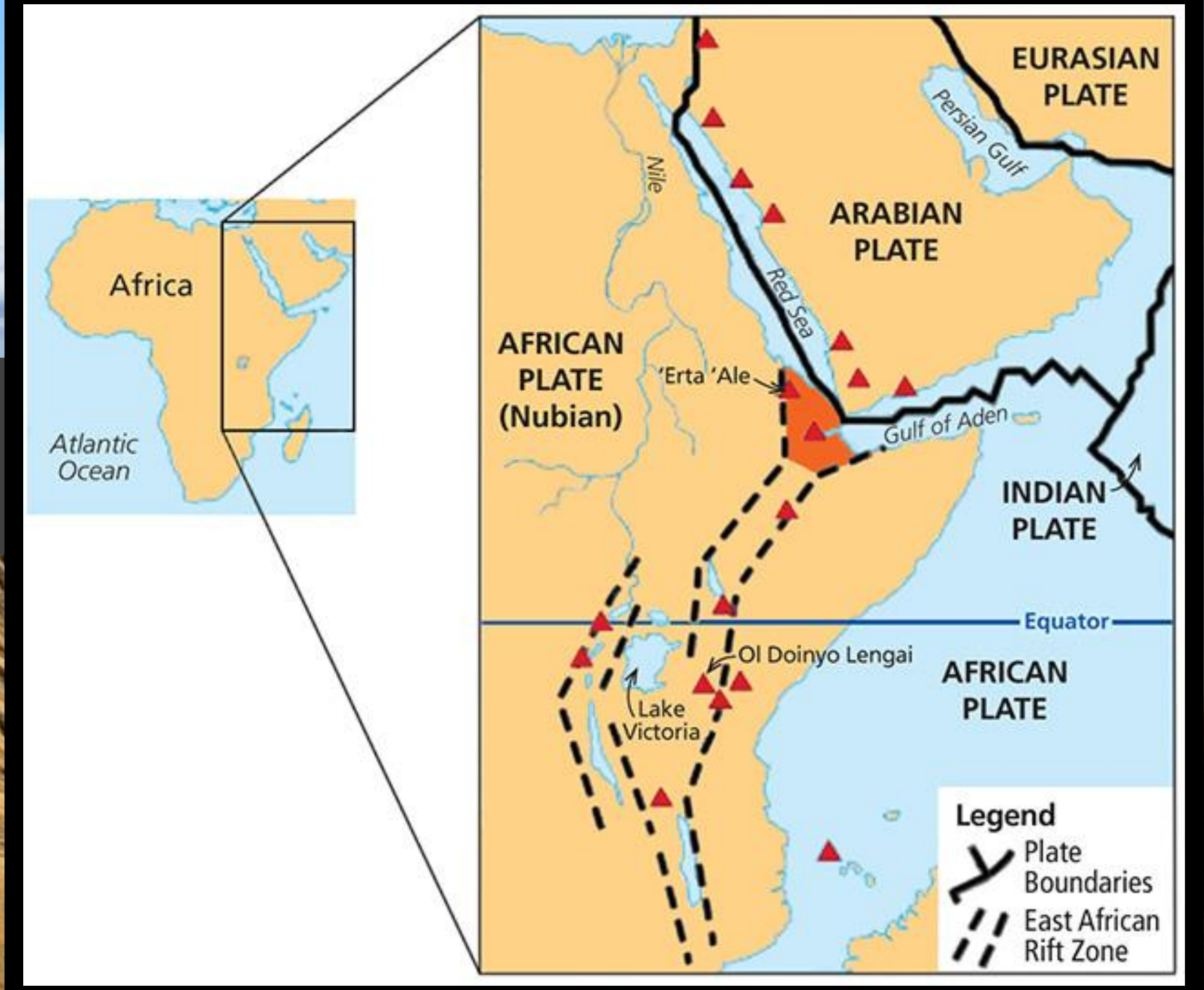
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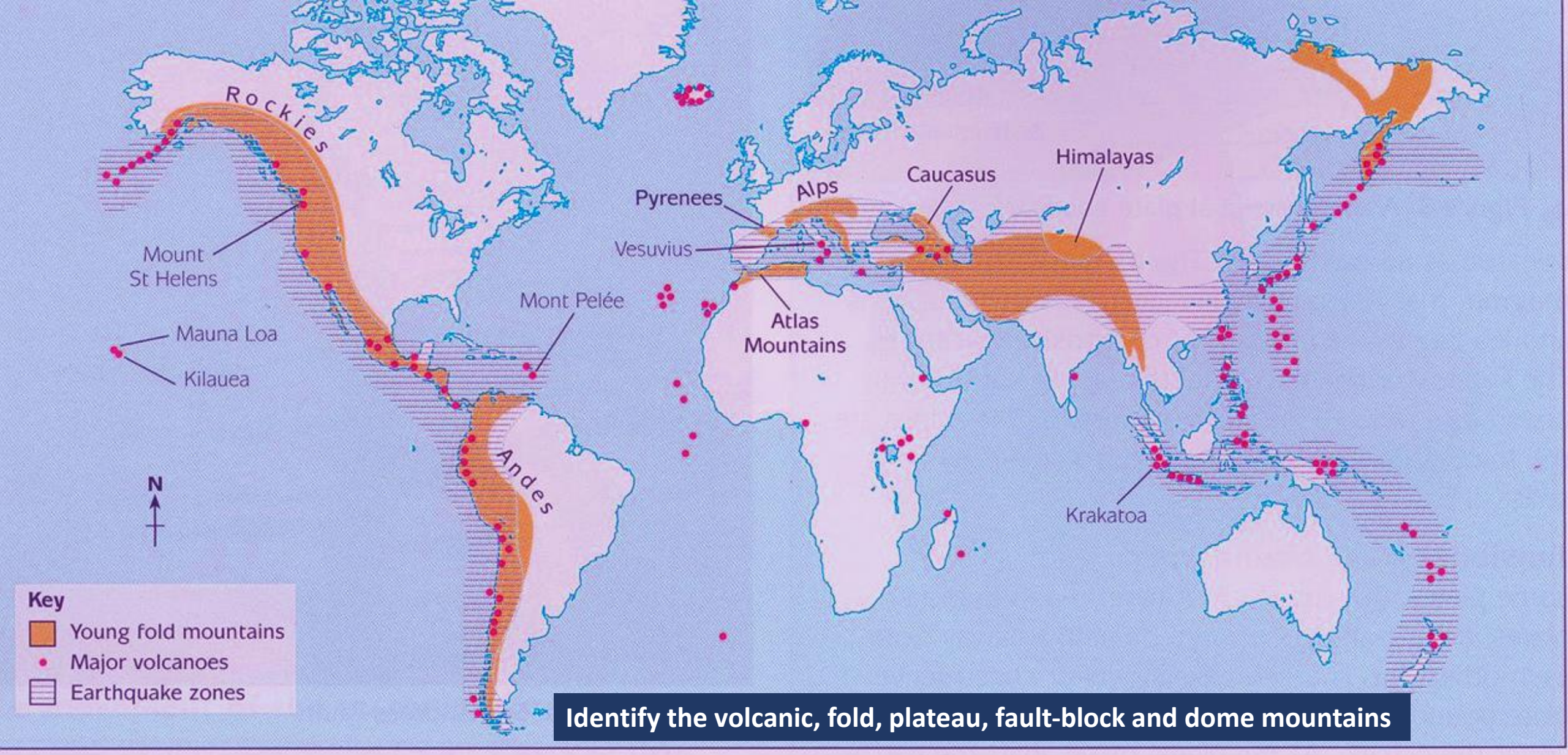
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Eroded
Surface Rocks
Rift Valley Surface
Normal
Faults
Faults Blocks


Fault blocks
Rift valley
Continental crust
Magma
Uppermost mantle
Asthenosphere
(a)

# AFRICAN RIFT VALLEY

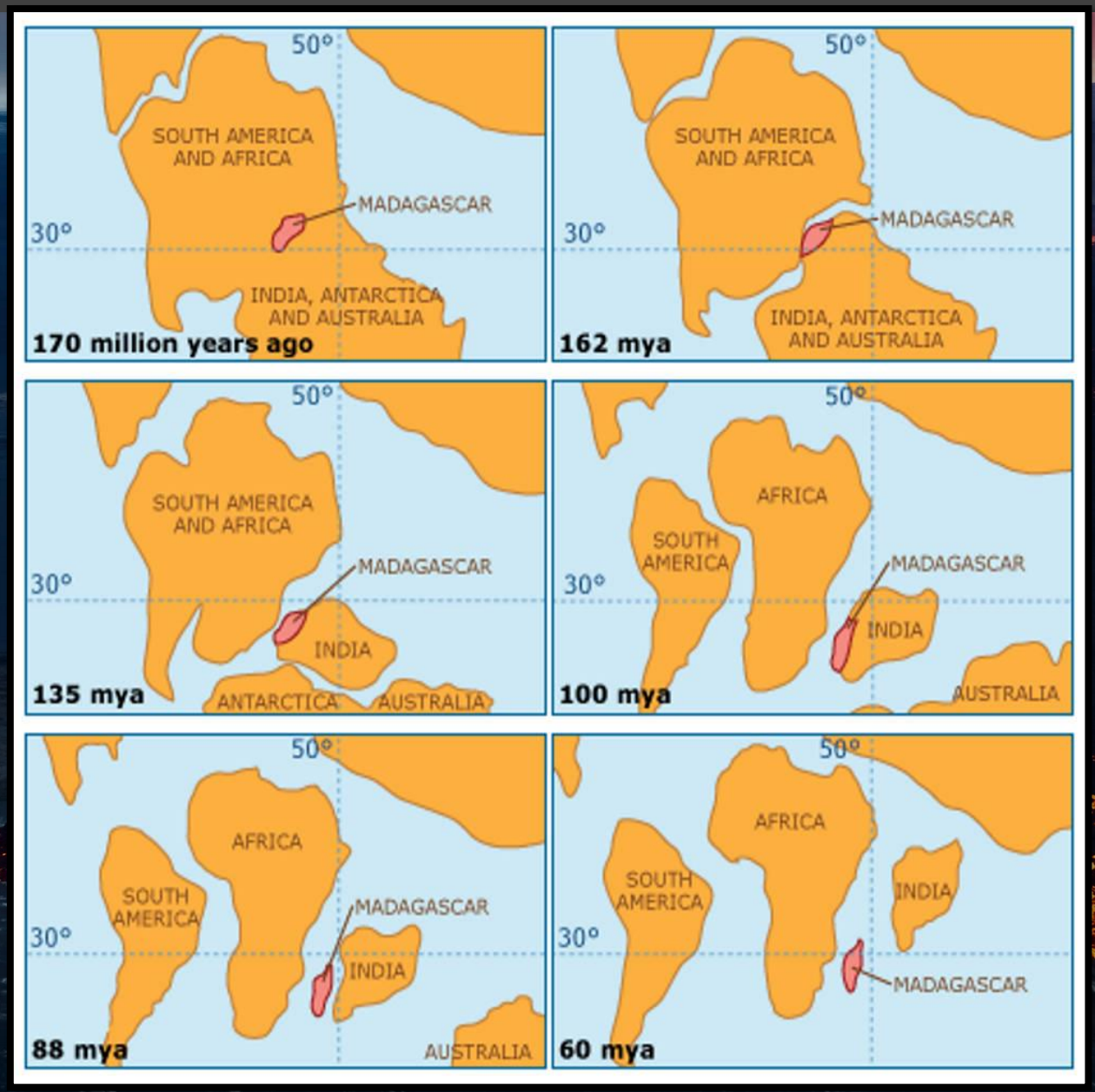




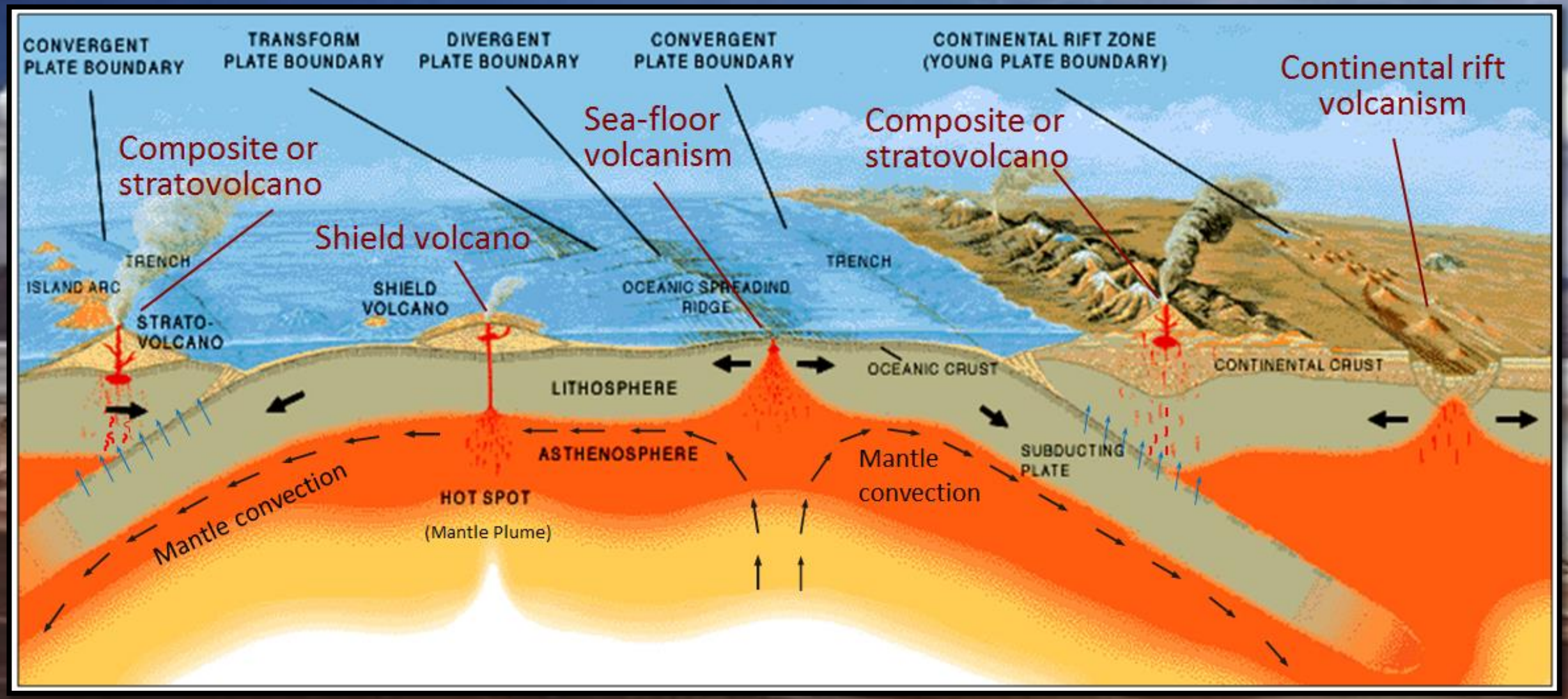

**Identify the volcanic, fold, plateau, fault-block and dome mountains**

The world distribution of young fold mountains, active volcanoes and earthquake zones.

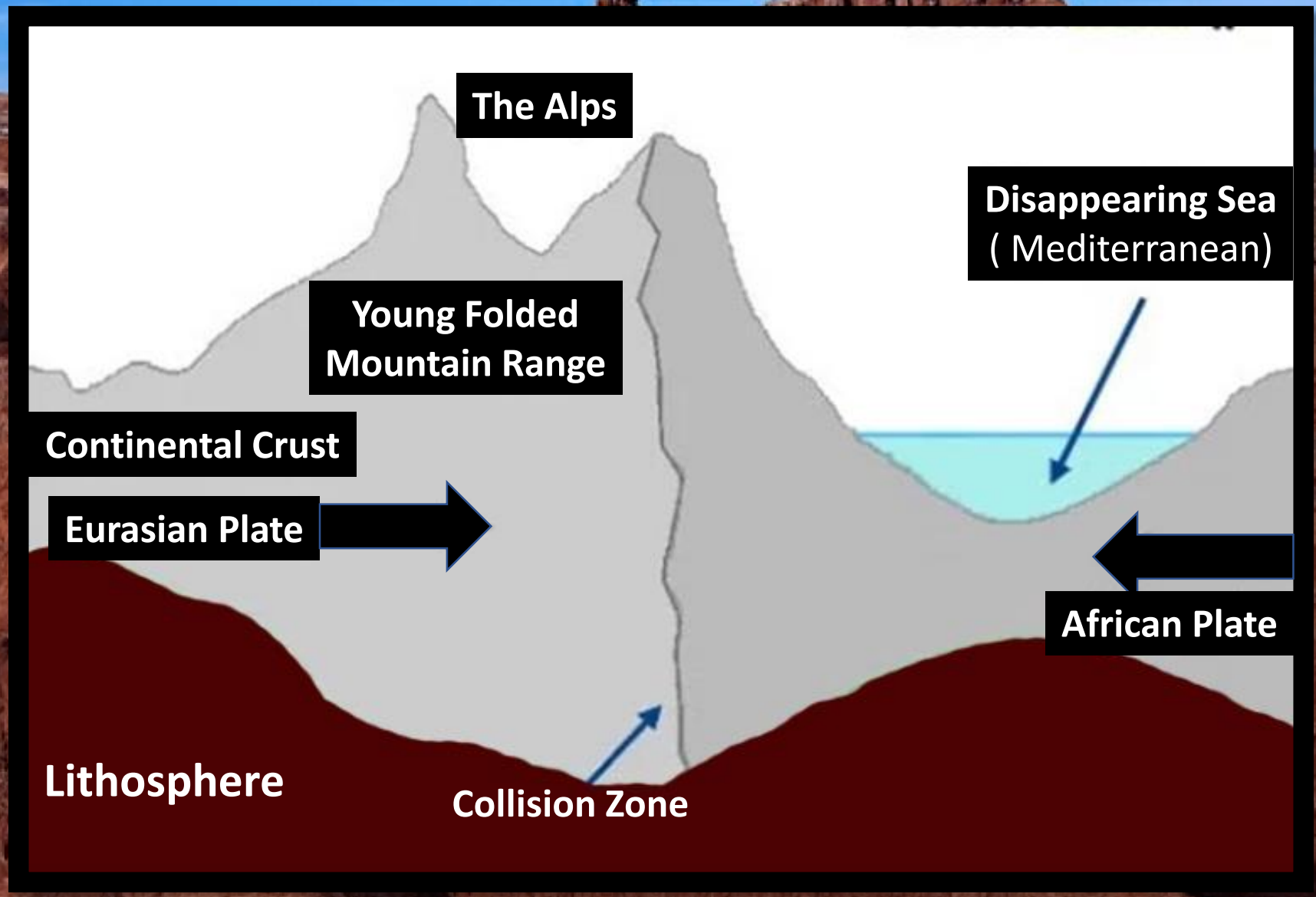
# INDIAN PLATE MOVEMENT







CONVERGENT PLATE BOUNDARY
TRANSFORM PLATE BOUNDARY
DIVERGENT PLATE BOUNDARY
CONVERGENT PLATE BOUNDARY
CONTINENTAL RIFT ZONE (YOUNG PLATE BOUNDARY)
Composite or stratovolcano
Shield volcano
Sea-floor volcanism
Composite or stratovolcano
Continental rift volcanism
TRENCH
ISLAND ARC
STRATO-VOLCANO
SHIELD VOLCANO
OCEANIC SPREADING RIDGE
TRENCH
LITHOSPHERE
OCEANIC CRUST
CONTINENTAL CRUST
ASTHENOSPHERE
SUBDUCTING PLATE
Mantle convection
HOT SPOT
(Mantle Plume)
Mantle convection

# DISAPPEARING SEA



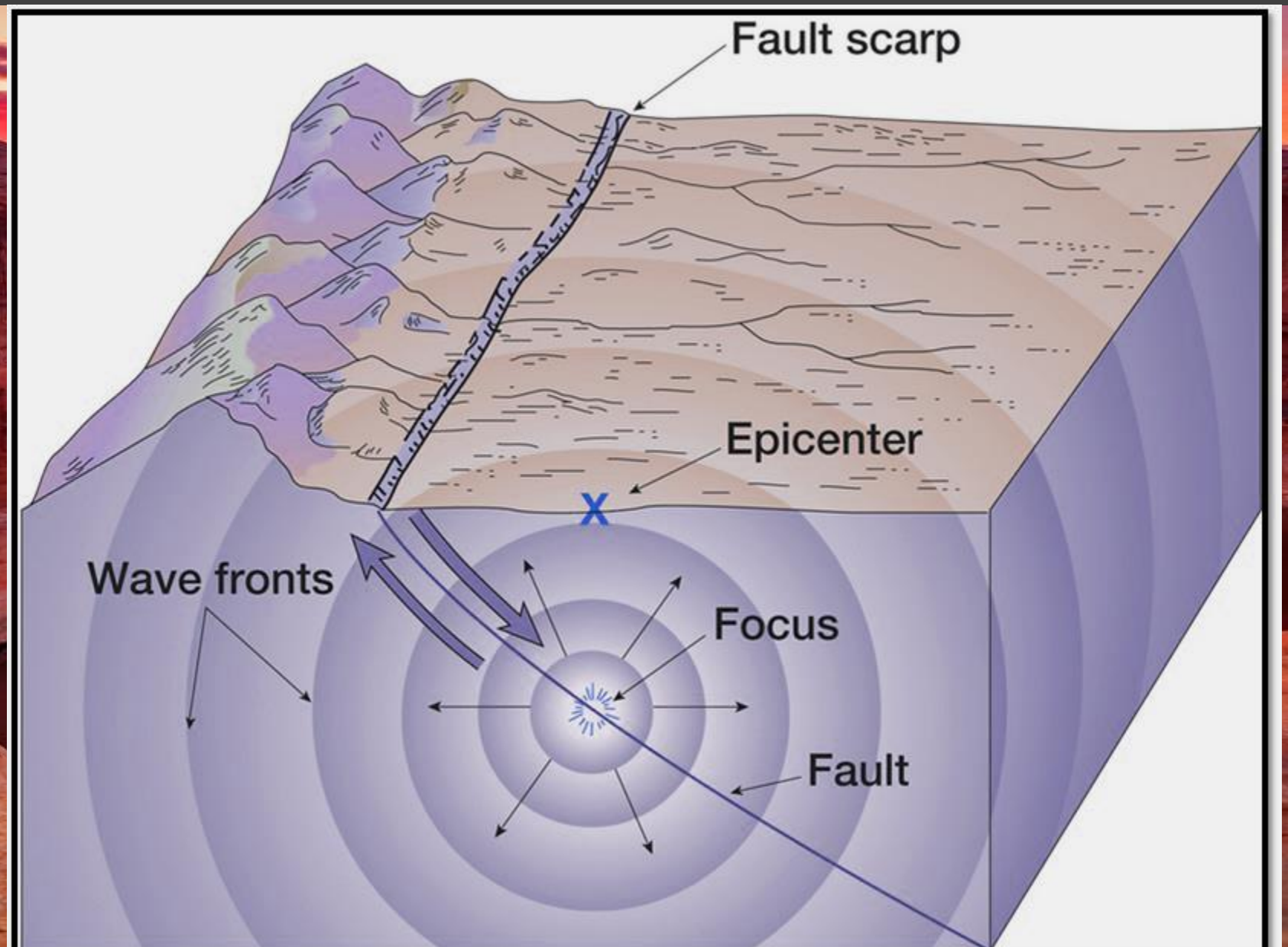

Poland
Belarus
Netherlands
London
Berlin
Warsaw
Germany
Kyiv
Київ
Belgium
Paris
Czechia
Slovakia
Ukraine
Austria
Moldova
Hungary
France
Romania
Croatia
Serbia
Black Sea
Italy
Rome
Bulgaria
Madrid
İstanbul
Ankara
Spain
Tyrrhenian Sea
Greece
Turkey
Tunisia
Mediterranean Sea
Lebanon
Israel
Jordan
Cairo
القاهرة
Algeria
Libya
Egypt
Map data ©2021 Google

# GEOMORPHOLOGY

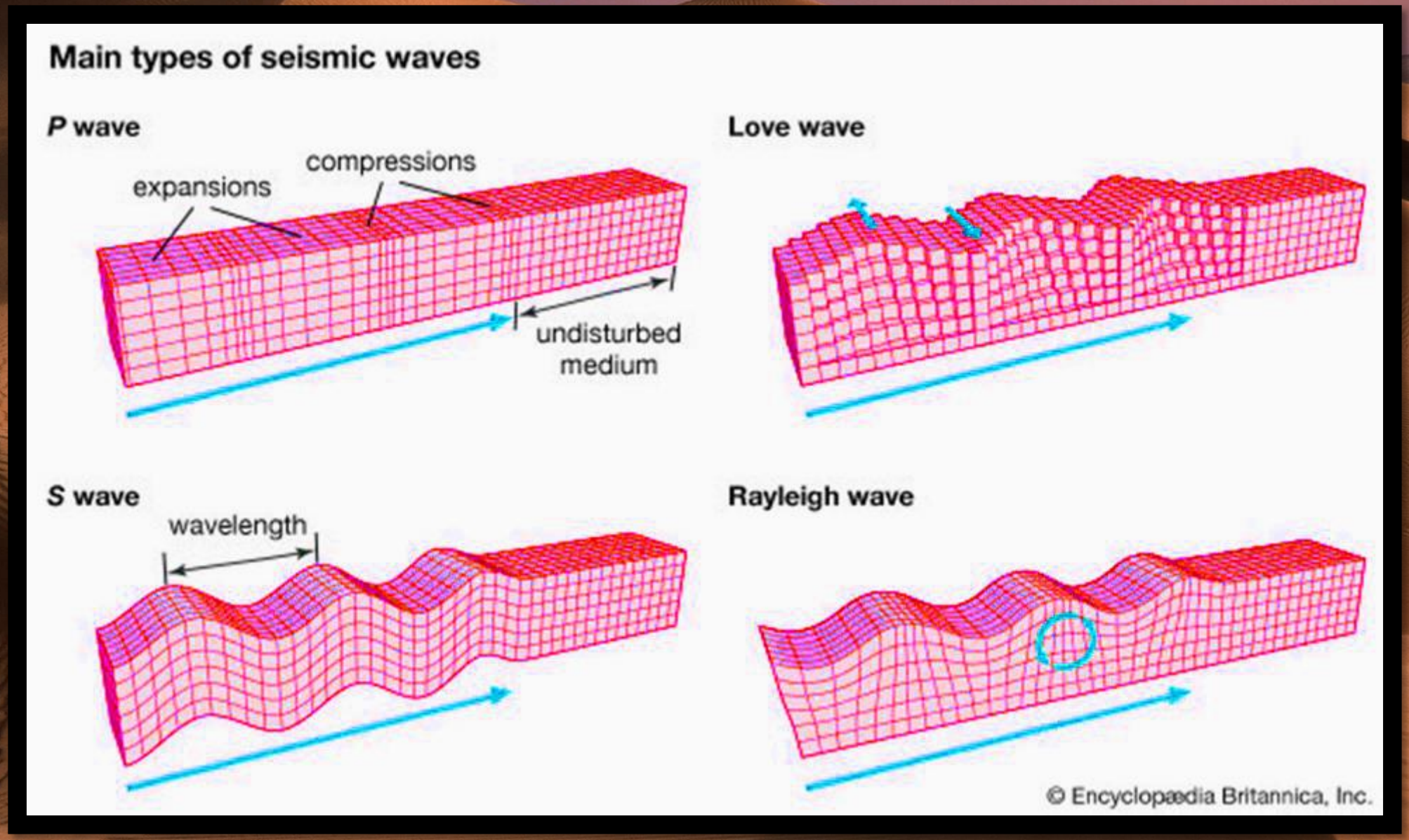
## EARTHQUAKES



# FOCUS AND EPICENTRE



# EARTHQUAKE WAVES



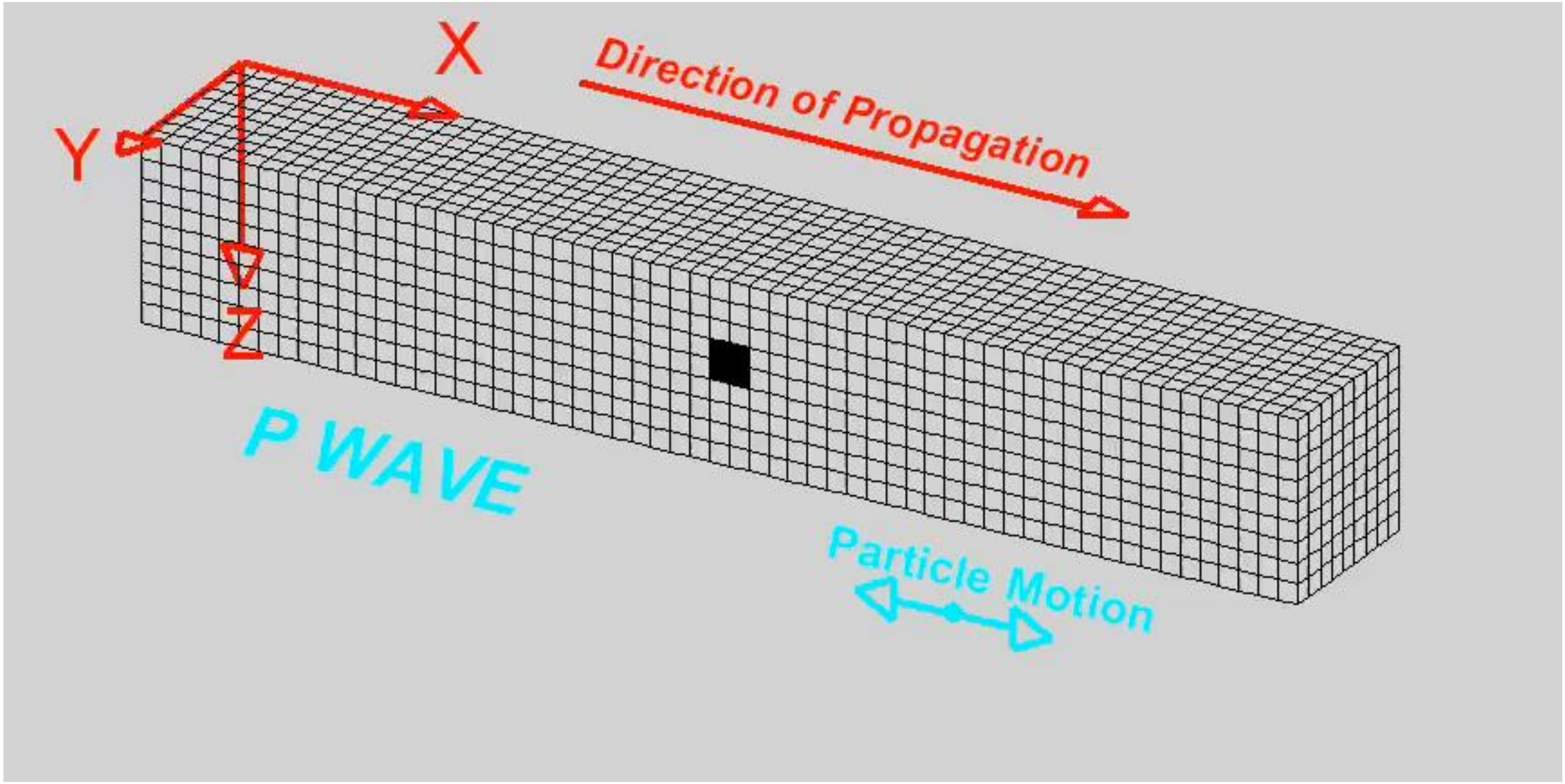
**Primary Waves (P-waves)**

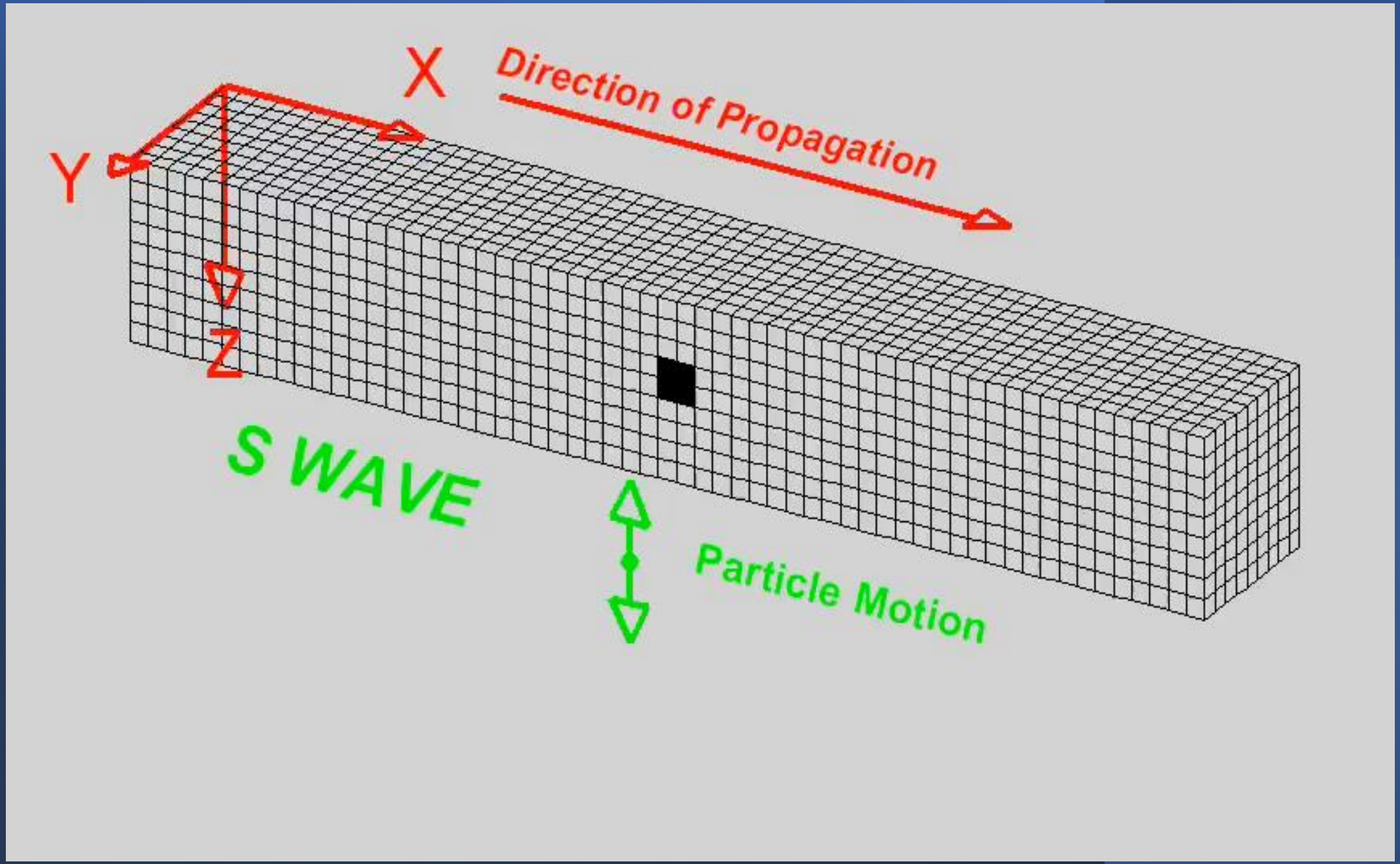
- **P-waves are also called as the longitudinal waves, compressional waves, pressure waves.**
- **P-waves creates density differences in the material leading to stretching (rarefaction) and squeezing (compression) of the material.**
- **They can travel in all mediums, and their velocity depends on shear strength (elasticity) of the medium.**

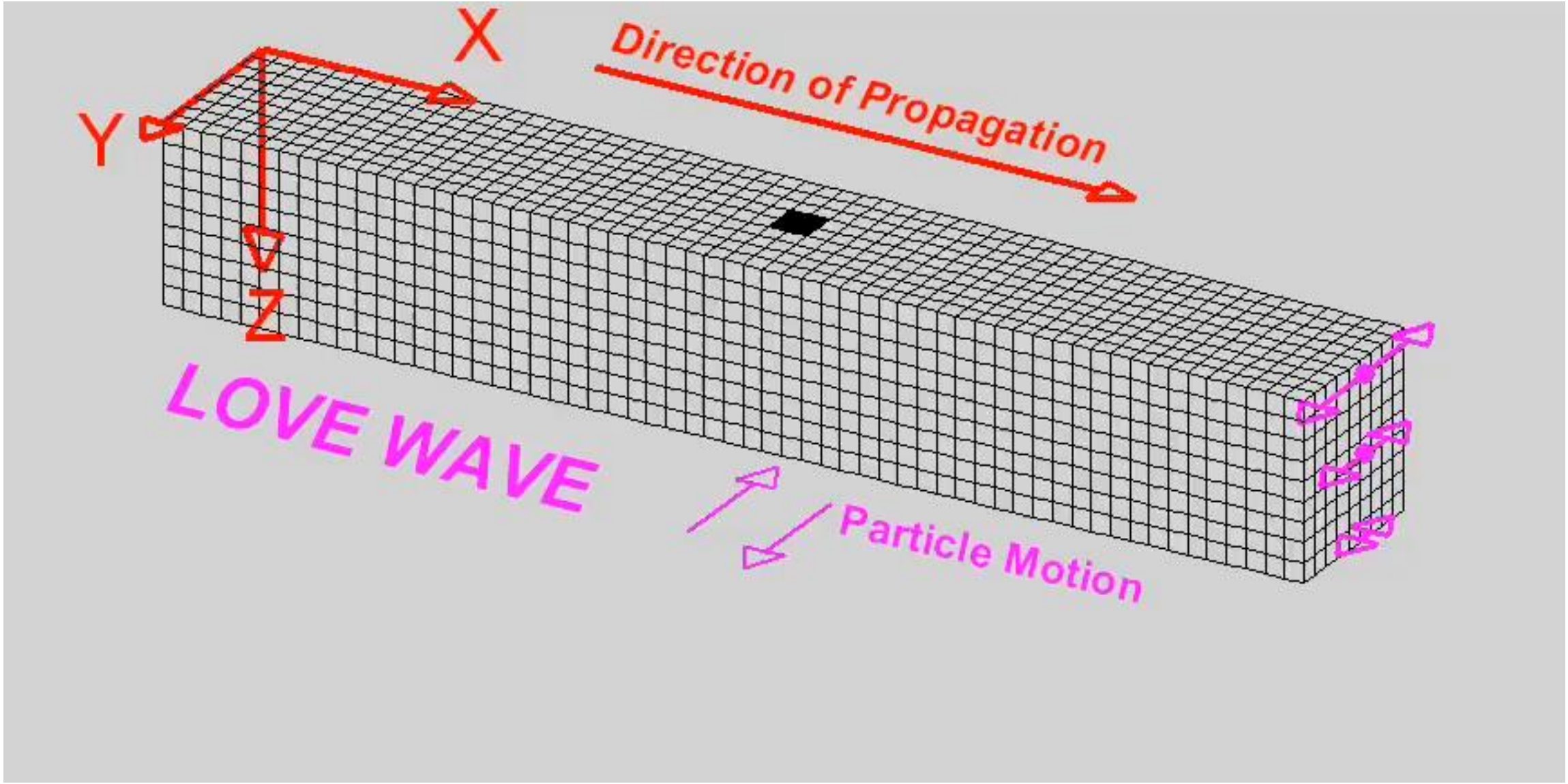
**Hence, the velocity of the P-waves in Solids > Liquids > Gases.**

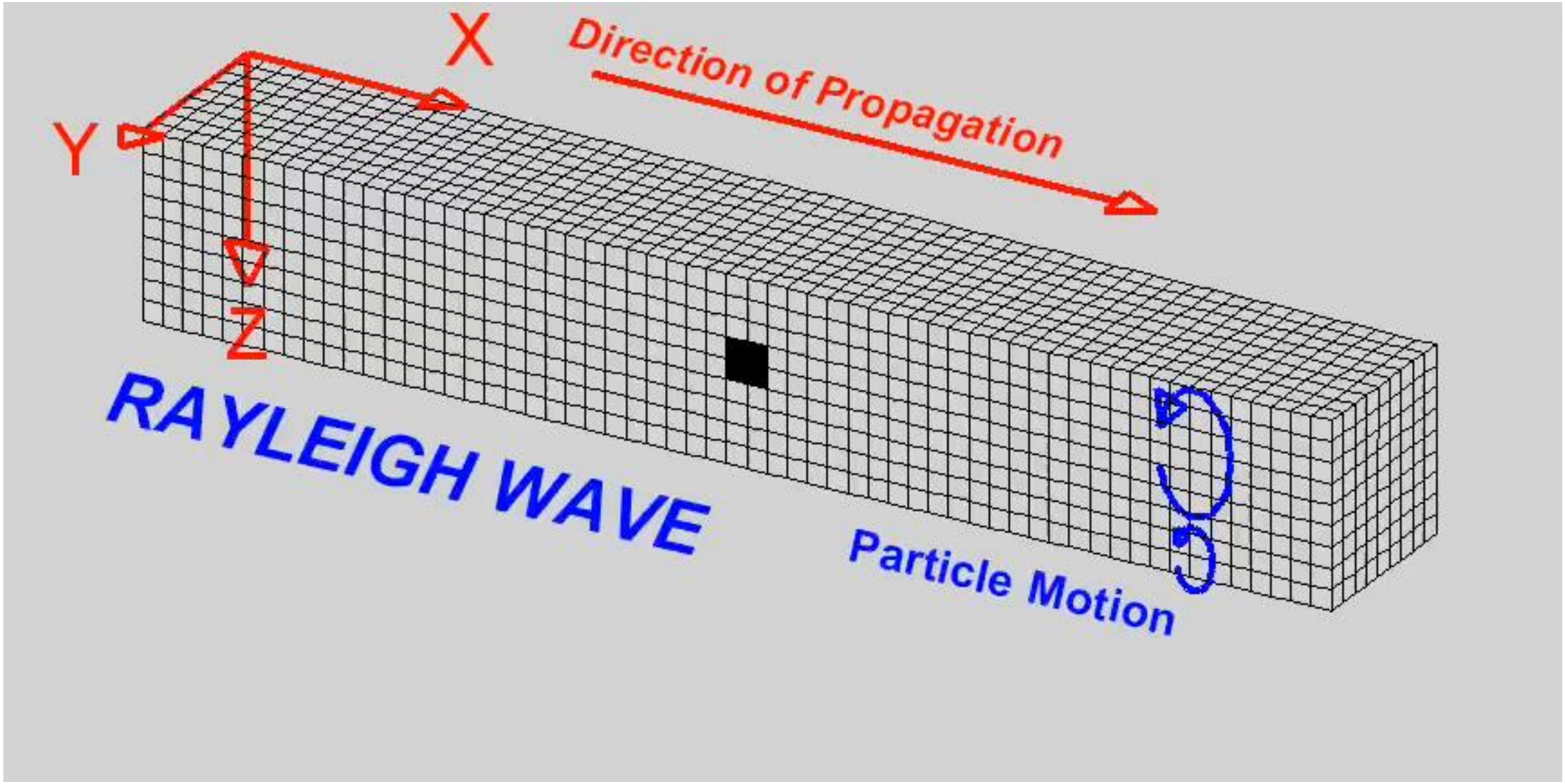
**Secondary Waves (S-waves)**

- S-waves are also called as **transverse waves or shear waves or distortional waves**.
- S-waves **cannot pass through fluids (liquids and gases)** as fluids do not support **shear stresses**.

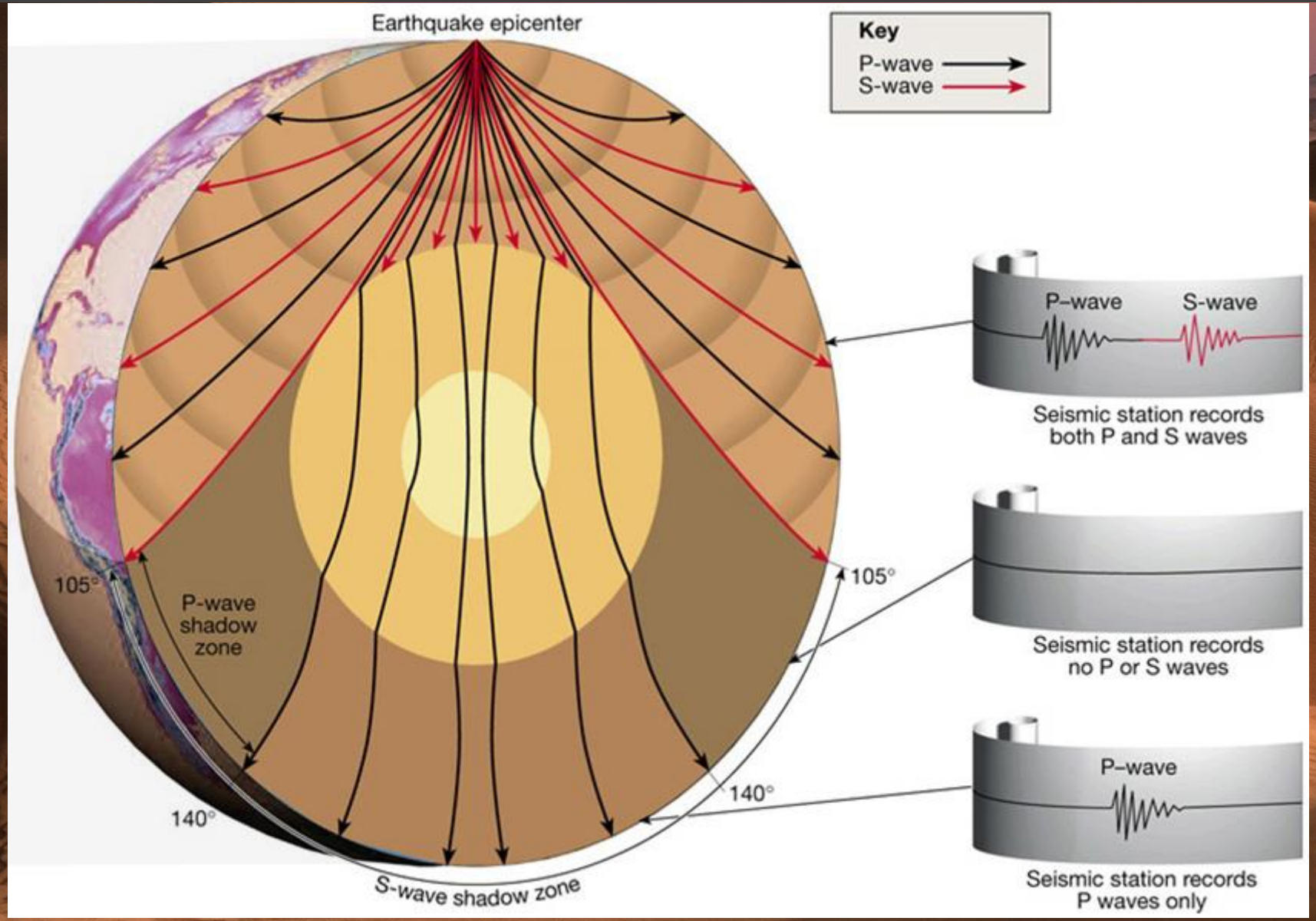

X
Y
Z
Direction of Propagation
P WAVE
Particle Motion


X
Direction of Propagation
Y
Z
S WAVE
Particle Motion

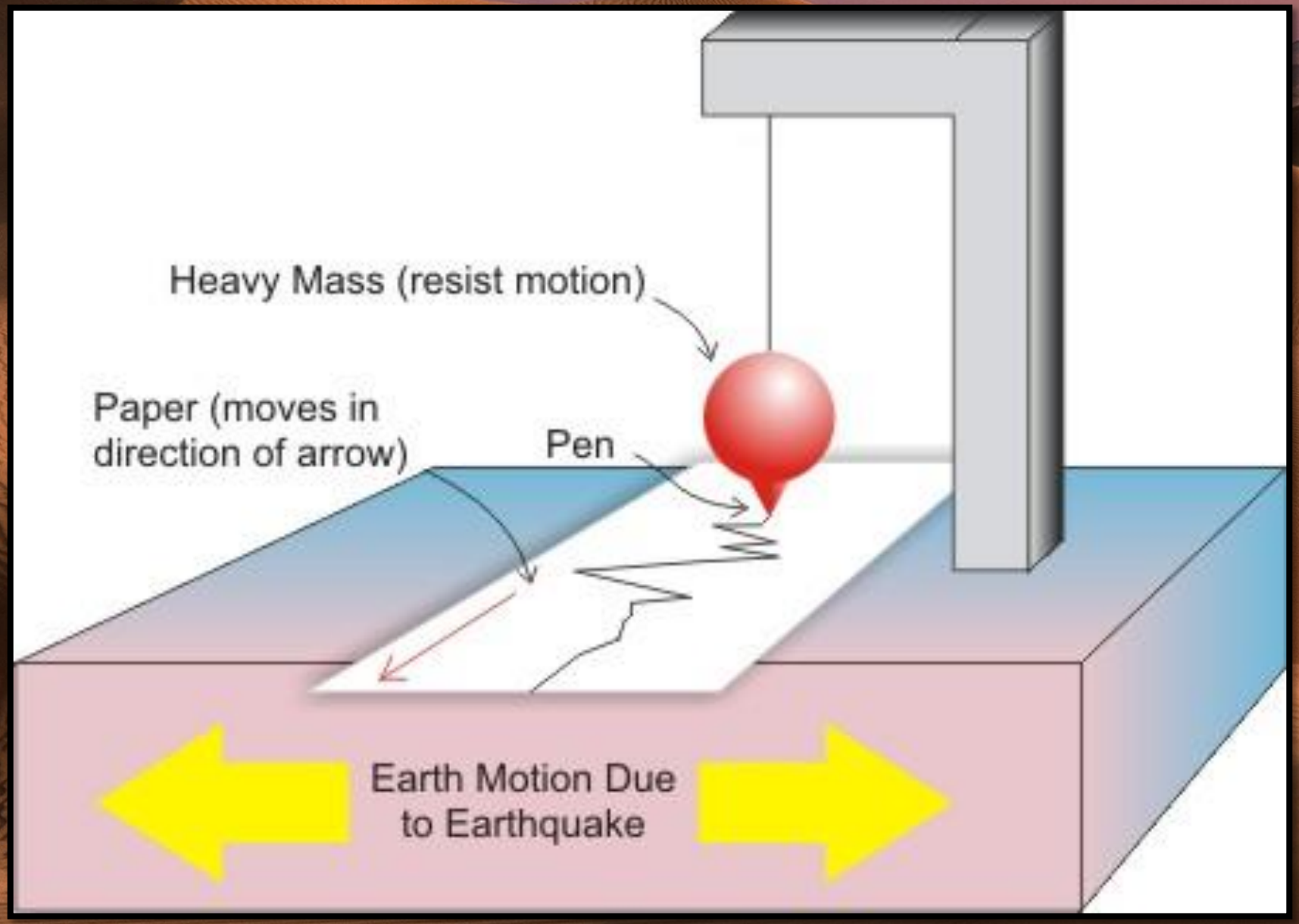

X
Y
Z
Direction of Propagation
LOVE WAVE
Particle Motion

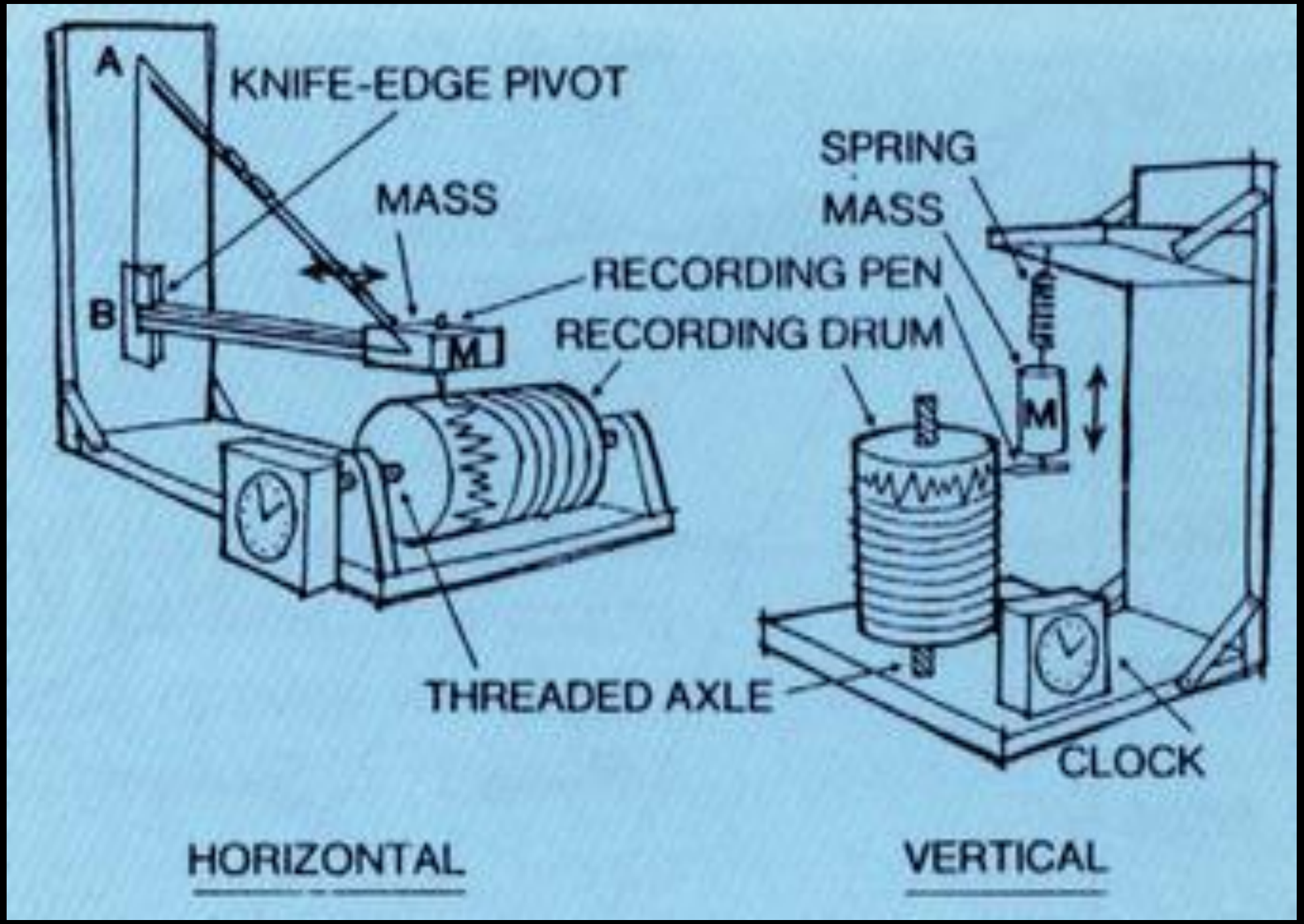

X
Direction of Propagation
Y
Z
RAYLEIGH WAVE
Particle Motion

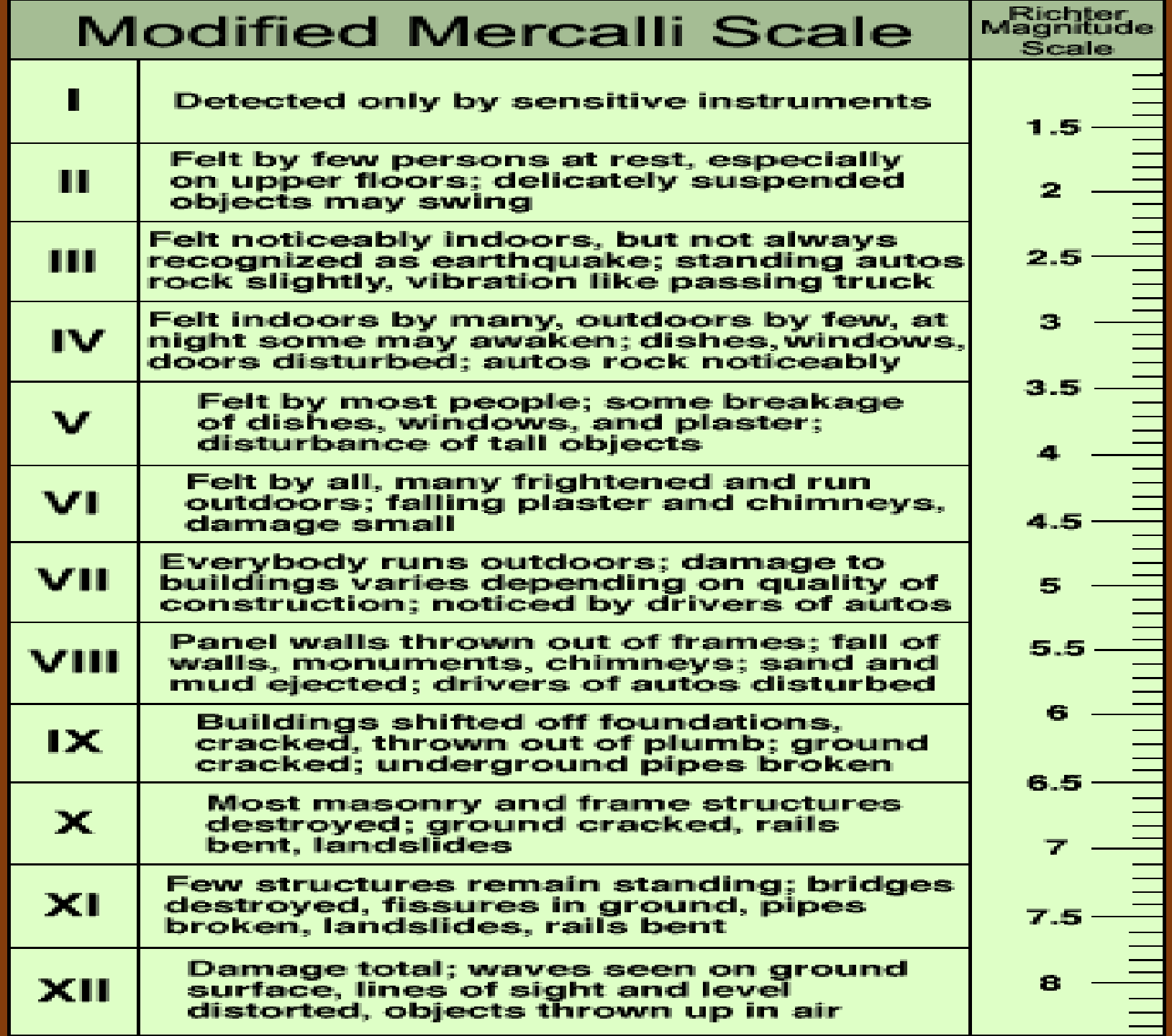
# EMERGENCE OF SHADOW ZONE



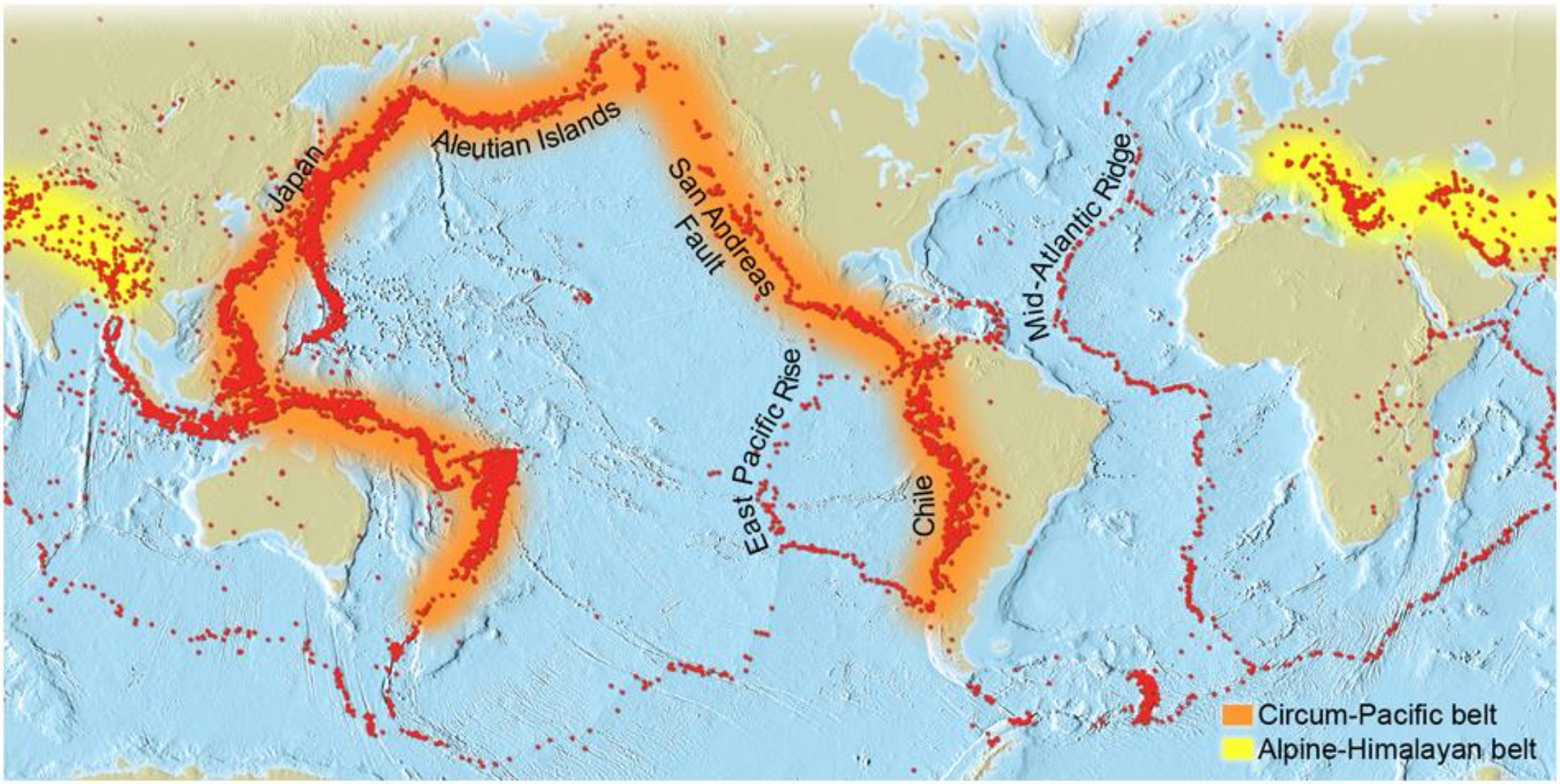
# Seismometer & Seismograph




A
KNIFE-EDGE PIVOT
MASS
B
M
RECORDING PEN
RECORDING DRUM
THREADED AXLE
SPRING
MASS
M
CLOCK
HORIZONTAL
VERTICAL


Modified Mercalli Scale
Richter Magnitude Scale
I
Detected only by sensitive instruments
1.5
II
Felt by few persons at rest, especially on upper floors; delicately suspended objects may swing
2
III
Felt noticeably indoors, but not always recognized as earthquake; standing autos rock slightly, vibration like passing truck
2.5
IV
Felt indoors by many, outdoors by few, at night some may awaken; dishes, windows, doors disturbed; autos rock noticeably
3
3.5
V
Felt by most people; some breakage of dishes, windows, and plaster; disturbance of tall objects
4
VI
Felt by all, many frightened and run outdoors; falling plaster and chimneys, damage small
4.5
VII
Everybody runs outdoors; damage to buildings varies depending on quality of construction; noticed by drivers of autos
5
VIII
Panel walls thrown out of frames; fall of walls, monuments, chimneys; sand and mud ejected; drivers of autos disturbed
5.5
IX
Buildings shifted off foundations, cracked, thrown out of plumb; ground cracked; underground pipes broken
6
6.5
X
Most masonry and frame structures destroyed; ground cracked, rails bent, landslides
7
XI
Few structures remain standing; bridges destroyed, fissures in ground, pipes broken, landslides, rails bent
7.5
XII
Damage total; waves seen on ground surface, lines of sight and level distorted, objects thrown up in air
8

# DISTRIBUTION OF EARTHQUAKES - WORLD

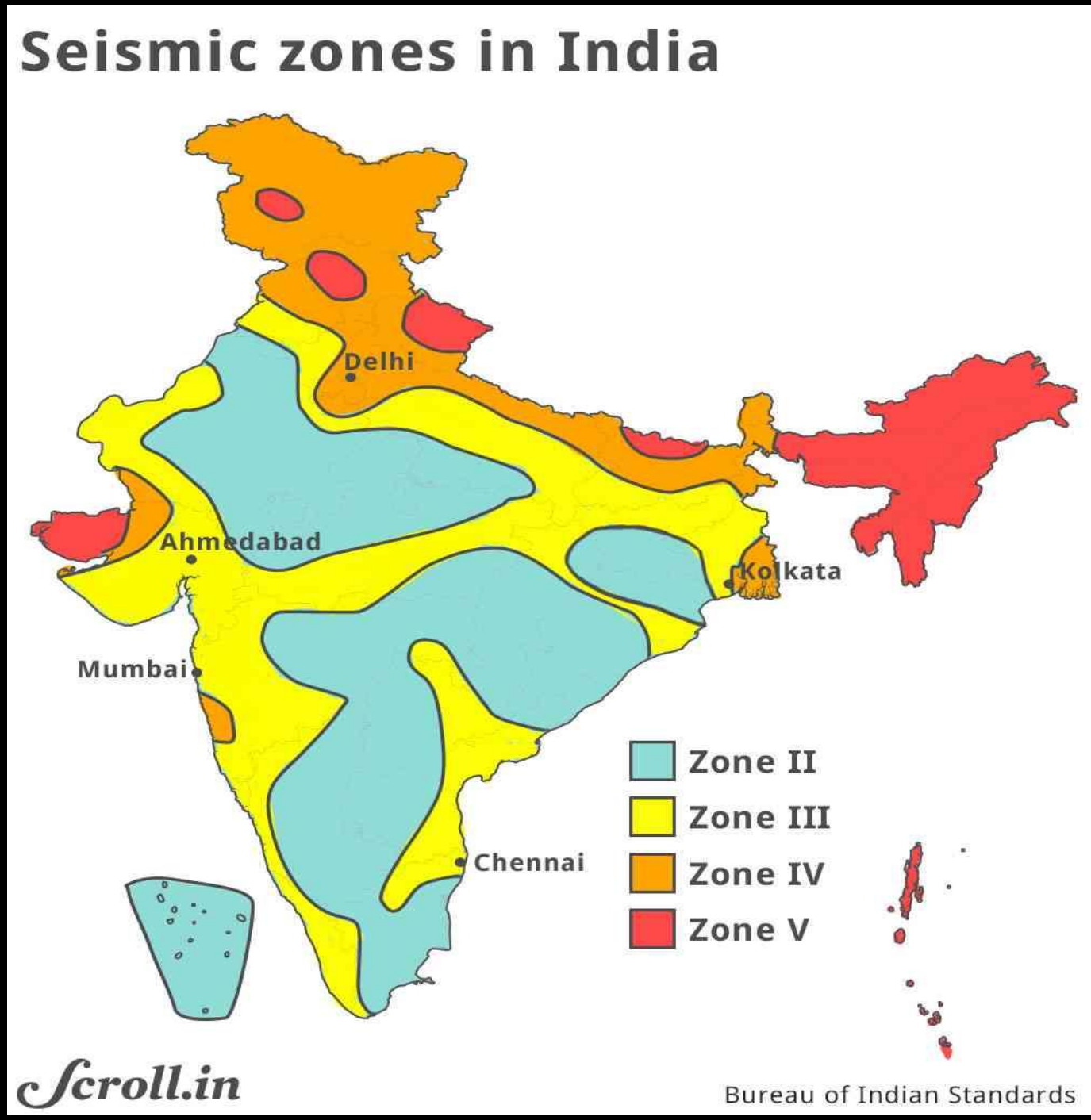



Distribution of nearly 15,000 earthquakes with magnitudes equal to or greater than 5 for a 10-year period.

© 2009 Tasa Graphic Arts, Inc.

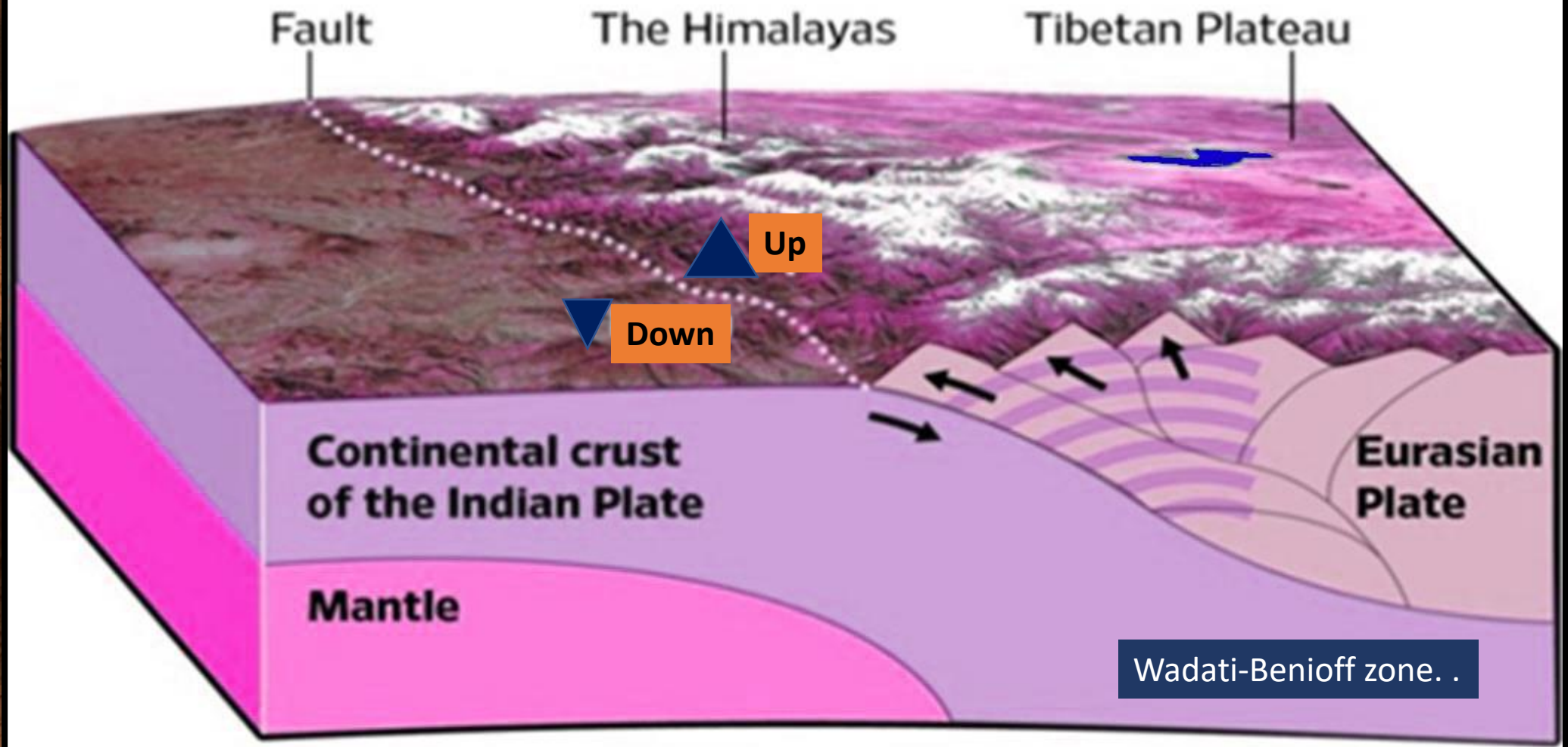
# DISTRIBUTION OF EARTHQUAKES IN INDIA

- ZONE V: Entire northeastern India, Uttarakhand, Rann of Kutch in Gujarat, some parts of Jammu and Kashmir, Himachal Pradesh, Andaman & Nicobar Islands.
- ZONE IV: Remaining parts of Jammu & Kashmir, Ladakh and Himachal Pradesh, Union Territory of Delhi, Sikkim, northern parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan.



# Continental Collision

As the Indian subcontinent pushes against Eurasia, pressure is released in the form of earthquakes. The constant crashing of the two plates forms the Himalayan mountain range.




Source: USGS; Google Earth

THE WALL STREET JOURNAL.

# Expected Question

Consider the following statements regarding the Earthquake waves:

I. Body waves move in all directions travelling through the interior of the earth..

II. Primary waves are responsible for elongating and squeezing of material.

III. Secondary waves travel only through a solid medium.

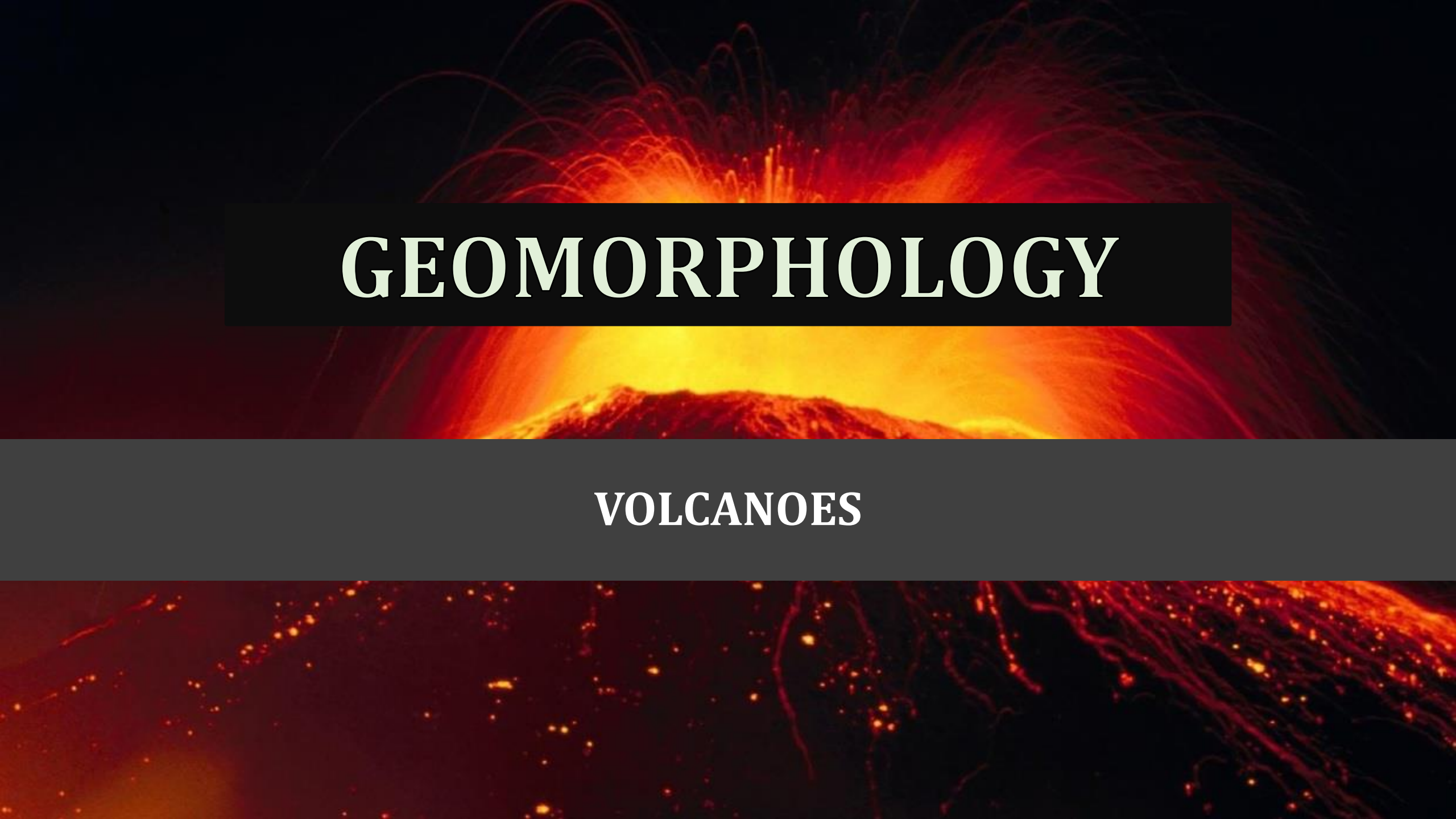
Select the wrong statement(s) using the codes given below:

a. I & II

b. II & III

c. All of the above.

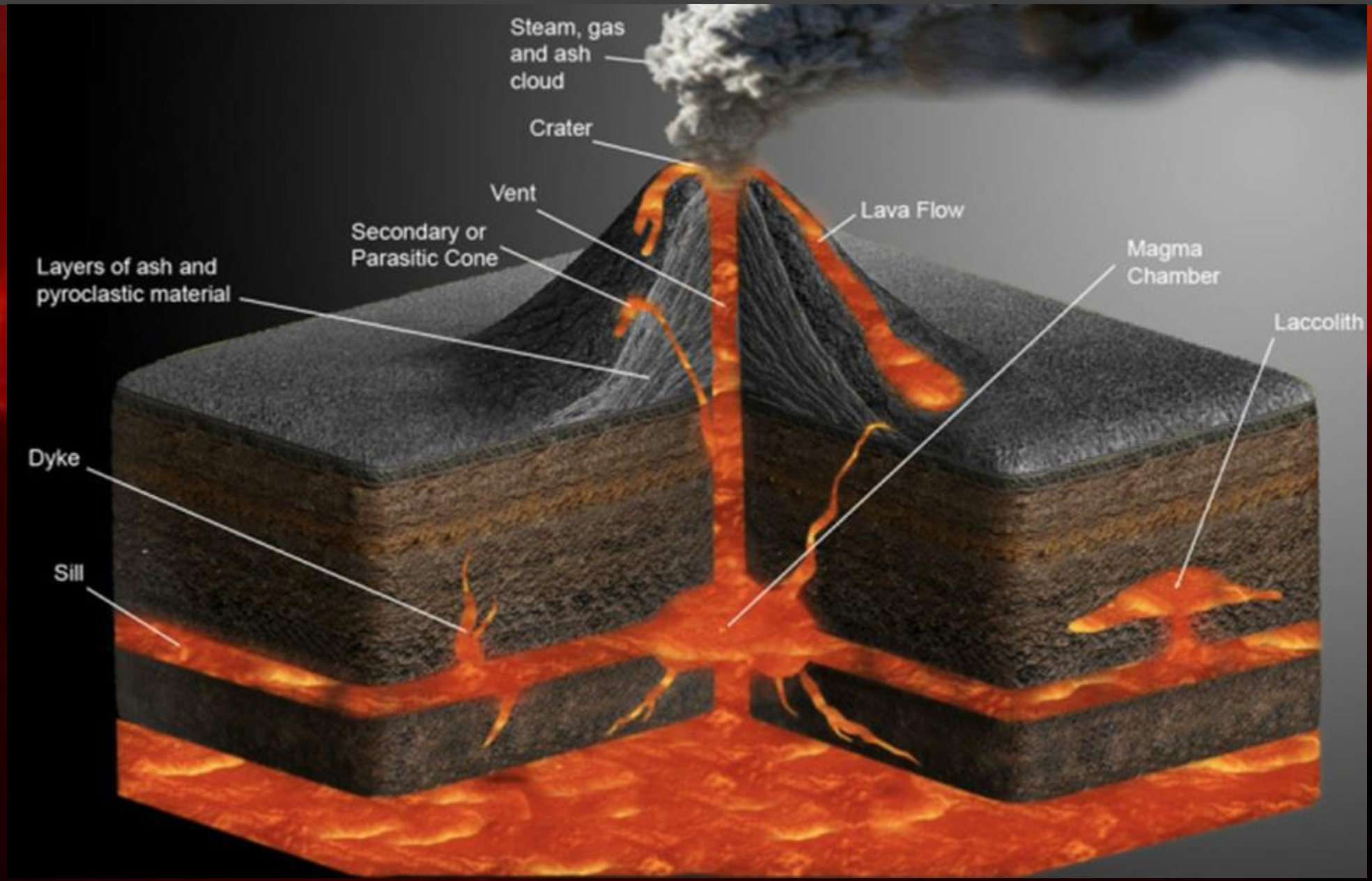
d. None of the above.



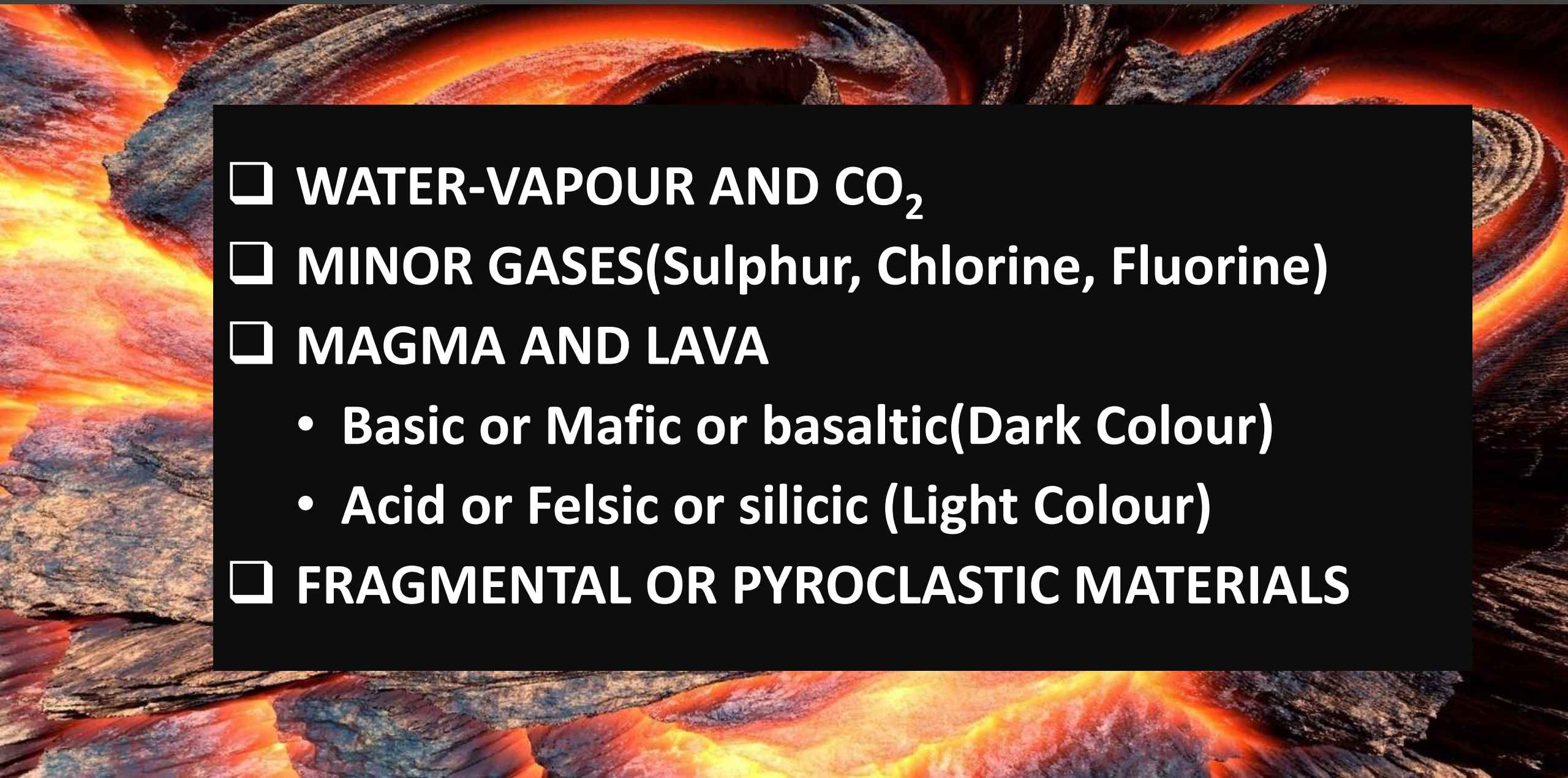
# GEOMORPHOLOGY

## VOLCANOES

# COMPONENTS


Steam, gas and ash cloud
Crater
Vent
Lava Flow
Secondary or Parasitic Cone
Magma Chamber
Layers of ash and pyroclastic material
Laccolith
Dyke
Sill

# VOLCANIC MATERIALS



- WATER-VAPOUR AND $CO_2$
- MINOR GASES(Sulphur, Chlorine, Fluorine)
- MAGMA AND LAVA
  - Basic or Mafic or basaltic(Dark Colour)
  - Acid or Felsic or silicic (Light Colour)
- FRAGMENTAL OR PYROCLASTIC MATERIALS

# Volcanism Lava types

## Basic or Basaltic or Shield lava

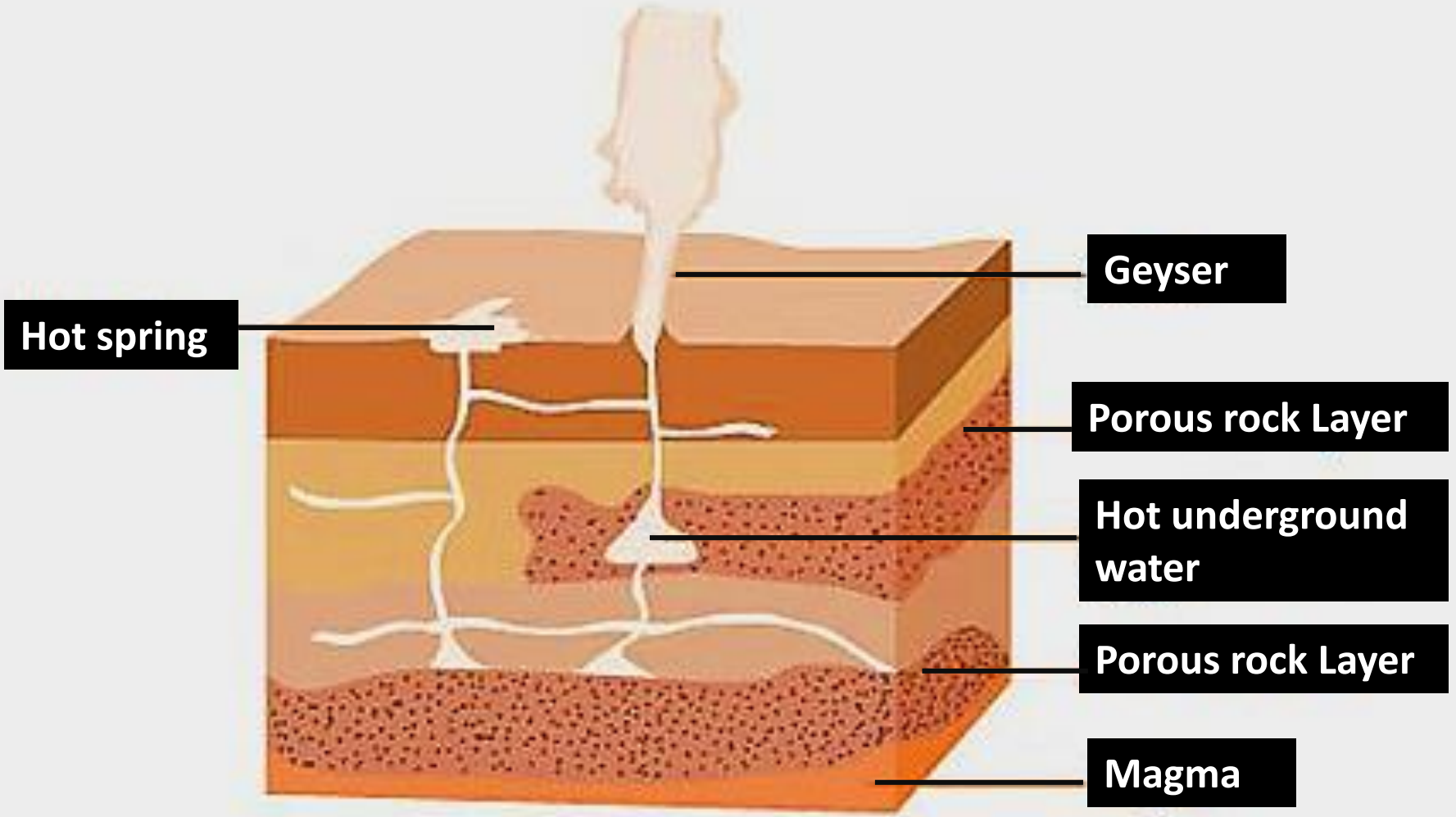
- **hottest lavas,, highly fluid(**10 to 30 miles per hour)
- **dark coloured basalt, rich in iron and magnesium but poor in silica**.
- **not very explosive**.
- affect extensive areas
- forms a flattened shield or dome.
- common along the **constructive boundaries** (divergent boundary).

# Volcanism Lava types

## Andesitic or Acidic or Composite or Stratovolcanic lava

- **highly viscous**
- **light-coloured, of low density, and have a high percentage of silica**.
- **flow slowly and seldom travel far**
- volcanic **bombs or pyroclasts**.
- Form a **lava plug, Mt. Pelée** in Martinique (an island in the Lesser Antilles, Caribbean Islands).
- **mostly along the destructive boundaries (convergent boundaries).**

# GEYSERS AND HOT SPRINGS

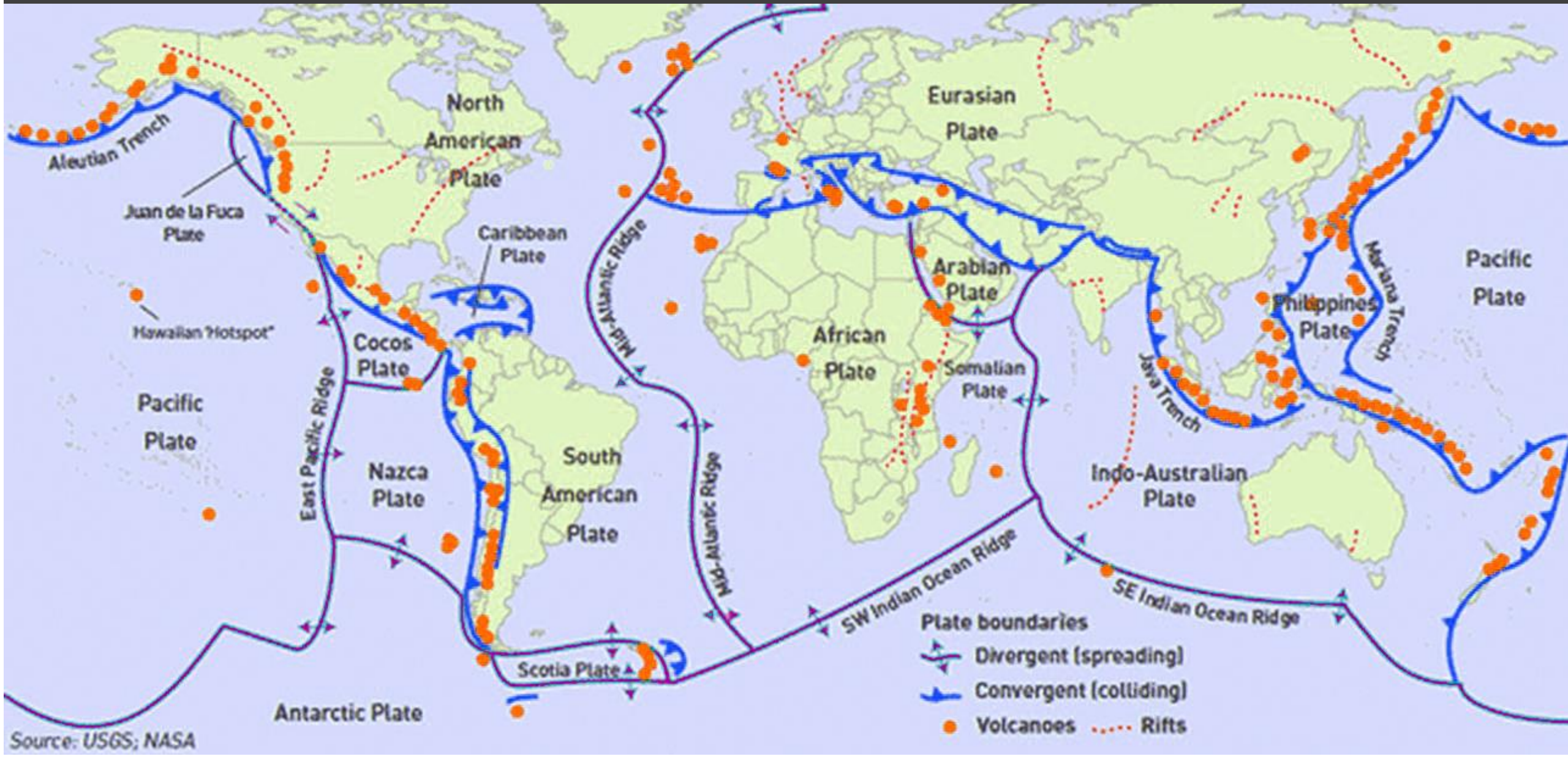



Geysers and hot Spring

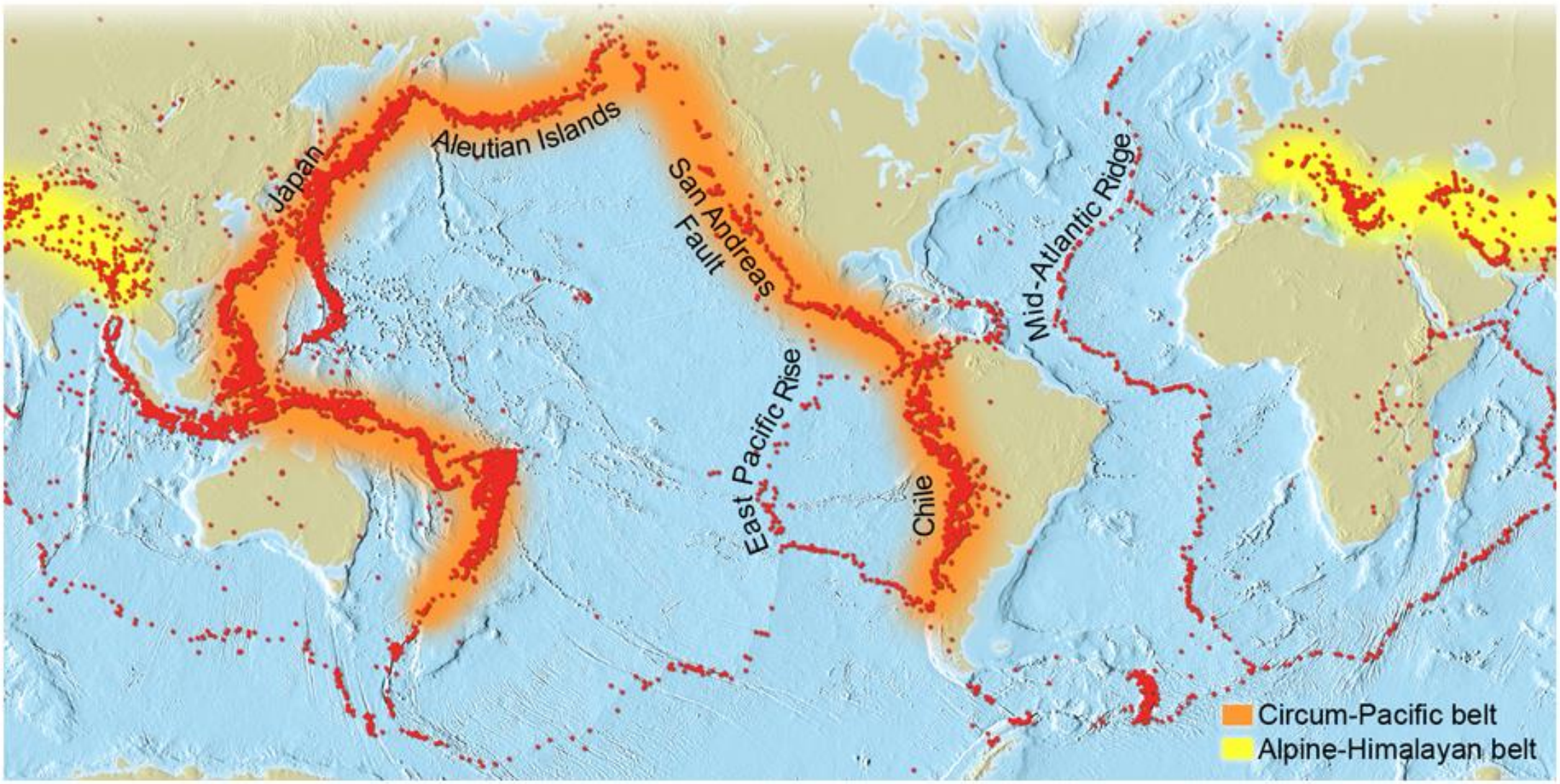




# DISTRIBUTION OF VOLCANOES



# DISTRIBUTION OF EARTHQUAKES - WORLD




Distribution of nearly 15,000 earthquakes with magnitudes equal to or greater than 5 for a 10-year period.

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# Distribution of Earthquakes and Volcanoes across the World

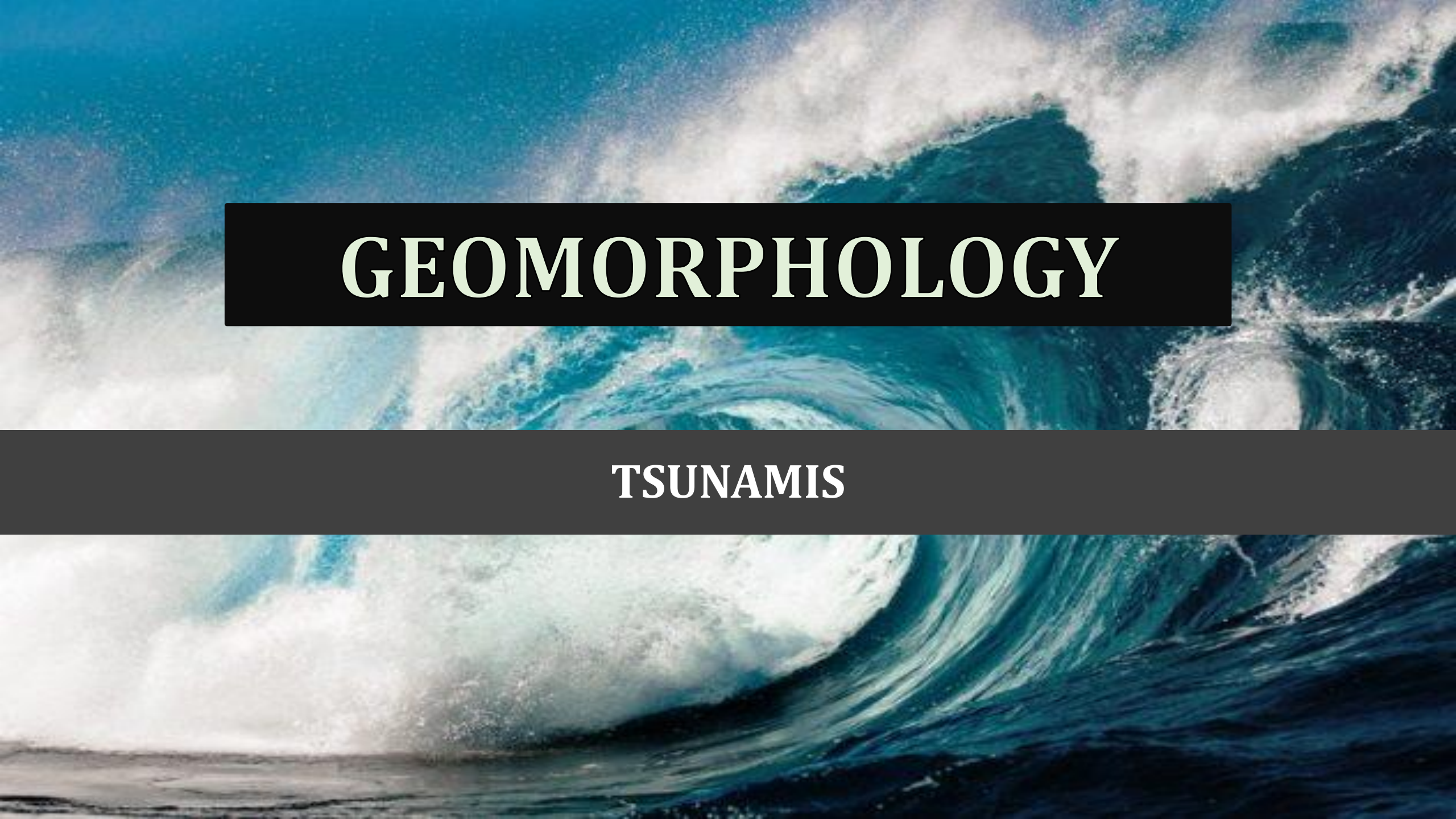
- **Along converging plate margins and mid-oceanic ridges**.
- 70 % earthquakes occur in the Circum-Pacific belt.
- 20 %in the Mediterranean-Himalayan belt including Asia Minor, the Himalayas and parts of north-west China.

# Distribution of Earthquakes and Volcanoes across the World

❖400 are located in and around the Pacific Ocean, and 80 are in the mid-world belt across the Mediterranean Sea, Alpine-Himalayan belt and in the Atlantic and Indian Oceans.

❖**Aleutian-Kurile islands** arc, **Melanesia** and **New Zealand-Tonga belt**.

- The Aleutian Islands into Kamchatka, Japan,
- the Philippines, and Indonesia (Java and Sumatra in particular),
- Pacific islands of Solomon, New Hebrides, Tonga and North Island, New Zealand.
- Andes to Central America (particularly Guatemala, Costa Rica and Nicaragua), Mexico and right up to Alaska.

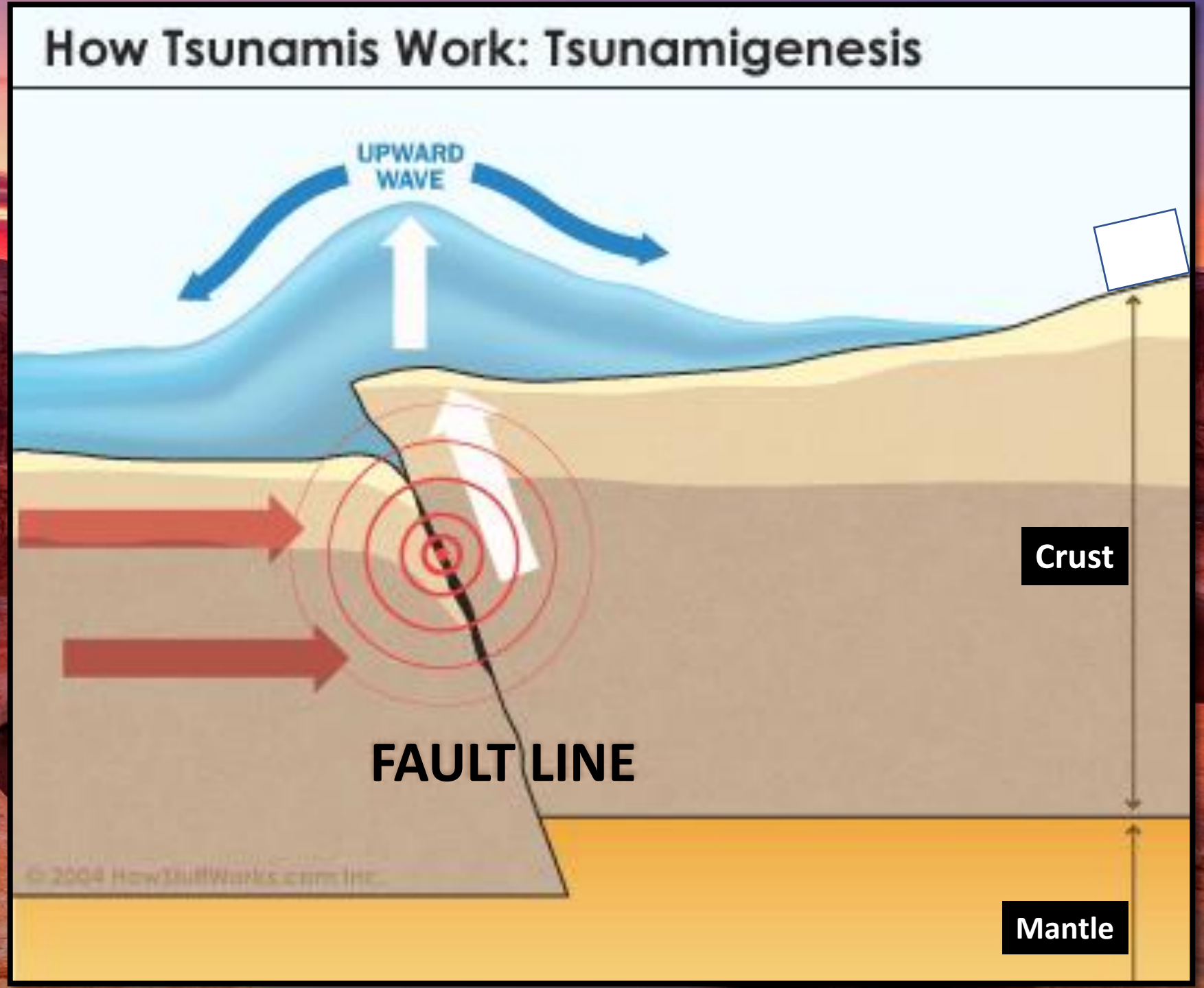


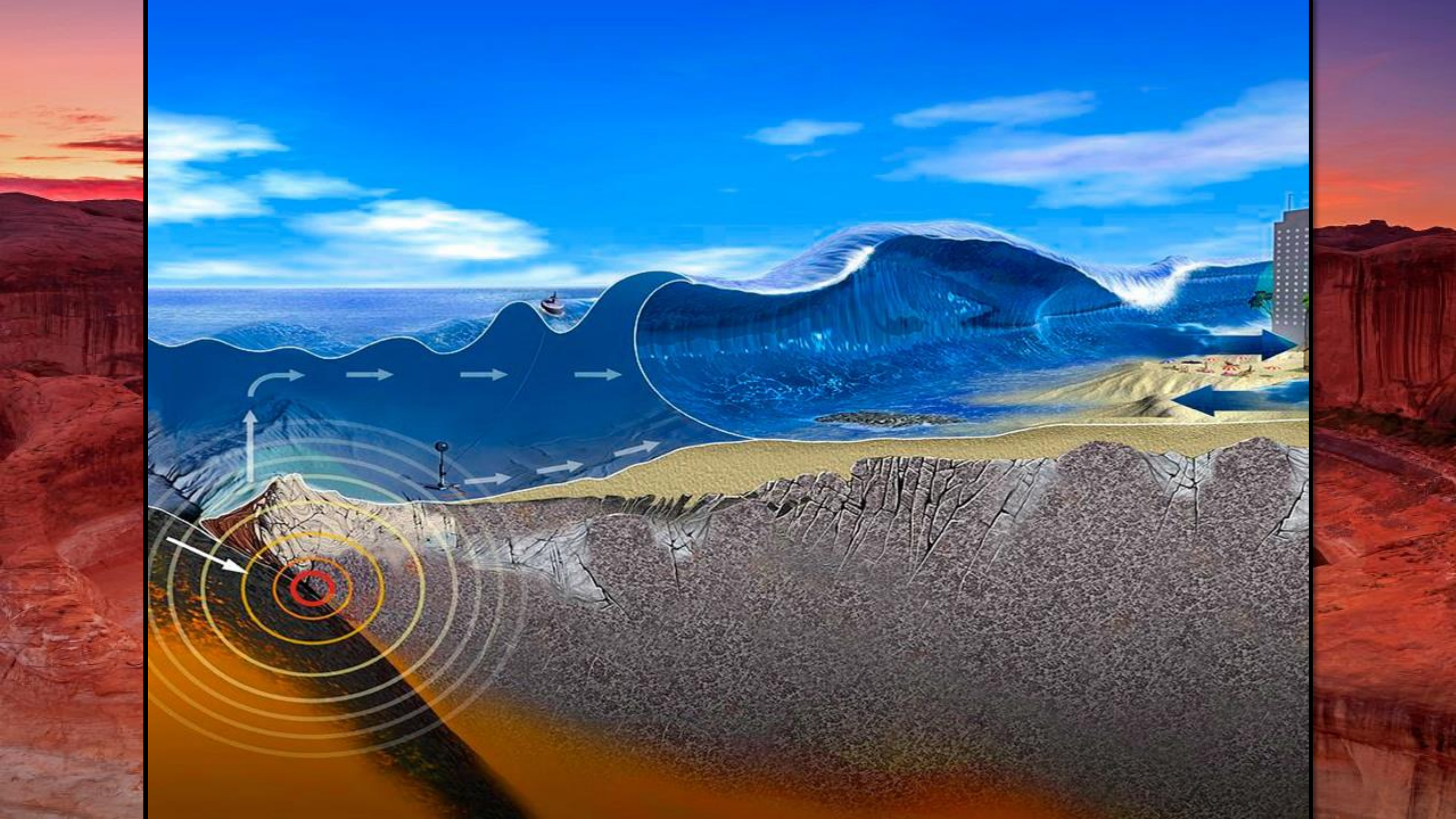
# GEOMORPHOLOGY

## TSUNAMIS

# CAUSES

- ❑ Undersea earthquake
- ❑ Volcanic eruptions
- ❑ Landslides
- ❑ Meteorites

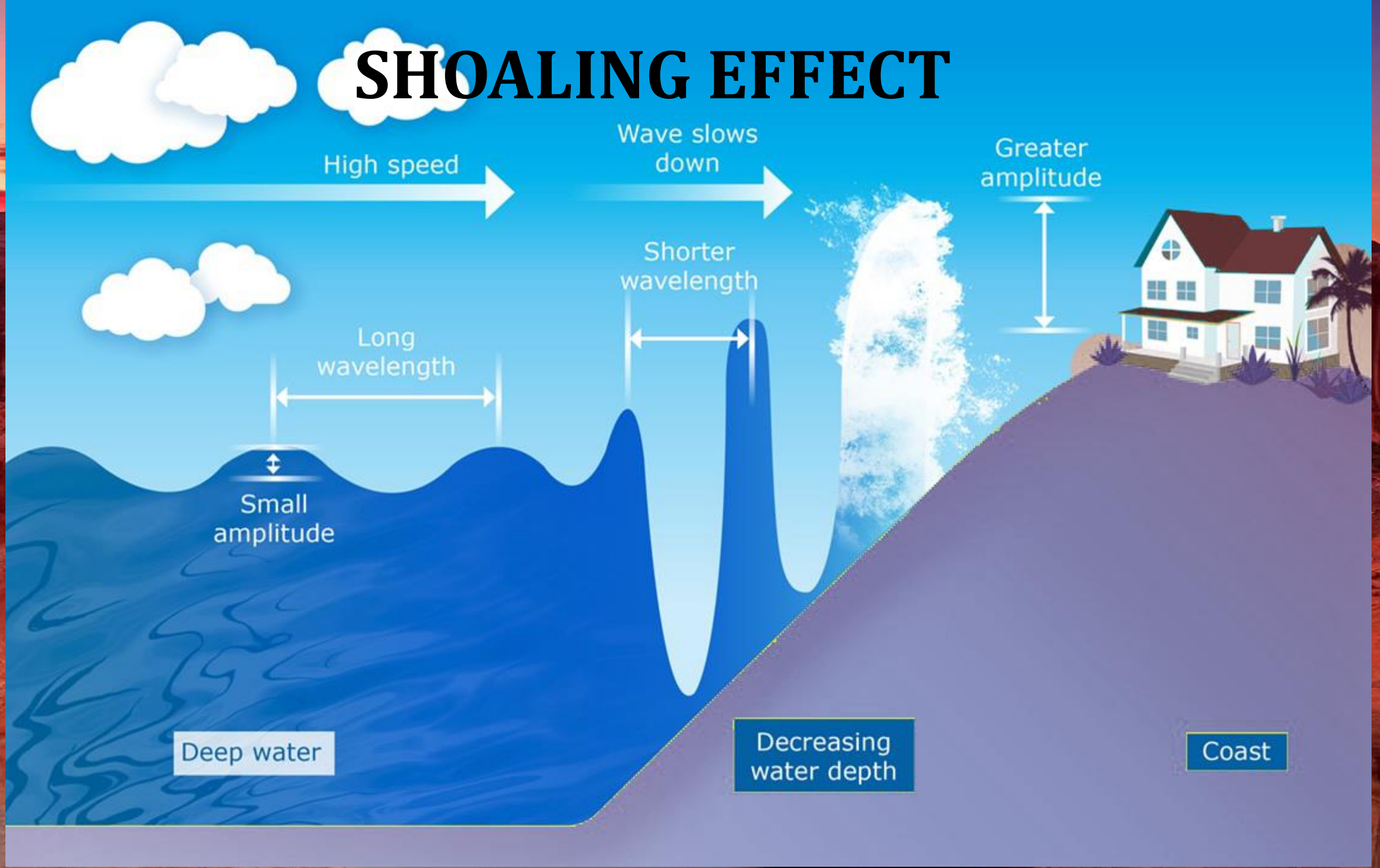

How Tsunamis Work: Tsunamigenesis
UPWARD WAVE
Crust
FAULT LINE
Mantle



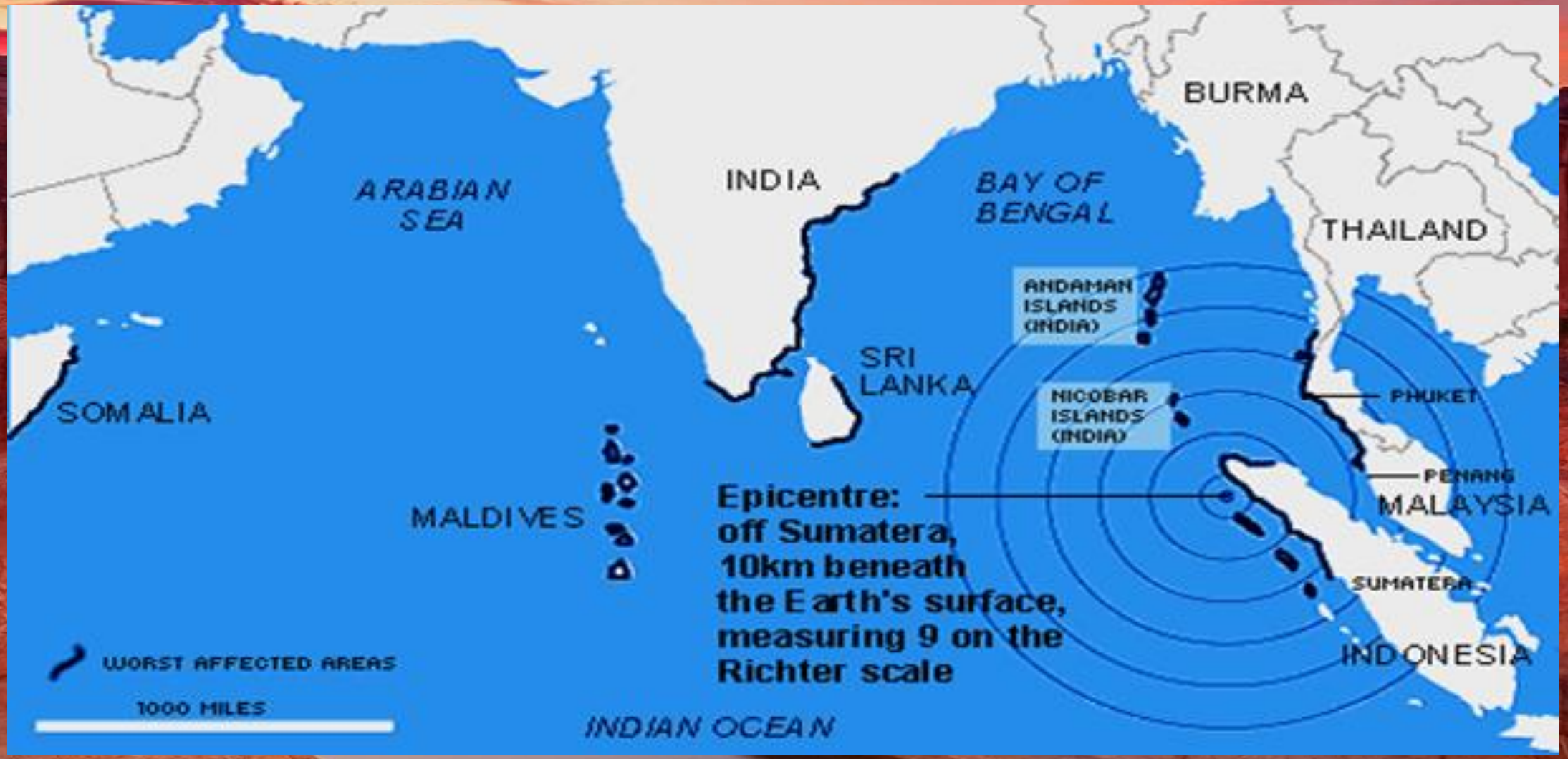
# CHARACTERISTICS OF TSUNAMI

- Tsunamis are high energy waves in the ocean.
- Tsunamis move unnoticed in deep sea.
- Tsunami waves have a slight swell of about 12 inches above the normal sea surface.
- Shoaling effect
- An approaching tsunami is sometimes preceded by a noticeable fall or rise in the water.

# SHOALING EFFECT



# SUMATRA TSUNAMI



## India’s preparedness:

1. The Deep Ocean Assessment and Reporting System (DOARS) was set up in the Indian Ocean post-2004.
2. The Indian government plans to set up a network with Indonesia, Myanmar and Thailand etc.
3. A National Tsunami Early Warning Centre, which can detect earthquakes of more than 6 magnitude in the Indian Ocean, was inaugurated in 2007 in India.
4. Set up by the Ministry of Earth Sciences in the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, the tsunami warning system would take 10-30 minutes to analyse the seismic data following an earthquake.

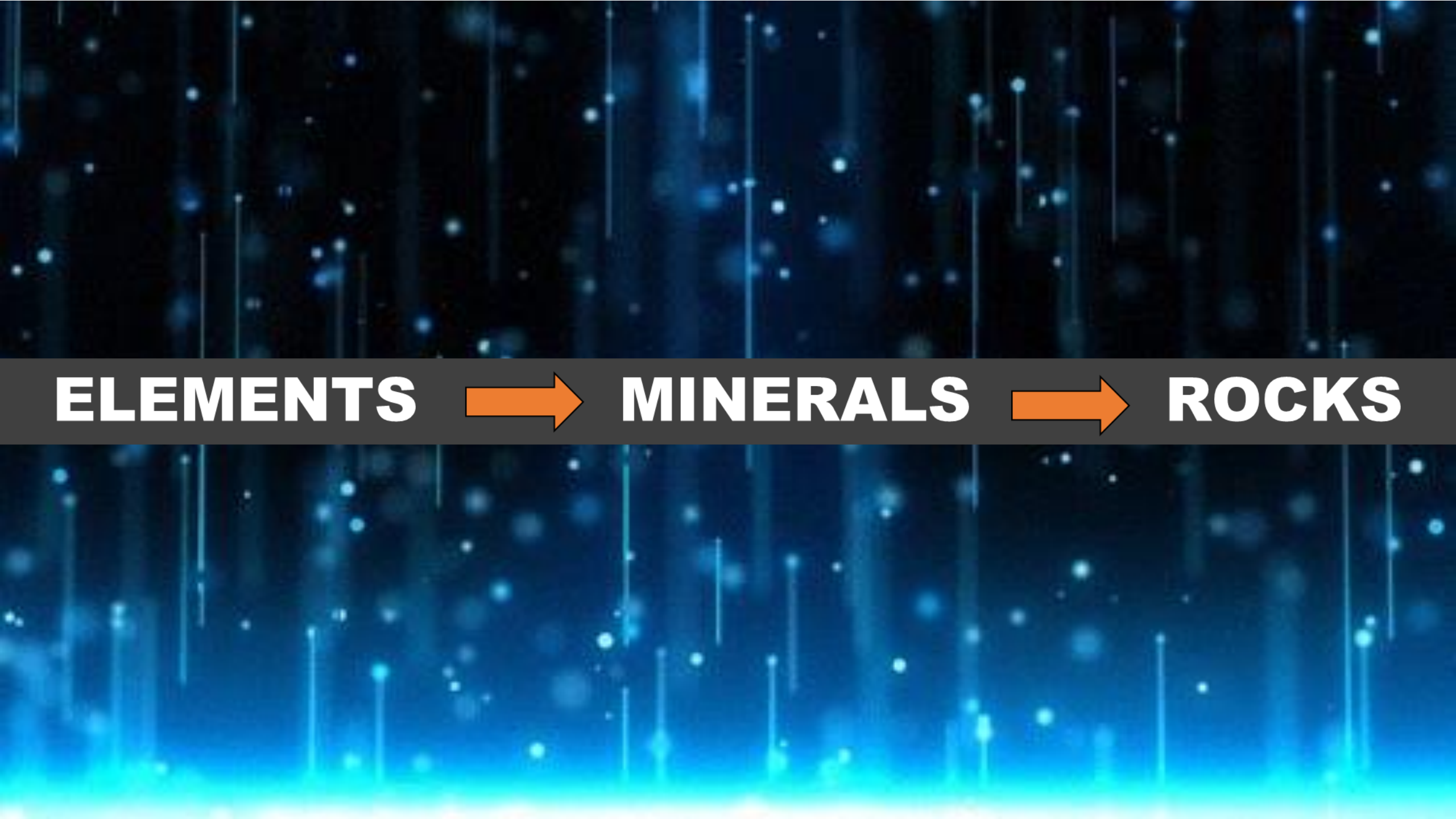
# Expected Question

Which of the following statement(s) is/are true with reference to Tsunami:

I. The effect of Tsunami occur if the epicentre of the tremor is below oceanic waters, and the magnitude is sufficiently high.
II. Over deep water, the tsunami has very long wavelengths.
III. Tsunamis have a small amplitude offshore.

Select the correct code:

a. I & II
b. II & III
c. I & III
d. All of the above


ELEMENTS
MINERALS
ROCKS

## WHOLE EARTH

| Elements | Percentage |
|---|---|
| 1. Iron | 35 |
| 2. Oxygen | 30 |
| 3. Silicon | 15 |
| 4. Magnesium | 13 |
| 5. Nickel | 2.4 |
| 6. Sulphur | 1.9 |
| 7. Calcium | 1.1 |
| 8. Aluminium | 1.1 |
| Others, less than | 1.0 |

## EARTH'S CRUST

| Elements | Percentage |
|---|---|
| 1. Oxygen | 46.6 |
| 2. Silicon | 27.7 |
| 3. Aluminium | 8.1 |
| 4. Iron | 5 |
| 5. Calcium | 3.6 |
| 6. Sodium | 2.8 |
| 7. Potassium | 2.6 |
| 8. Magnesium | 2.1 |
| Others, less than | 1.4 |

# ROCK FORMATION PROCESS

| | | |
|---|---|---|
| *SOLIDIFICATION* | → | *IGNEOUS ROCK* |
| *SEDIMENTATION* | → | *SEDIMENTARY ROCK* |
| *METAMORPHISM* | → | *METAMORPHIC ROCK* |

The scientific study of rocks is called **petrology**

# Igneous (Plutonic rocks)

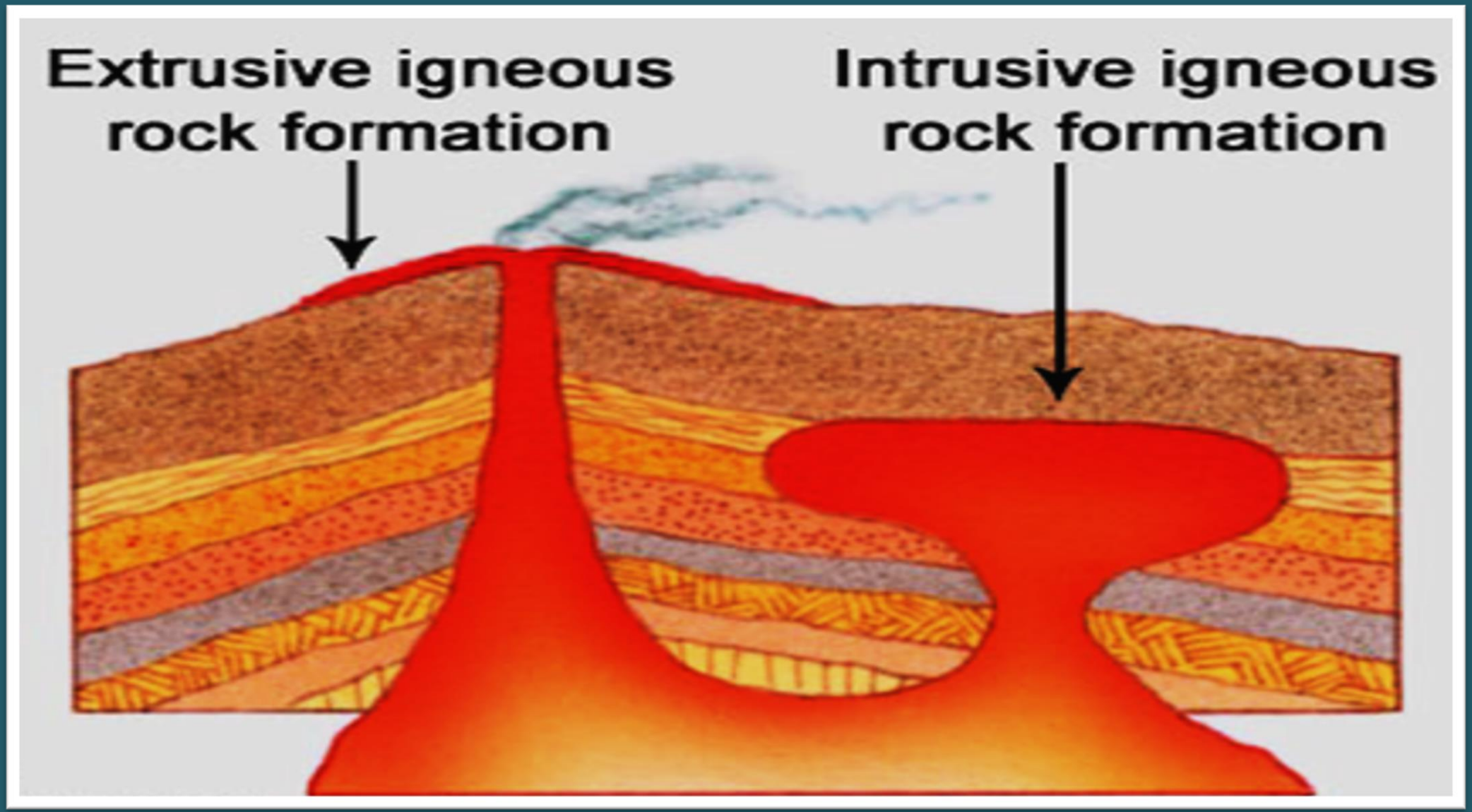
Formed from the cooling & solidification of lava or Magma.

## Intrusive (Plutonic rocks)

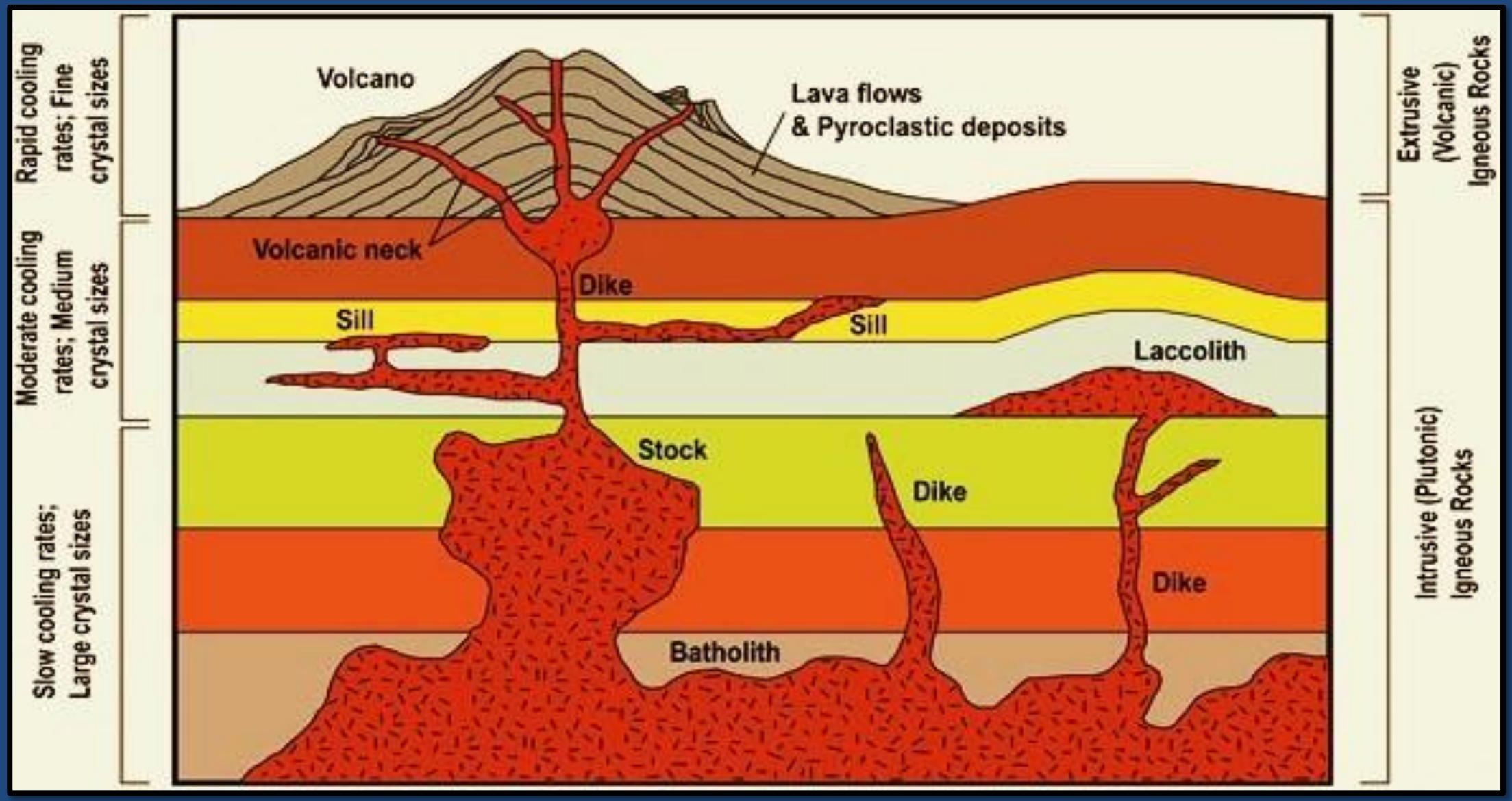
1. Formed inside the earth from Magma
2. Magma cools slowly
3. Large crystal formed.(any crystal larger than 1 mm are Intrusive rocks)

## Extrusive (Lava or Volcanic rocks)

1. Lava cools quickly.
2. Small or no crystal formed.
3. May be vesicular.
4. Contains air bubbles.

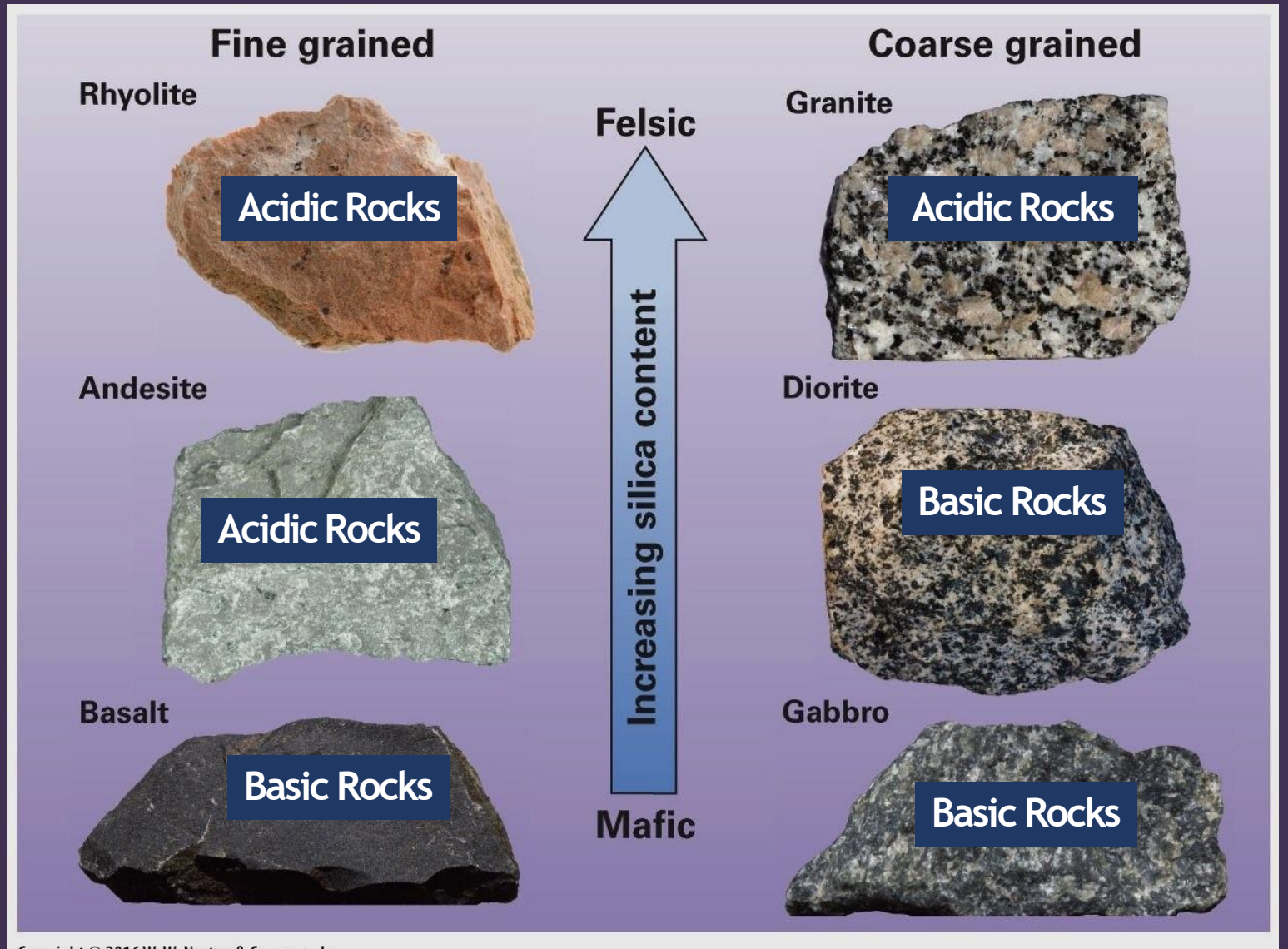

Extrusive igneous rock formation
Intrusive igneous rock formation

# Hypabyssal or Dyke Rocks or Intermediate rocks



# CHARACTERISTICS OF IGNEOUS ROCKS

- Hard Rocks
- Water Penetrates with Great Difficulty
- Granular or Crystalline Rocks
- No Strata/layers
- They are Less Affected by Chemical Weathering (Except Basalts)
- No Fossils



# Economic Significance of Igneous Rocks

- Since magma is the chief source of metal ores, many of them are associated with igneous rocks.
- The minerals of great economic value found in igneous rocks are magnetic iron, nickel, copper, lead, zinc, chromite, manganese, gold, diamond and platinum.
- Amygdales are almond-shaped bubbles formed in basalt due to escape of gases and are filled with minerals.
- The old rocks of the great Indian peninsula are rich in these crystallised minerals or metals.
- Many igneous rocks like granite are used as building materials as they come in beautiful shades.

# Expected Question

Which of the following statement(s) is/are true regarding Igneous Rocks:

I. Igneous rocks solidify from magma and lava.
II. Igneous rocks are nonfossiliferous.
III. They form under conditions of high temperatures.

Choose the correct statement(s) using the codes given below:

a. I Only
b. II and III
c. I and III
d. I, II and III

# CHARACTERISTICS OF SEDIMENTARY ROCKS

- Made of sediments
- Largest surface areas
- Layered in structure
- Contains fossils
- Not massive forms
- Deformed formations



# Sedimentary
## Lithification of Rocks

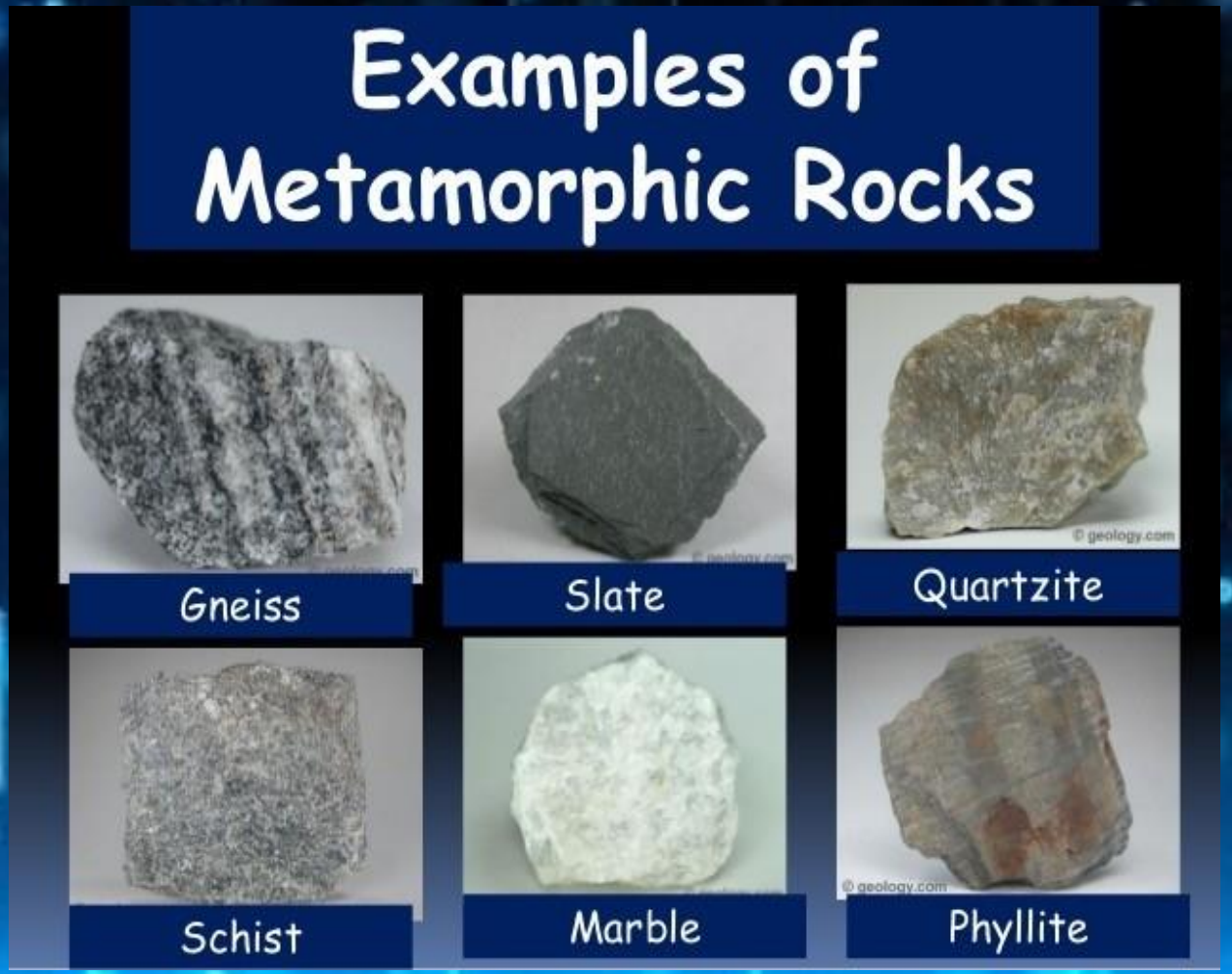
| Mechanically | Chemically | Organically |
| --- | --- | --- |
| running water, wind, ocean currents | Evaporates | 3. Biological Matter. |
| Arenaceous (hard and porous | Precipitates | heat and pressure |
| Argillaceous (mostly impermeable) | Stalactites and stalagmites | Coal and limestone |

# Economic Significance of Sedimentary Rocks

- Sedimentary rocks are not as rich in minerals of economic value as the igneous rocks.
- But important minerals such as hematite iron ore, phosphates, building stones, coals, petroleum and material used in the cement industry are found.
- The decay of tiny marine organisms yields petroleum. Petroleum occurs in suitable structures only.
- Important minerals like bauxite, manganese, tin, are derived from other rocks but are found in gravels and sands carried by water.
- Sedimentary rocks also yield some of the richest soils.

# METAMORPHIC ROCKS

- *DYNAMIC METAMORPHISM*
  - Granite → Gneiss
  - Clay and shale → Schist
- *THERMAL METAMORPHISM*
  - Sandstone → Quartzite
  - Clay and shale → Slate
  - Limestone → Marble
  - Coal → Anthracite and graphite



# Metamorphic
(Changes of state by heat, pressure)

## Thermal Metamorphism

## Dynamic Metamorphism

**Contact Metamorphism**

**Contact by Heat**

**Regional Metamorphism**

**Contact by Pressure**

# Expected Question

Consider the following statements with reference to the Earth's crust:

I. The crust is the outermost solid part of the earth.
II. The continental crust is mainly formed by basaltic rocks.
III. The oceanic crust are mainly formed by granitic rocks.

Which of the following statements is/are NOT correct:

a. I Only
b. II and III
c. I and III
d. I, II and III

# Expected Question

Which of the following statement(s) is/are true regarding Sedimentary Rocks:

I. Sedimentary rocks  have layers or stratifications of varying thickness.

II. Sedimentary rocks are formed by mechanical agents like running water, wind, ocean currents, ice, etc.

Choose the correct statement(s) using the codes given below:

a. I Only
b. II Only
c. Both I and II
d. None of the above.

# Rock-Forming Minerals

Feldspar:
Quartz:
Bauxite:
Cinnabar (mercury sulphide):
Dolomite:
Gypsum:
Haematite:
Magnetite:
Amphibole:

Mica:
Olivine:
Pyroxene:
Chlorite:
calcite:
magnetite:
hematite:
bauxite:
Barite:

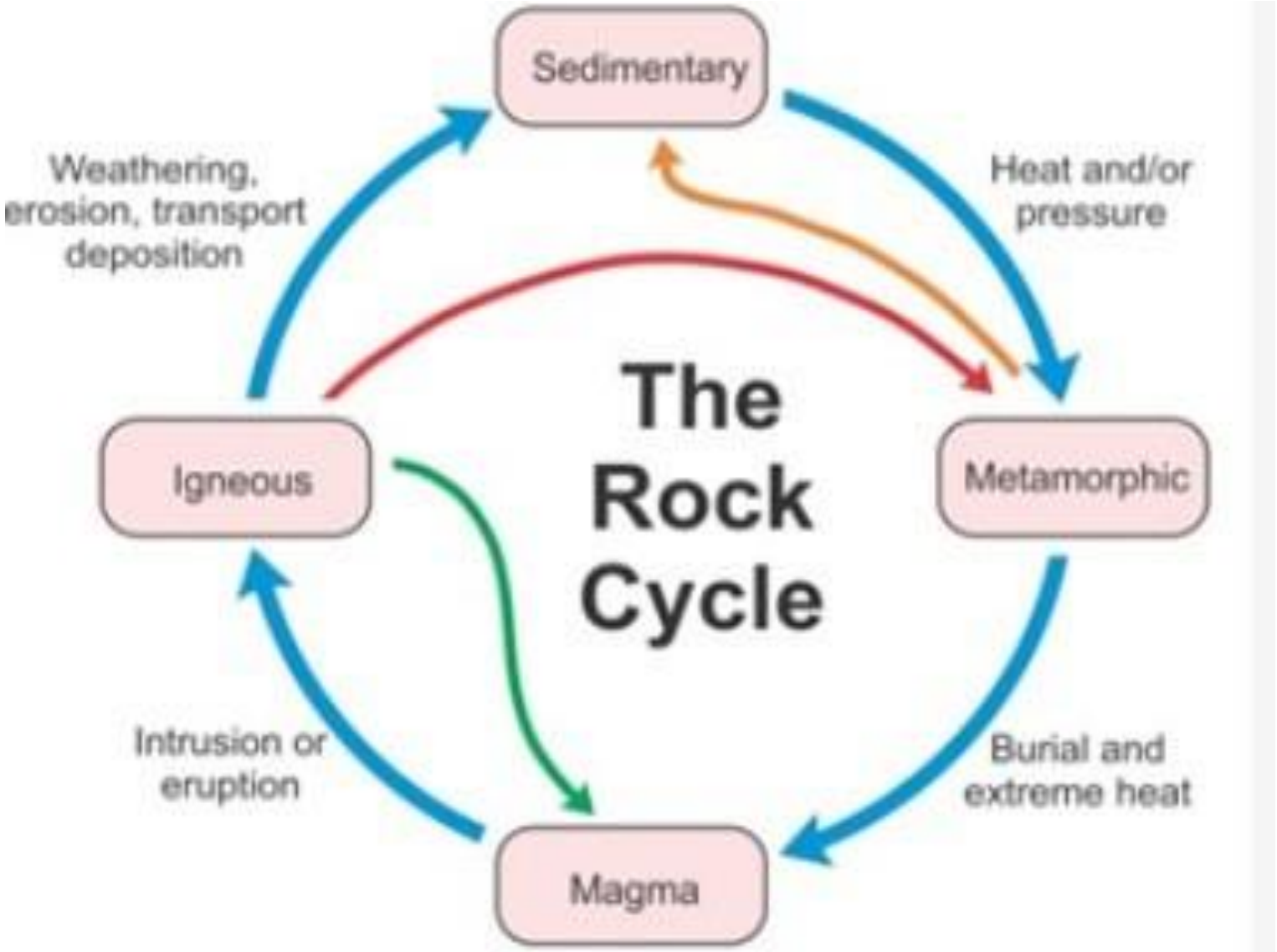
# Rock-Forming Minerals

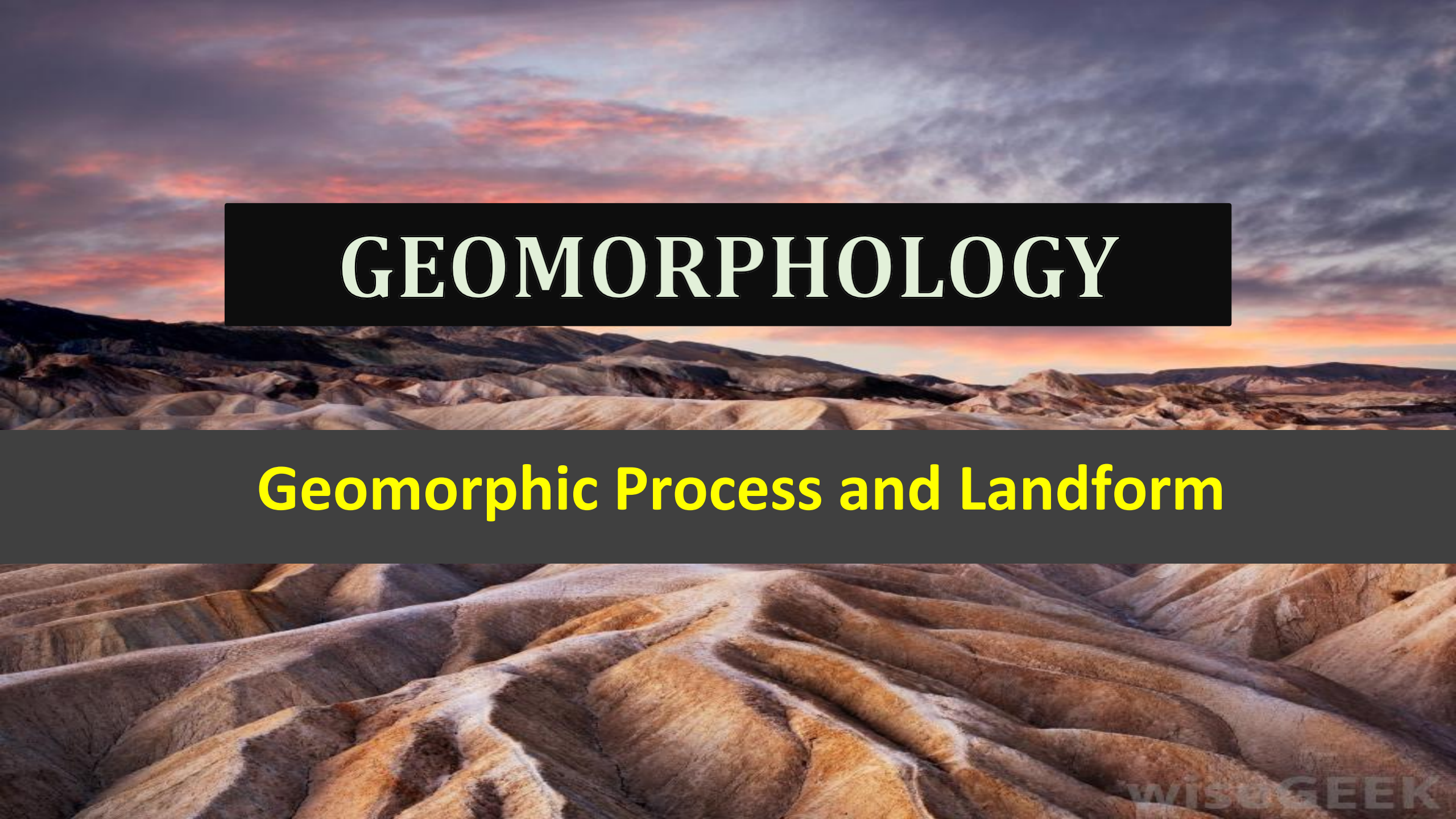
- **Feldspar:** Half the crust is composed of feldspar. It has a light colour, and its main constituents are silicon, oxygen, sodium, potassium, calcium, aluminium. It is used for **ceramics and gloss making**.
- **Quartz:** It has two elements, silicon and oxygen. It has a hexagonal crystalline structure. It is uncleaved, white or colourless. It cracks like glass and is present in sand and granite. It is used in the manufacture of **radio and radar**.
- **Bauxite:** A hydrous oxide of aluminium, it is the **ore of aluminium**. It is non-crystalline and occurs in small pellets.
- **Cinnabar (mercury sulphide):** Mercury is derived from it. It has a brownish colour.
- **Dolomite:** A double carbonate of calcium and magnesium. It is used in cement and iron and steel industries. It is white.
- **Gypsum:** It is hydrous calcium sulphate and is used in cement, fertiliser and chemical industries.
- **Haematite:** It is a red ore of iron.

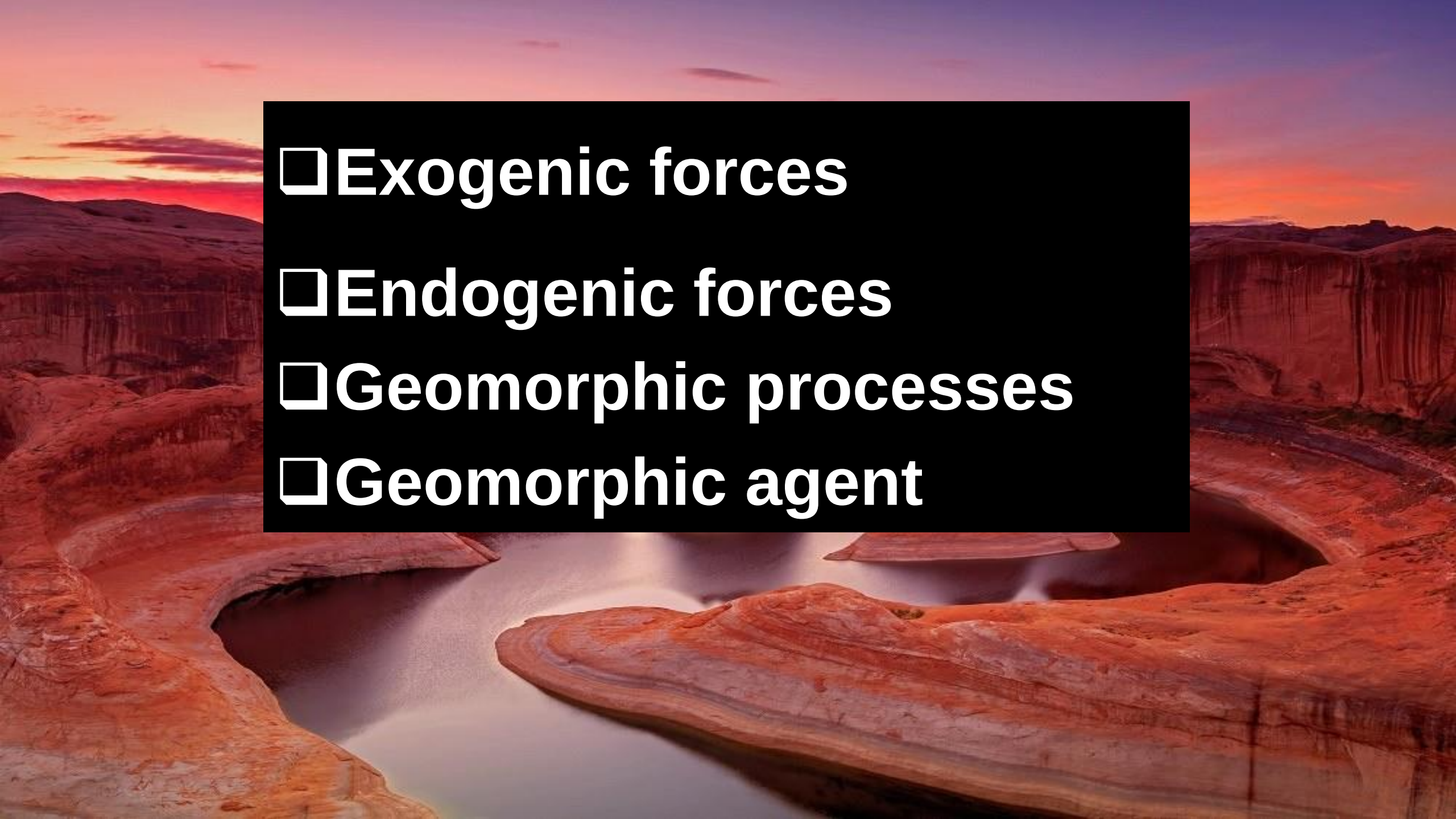
# Rock-Forming Minerals

- **Magnetite:** It is the black ore (or iron oxide) of iron.
- **Amphibole:** It forms about 7 per cent of the earth's crust and consists mainly of aluminium, calcium, silica, iron, magnesium, etc. It is used in the **asbestos industry**.
- **Mica:** It consists of potassium, aluminium, magnesium, iron, silica, etc., and forms 4 % of the earth's crust. It is generally found in igneous and metamorphic rocks and is mainly used in **electrical instruments**.
- **Olivine:** The main elements of olivine are magnesium, iron and silica. It is normally a greenish crystal.
- **Pyroxene:** It consists of calcium, aluminium, magnesium, iron and silica. It is of green or black colour.
- Other minerals like chlorite, calcite, magnetite, hematite, bauxite, barite, etc., are also present in rocks.

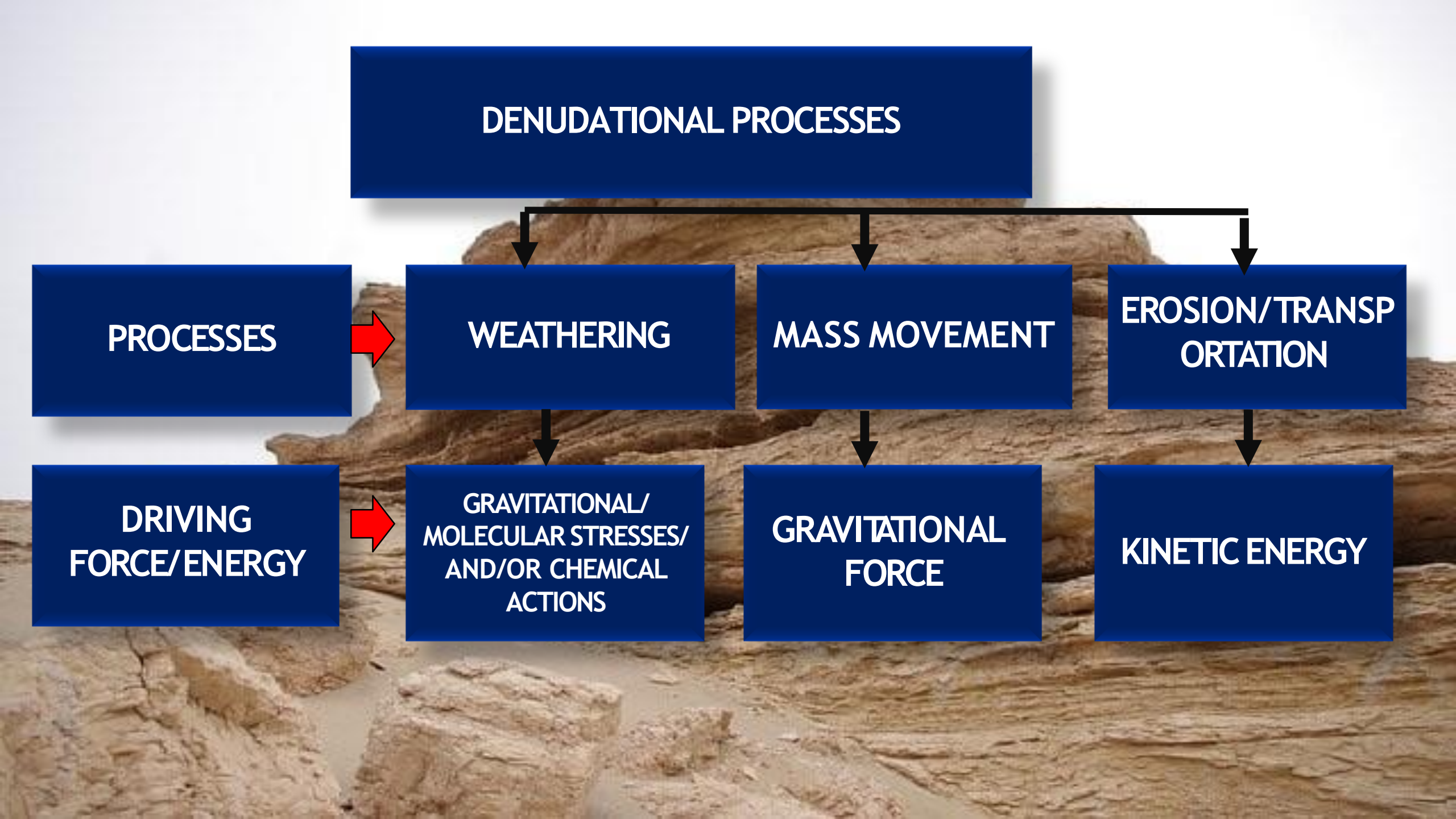
# ROCK CYCLE


Sedimentary
Weathering, erosion, transport deposition
Heat and/or pressure
The Rock Cycle
Igneous
Metamorphic
Intrusion or eruption
Burial and extreme heat
Magma


GEOMORPHOLOGY
Geomorphic Process and Landform



- Exogenic forces
- Endogenic forces
- Geomorphic processes
- Geomorphic agent


DENUDATIONAL PROCESSES
PROCESSES
WEATHERING
MASS MOVEMENT
EROSION/TRANSP ORTATION
DRIVING FORCE/ENERGY
GRAVITATIONAL/ MOLECULAR STRESSES/ AND/OR CHEMICAL ACTIONS
GRAVITATIONAL FORCE
KINETIC ENERGY

Weathering is defined as mechanical disintegration, chemical decomposition of rocks and Biological effects in rocks through the actions of various elements of weather and climate.

## Physical Weathering

- Exfoliation( Onion Weathering)
- Temperature changes and Expansion
- Freezing, Thawing and Frost Wedging
- Salt Weathering

## Chemical Weathering

- Oxidation
- Carbonation
- Hydration
- Solution

# Biological and Chemical Weathering

**Exfoliation. :**

- Continued erosion causes vertical pressure
- Upper layers of the rock expand and fracture parallel to the surface
- Exfoliation due to pressure release is also known as "**sheeting**".



**Temperature:**

- The subsequent expansion and contraction of rocks causes Thermal stress weathering
- Most effective in **dry climates** and **high elevations**



**Frost weathering:**

- These processes include **frost shattering, frost-wedging** and **freeze-thaw weathering.**

## Chemical Weathering

- Acids produced by microbial and plant-root metabolism, water and air (oxygen and carbon dioxide) along with heat speed up all chemical reactions.

## Natural dissolution

- Nitrates, sulphates, and potassium, oxidation potential (iron-rich minerals) will weather through dissolution naturally (rains).

## Solution weathering

- When the solvent is an acidic solution
- Higher concentration of hydrogen ions than water turns into Acidic solution
- Lower concentration of hydrogen ions than water is called basic or alkaline solutions.

## Carbonation

Carbonic acid reacts with limestone, it produces calcium bicarbonate, which is partially soluble in water (dissolution weathering).
Colder water holds more dissolved carbon dioxide gas. Carbonation is, therefore, a large feature of glacial weathering.
Acid rain occurs when gases such as sulphur dioxide and nitrogen oxides are present in the atmosphere.

## Hydration

Chemical addition of water
Continued repetition of this process causes fatigue in the rocks and may lead to their disintegration.

## ➢ MASS MOVEMENTS

### SLOW MOVEMENT

- ❑ Creep
- ❑ Solifluction

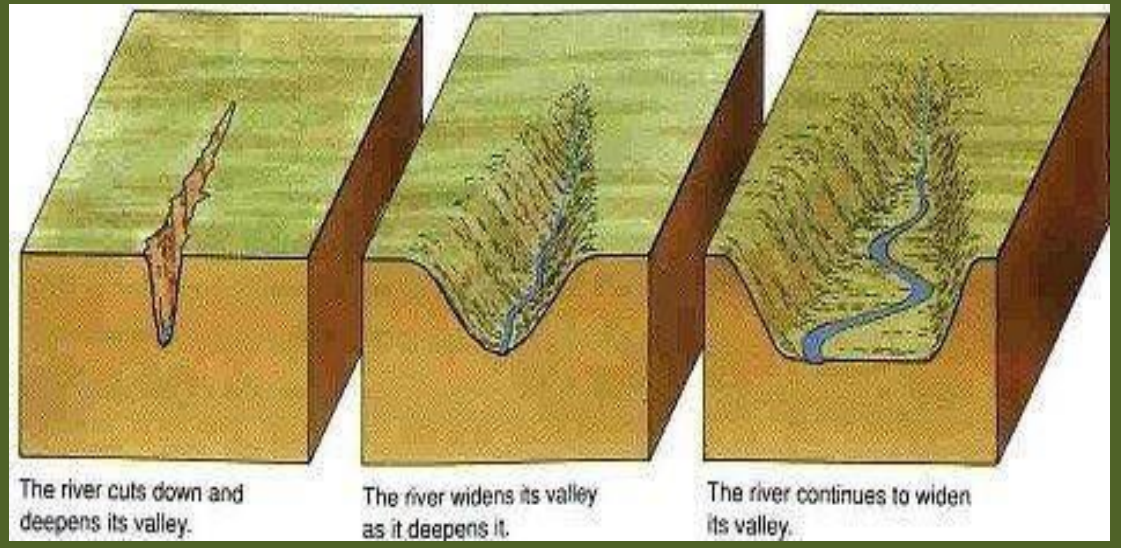



### ❖ Rapid Movements

- ❑ Landslides
- ❑ Earth Flow
- ❑ Mud Flow
- ❑ Snow / Debris Avalanche

- **Youth**

- **Also known as river 's source**
- **High Velocity**
- **Flows with high erosion**
- **located high up in the mountains, forests, etc, in landscapes at very high elevation**
- **Formation of V shape valley**
- A deep and narrow ‘V’ shaped valley is also referred to as gorge
- An extended form of the gorge is called a canyon.



- **Maturity**
- **In the maturity of a river, erosion changes**
- **The river begins to erode sideways (horizontally)**
- **This creates meanders (bends in the river) as it moves closer to ground level**
- **Decrease of Velocity**
- **Formation of U shaped Valleys**
- The outer bend is called Cliff Slope Side.
- The inner side is called the slip-off side.



- **Old Stage**
- **The final Stage in the river has many meanders**

**•It is the slowest stage of the river, and flows at almost ground level. Here, deposition occurs**

**•The river lets go of its rocks and other materials (the load), which is left at the bottom Of the river**

**•These processes Of the Old river make lakes that are separate from the river**



# Landforms formed by Rivers

## EROSIONAL LANDFORMS

- **Valleys**
- **Potholes and plunge pools**
- **Incised or entrenched meanders**
- **River terraces**



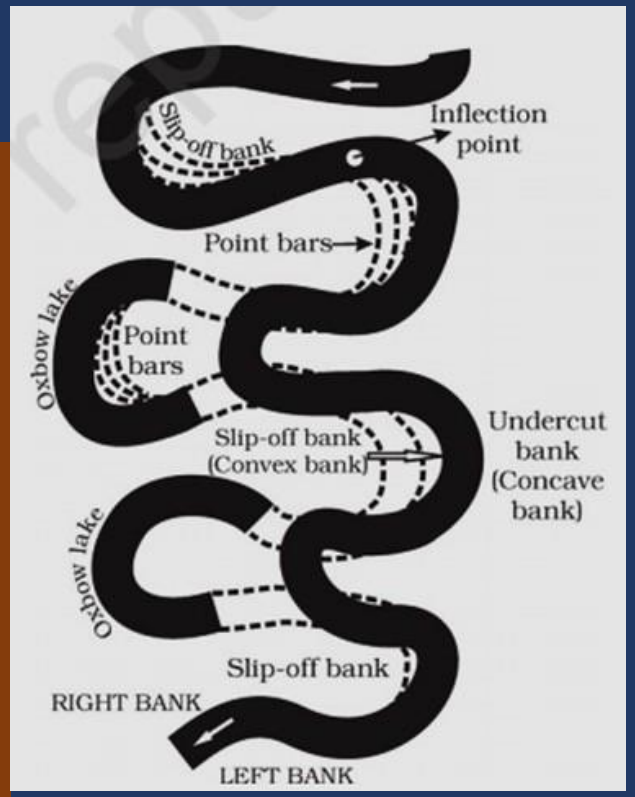







## Depositional Landforms

- **Alluvial fans**
- **Deltas**
- **Floodplains, Natural levees and Point bars**
- **Meanders**
- **Braided channels**












## Drainage Basin

- Also known as **catchment, catchment area, catchment basin, drainage area, river basin, and water basin.**
- A funnel by collecting all the water within the area covered by the basin and channelling it to a single point.
- In **closed drainage** basins the water converges to a single point inside the basin, known as a **sink**, which may be a permanent lake (e.g. Lake Aral, also known Aral Sea, Dead Sea), dry lake (some desert lakes like Lake Chad, Africa), or a point where surface water is lost underground.

## Difference between a River Basin and a Watershed:

- Both river basins and watersheds are areas of land that drain to a particular water body, such as a lake, stream, river or estuary.
- In a river basin, all the water drains to a large river. The term watershed is used to describe a smaller area of land that drains to a smaller stream, lake or wetland.
- There are many smaller watersheds within a river basin.

Example: watershed of Yamuna + watershed of Chambal + watershed of Gandak + .... = Drainage basin of Ganga.

**Find the important drainage basins across the world**

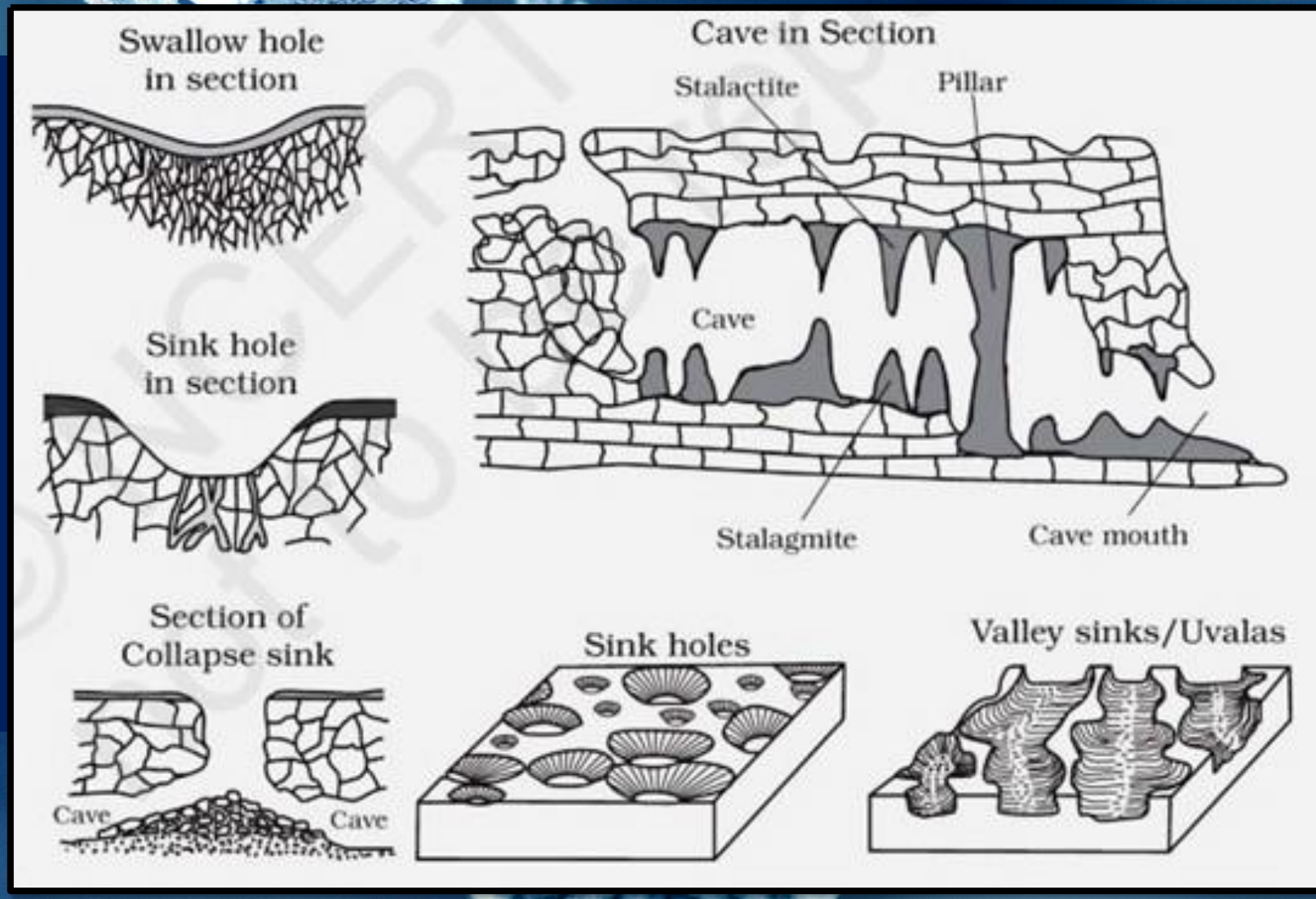
# LANDFORMS FORMED BY GROUNDWATER

## ➢ EROSIONAL LANDFORMS

- Pools, Sinkholes, Lapis and Limestone pavements
- Caves

## ➢ DEPOSITIONAL LANDFORMS

- Stalactites, stalagmites and pillars



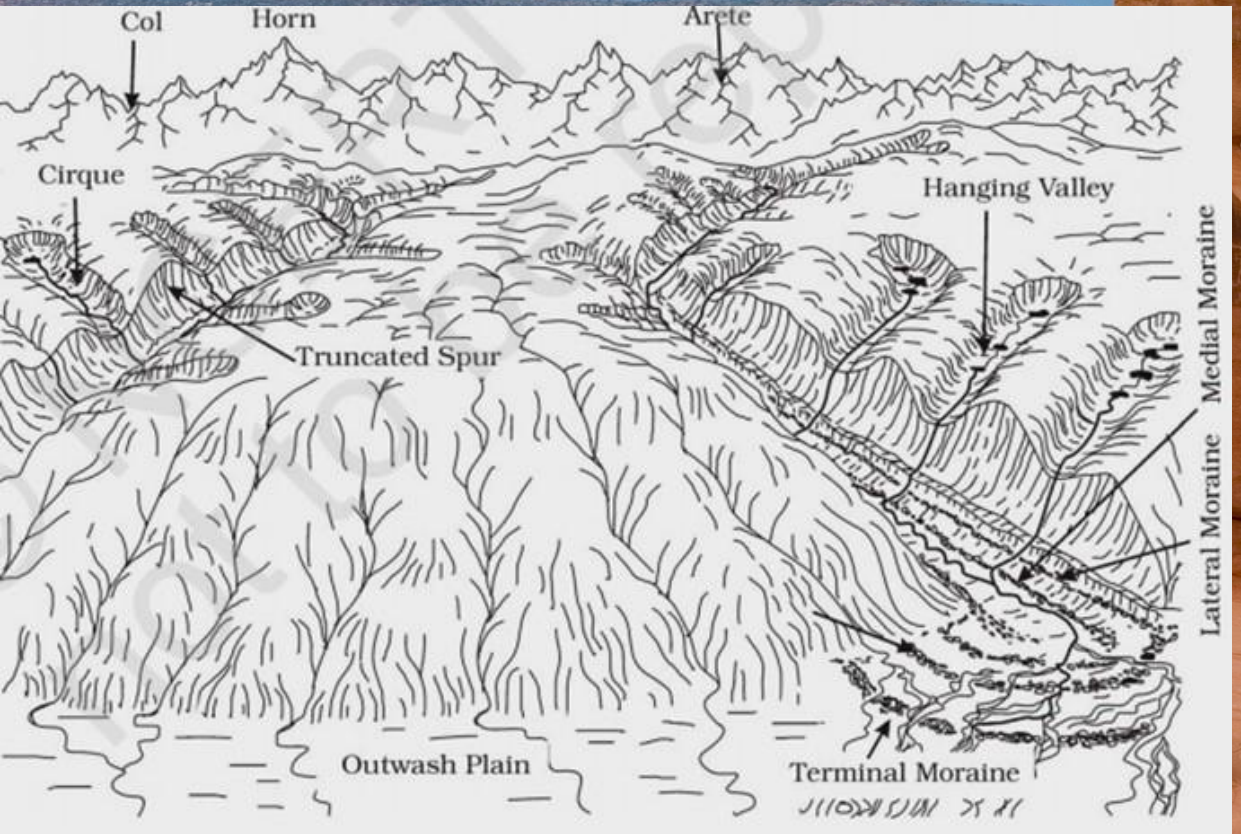
# GLACIERS

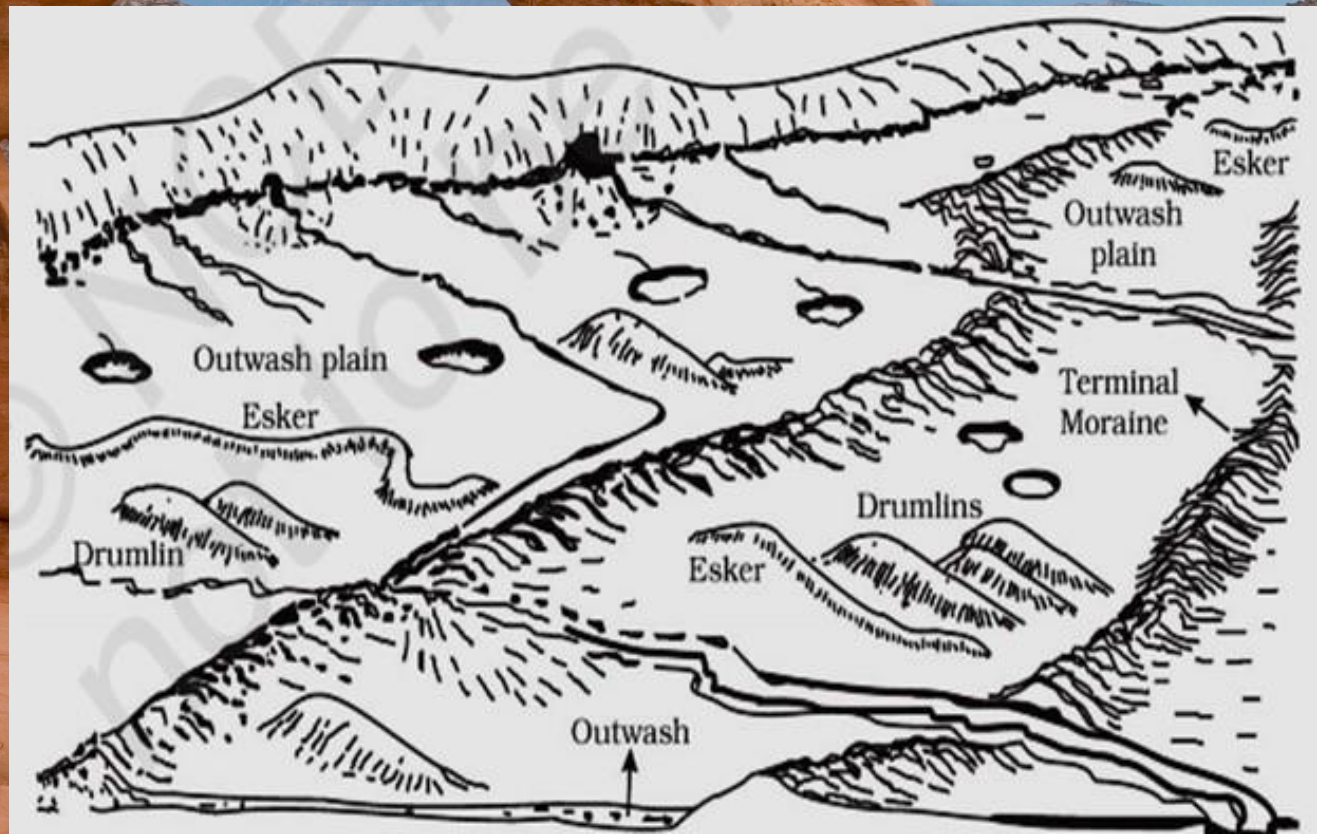
## ➢ EROSIONAL LANDFORMS

- Cirque
- Horns and serrated ridges
- Glacial valleys / troughs

## ➢ DEPOSITIONAL LANDFORMS

- Moraines
- Eskers
- Outwash plains
- Drumlins



## Cirque/Corrie:

- Hollow basin cut into a mountain ridge.
- It has steep sided slope on three sides, an open end on one side and a flat bottom.
- When the ice melts, the cirque may develop into a **tarn lake.**

## Glacial Trough:

- Original stream-cut valley, further modified by glacial action.
- It is a 'U' Shaped Valley. It at mature stage of valley formation.
- Since glacial mass is heavy and slow moving, erosional activity is uniform – horizontally as well as vertically.
- A steep sided and flat bottomed valley results, which has a 'U' shaped profile.

## Hanging Valley:

- Formed when smaller tributaries are unable to cut as deeply as bigger ones and remain ‘hanging’ at higher levels than the main valley as discordant tributaries.
- A valley carved out by a small tributary glacier that joins with a valley carved out by a much larger glacier.

## Arete:

- Steep-sided, sharp-tipped summit with the glacial activity cutting into it from **two**

## Horn:

- Ridge that acquires a ‘horn’ shape when the glacial activity cuts it from **more than two sides.**

## Glacial Depositional Landforms

# Outwash Plain

When the glacier reaches its lowest point and melts, it leaves behind a stratified deposition material, consisting of rock debris, clay, sand, gravel etc. This layered surface is called till plain or an outwash plain.

# Esker

Winding ridge of un-assorted depositions of rock, gravel, clay etc. running along a glacier in a till plain.

The eskers resemble the features of an embankment and are often used for making roads.

# Glacial Depositional Landforms

## Kame Terraces

Broken ridges or un-assorted depositions looking like hump in a till plain.

## Drumlin

Inverted boat-shaped deposition in a till plain caused by deposition.

## Kettle Holes

Formed when the deposited material in a till plain gets depressed locally and forms a basin.

## Moraine

General term applied to rock fragments, gravel, sand, etc. carried by a glacier. Depending on its position, the moraine can be ground moraine and end moraine.

# WAVES AND CURRENTS

- **EROSIONAL LANDFORMS**
  - Cliffs, terraces, caves
- **DEPOSITIONAL LANDFORMS**
  - Beaches and dunes
  - Bars, barriers



# WINDS

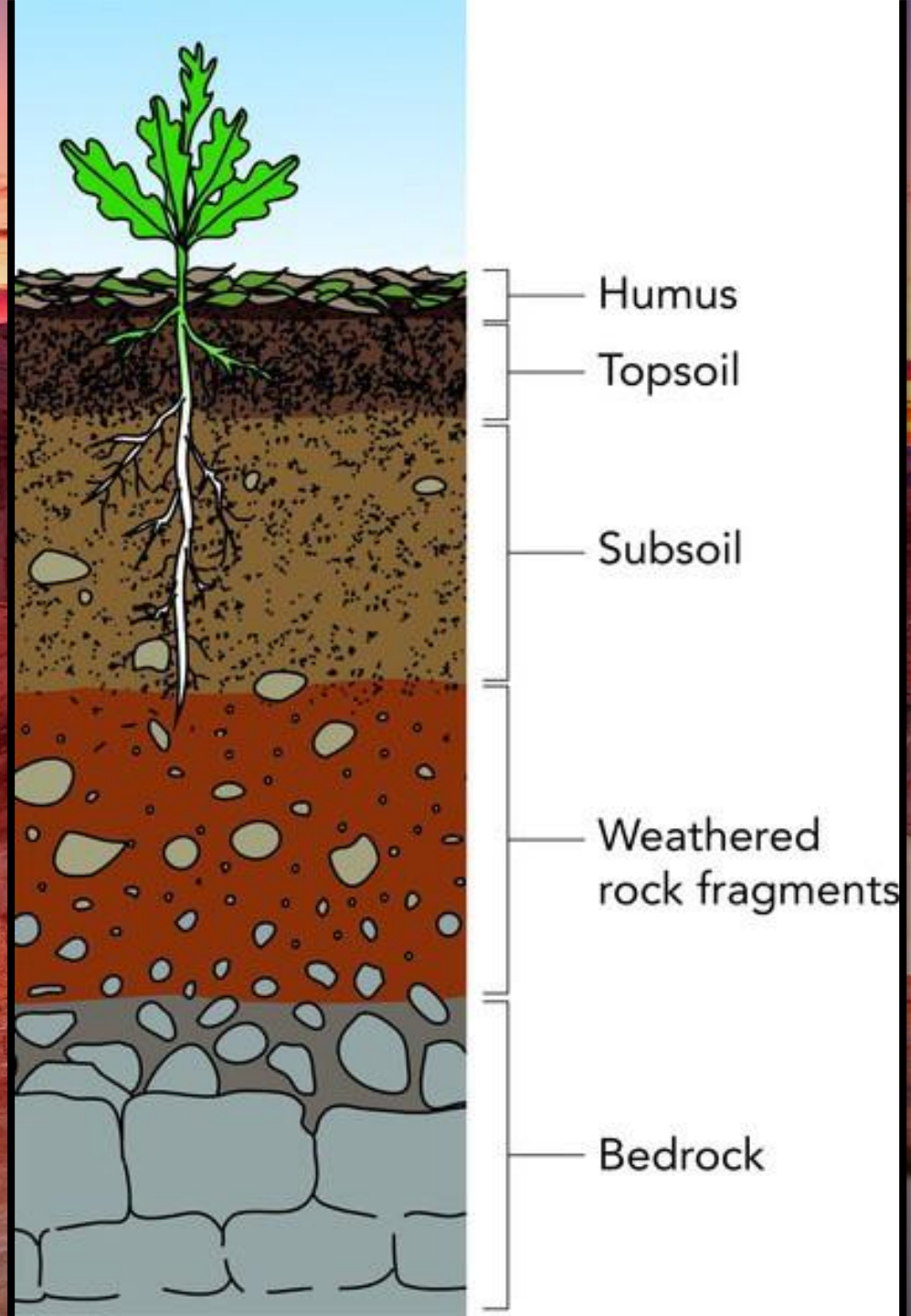
- EROSIONAL LANDFORMS
  - Pediments and pediplains
  - Plays
  - Deflation hollows and caves
  - Mushroom table and pedestal rocks
- DEPOSITIONAL LANDFORMS
  - Sand dunes



# GEOMORPHOLOGY

## SOIL

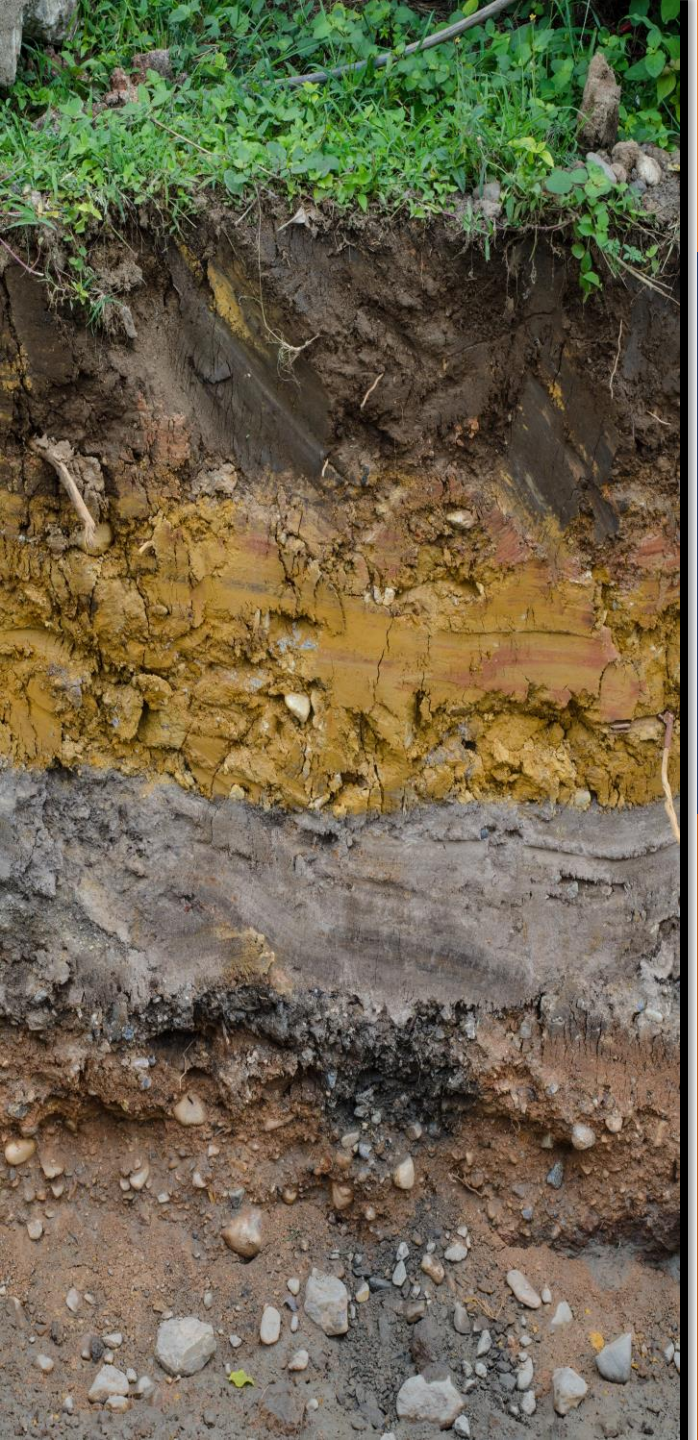





# SOIL PROFILE

**Pedology** is the study

**Pedogenesis** is the natural process of soil formation



## O Horizon/Humus

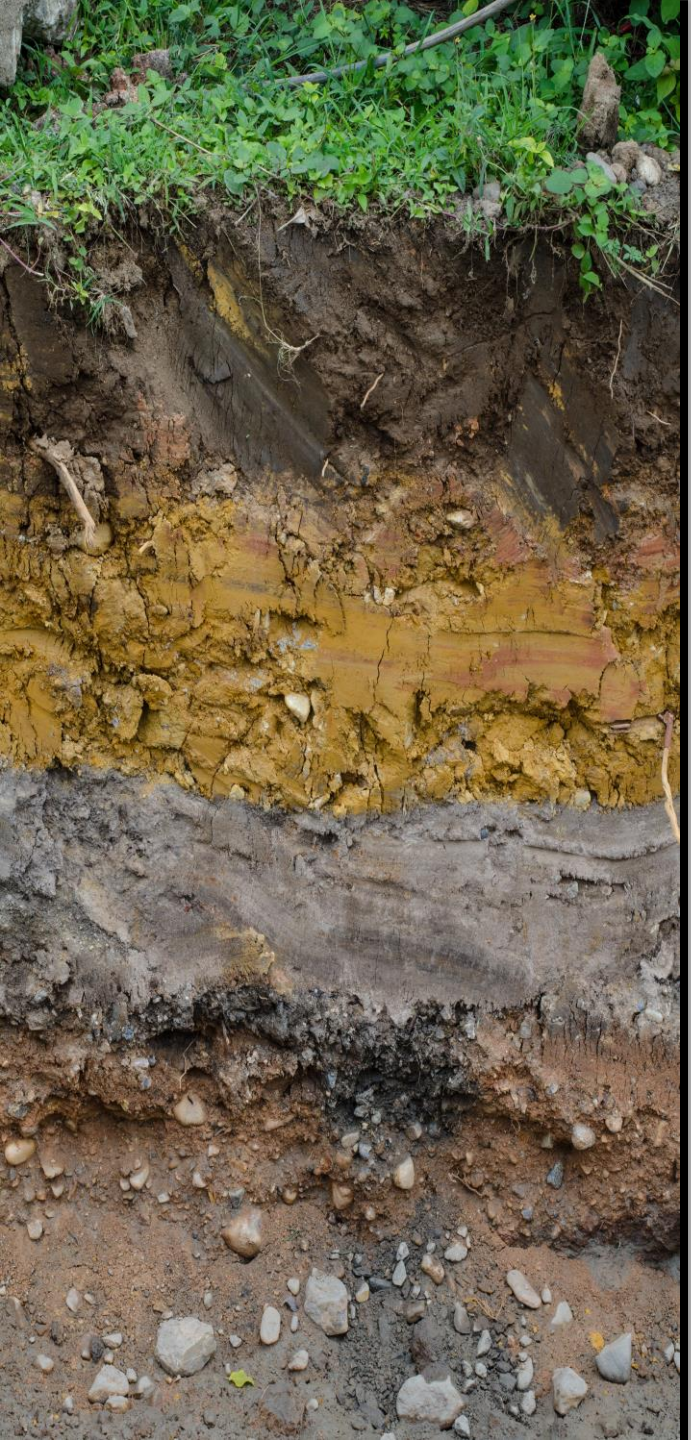
- Layers mainly dominated by organic material.
- decomposed litter such as leaves, needles, twigs, moss, and lichens

## A Horizon or Surface soil

- Here, organic matter is mixed with mineral matter.
- This layer is depleted of (eluviated of) iron, clay, aluminum, organic compounds, and other soluble constituents.
- Due to depletion of the above materials this layer has a lighter coloured texture

## E horizon

- ‘E’stands for eluviated layer.
- Leaching of clay, iron, and aluminum oxides that leaves a concentration of resistant minerals (quartz, in the sand and silt sizes)
- Present in older, well-developed soils
- Occur between the A and B horizons



## B Horizon or Subsoil

- Chemical or physical alteration of parent material.
- Accumulates all the leached minerals from A and E horizon.
- Iron, Clay, Aluminium and organic compounds accumulate in this horizon

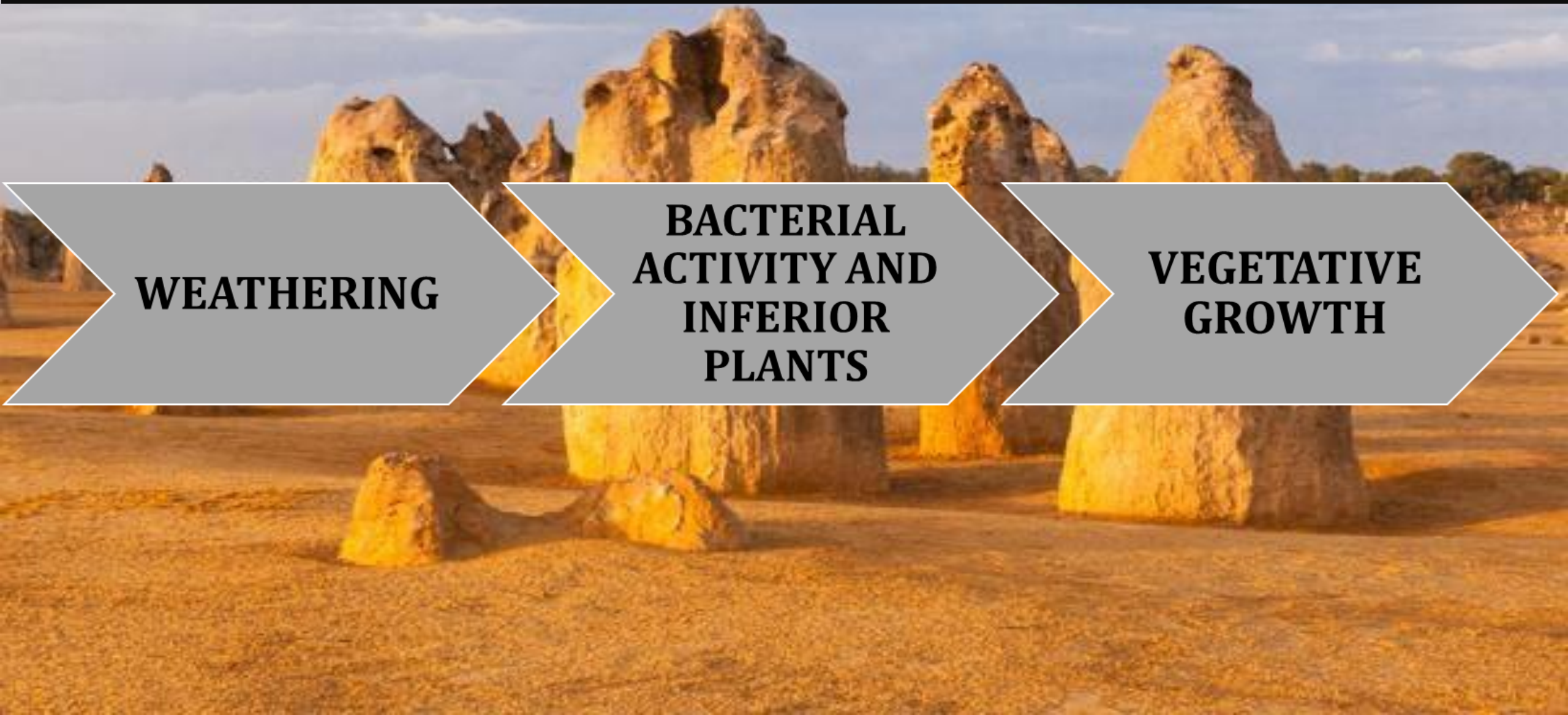
## C Horizon or Parent rock

- Weathered parent material accumulates in this layer
- Layer of large unbroken rocks.
- This layer may accumulate the more soluble compounds (inorganic material).

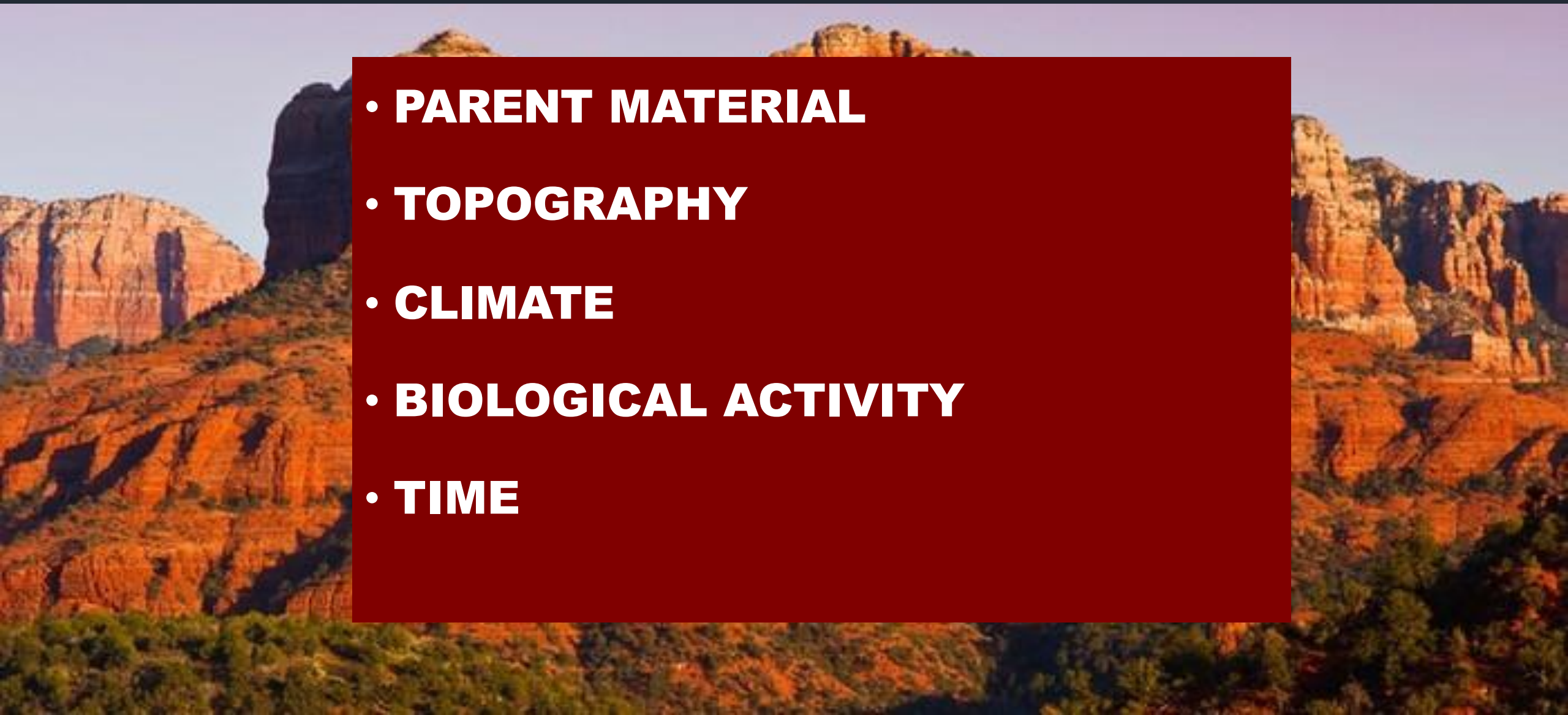
## R Horizon or Bedrock

- Partially weathered bedrock at the base of the soil profile.
- R horizons largely comprise continuous masses of hard rock.

# SOIL FORMATION

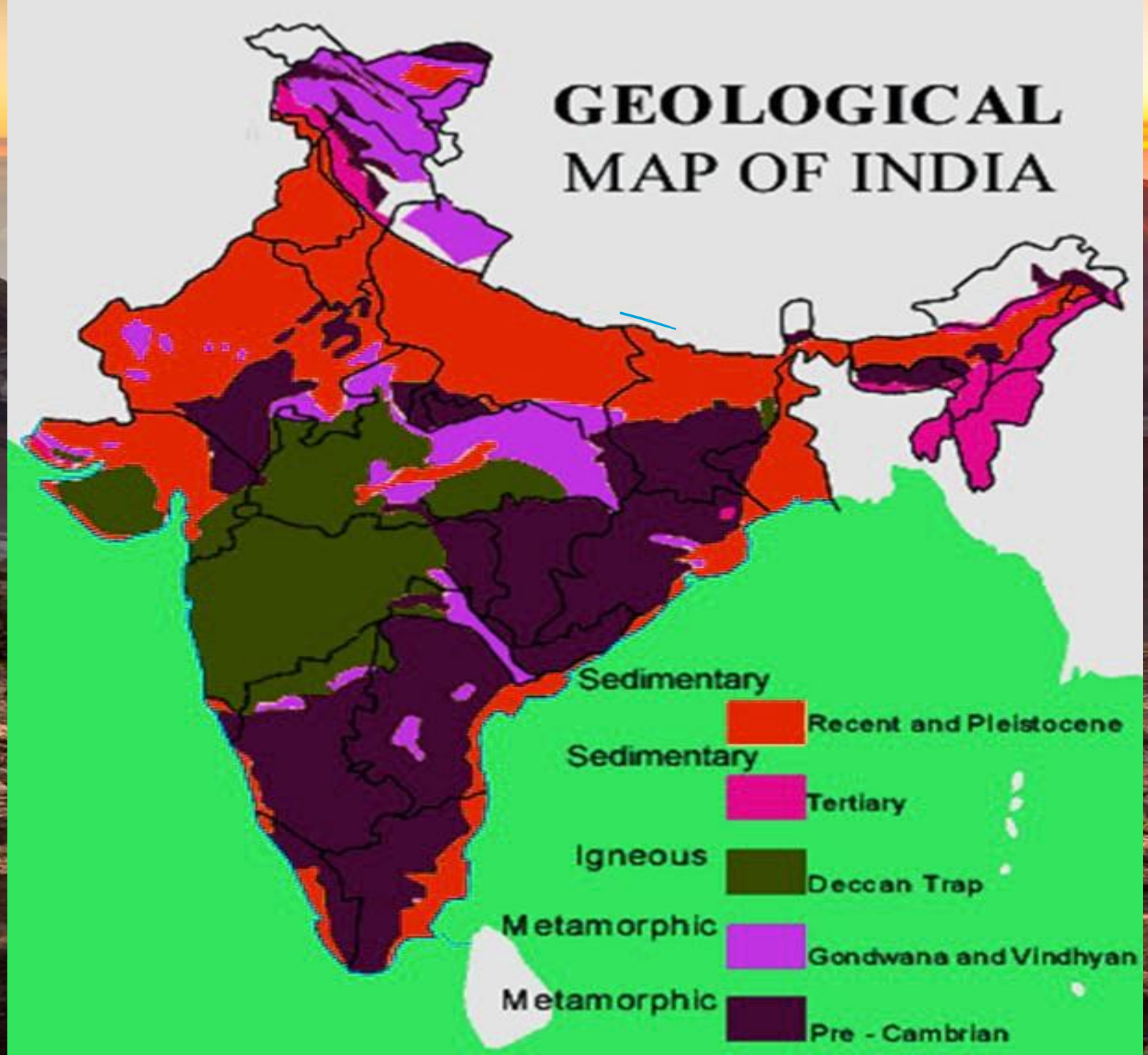


# FACTORS



- PARENT MATERIAL
- TOPOGRAPHY
- CLIMATE
- BIOLOGICAL ACTIVITY
- TIME

# ROCK TYPES


GEOLOGICAL
MAP OF INDIA
Sedimentary
Recent and Pleistocene
Sedimentary
Tertiary
Igneous
Deccan Trap
Metamorphic
Gondwana and Vindhyan
Metamorphic
Pre - Cambrian

# ALLUVIAL SOIL

- Around 40 % of total land area
- Soil vary in nature from sandy loam to clay
- Rich in potash but poor in phosphorous
- Khadar(young)and Bhangar(old) soils contain calcareous/ calcium carbonate concretions (Kankars)
- Colour of the alluvial soils varies from the light grey to ash grey



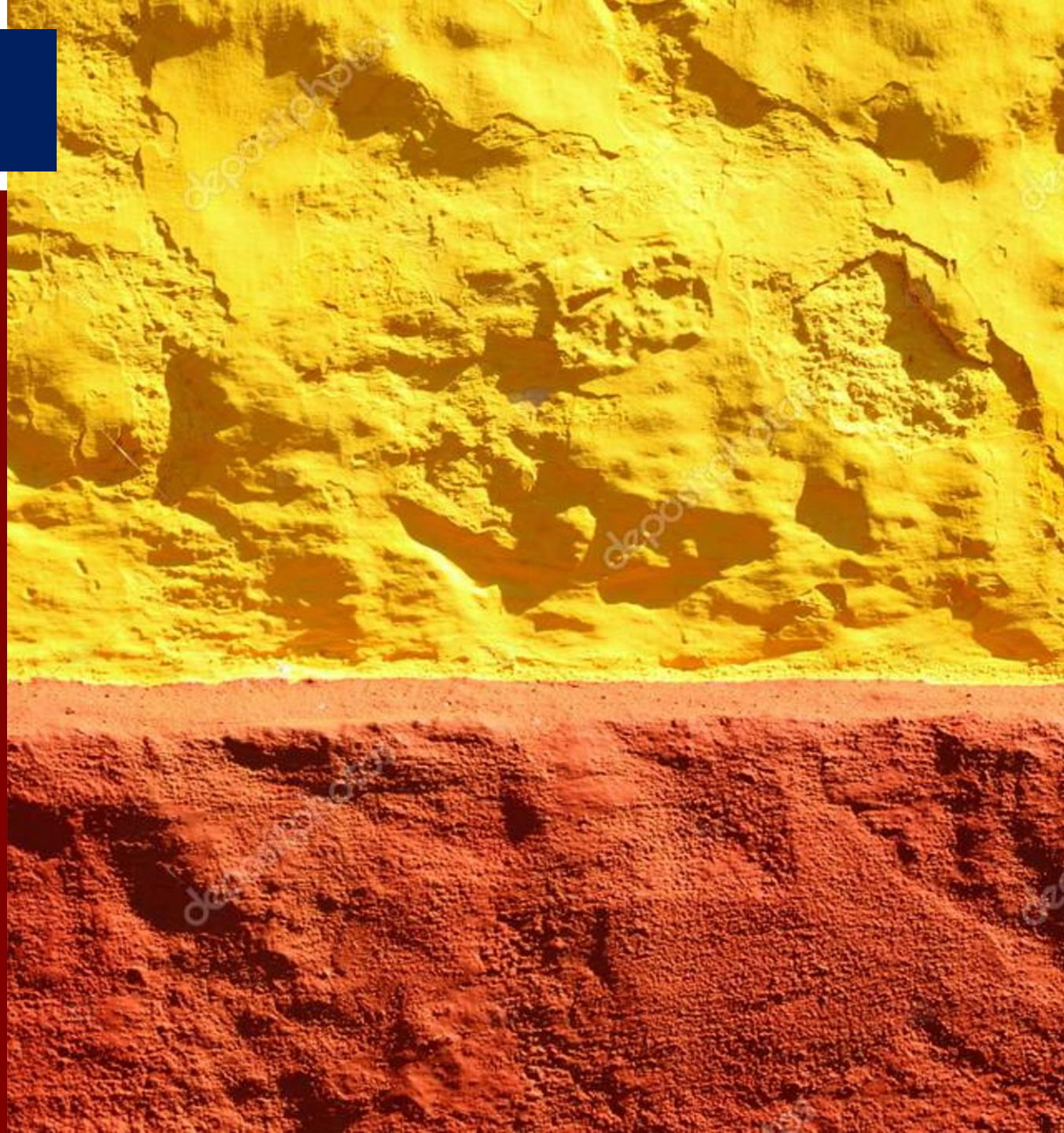


# BLACK SOIL

- Black soil is very deep.
- ‘Regur Soil’ or  the ‘Black Cotton Soil
- Generally clayey, deep and impermeable.
- Self ploughing - They swell and become sticky when wet and shrink when dried.
- Rich in lime, iron, magnesia and alumina. They also contain potash.
- Lack in phosphorous, nitrogen and organic matter.
- The colour of the soil ranges from deep black to grey.

# RED AND YELLOW SOIL

- The soil develops a reddish colour due to a wide diffusion of iron in crystalline and metamorphic rocks.
- It looks yellow when it occurs in a hydrated form.
- The fine-grained red and yellow soils are normally fertile, whereas coarse-grained soils found in dry upland areas are poor in fertility.
- They are generally poor in nitrogen, phosphorous and humus.



# LATERITE SOIL

- The laterite soils develop in areas with high temperature and high rainfall
- Intense leaching due to tropical rains
- With rain, lime and silica are leached away, and soils rich in iron oxide and aluminium compound are left behind
- Humus content of the soil is removed fast by bacteria that thrives well in high temperature.

# LATERITE SOIL

- Poor in organic matter, nitrogen, phosphate and calcium, while iron oxide and potash are in excess.
- Hence, laterites are not suitable for cultivation
- Red laterite soils in Tamil Nadu, Andhra Pradesh and Kerala are more suitable for tree crops like cashew nut, Tapioca
- Laterite soils are widely cut as bricks for use in house construction.

# ARID SOIL



- Sandy in structure and saline in nature
- They lack moisture and humus
- Nitrogen is insufficient and the phosphate content is normal
- ‘Kankar’ layers

# SALINE SOIL

- Usara soils.
- Larger proportion of sodium, potassium and magnesium, and thus, they are infertile
- They have more salts, largely because of dry climate and poor drainage.
- Their structure ranges from sandy to loamy.
- They lack in nitrogen and calcium.
- Seawater intrusions in the deltas promote the occurrence of saline soils.
- In the areas of intensive cultivation with excessive use of irrigation, especially in areas of green revolution, the fertile alluvial soils are becoming saline.
- Farmers are advised to add gypsum to solve the problem of salinity in the soil.

# PEATY SOIL

- Areas of heavy rainfall and high humidity and high vegetation
- High organic matter content

# FOREST SOIL

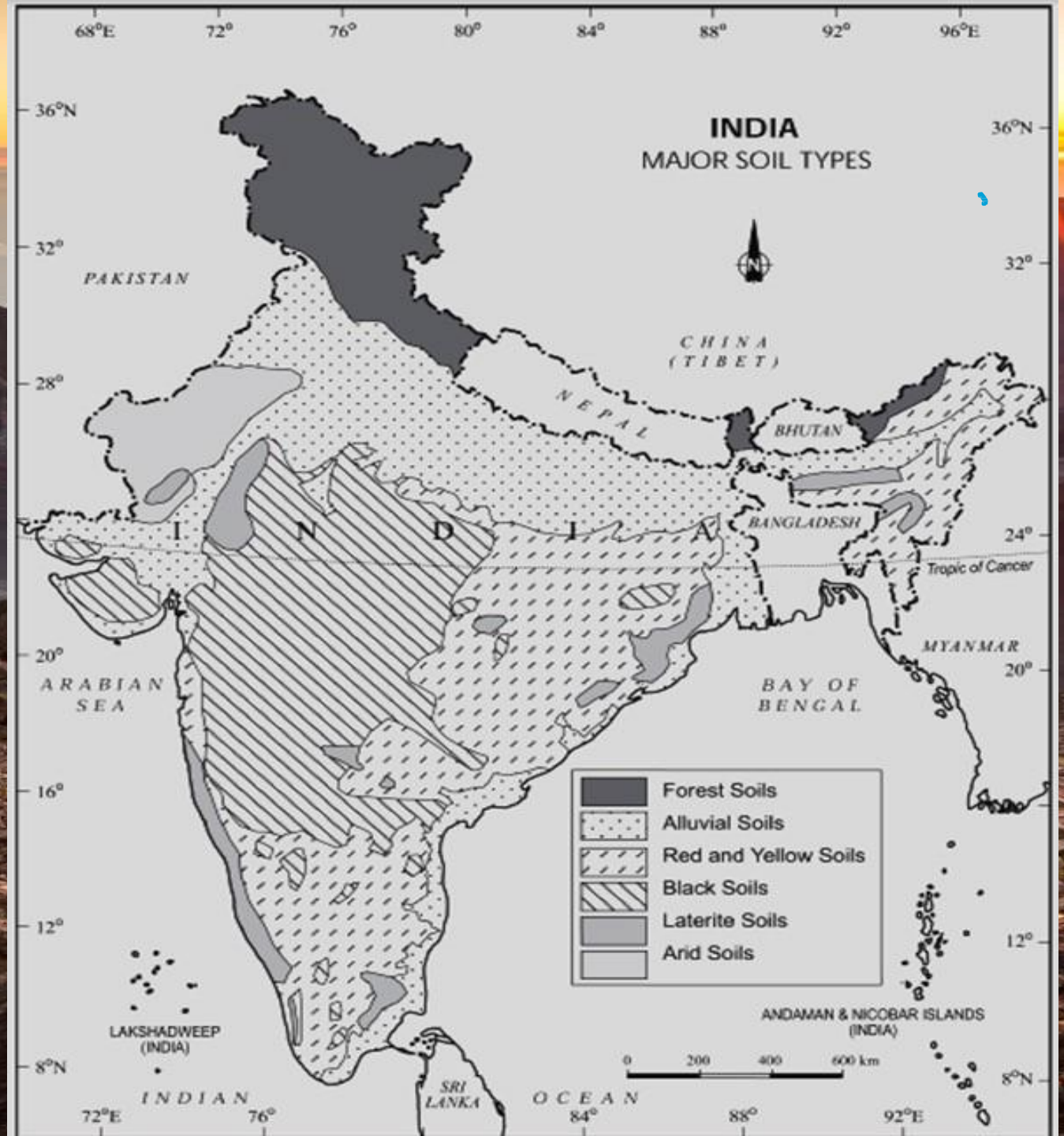
- Loamy and silty on valley sides and coarse-grained in the upper slopes.



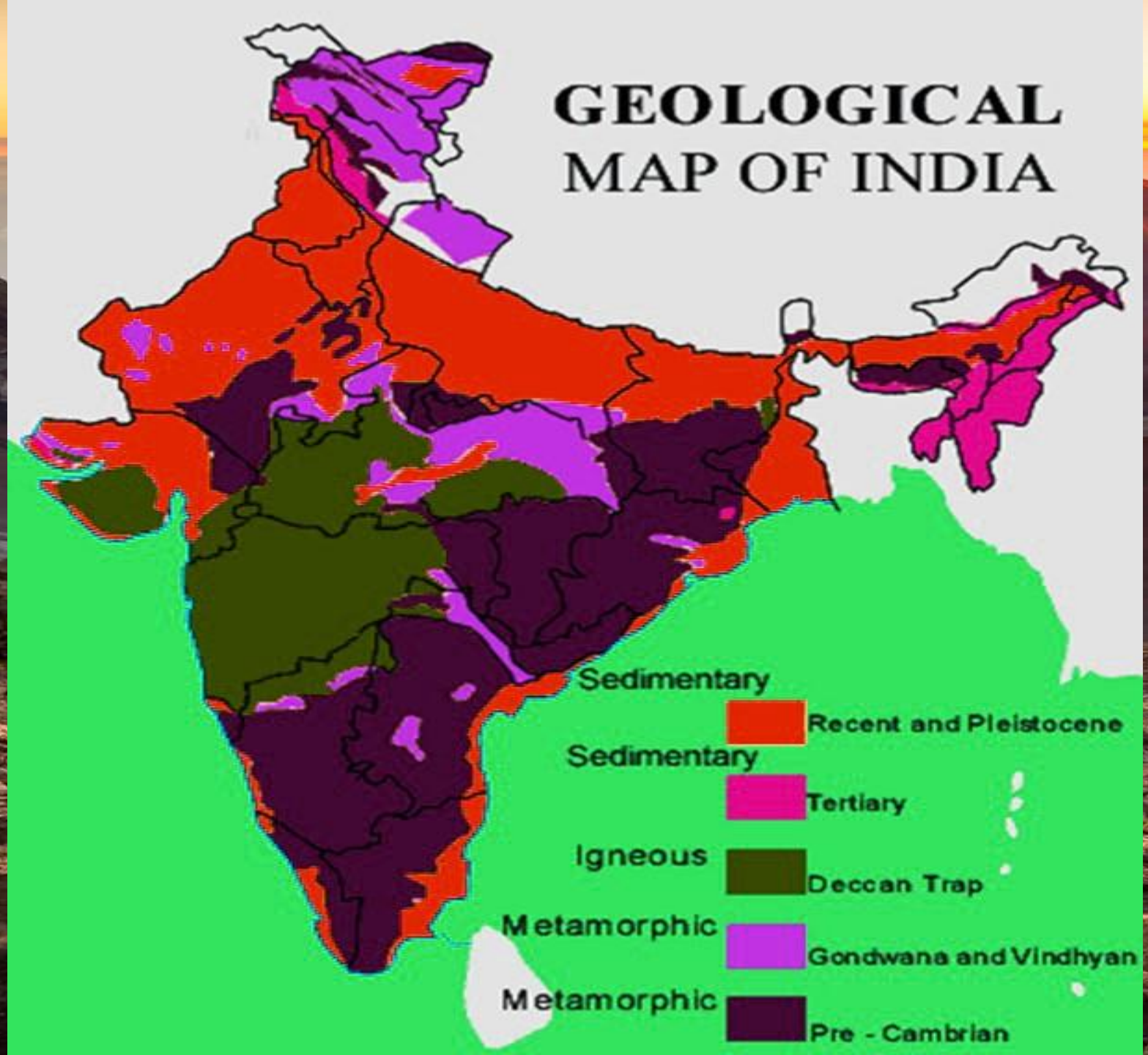
| Soil Types | Properties | Nutrients | Places Found | Crops Type |
|---|---|---|---|---|
| ALLUVIAL SOIL | sandy loam to clay, the most fertile soil of all other soils | Potassium, Calcium carbonate, phosphoric acid and lime | The entire northern plains,Arunachal Pradesh, Assam, Bihar, eastern costal plains | Sugarcane, paddy, wheat, and other cereal and pulse crops. |
| BLACK SOIL | Clayey, deep and impermeable, Self ploughing | Iron, lime, calcium, potash, magnesium, and aluminium. Poor in phosphoric, nitrogen & organic matter contents | North west Deccan plateau, Maharashtra, Saurashtra, Malwa, M adhya Pradesh, and Chattishgarh and extend in the south-east direction along the Godavari and the Krishna valleys. | Cotton. Other major crops grown on the black soils include wheat, jowar, linseed, virginia tobacco, castor, sunflower and millets. |
| RED AND YELLOW SOIL | Reddish colour due to diffusion of iron in crystalline and metamorphic rocks. | Non-soluble material 90.47%, iron 3.61%, aluminium 2.92%, Poor in nitrogen, phosphorous and humus. | Eastern and southern parts of the Deccan plateau, Odisha, Chhattisgarh, southern parts of the middle Ganga plain and along the Piedmont zone of the Western Ghats. | Rice, wheat, sugarcane, maize/corn, groundnut, ragi (finger millet) and potato, oilseeds, pulses, millets, and fruits such as mango, orange, citrus, and vegetables |

| | | | | |
|---|---|---|---|---|
| LATERITE SOIL | Develops in areas with high temperature and heavy rainfall. Humus content of the soil is low | 90–100% of iron, aluminium, titanium, and manganese oxides. lower content of nitrogen, phosphorus, potassium, lime, and magnesia | Karnataka, Kerala, Tamil Nadu, Madhya Pradesh, and the hilly areas of Odisha and Assam | Tea and coffee. More suitable for crops like cashew nut, tapioca starch. |
| ARID SOIL | Red and brown in colour. sandy & saline in nature and lacks humus and moisture. Soluble salts. It is alkaline in nature because there is no rain to wash soluble salts. | Calcium carbonates, gypsum, as well as sodium. | Western Rajasthan, Haryana, and Punjab and extends up to the Rann of Kutch in Gujarat | Wheat, cotton, corn (maize), millets, pulses, and barley |

# SOIL TYPES


INDIA
MAJOR SOIL TYPES
68°E
72°
76°
80°
84°
88°
92°
96°E
36°N
32°
28°
24°
20°
16°
12°
8°N
PAKISTAN
CHINA (TIBET)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
I N D I A
Tropic of Cancer
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
LAKSHADWEEP (INDIA)
SRI LANKA
ANDAMAN & NICOBAR ISLANDS (INDIA)
Forest Soils
Alluvial Soils
Red and Yellow Soils
Black Soils
Laterite Soils
Arid Soils
0 200 400 600 km

# ROCK TYPES


GEOLOGICAL
MAP OF INDIA
Sedimentary
Recent and Pleistocene
Sedimentary
Tertiary
Igneous
Deccan Trap
Metamorphic
Gondwana and Vindhyan
Metamorphic
Pre - Cambrian

# Types of Soils required for crops

- Clayey and loamy soils are both suitable for growing cereals like wheat, and gram. Such soils are good at retaining water.
- For paddy, soils rich in clay and organic matter and having a good capacity to retain water are ideal.
- For lentils (masoor) and other pulses, loamy soils, which drain water easily, are required.
- For cotton, sandy loam or loam, which drain water easily and can hold plenty of air, are more suitable.

# SOIL EROSION

- WATER EROSION
  - Splash erosion,
  - Sheet erosion,
  - Rill erosion and Gully erosion
- WIND EROSION / aeolian erosion

# SOIL EROSION

- ☐ Streambank erosion
- ☐ Landslide
- ☐ Coastal erosion
- ☐ Glacial erosion



# RILL EROSION



# GULLY EROSION




Rill
Gully
Ravine
Badland
Gorge
Canyon

# WIND EROSION / aeolian erosion

- Depression formation in deserts is the first step in Oasis formation.
- Oasis forms in depressions when there is underground water that gets accumulated above rocks.
- Very fine and medium sands are moved by wind in a succession of bounds and leaps, known as **saltation**.
- Small sand and dust particles are transported over long distances through the air by a process known as **suspension**.
- Coarse sand is not usually airborne but rather is rolled along the soil surface. This type of erosion is called **surface creep.**
- Very coarse sand and gravels are too large to be rolled by wind, so wind-eroded soils have surfaces covered with coarse fragments. This kind of arid soil surface is known as desert pavement.

# Soil Conservation

Contour Ploughing
Strip Cropping
Mulching
Terrace Farming
Sand Fence
Wind Break

# Soil Conservation

- Crop Rotation
- Use of Early Maturing Varieties
- Checking Shifting Cultivation
- Ploughing the Land in Right Direction
- Afforestation
- Checking Overgrazing
- Dams

# CONTOUR PLOWING



# STRIP CROPPING



# TERRACE FARMING

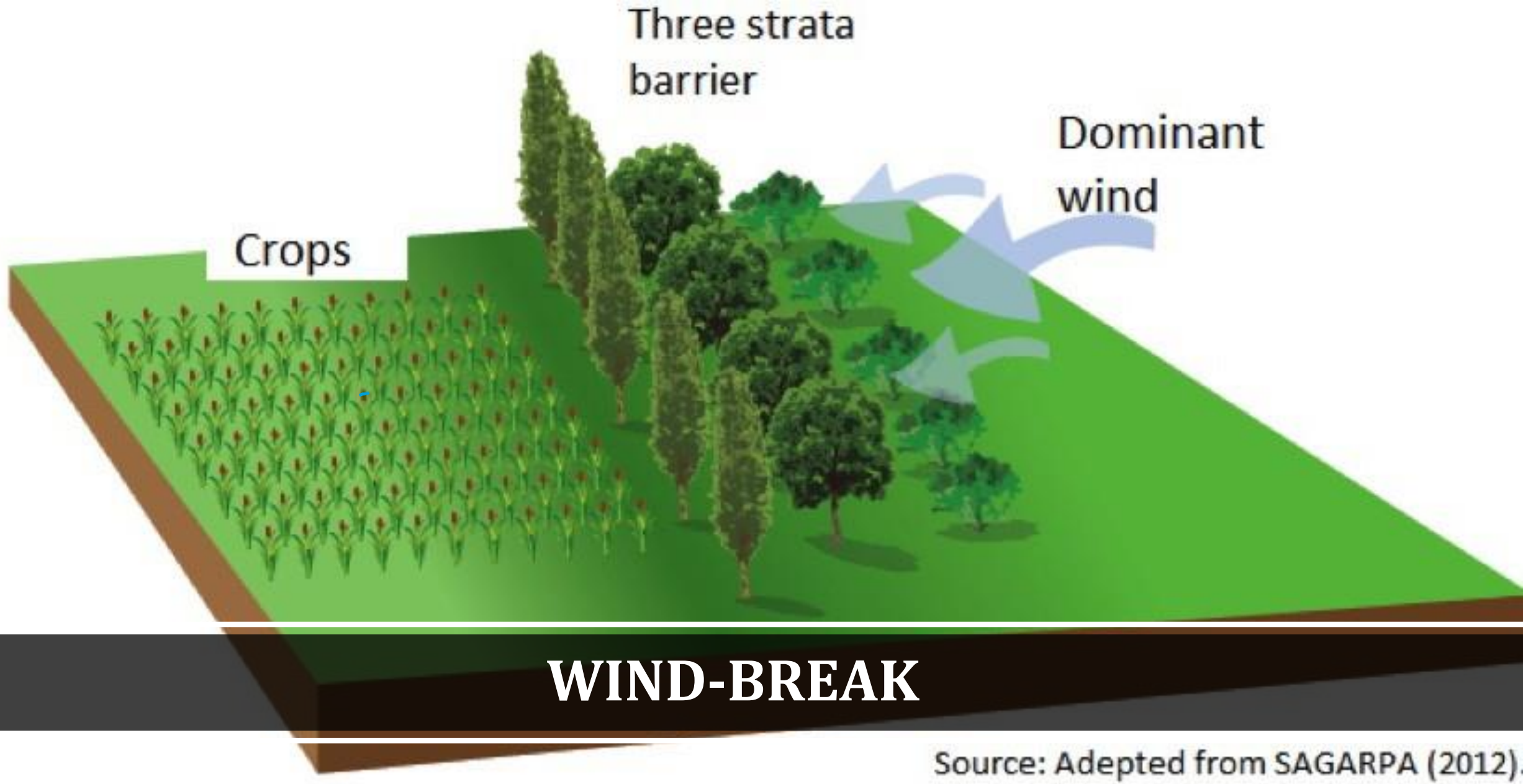


# MULCHING



# SAND FENCE



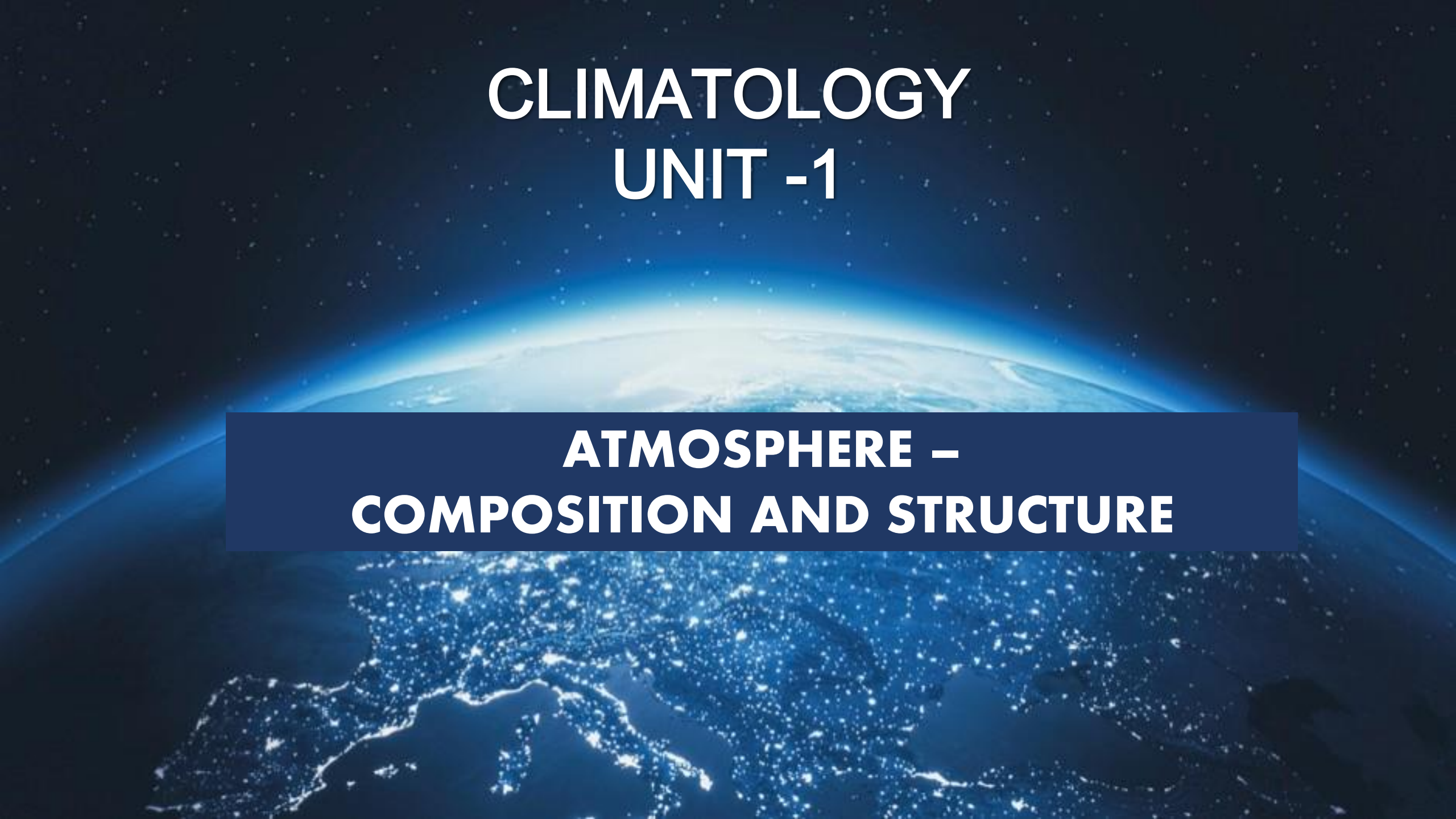



# WIND-BREAK

Source: Adepted from SAGARPA (2012).

# CLIMATOLOGY
# UNIT -1

## ATMOSPHERE – COMPOSITION AND STRUCTURE



# Introduction

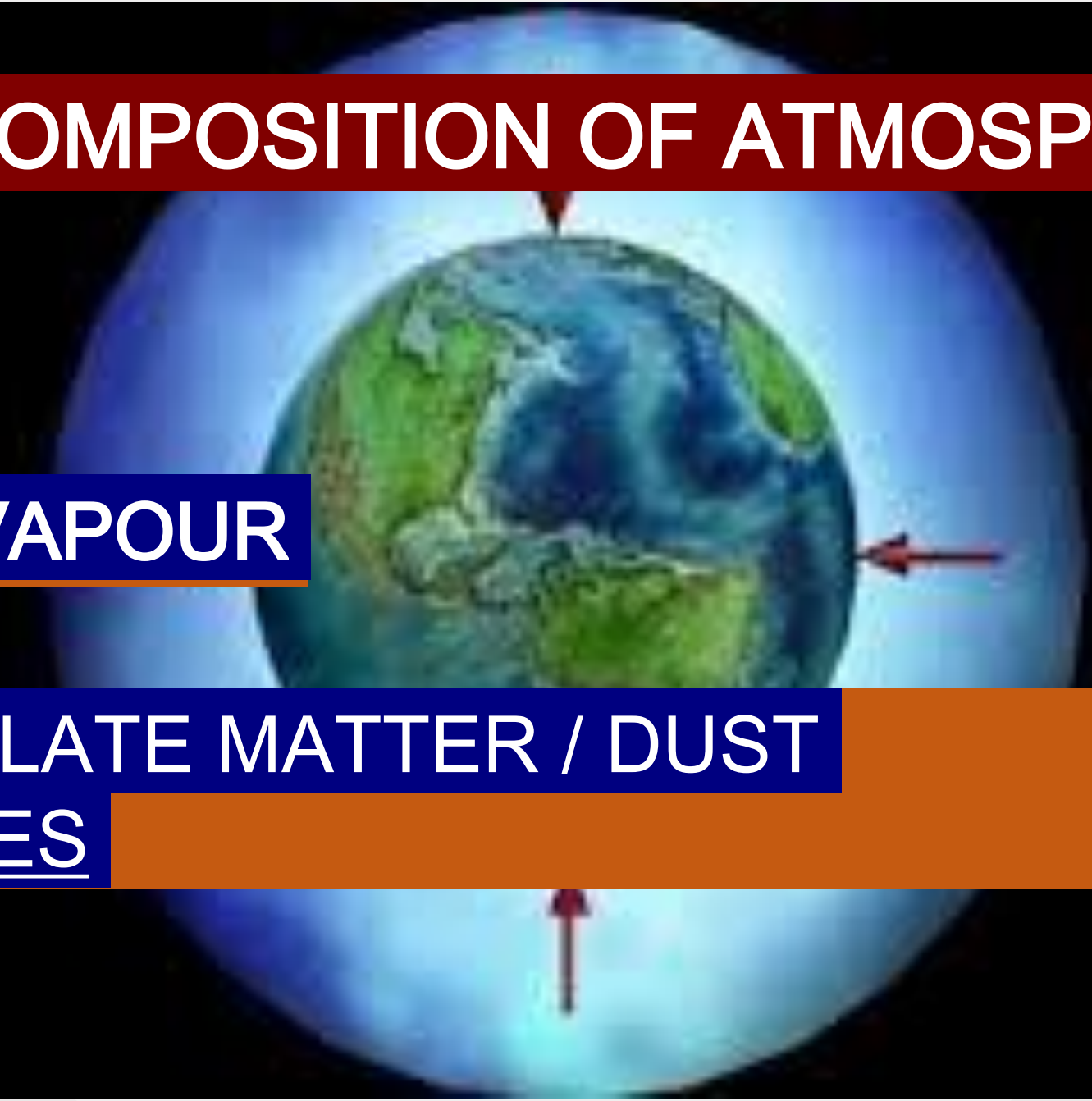
- Thick gaseous envelope surrounding the Earth
- Attached to the earth's surface by gravitational force
- 99% mass is within the height of 32 km
- Acts like a greenhouse by trapping the heat

# ORIGIN OF THE ATMOSPHERE

**Three stages in the evolution of present atmosphere**

- **Loss of primordial atmosphere**
- **Degassing by Volcanic eruptions, Hot springs, chemical breakdown of solid matter.**
- **Photosynthesis and Human Activity**

# COMPOSITION OF ATMOSPHERE



- GASES
- WATER VAPOUR
- PARTICULATE MATTER / DUST PARTICLES

# COMPOSITION

## ➢GASES

| CONSTITUENT | FORMULA | PERCENTAGE BY VOLUME |
|---|---|---|
| **Nitrogen** | **$N_2$** | **78.08** |
| **Oxygen** | **$O_2$** | **20.95** |
| Argon | Ar | 0.93 |
| **Carbon dioxide** | **$CO_2$** | **0.036** |
| Neon | Ne | 0.002 |
| Helium | He | 0.0005 |
| Krypton | Kr | 0.001 |
| Xenon | Xe | 0.00009 |
| Hydrogen | $H_2$ | 0.00005 |

# COMPOSITION

➢ WATER VAPOUR

- **Variable gas**
- **Absorbs insolation and terrestrial radiation**
- **Latent heat**

# COMPOSITION

## ➢ PARTICULATE MATTER / DUST PARTICLES

- **High concentration in subtropical and temperate regions**
- **Hygroscopic nuclei**
- **Scatters incoming solar rays**
- **Particles like sea salts, fine soil, smoke-soot, ash, pollen, dust & disintegrated particles of Meteors**

# Expected Question

Which of the statements is/are true regarding the composition of the atmosphere:

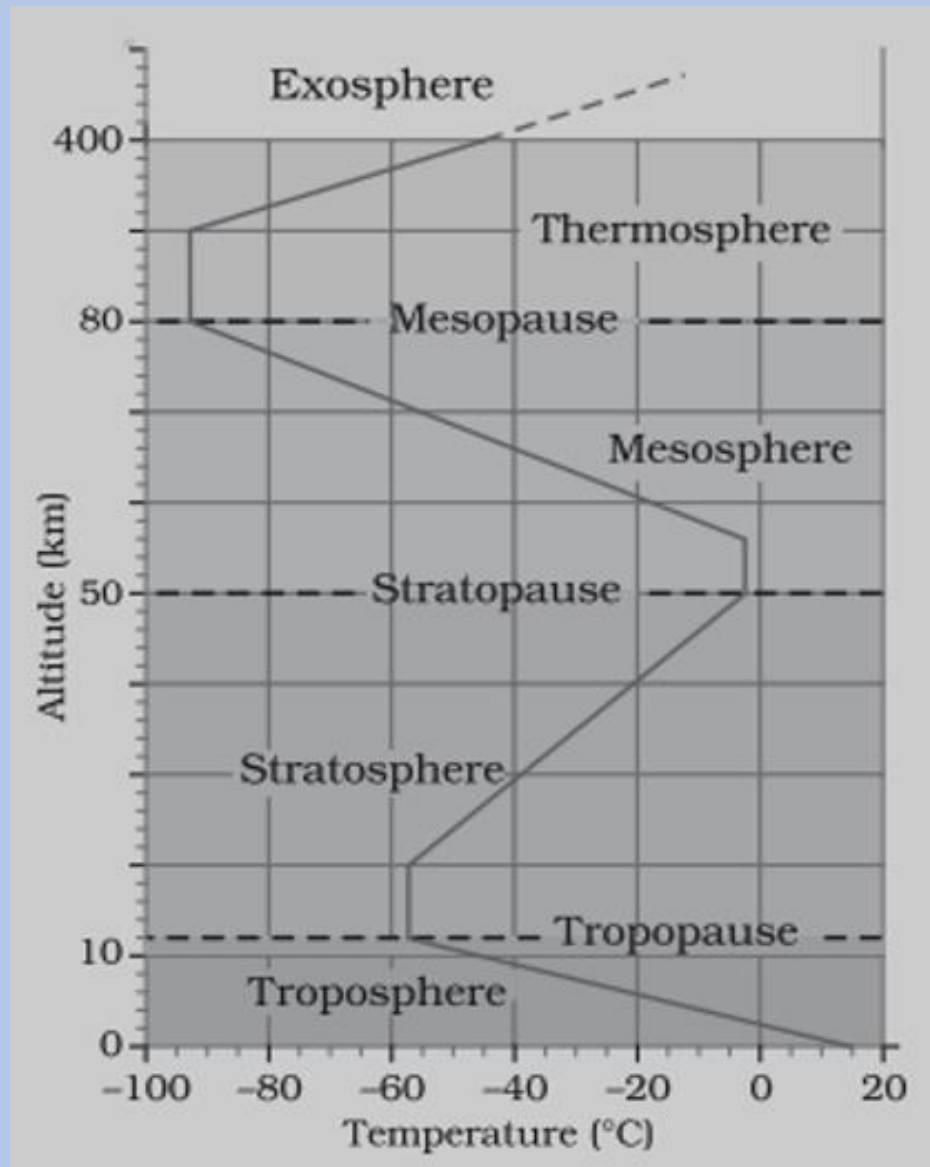
I. Water vapour in the atmosphere decreases with altitude.
II. It decreases from the equator towards the poles.
III. Water vapour absorbs all forms of solar radiations.

Choose the correct statements using the codes given below:

a. I & II
b. II & III
c. I & III
d. All of the above.

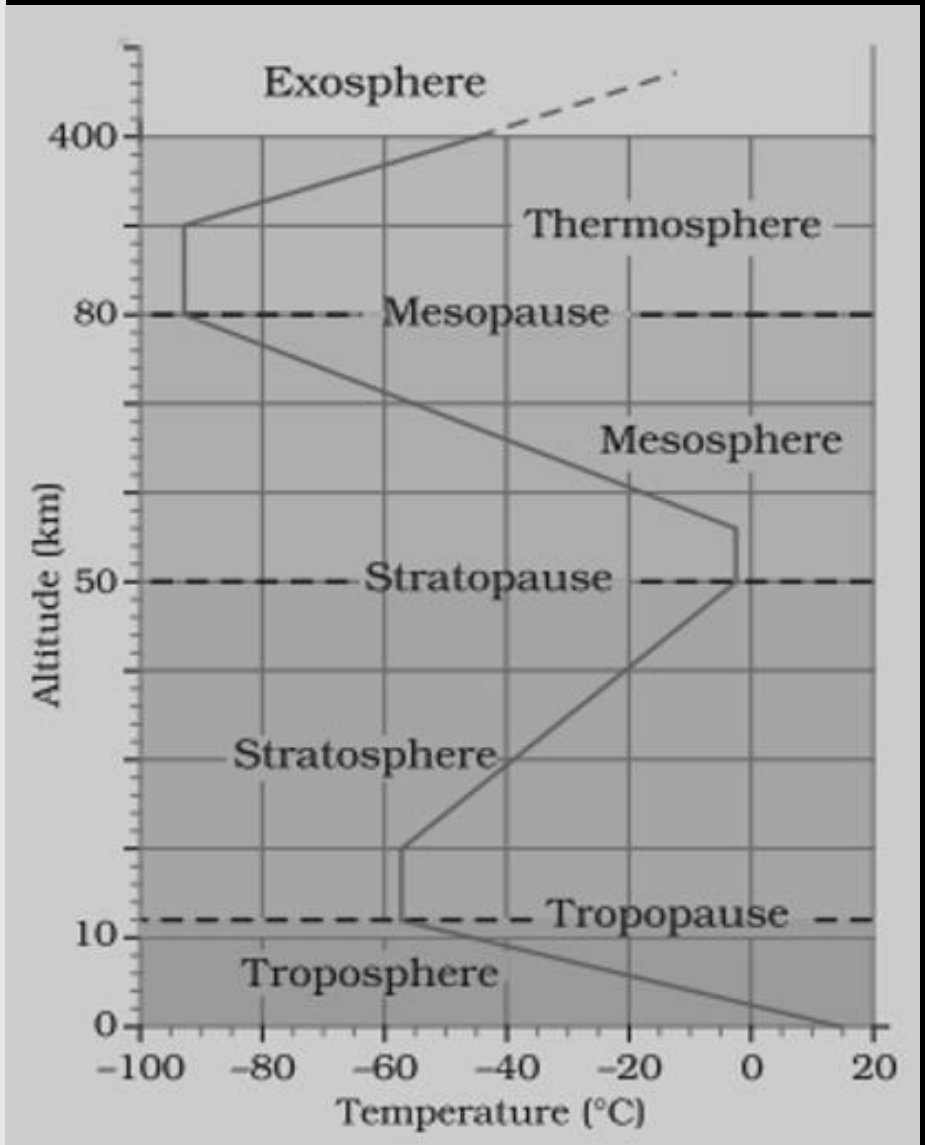
# STRUCTURE

- **Consists of different layers**
- **Density decreases with altitude**
- **Homosphere and Heterosphere**



# TROPOSPHERE

- **Strong convectional currents**
- **Height of troposphere**
- **Temperature decreases with altitude**
- **Contains dust particles and water vapour**
- **Jet aeroplanes often avoid this layer**
- **Tropopause**



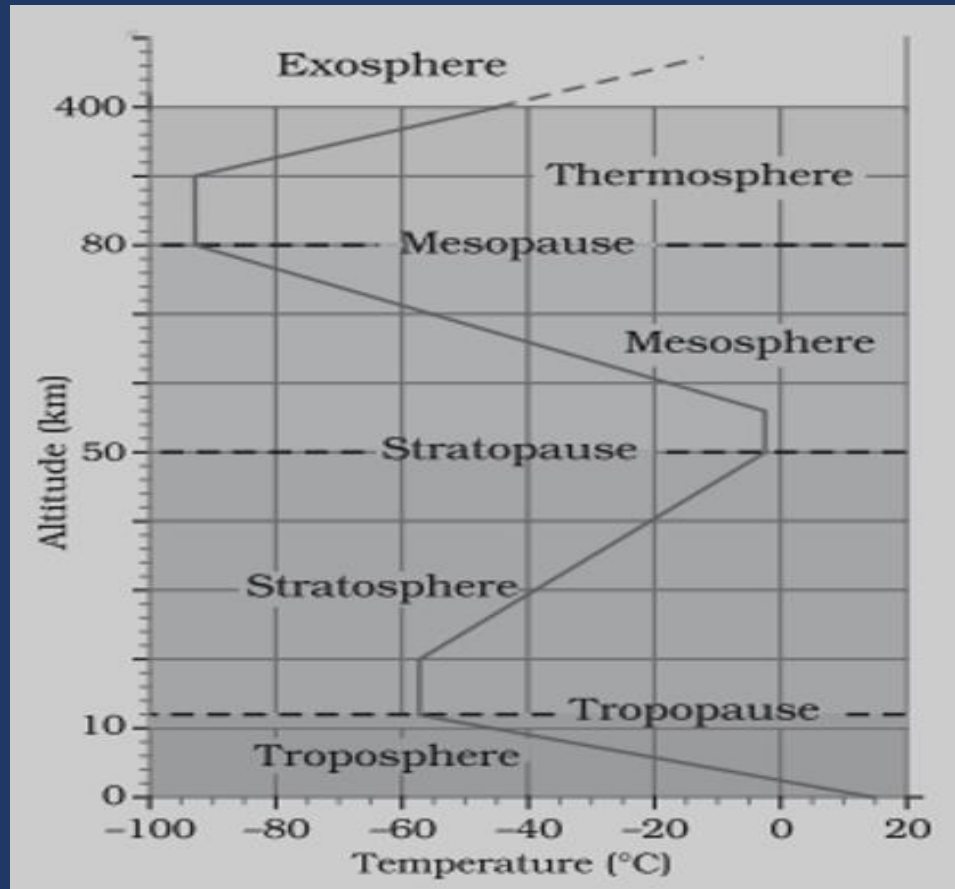
# ANVIL SHAPED CLOUD



# STRATOSPHERE

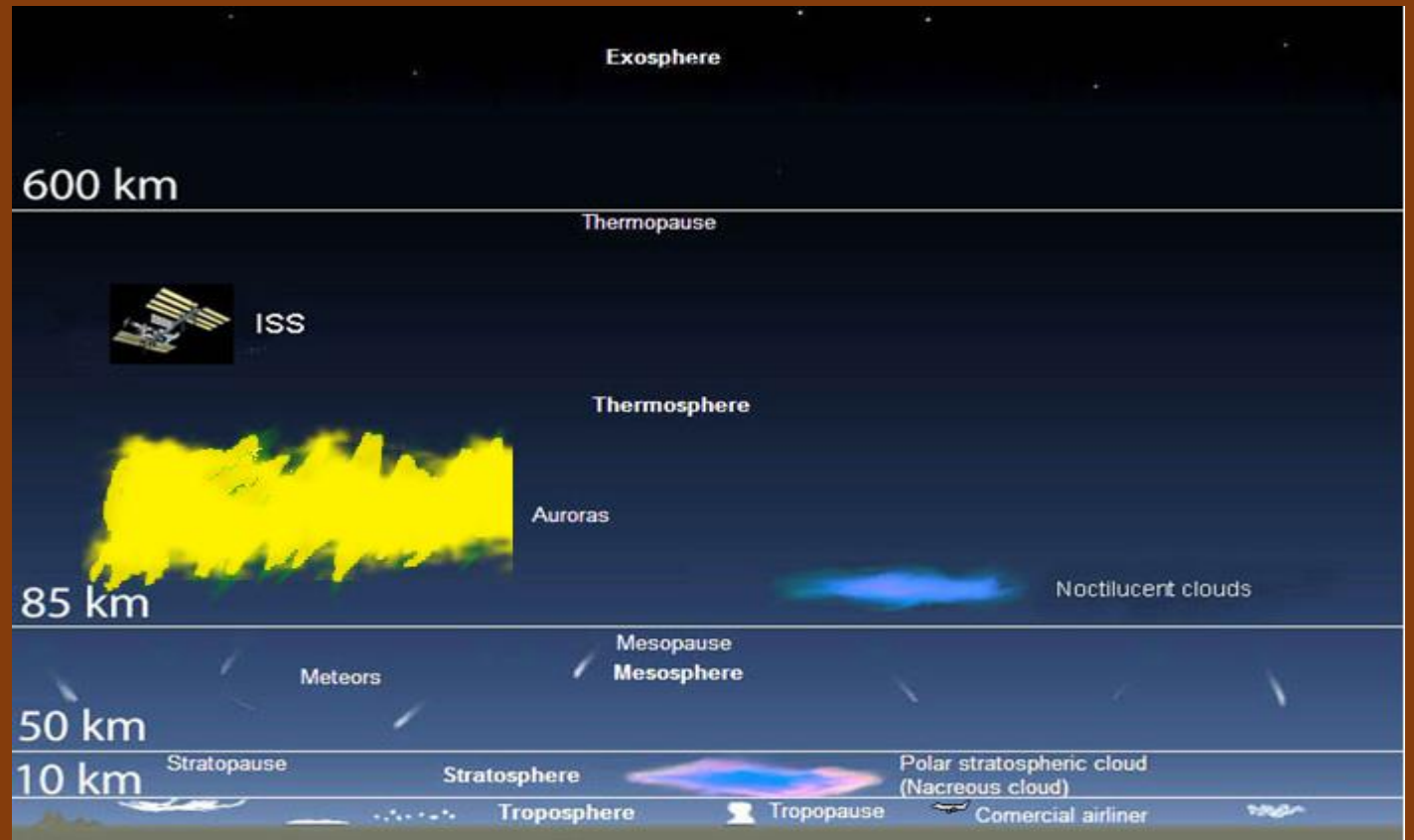
- **Presence of ozone layer**
- **Temperature increases with altitude**
- **Low vertical mixing**
- **Less cloud formation**
- **Stratopause**

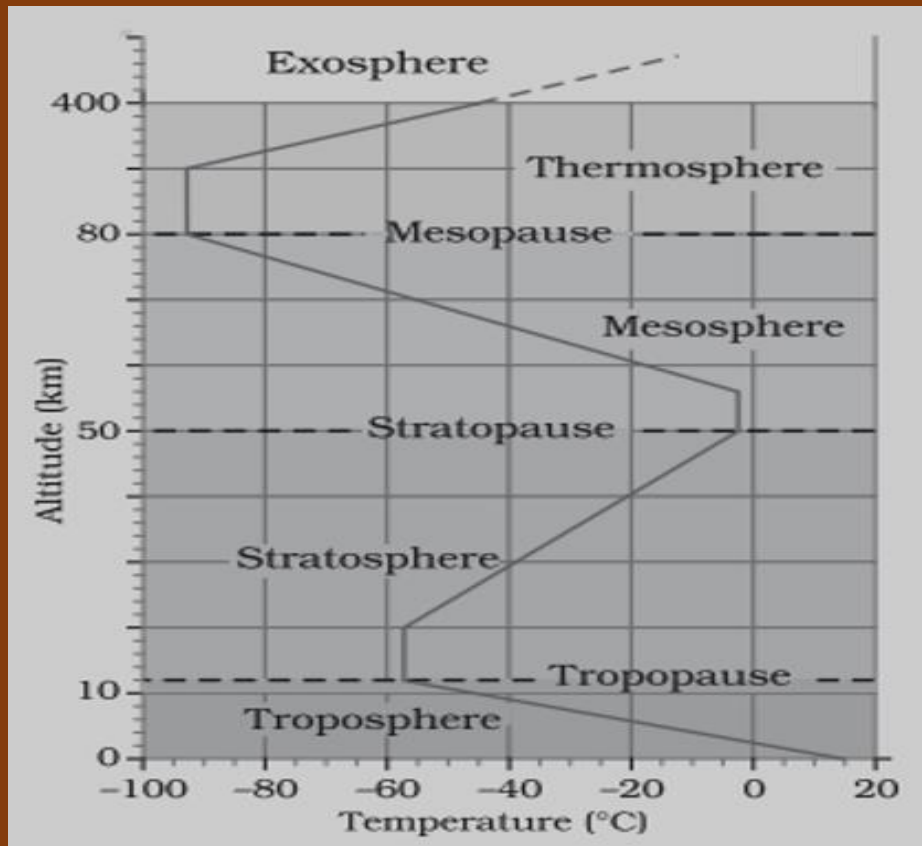




# Mesosphere

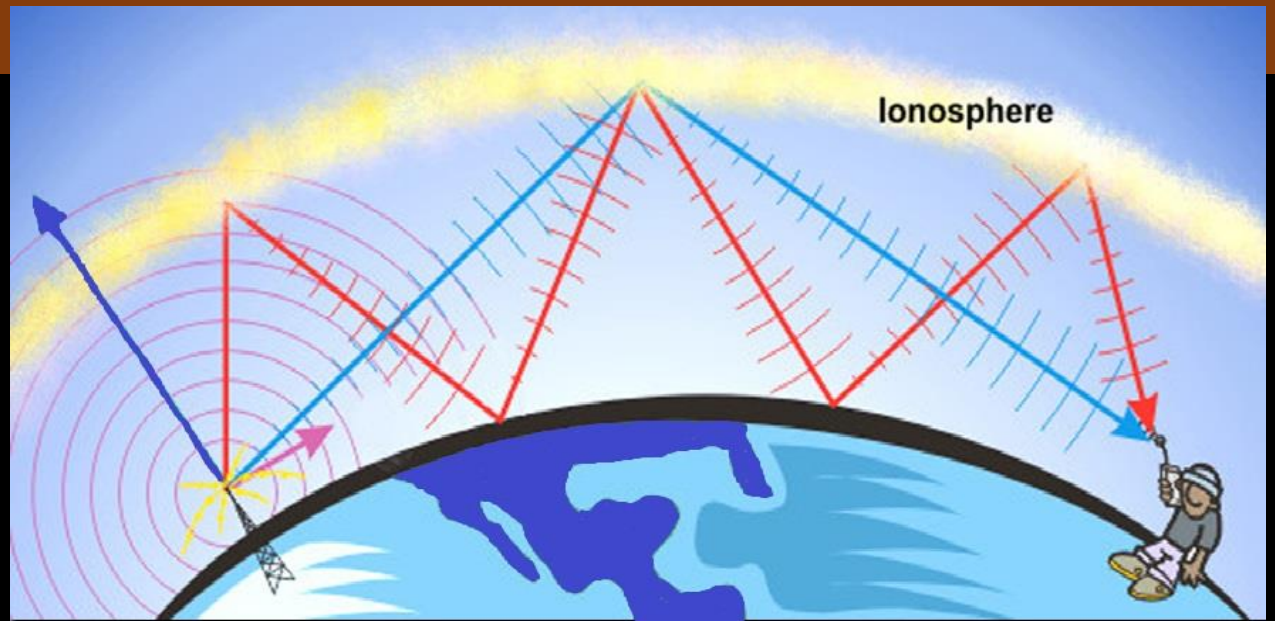
- **Temperature decreases with altitude**
- **Coldest region in atmosphere**



# Ionosphere

- **Electrically charged particles**
- **Peak concentration at 250 km**
- **Aurora Borealis and Aurora Australis**





# Expected Question

**Read the following statements:**

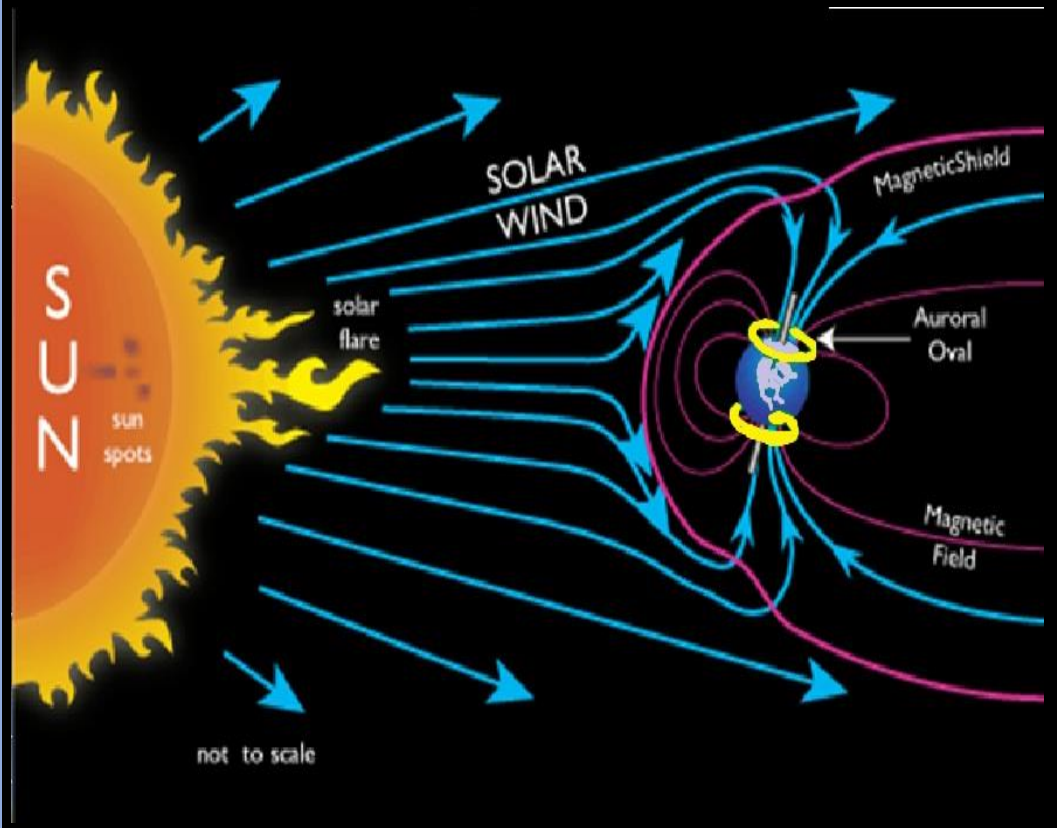
I. **Jet planes avoid flying in the stratosphere.**
II. **Meteor showers takes place in mesosphere.**

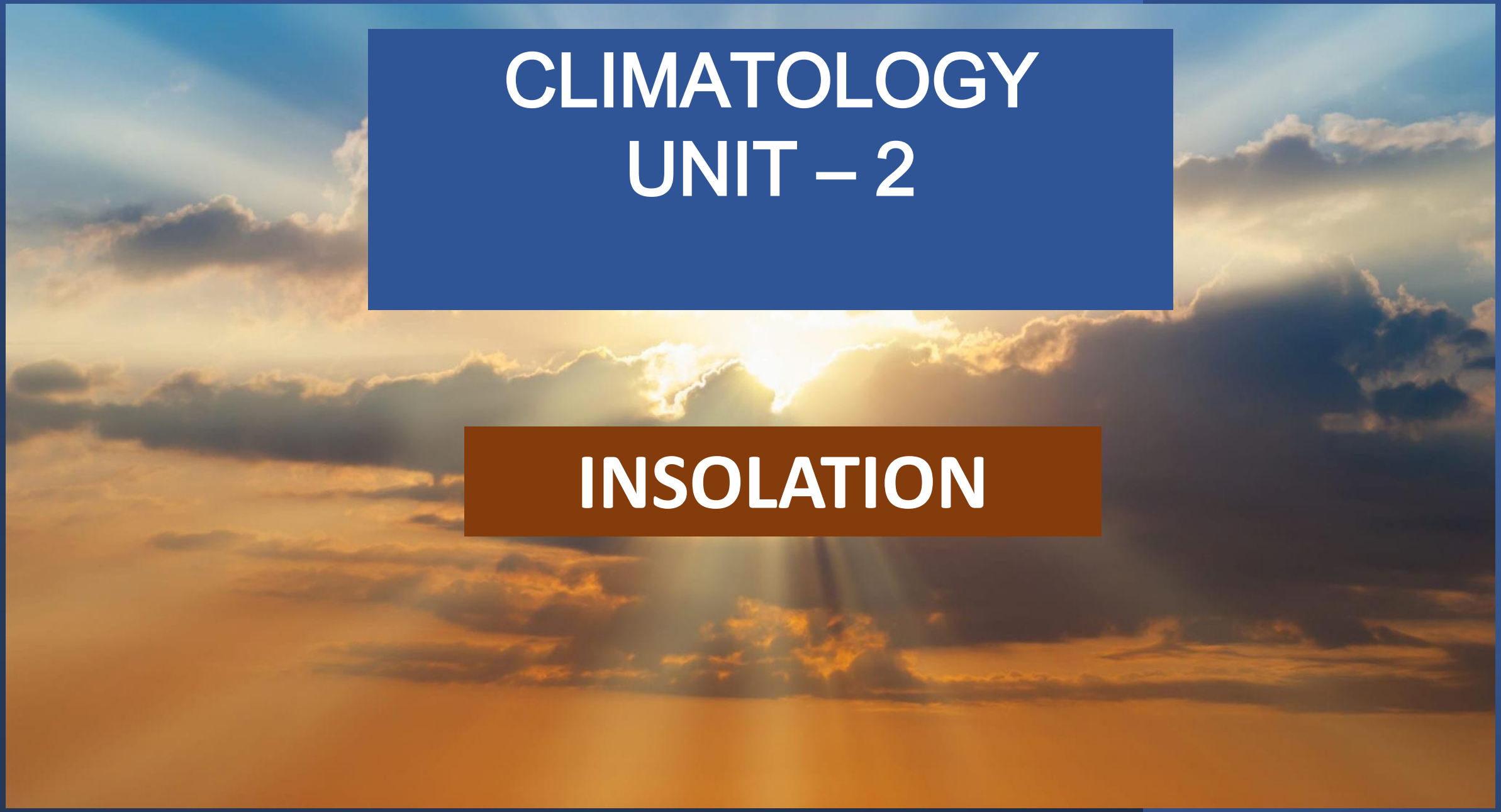
**Which of the above statement(s) is/are true:**

a. **I Only**
b. **II Only**
c. **I & II**
d. **None of the above.**

# Exosphere

- **Gases are very thin**
- **Gradually merges with the outer space**
- **Magnetosphere**





# CLIMATOLOGY
# UNIT – 2

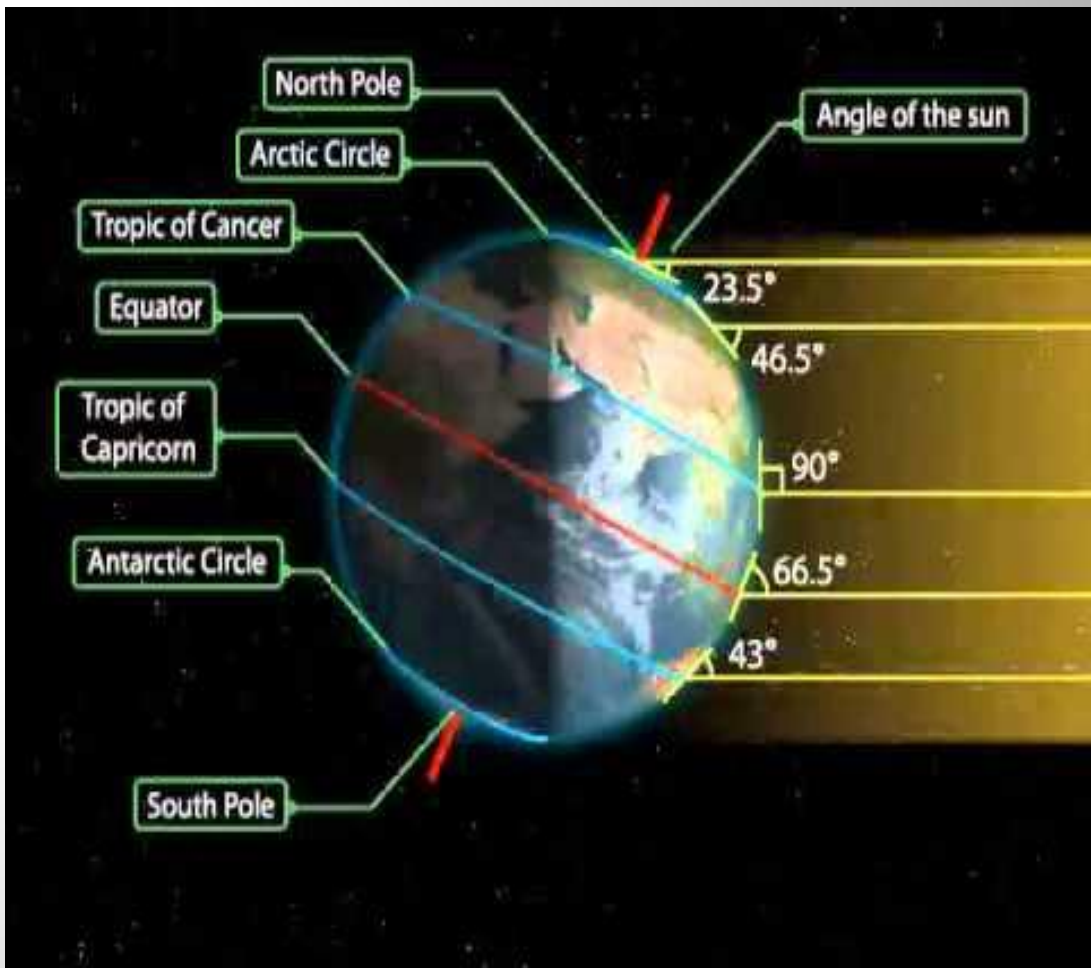
## INSOLATION

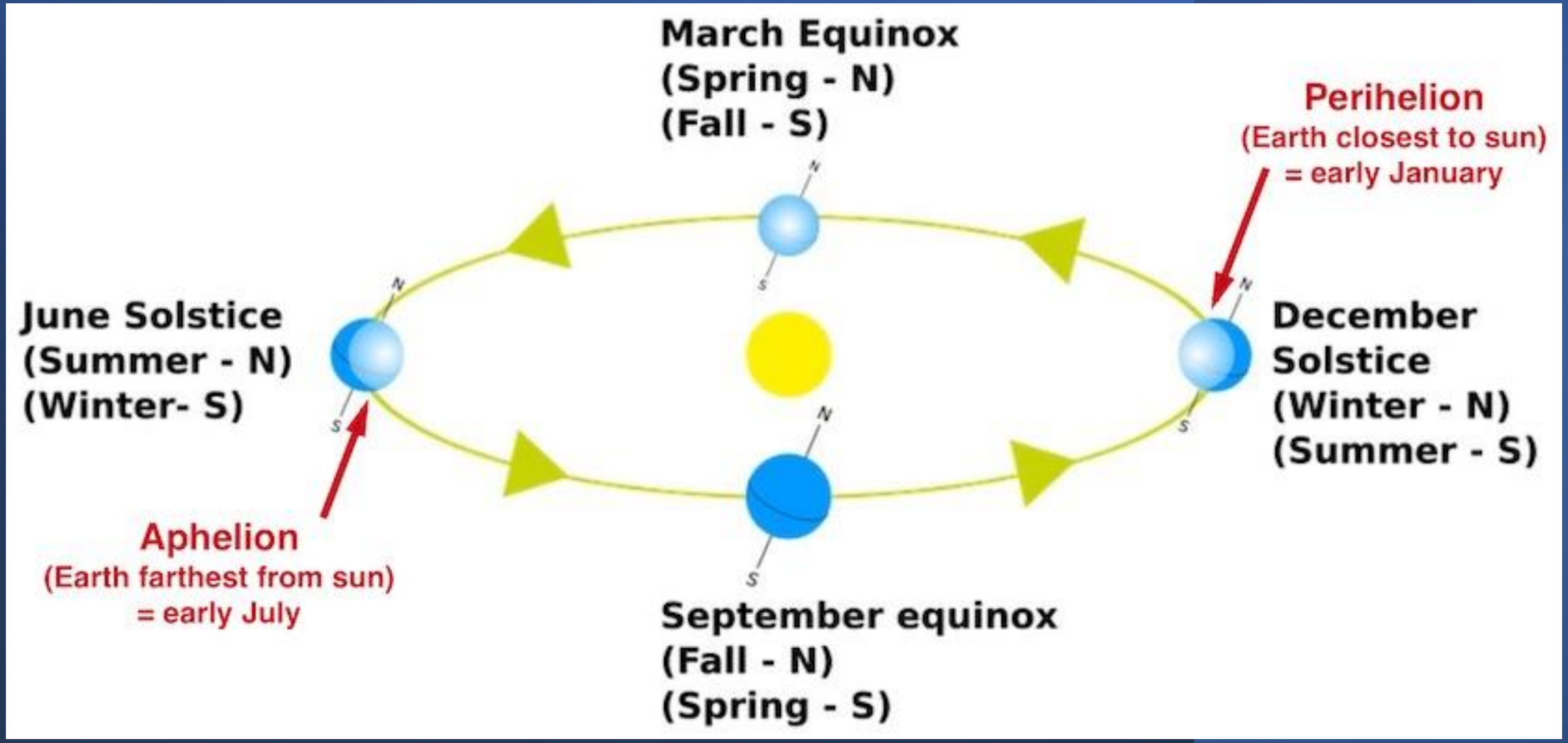
# INSOLATION

- Incoming solar radiation
- Equator receives comparatively less insolation than the tropics
- Maximum insolation is received over the subtropical deserts
- At the same latitude, more insolation over the continents than over the oceans

# FACTORS AFFECTING INSOLATION

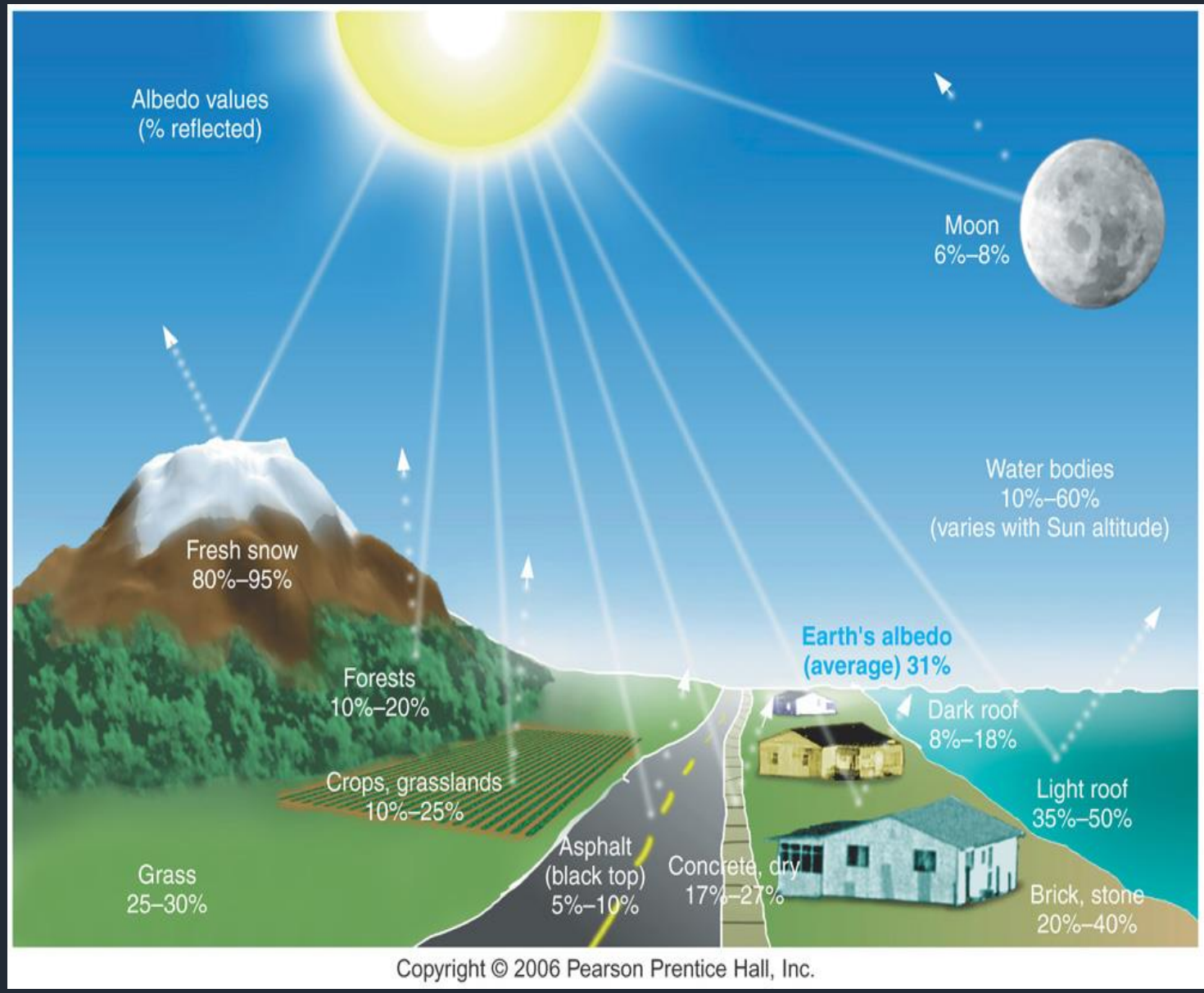
- The Revolution & Rotation of earth on its tilted axis
- The angle of inclination of sun's rays
- The length of the day
- Effects of the atmosphere
- Sunspots
- Impact of land and water




March Equinox
(Spring - N)
(Fall - S)
Perihelion
(Earth closest to sun)
= early January
June Solstice
(Summer - N)
(Winter- S)
December
Solstice
(Winter - N)
(Summer - S)
Aphelion
(Earth farthest from sun)
= early July
September equinox
(Fall - N)
(Spring - S)

# ALBEDO

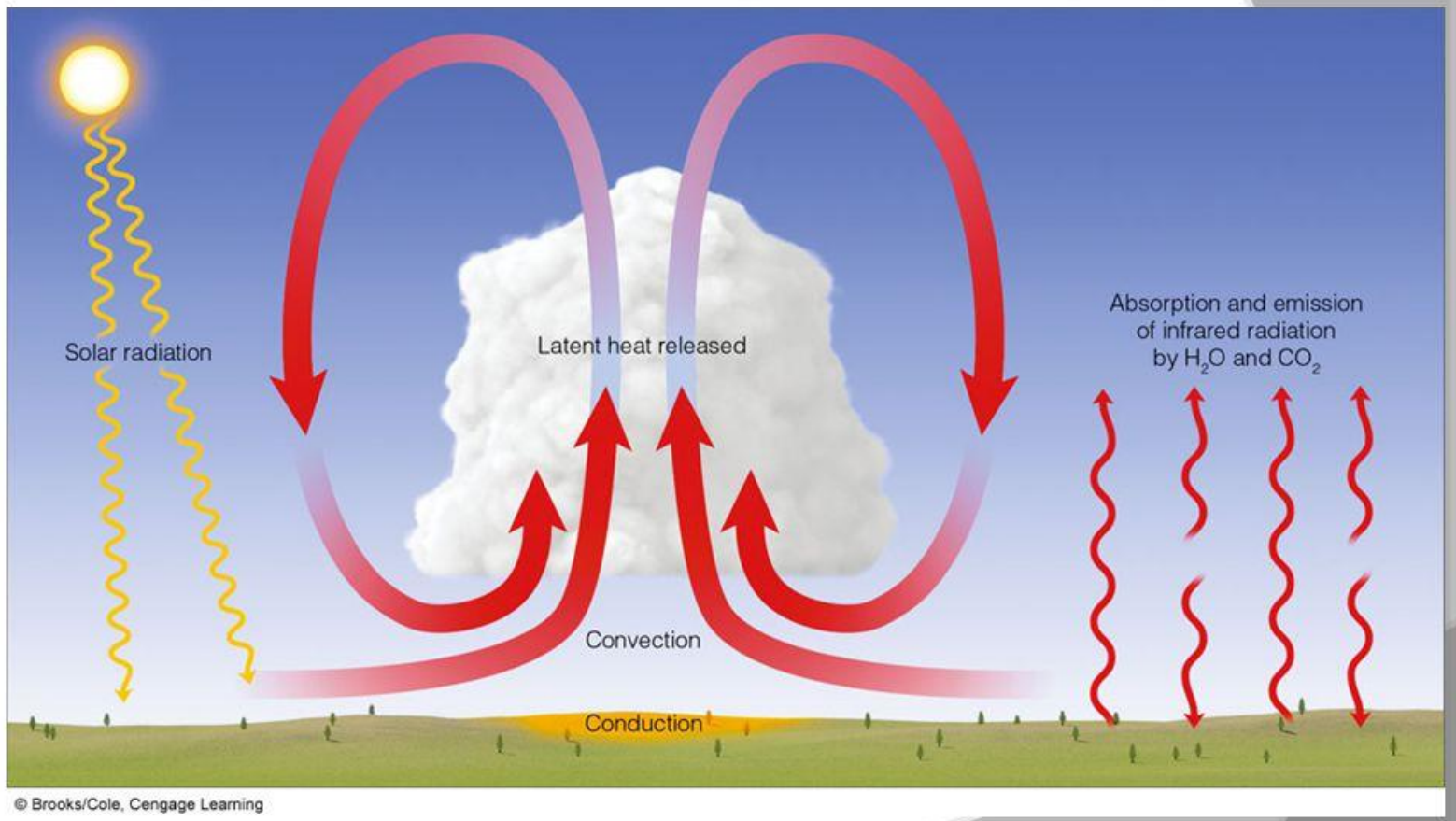
- Radiation reflected by a surface
- Reflectivity
- Visual brightness
- Earth's albedo is around 30%.
- Moon (7%), Mercury (6%), Mars (16%), Venus (76%) and the outer planets (73% to 94%)



# HEATING AND COOLING OF THE ATMOSPHERE

- TERRESTRIAL RADIATION
- CONDUCTION
- CONVECTION
- ADVECTION

Air in the lower atmosphere is heated from the ground upward. Sunlight warms the ground, and the air above is warmed by conduction, convection, and infrared radiation.




Further warming occurs during condensation as latent heat is given up to the air inside the cloud.

# Previous year Question (2010)

Which one of the following reflects back more sunlight as compared to other three?

a. Sand desert
b. Paddy crop land
c. Land covered with fresh snow
d. Prairie land

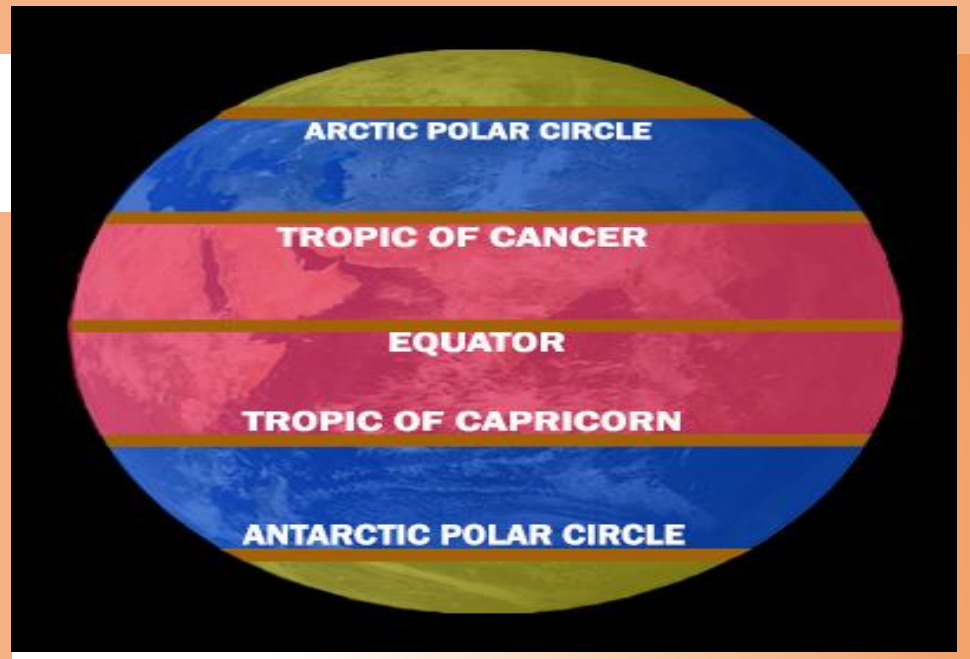
# CLIMATOLOGY

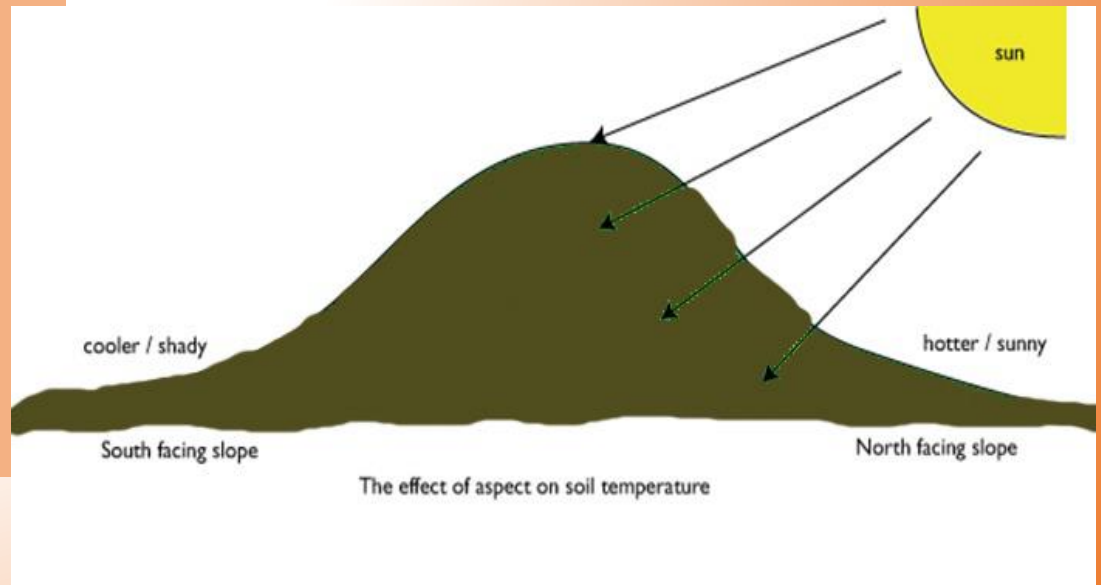


## TEMPERATURE

# FACTORS CONTROLLING TEMPERATURE DISTRIBUTION

- Latitude
- Altitude
- Distance from the sea
- Prevailing winds
- Oceans currents
- Nature of ground surface and slope

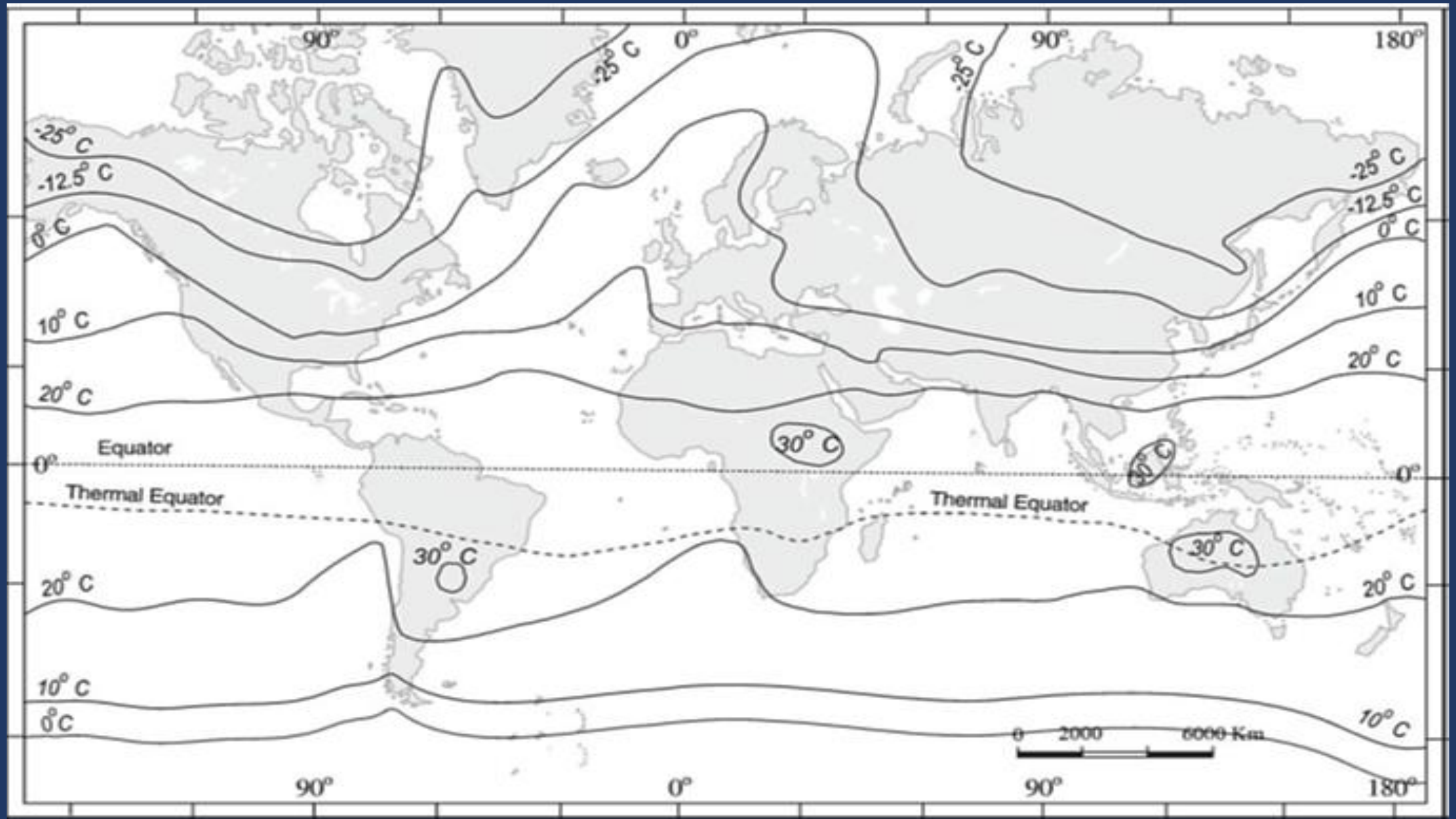


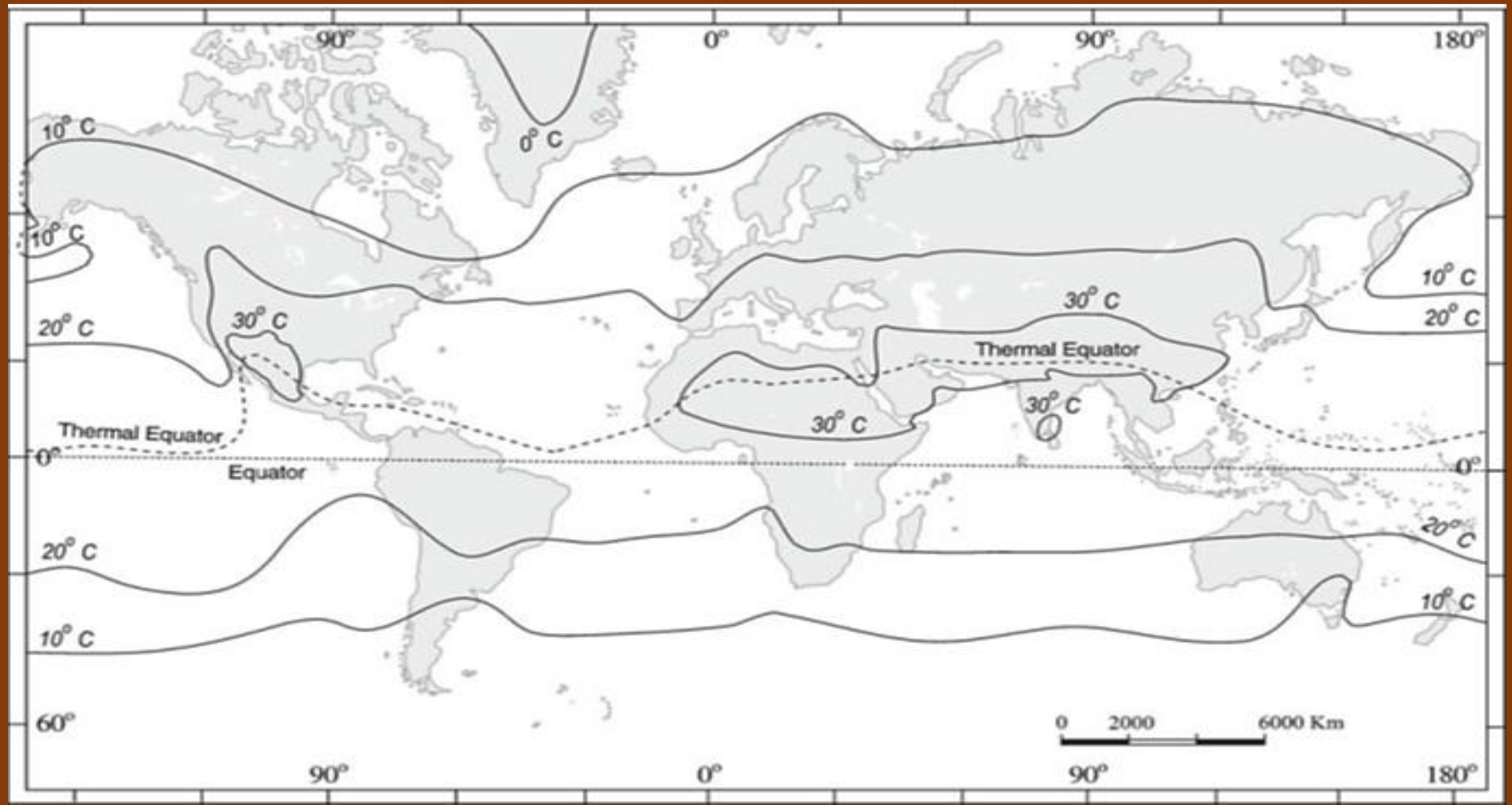
# Heat Budget

The earth receives a certain amount of Insolation **(short waves)** and gives back heat into space by terrestrial radiation **(longwave radiation).** Through this give and take, or the heat budget, the earth maintains a constant temperature.

# JANUARY-ISOTHERMS



# JULY-ISOTHERMS



## Daily mean temperature:

- It is **calculated by adding the maximum and minimum temperature of the day and dividing the total by two**.

## Monthly mean temperature:

- **It is calculated by adding the daily mean temperatures for the each day of the month and dividing the total by the number of days in a month.**

## Annual mean temperature:

- **It is calculated by adding the mean monthly temperatures of all the twelve months and dividing the total by 12.**

## Annual range of temperature:

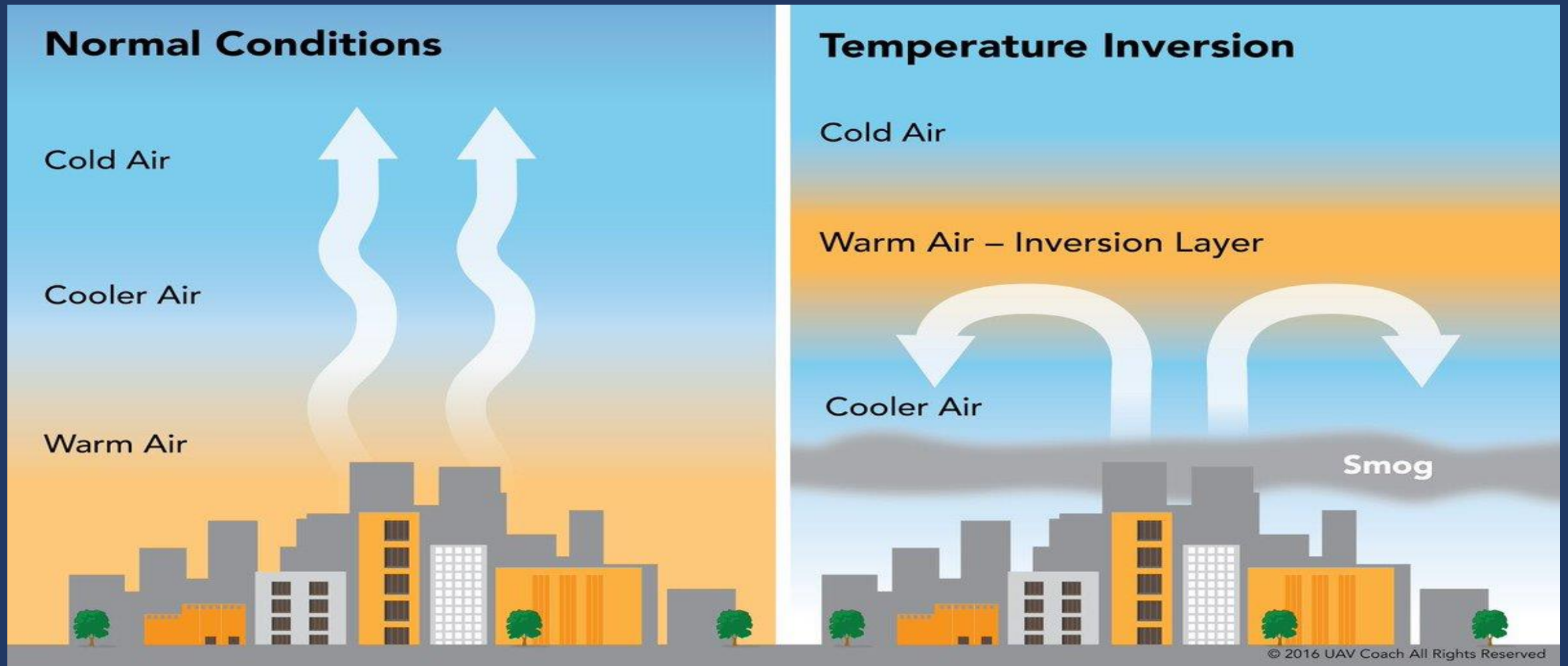
- **It is calculated by subtracting the minimum monthly mean temperature from the maximum monthly mean temperature in a year.**

# ANNUAL RANGE OF TEMPERATURE

- High ART in land than that in Ocean
- Larger the Ocean, smaller the ART
- Greater in Northern Hemisphere than that in Southern Hemisphere
- Diurnal range of temperature

# INVERSION OF TEMPERATURE

- Normal lapse rate is inverted

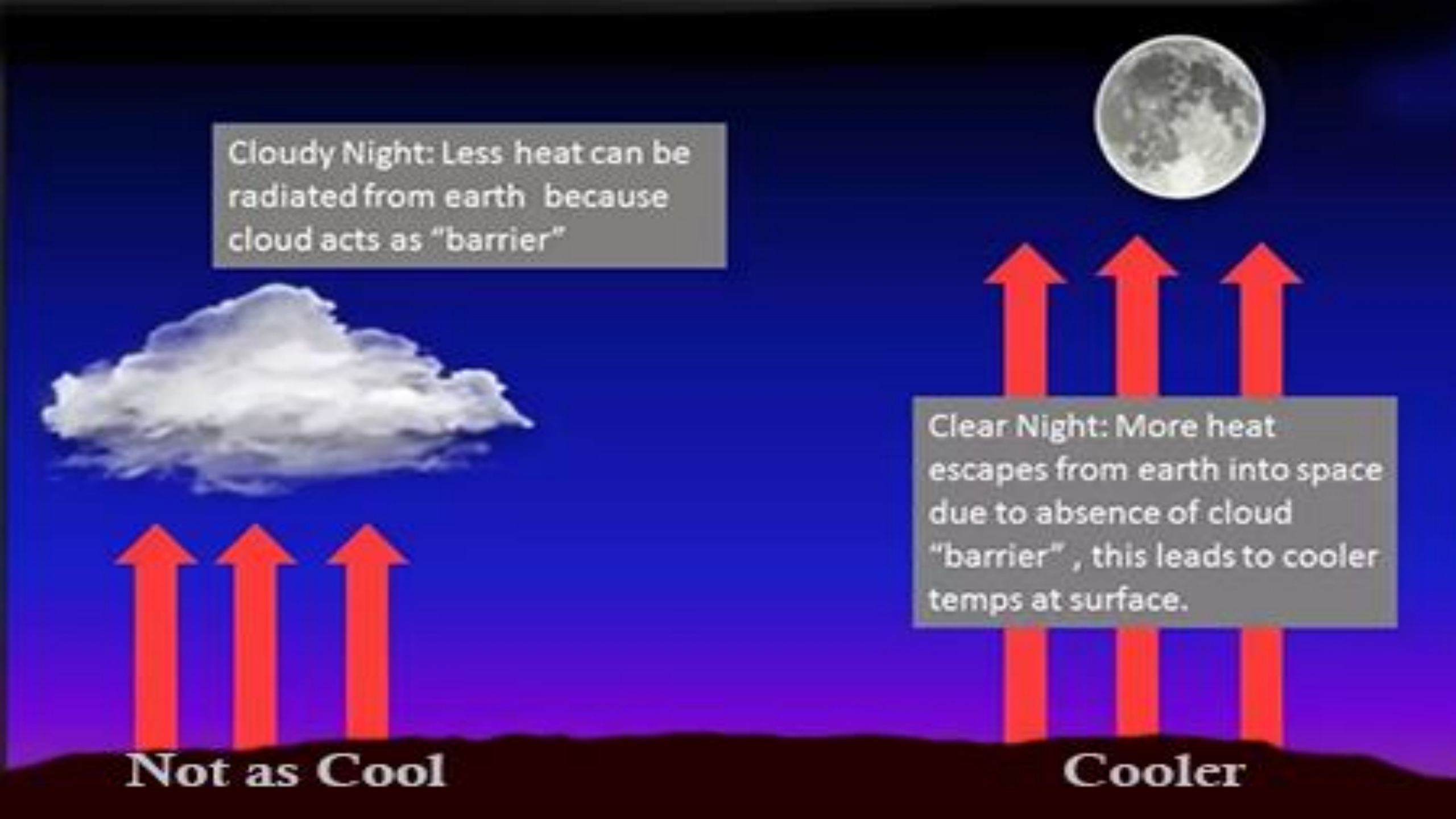


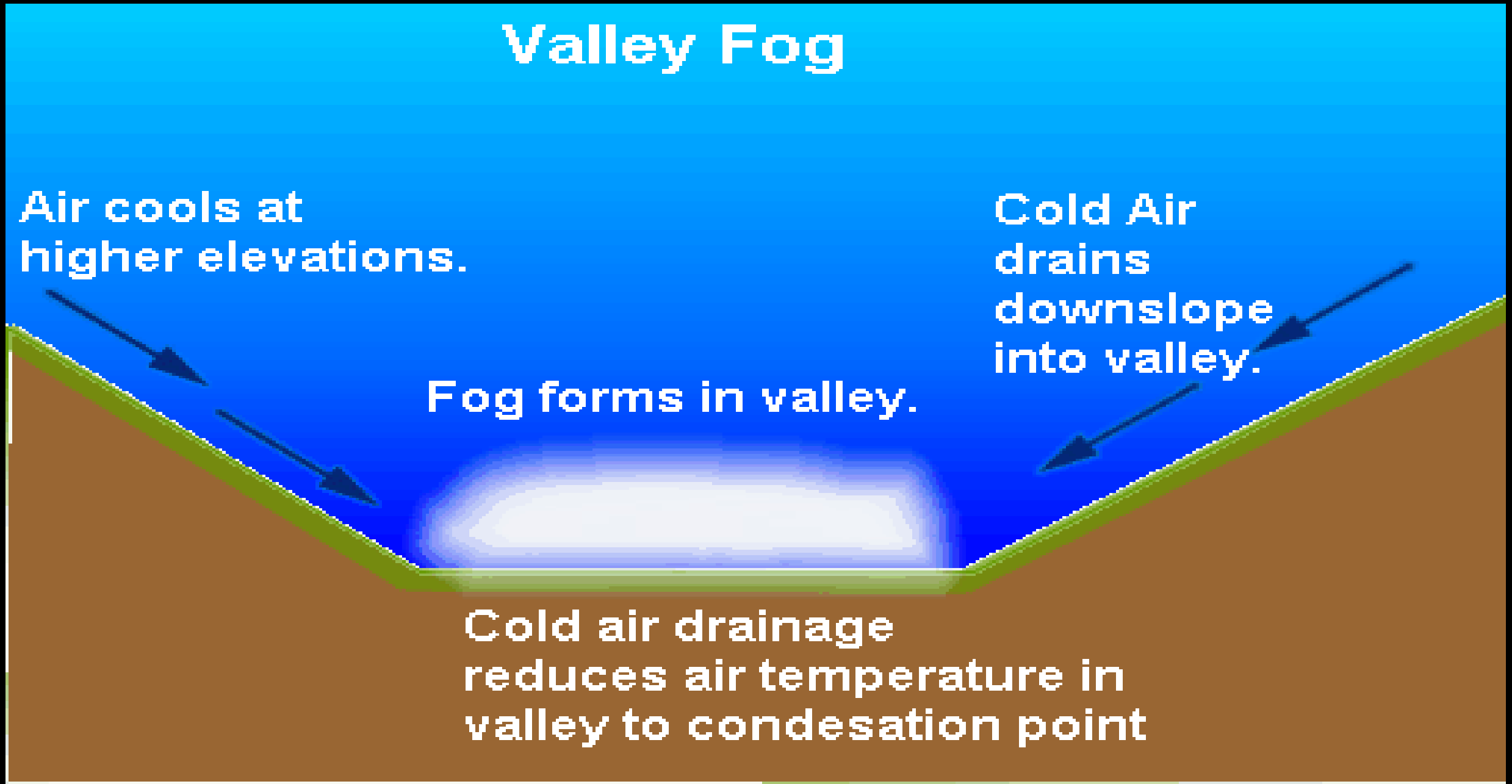
## CAUSES

- Polar regions
- Cloudless winter night
- Air drainage
- Subsidence from upper troposphere

## EFFECTS

- Frost formation
- Fog and smog
- Decreases rainfall
- Valley floors are avoided for human settlements


Cloudy Night: Less heat can be radiated from earth because cloud acts as "barrier"
Clear Night: More heat escapes from earth into space due to absence of cloud "barrier" , this leads to cooler temps at surface.
Not as Cool
Cooler


Valley Fog
Air cools at higher elevations.
Cold Air drains downslope into valley.
Fog forms in valley.
Cold air drainage reduces air temperature in valley to condesation point



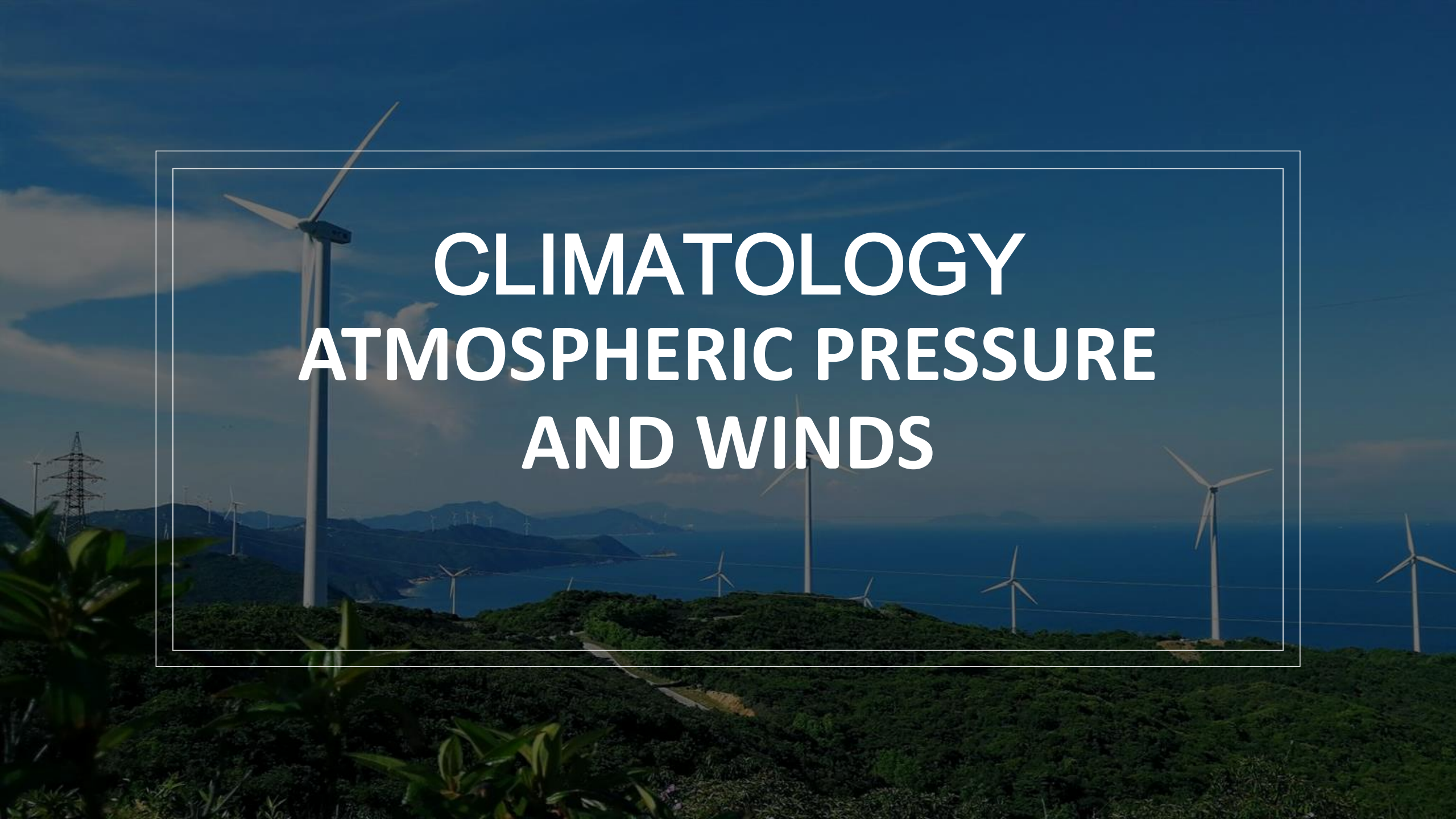
# Expected Question

Which of the statements is/are correct for inversion of temperature:

I. Inversion of temperature is related with the vertical distribution of temperature.
II. The land surface will be cooler in cloudless winter night is due to temperature inversion.
III. Frost formation is due to temperature inversion.

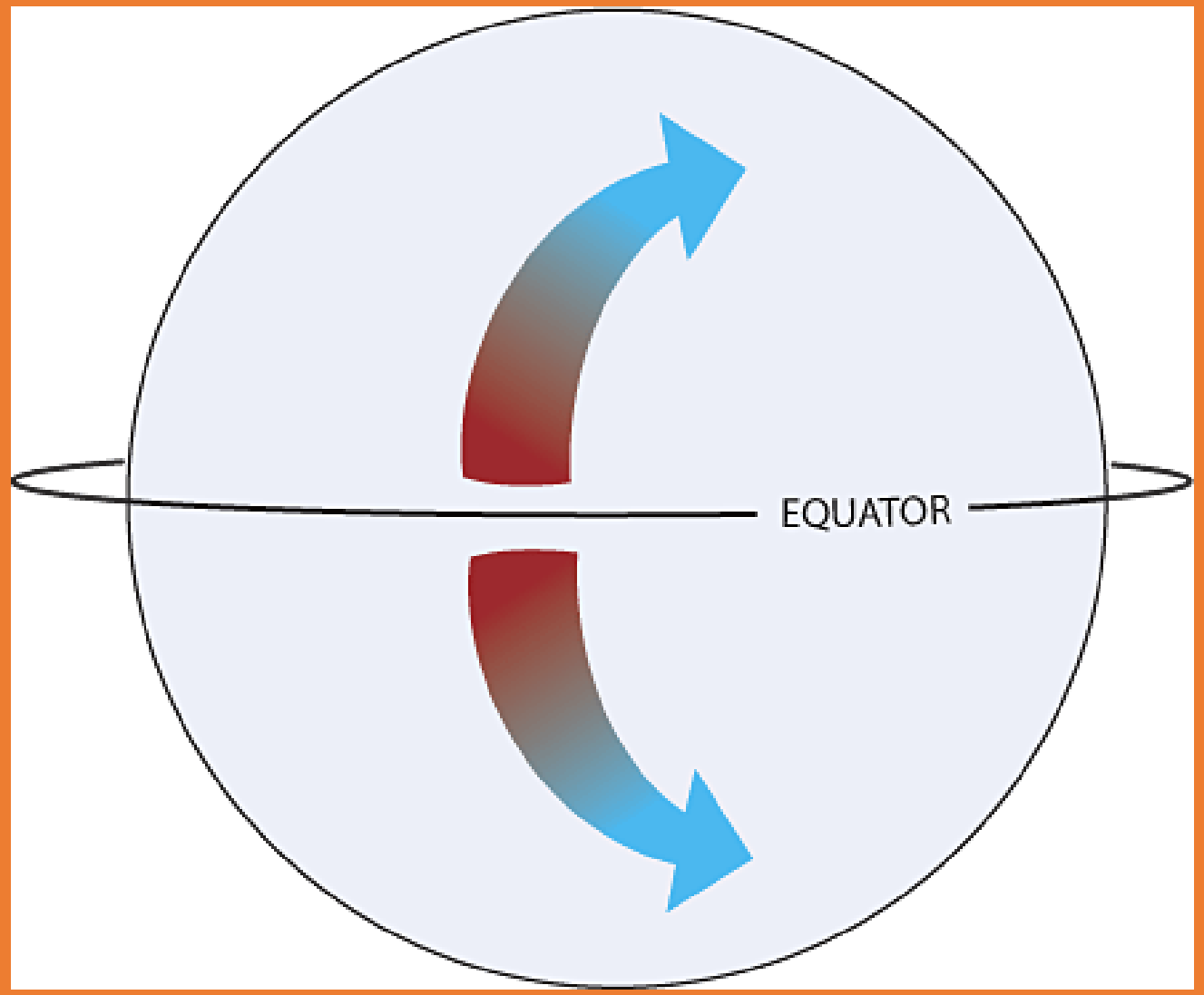
Choose the correct statements using the codes given below:

a. I & II
b. II & III
c. I & III
d. All of the above.



# CLIMATOLOGY
# ATMOSPHERIC PRESSURE AND WINDS

# CORIOLIS EFFECT



# Expected Question

**Arrange the following according to decreasing Coriolis effect:**

I. Tropic of Capricorn
II. Equator
III. Poles

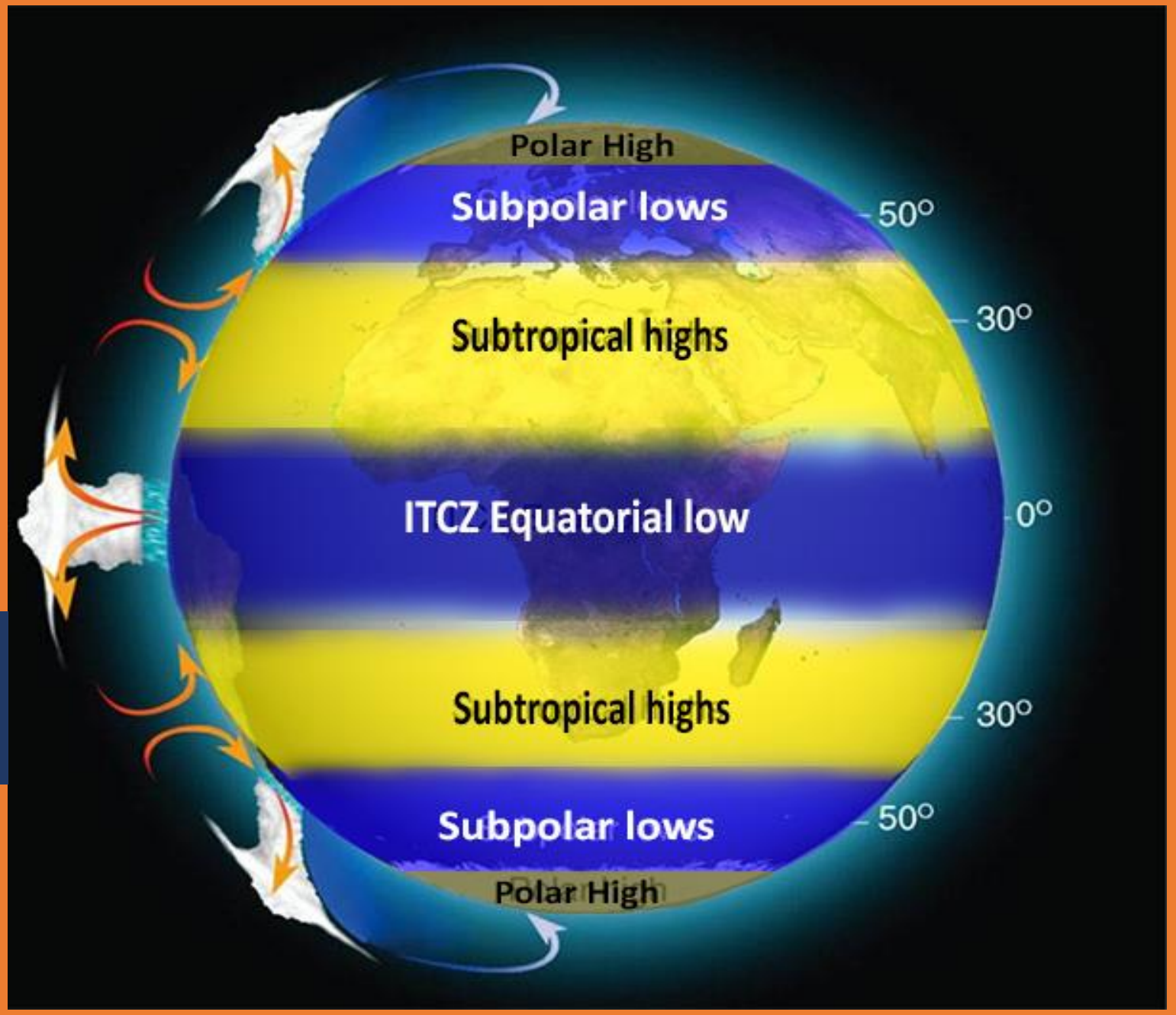
**Select the correct code:**

a. I–II-III
b. III-I-II
c. II-III-I
d. I-III-II

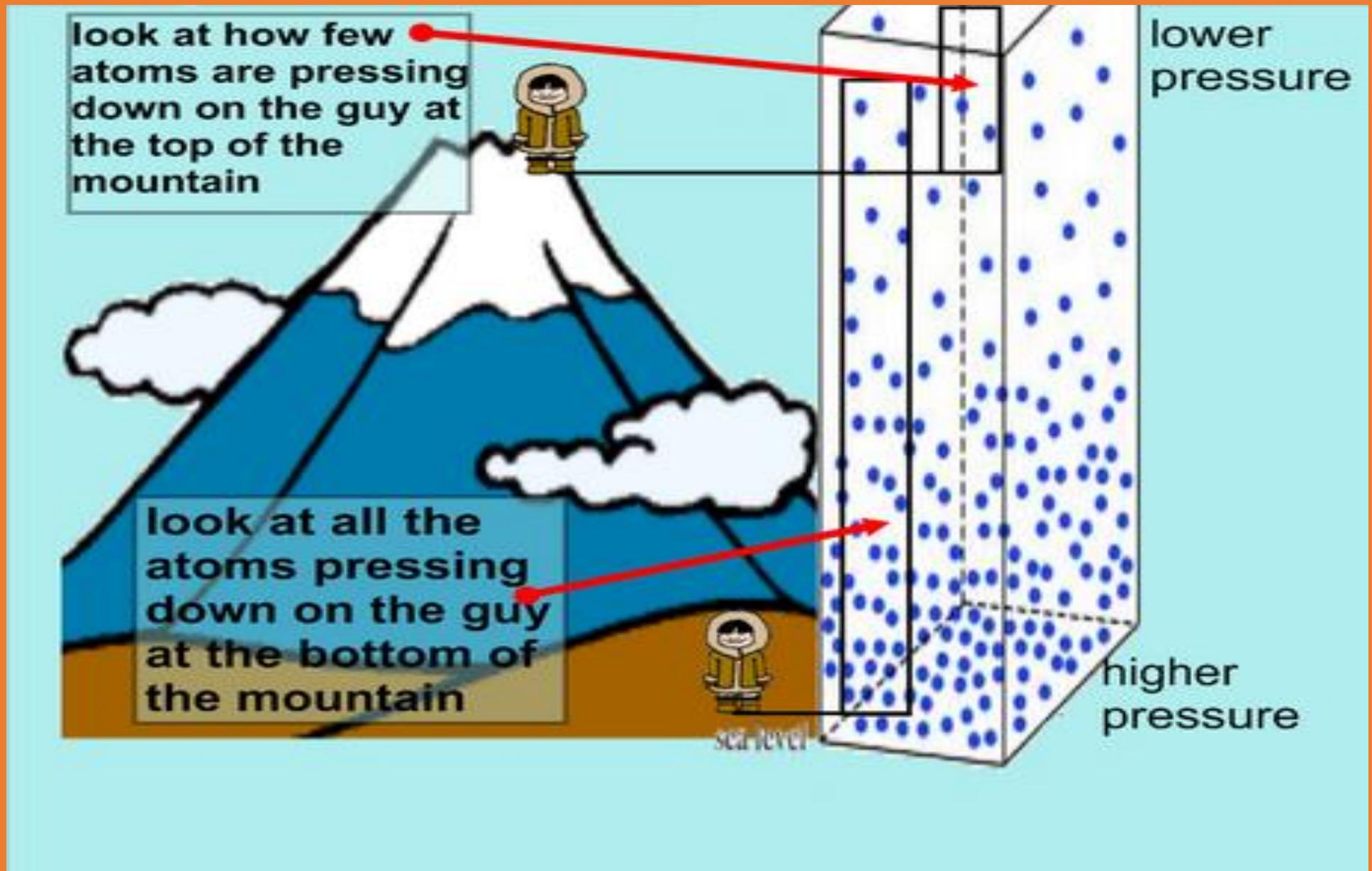
# PRESSURE BELTS

- **Zonal character**

1. Thermal Energy/Heat
2. Pressure Difference

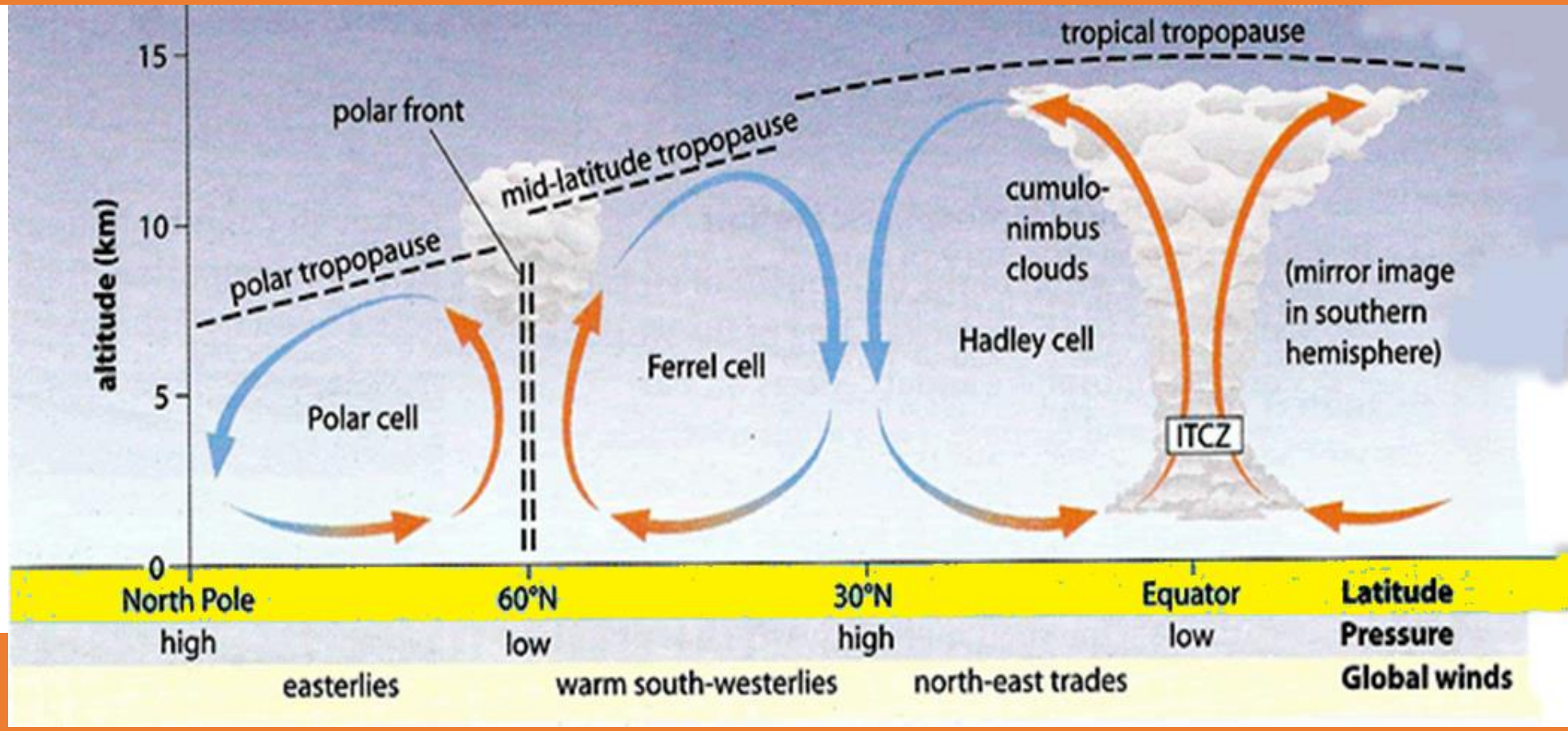


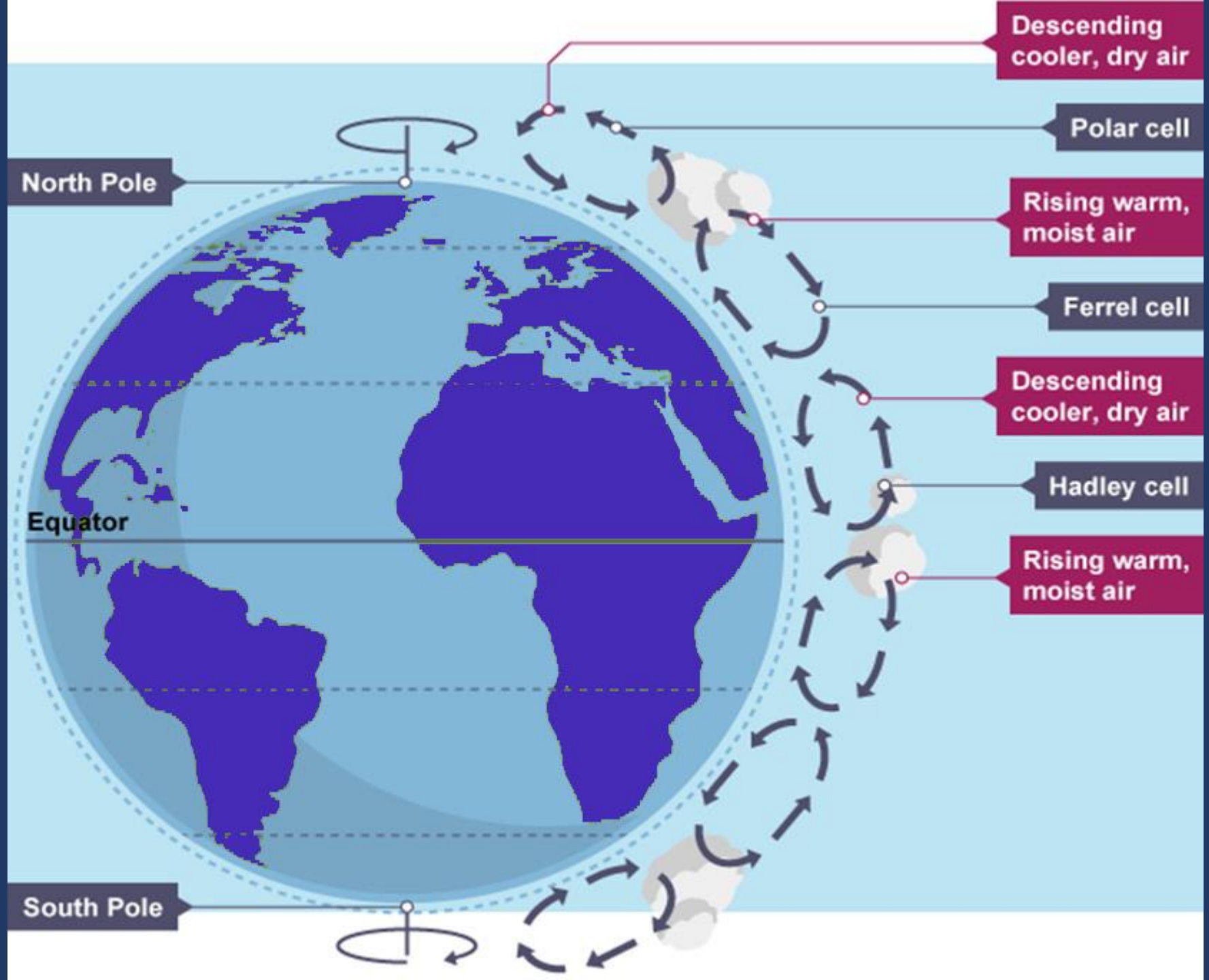
# ATMOSPHERIC PRESSURE



# GENERAL CIRCULATION OF ATMOSPHERE

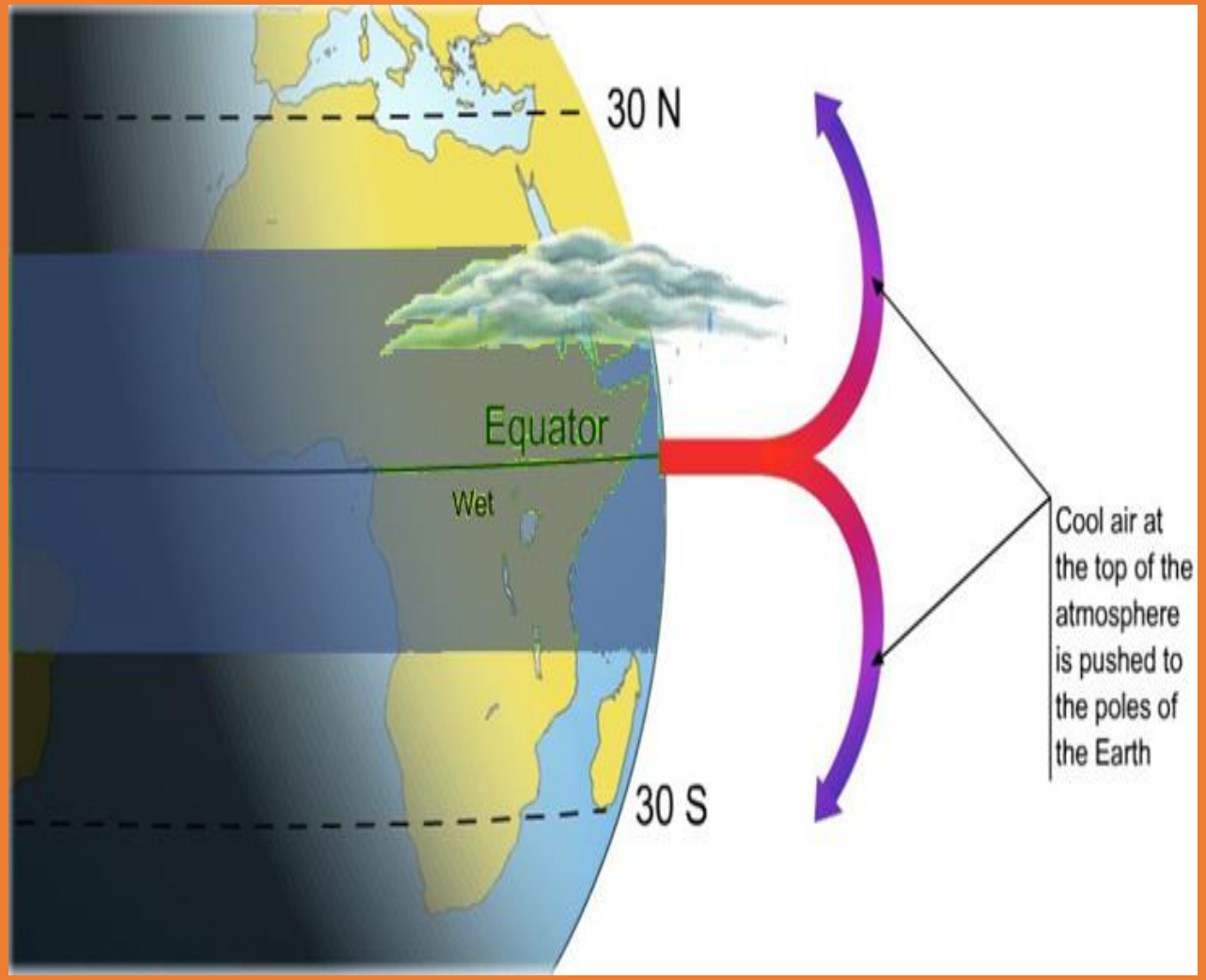
- **ITCZ**
- **Hadley Cell**
- **Ferrell cell**
- **Polar cell**
- **Cloud Formation**




Descending cooler, dry air
Polar cell
North Pole
Rising warm, moist air
Ferrel cell
Descending cooler, dry air
Hadley cell
Equator
Rising warm, moist air
South Pole

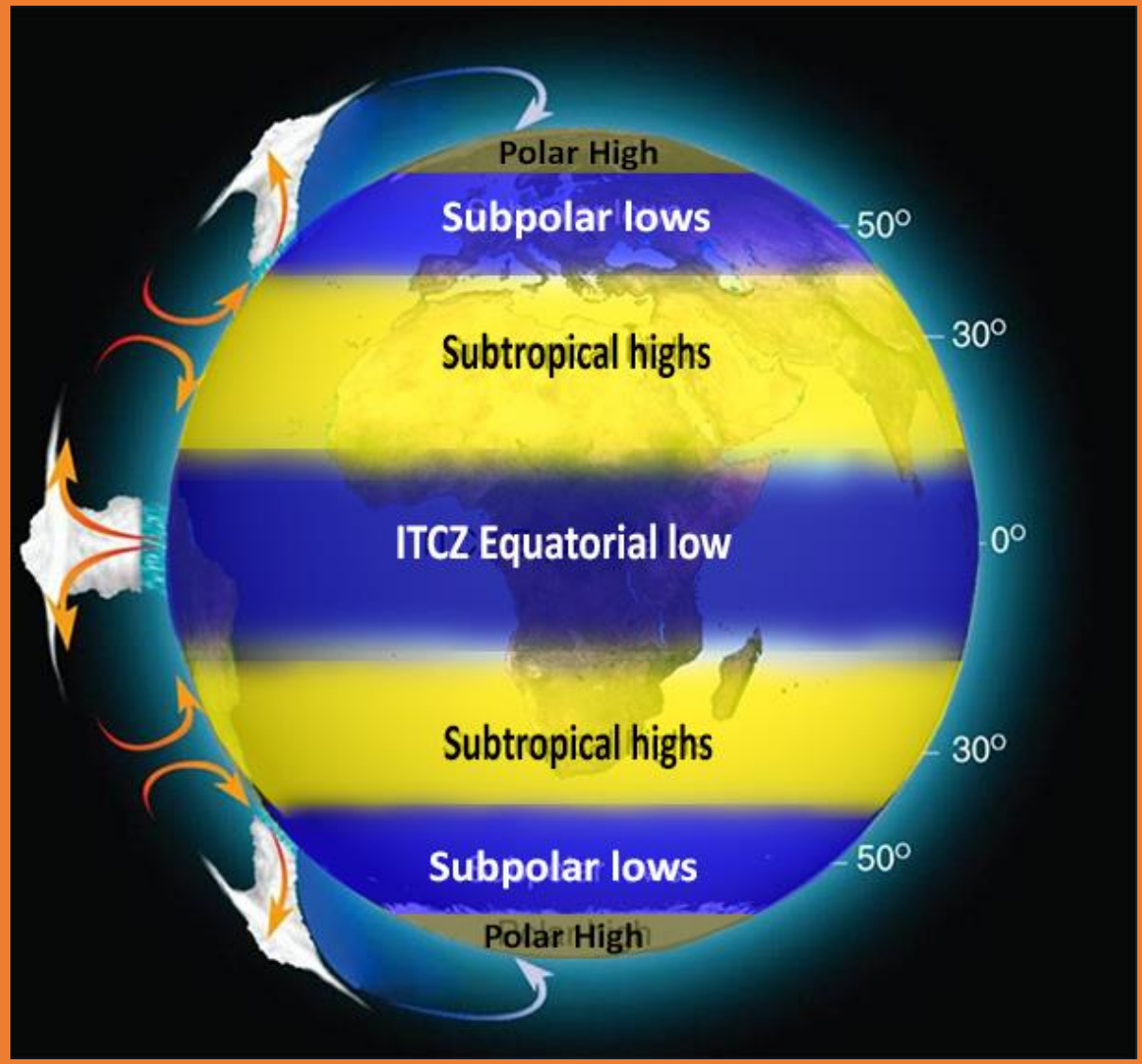
# EQUATORIAL LOW

- Thermally produced low pressure belt
- 0° - 10° North and South
- Pressure is more uniform
- Surface winds are generally absent



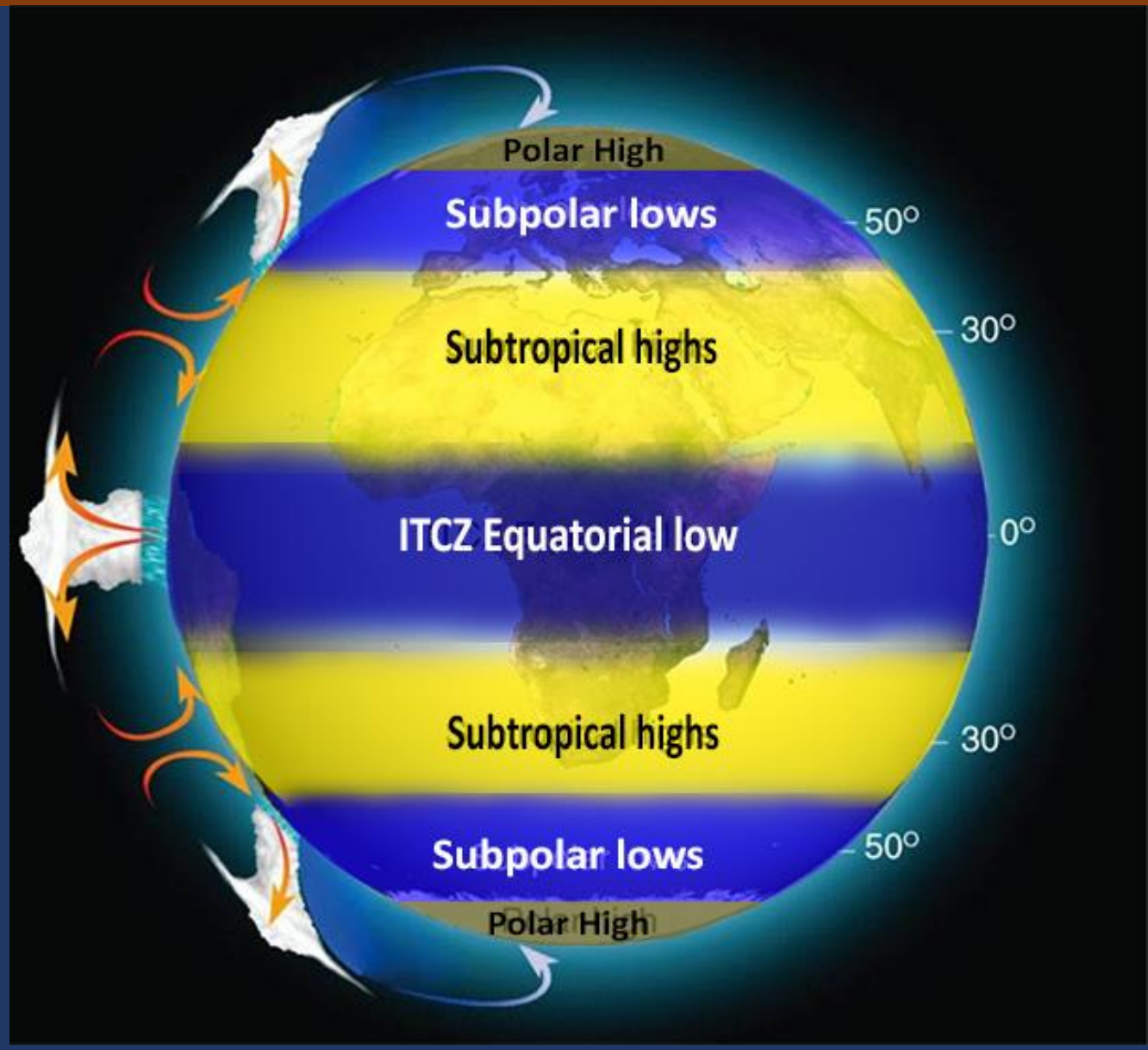
# SUBTROPICAL HIGH

- Subsidence of air
- 25° - 35° north and south
- 30°-35° - Horse latitudes
- Anticyclonic condition
- Aids desert formation



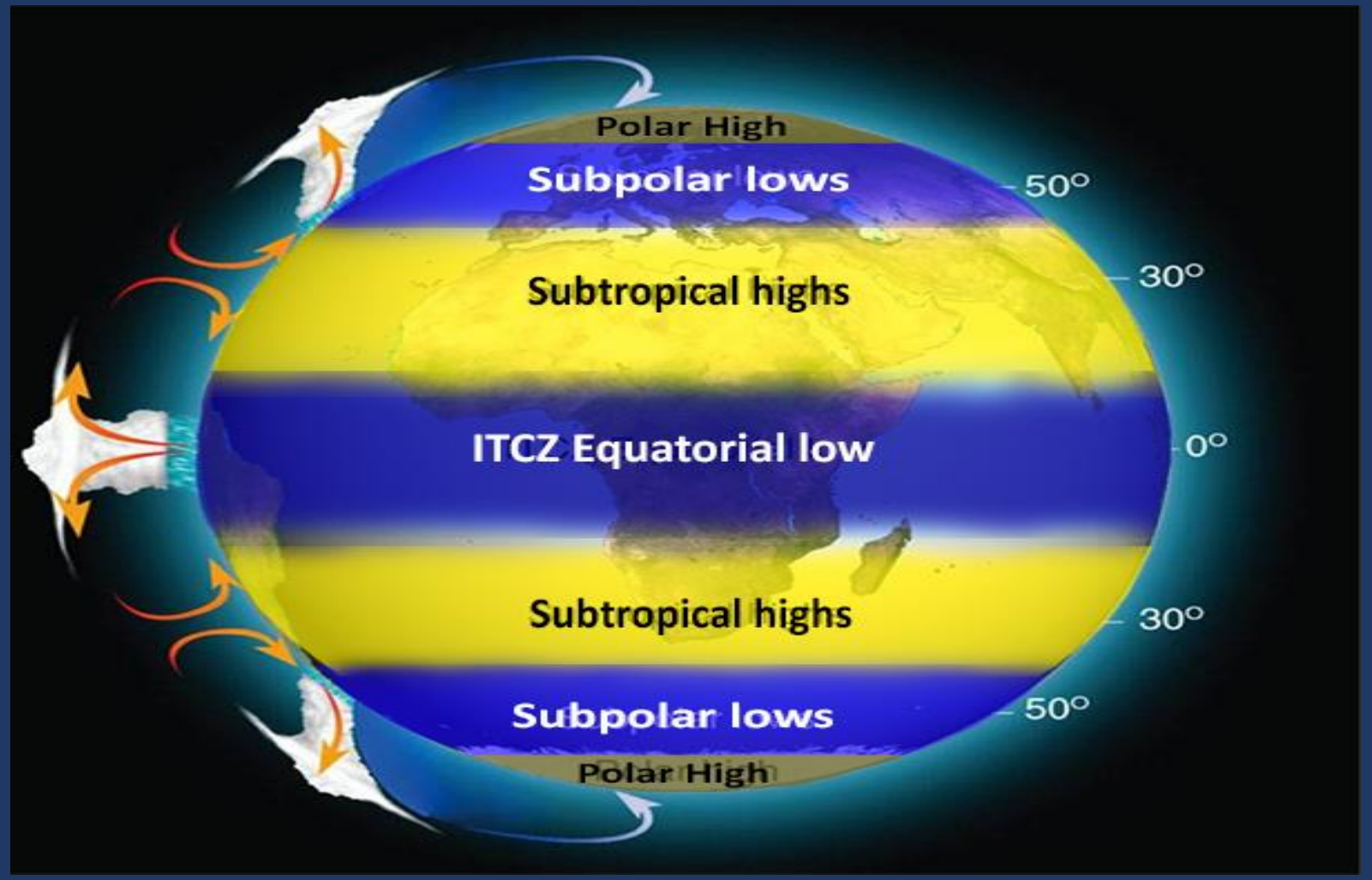
# SUBPOLAR LOW

- 45 N and S latitudes to Arctic and Antarctic circles
- Converging and rising air
- Extra-tropical, Mid-latitude,wave cyclones



# POLAR HIGHS

- **Persistent low temperature**



# JANUARY ISOBARS

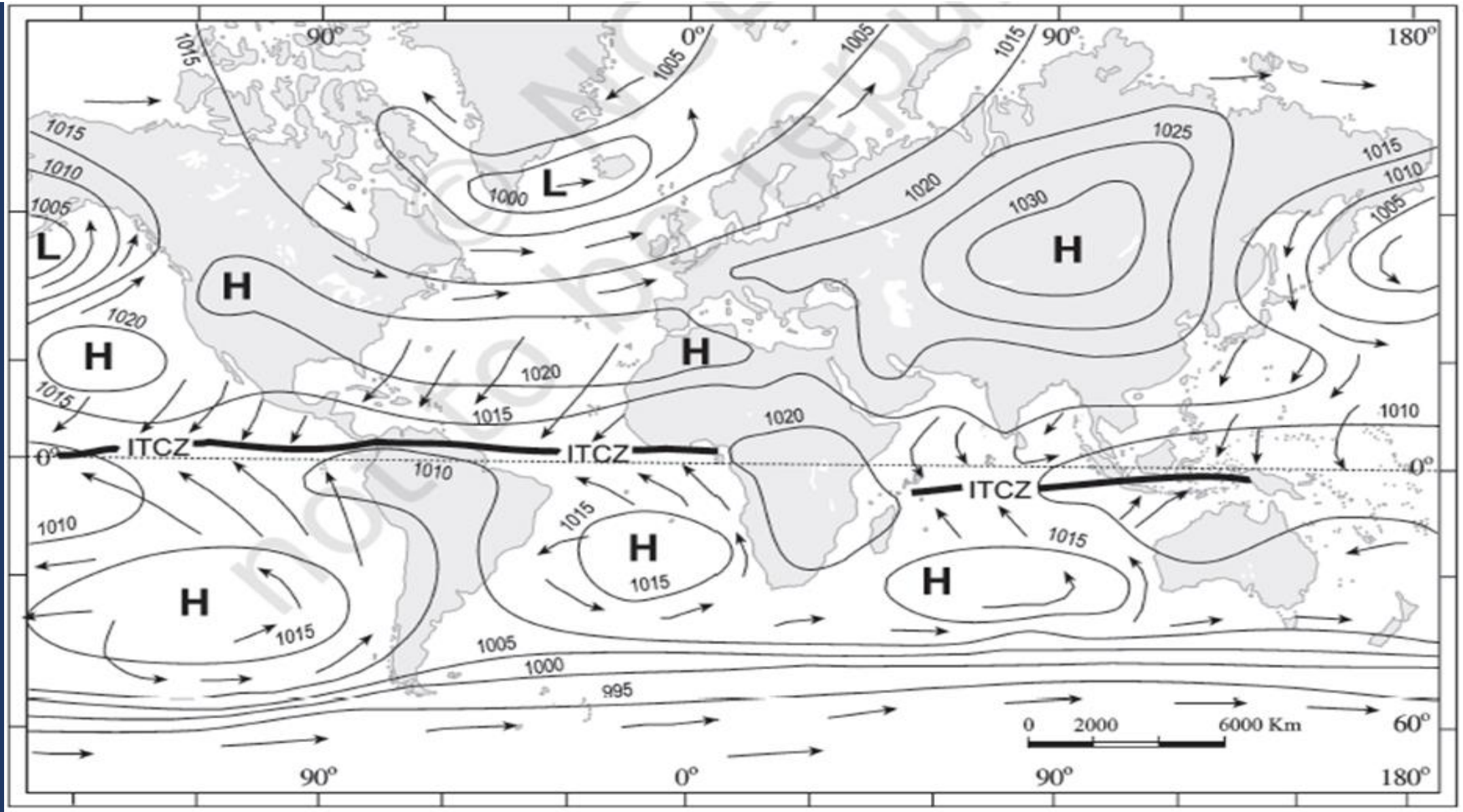



Figure 10.2 : Distribution of pressure (in millibars) — January

# JULY ISOBARS

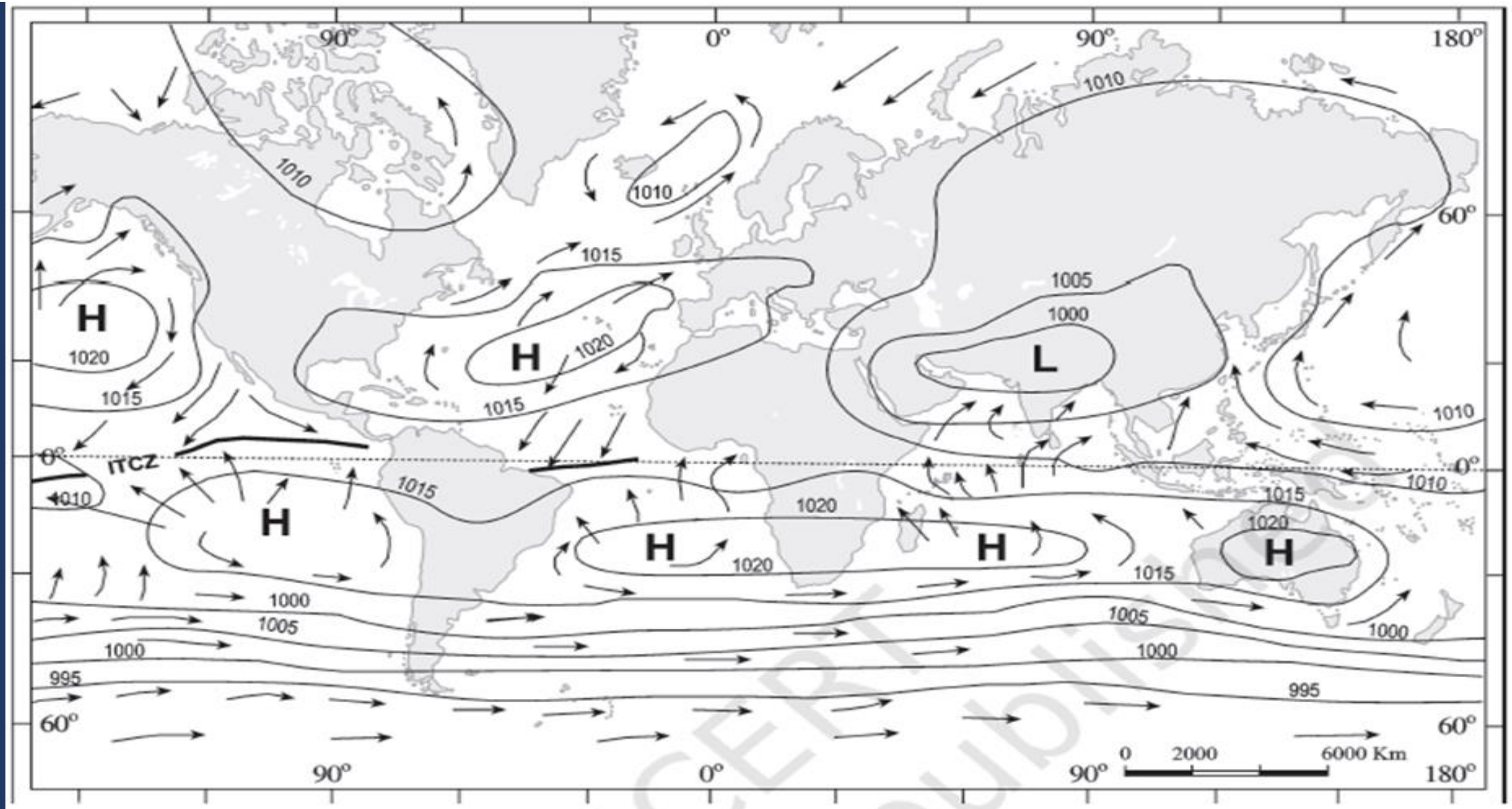



Figure 10.3 : Distribution of pressure (in millibars) — July

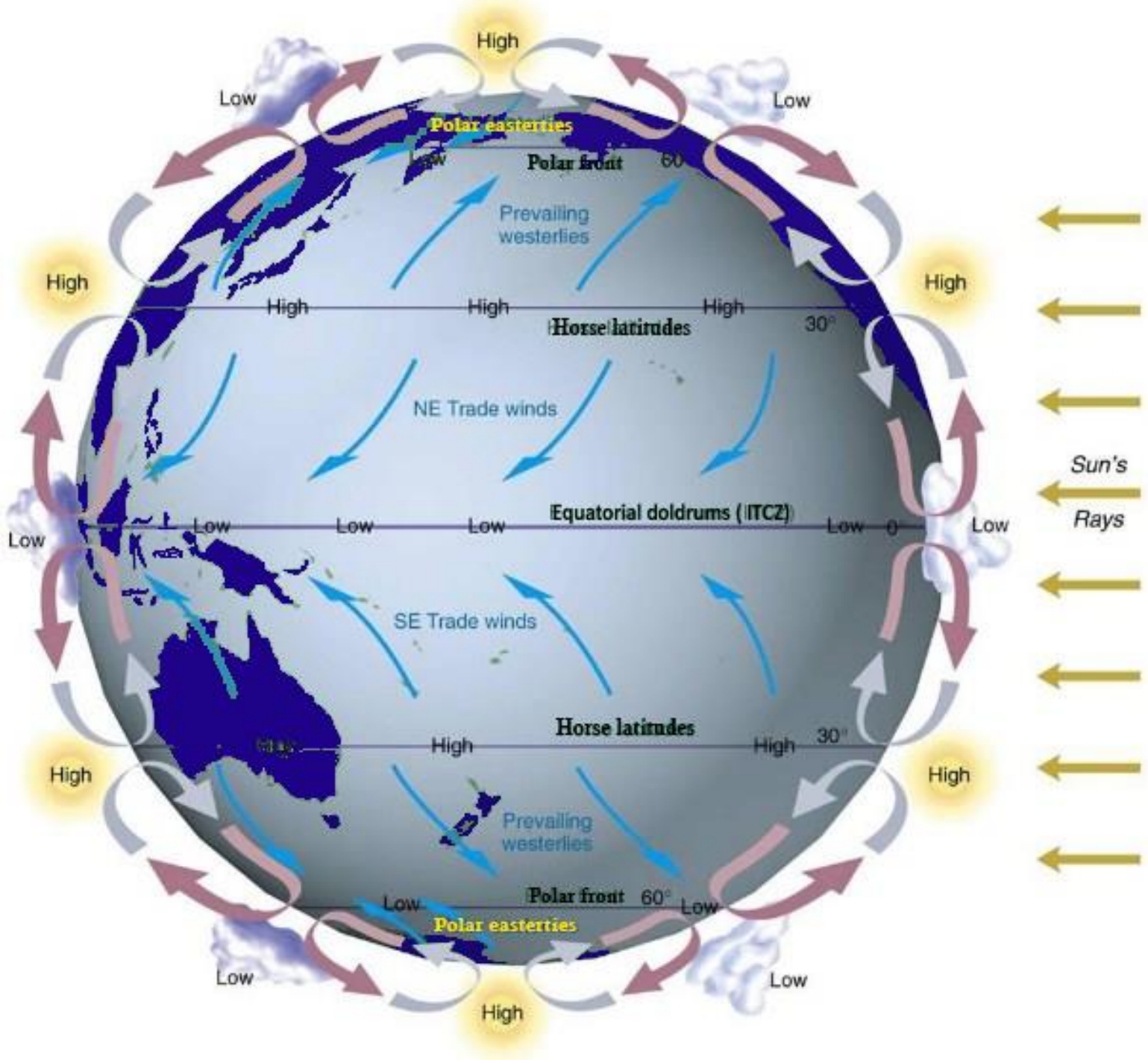


# WINDS

- CLIMATOLOGY

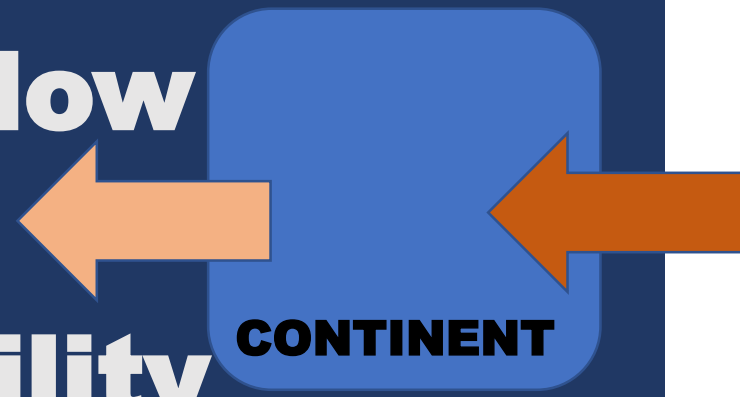
# PREVAILNG WINDS

- Doldrums
- Trade winds
- Westerlies
- Polar easterlies



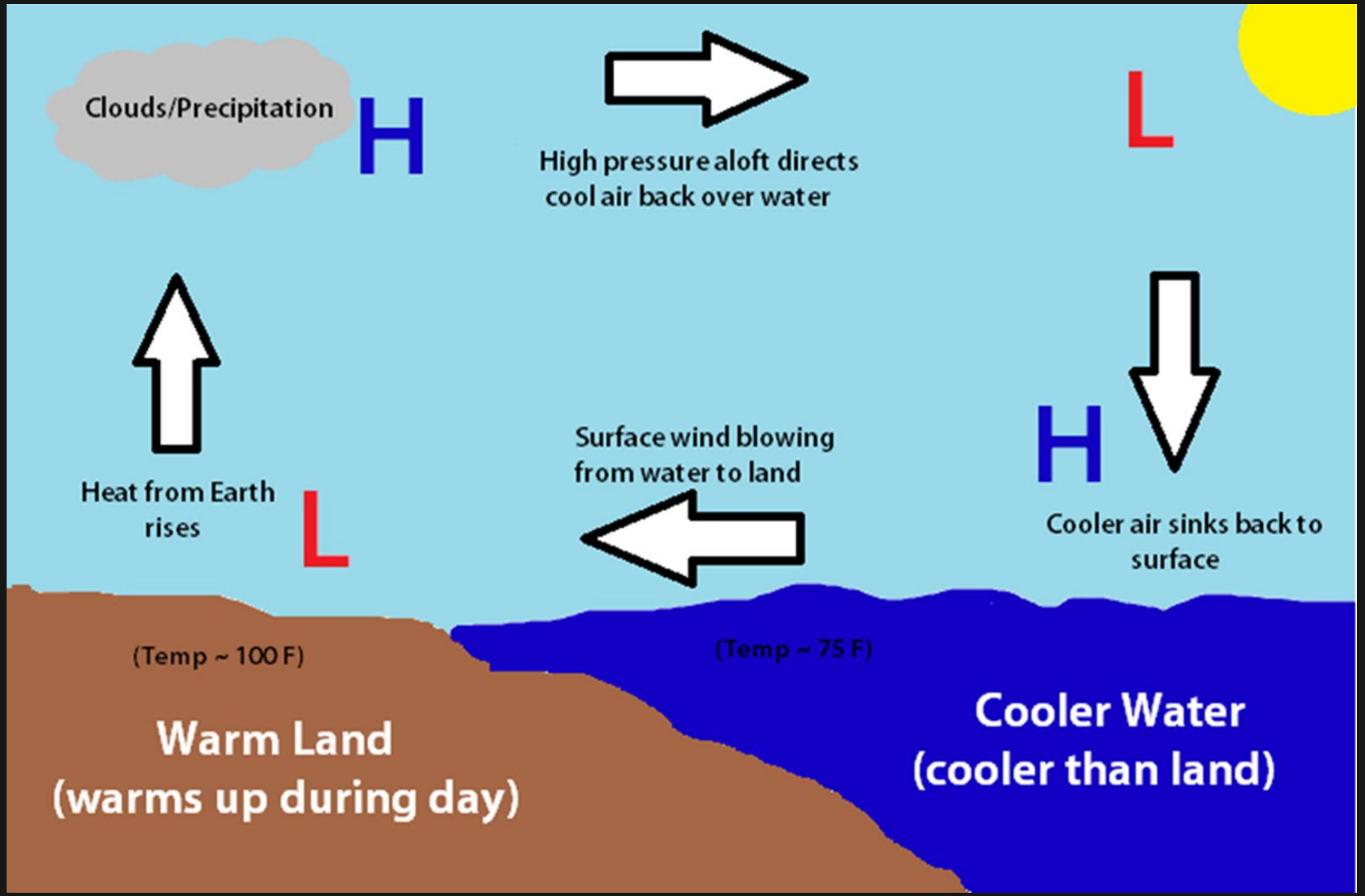
# TRADE WINDS

- 10° and 25° north and south latitudes
- Sub-tropical high - equatorial low
- Steady winds
- Beginning – atmospheric stability
- Ending – atmospheric instability
- Onshore – eastern margin of continent
- Offshore – western margin of continent

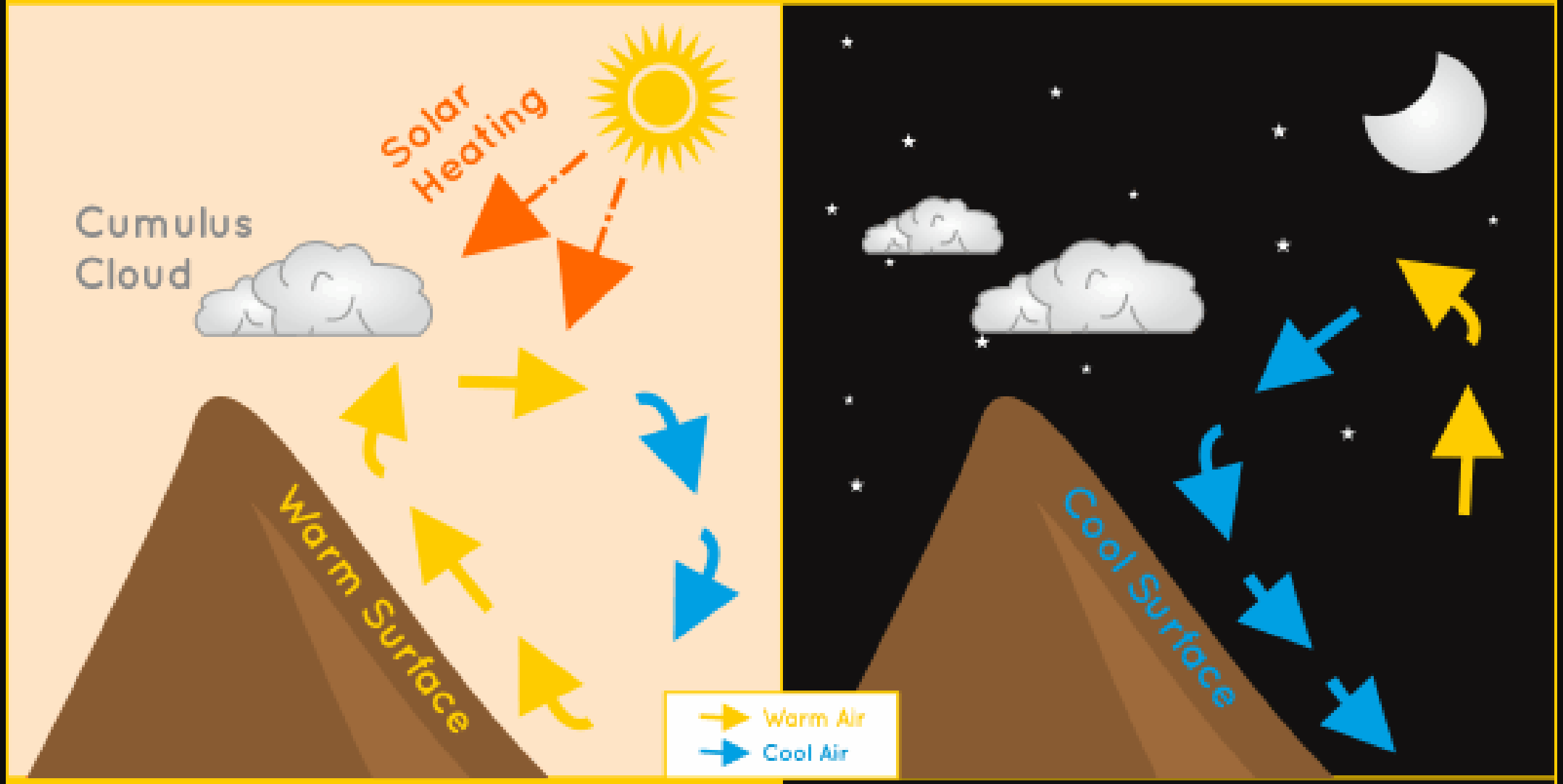


# WESTERLIES

- 35º and 60º north and south latitudes
- Sub-tropical high - subpolar low
- Violent and variable in direction
- Seasonal change in strength
- Westerlies of the southern hemisphere are stronger
- Roaring Forties, Furious Fifties, and Shrieking Sixties


Clouds/Precipitation
H
High pressure aloft directs cool air back over water
L
Heat from Earth rises
L
Surface wind blowing from water to land
H
Cooler air sinks back to surface
(Temp ~ 100 F)
(Temp ~ 75 F)
Warm Land
(warms up during day)
Cooler Water
(cooler than land)

# ANABATIC AND KATABATIC WINDS




## Anabatic Winds

## Katabatic Winds

# Distribution of Local Winds Over the Globe



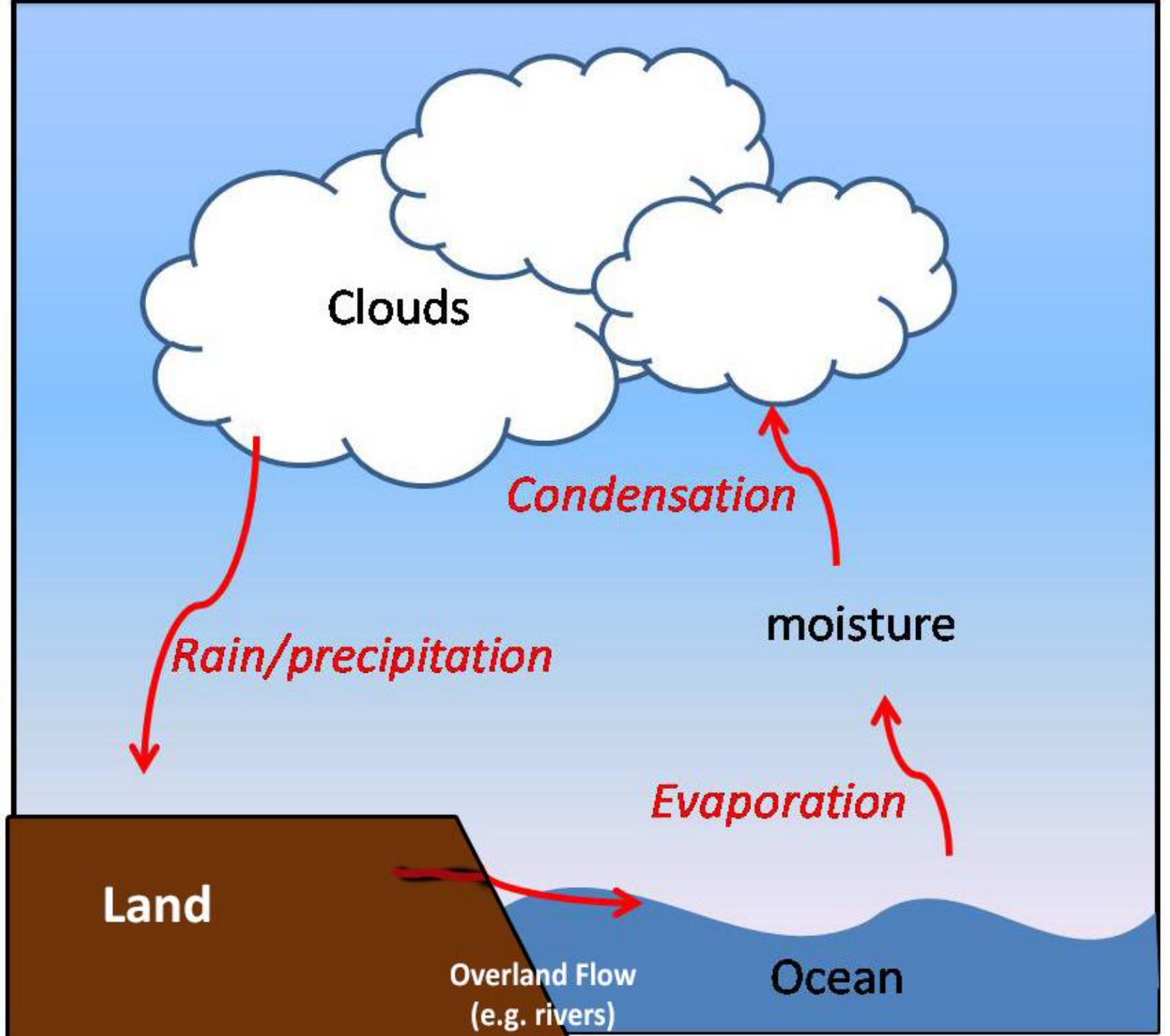
# ATMOSPHERIC MOISTURE – PART 1



# Humidity

## Absolute Humidity

## Relative Humidity



# DEW

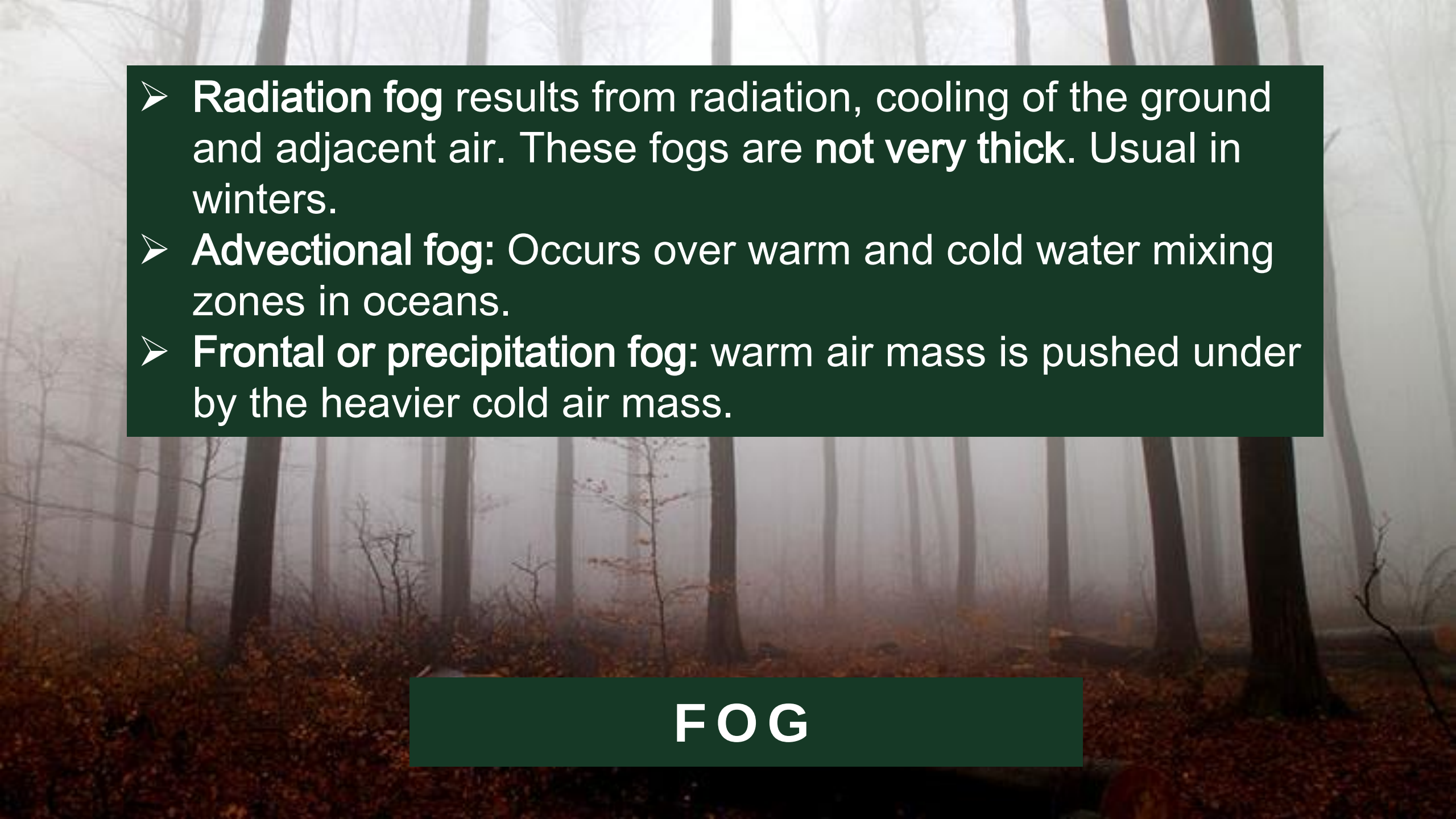
- Forms in clear sky, calm air, high relative humidity, and cold and long nights.
- Dew point is above the freezing point.





# FROST

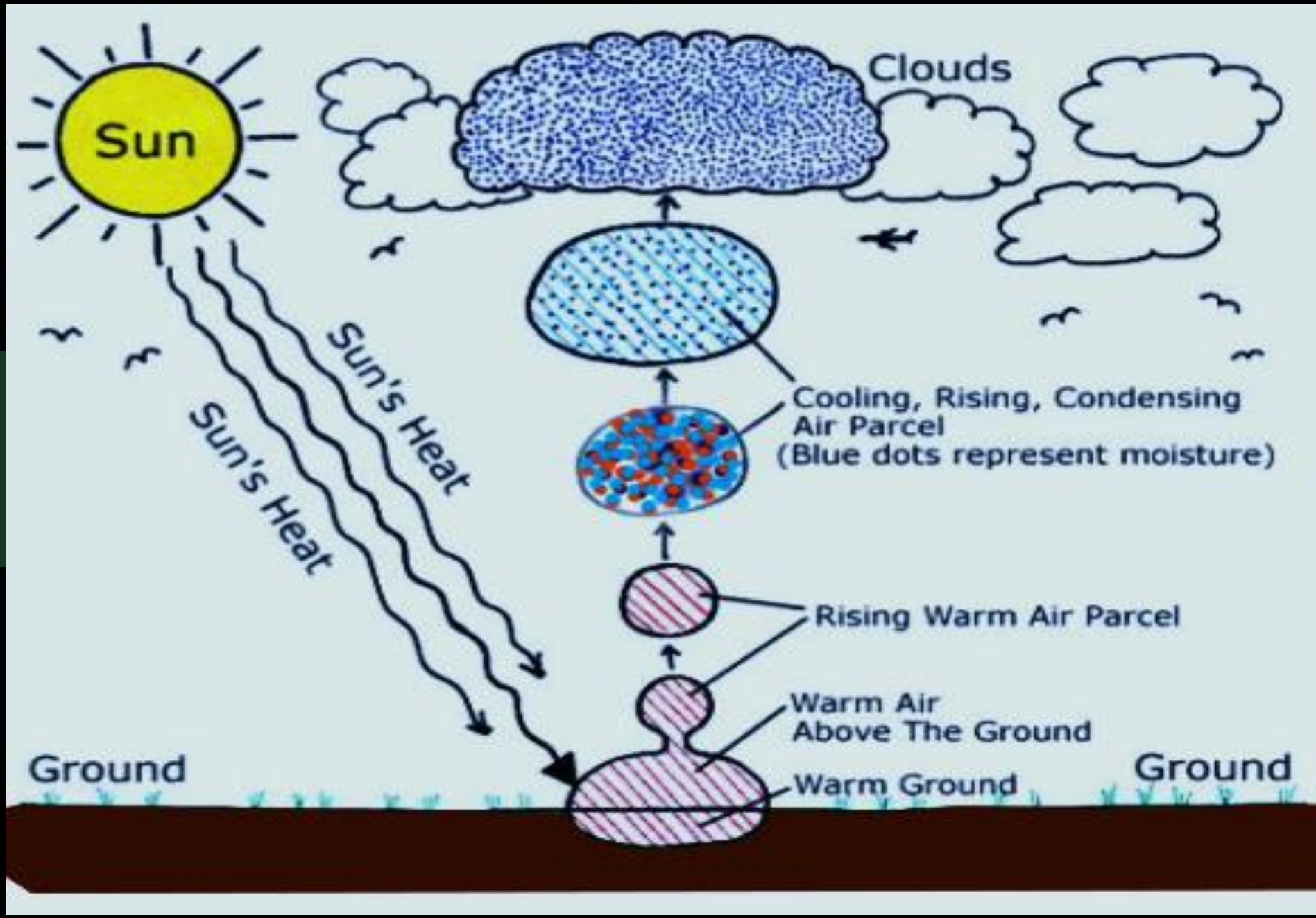
- Below freezing point (0° C), i.e. the dew pointis at or below the freezing point.
- Minute ice crystals instead of water droplets.
- Air temperature must be at or below the freezing point.



- **Radiation fog** results from radiation, cooling of the ground and adjacent air. These fogs are **not very thick**. Usual in winters.
- **Advectional fog:** Occurs over warm and cold water mixing zones in oceans.
- **Frontal or precipitation fog:** warm air mass is pushed under by the heavier cold air mass.

# FOG

# CLOUD FORMATION



# CLIMATOLOGY

## ATMOSPHERIC MOISTURE – Part 2

# BASED ON APPEARANCE

# CLOUDS



- HIGH, WHITE AND THIN
- ICE CRYSTALS
- FEATHERY APPEARANCE

# CLOUDS

- FLAT BASE
- RISING DOMES
- VERTICAL DEVELOPMENT
- FAIR WEATHER



# CLOUDS



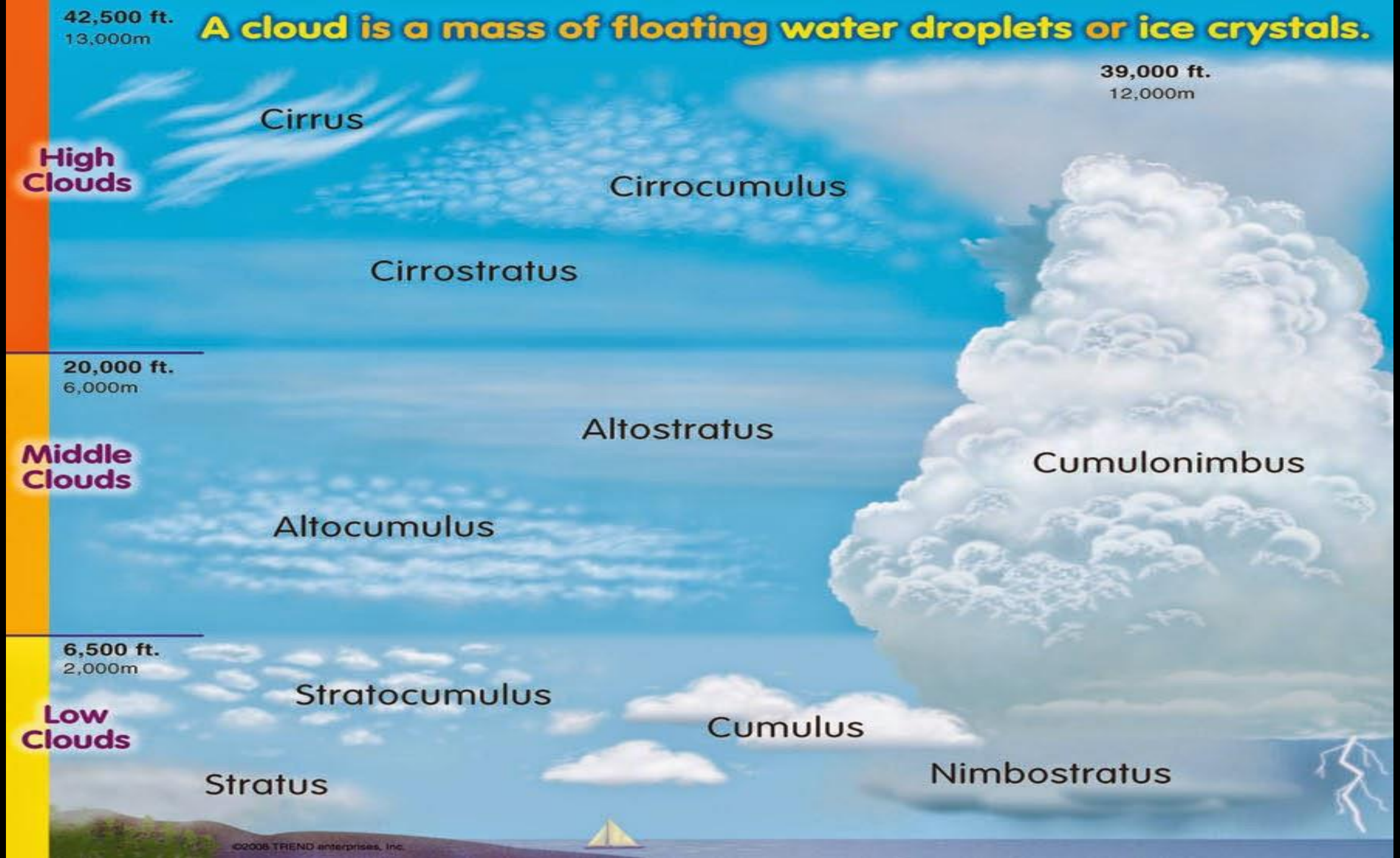
- **SHEETS OR LAYERS**
- **NO RAINFALL**

# CLOUDS

- DARK GREY
- THICK VAPOUR
- LOW ALTITUDE



# BASED ON HEIGHT


42,500 ft.
13,000m
A cloud is a mass of floating water droplets or ice crystals.
39,000 ft.
12,000m
Cirrus
High Clouds
Cirrocumulus
Cirrostratus
20,000 ft.
6,000m
Altostratus
Middle Clouds
Cumulonimbus
Altocumulus
6,500 ft.
2,000m
Stratocumulus
Low Clouds
Cumulus
Nimbostratus
Stratus
©2008 TREND enterprises, Inc.

# HIGH CLOUDS

## CIRRUS
- FAIR WEATHER

## CIRROSTRATUS
- SHEET OF CLOUD
- HALO

## CIRROCUMULUS
- MACKEREL SKY
- SMALL GLOBULAR MASSES
- WITHOUT SHADOWS

# MIDDLE CLOUDS

## ALTOSTRATUS
-SHEET OF CLOUDS
- CORONA
- CONTINUOUS PRECIPITATION

## ALTO CUMULUS
- FLATTENED GLOBULAR MASS
- SHADOWS

# LOW CLOUDS

## STRATOCUMULUS
- LARGE GLOBULAR MASSES

## NIMBOSTRATUS
- CONTINUOUS RAINFALL

## CUMULONIMBUS
- GREAT VERTICAL DEVELOPMENT
- THUNDERSTORMS

# HALO FORMATION



# CORONA FORMATION



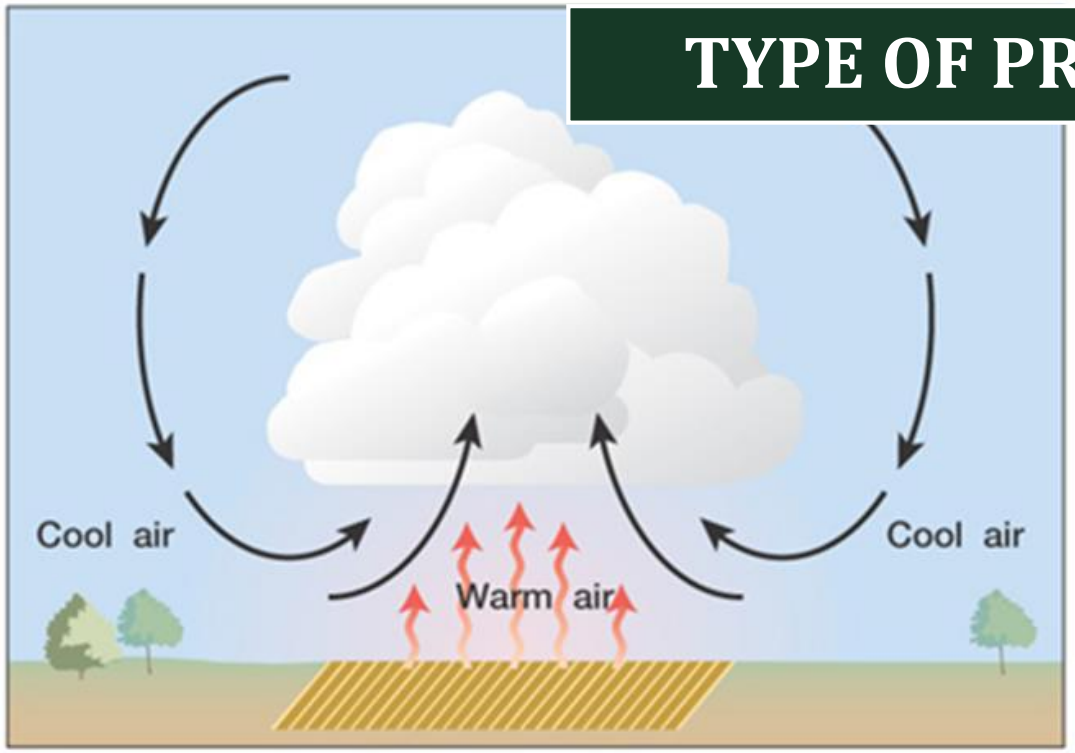
# MACKEREL SKY



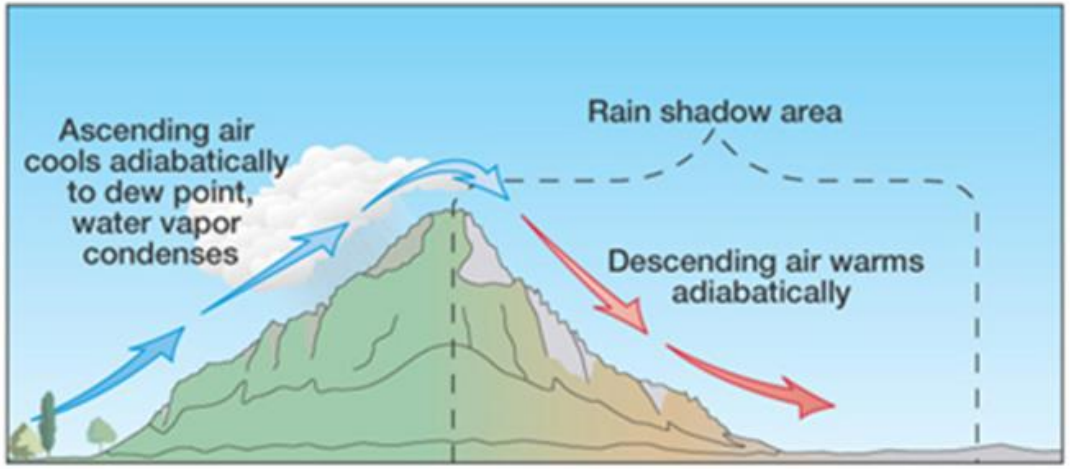
# THUNDER CLOUDS



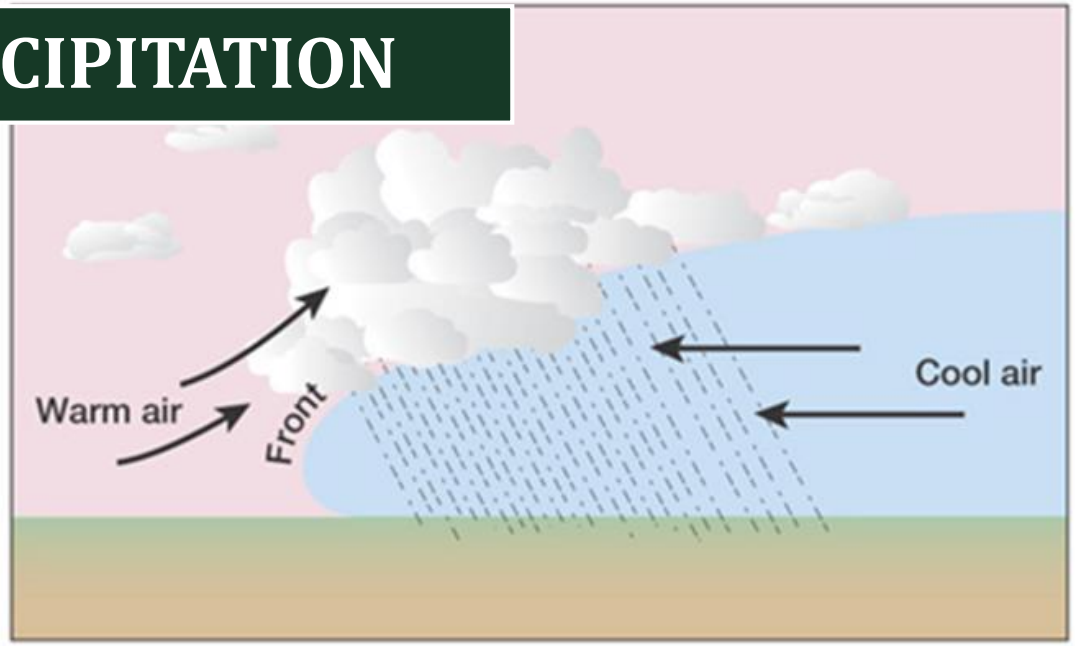
# TYPE OF PRECIPITATION



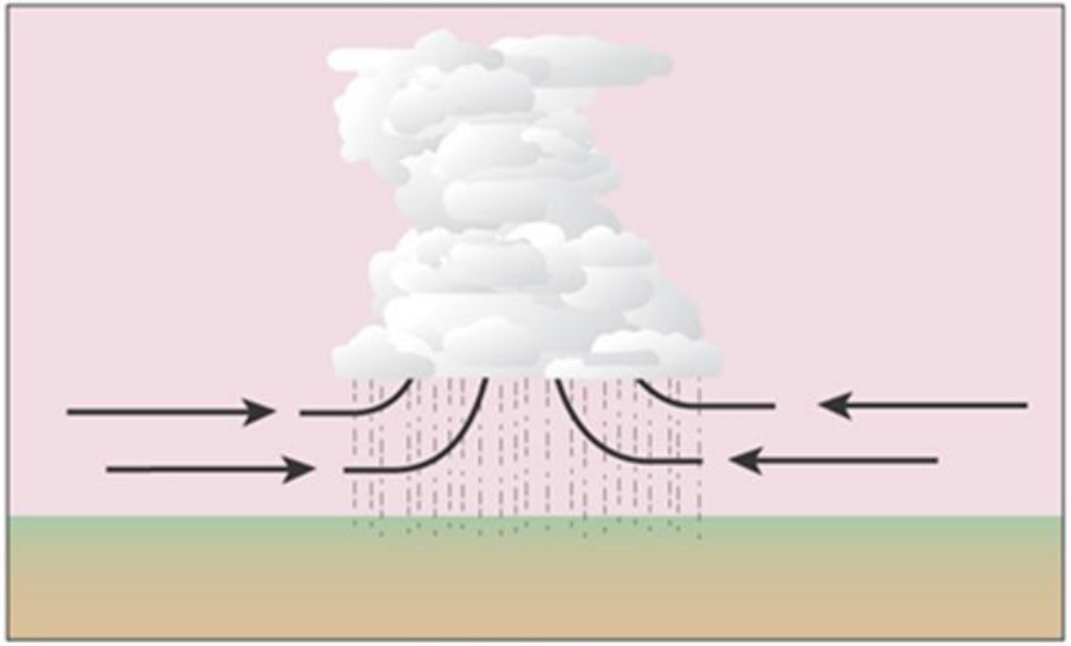

(a) Convective




(b) Orographic



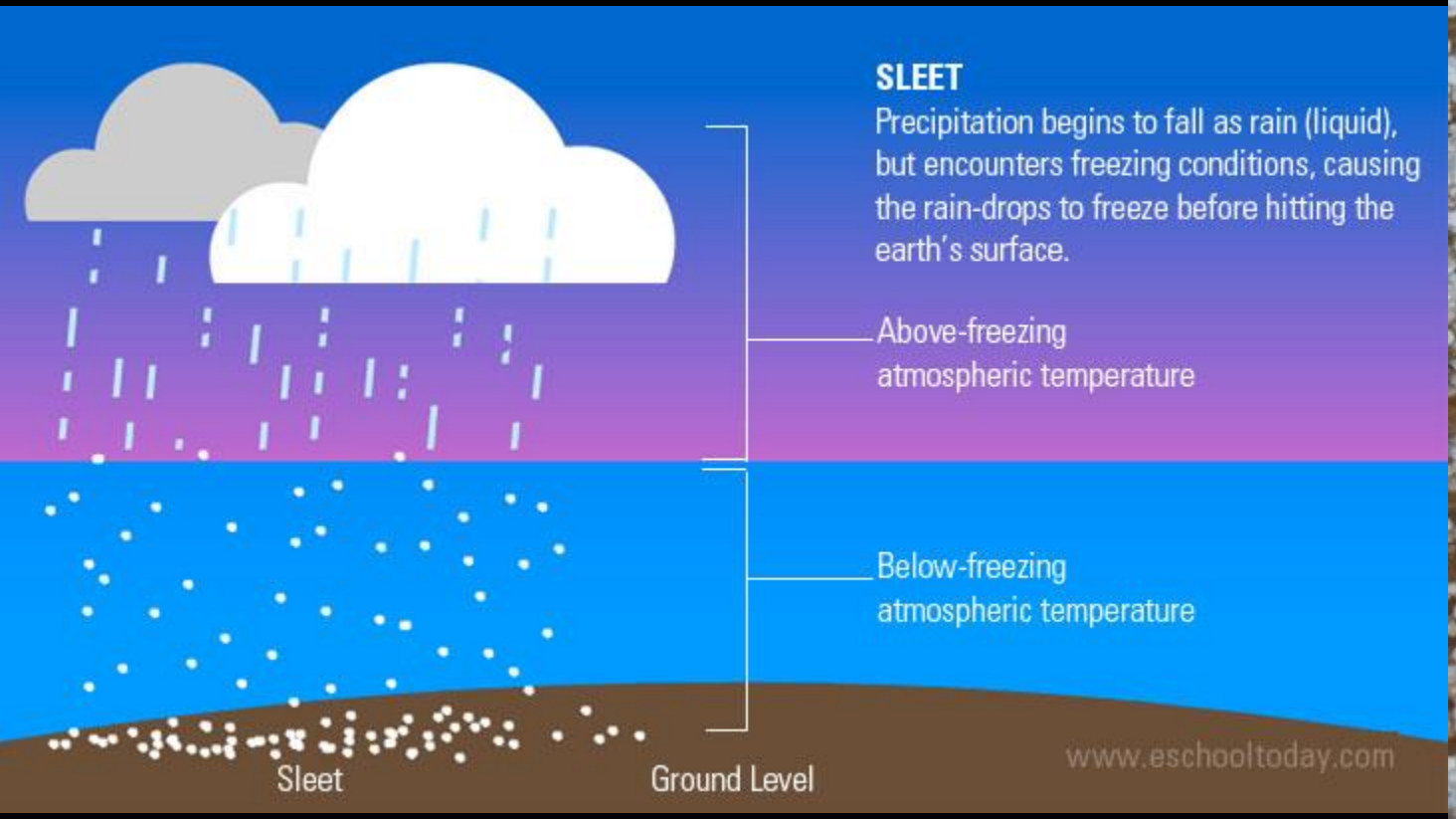

(c) Frontal



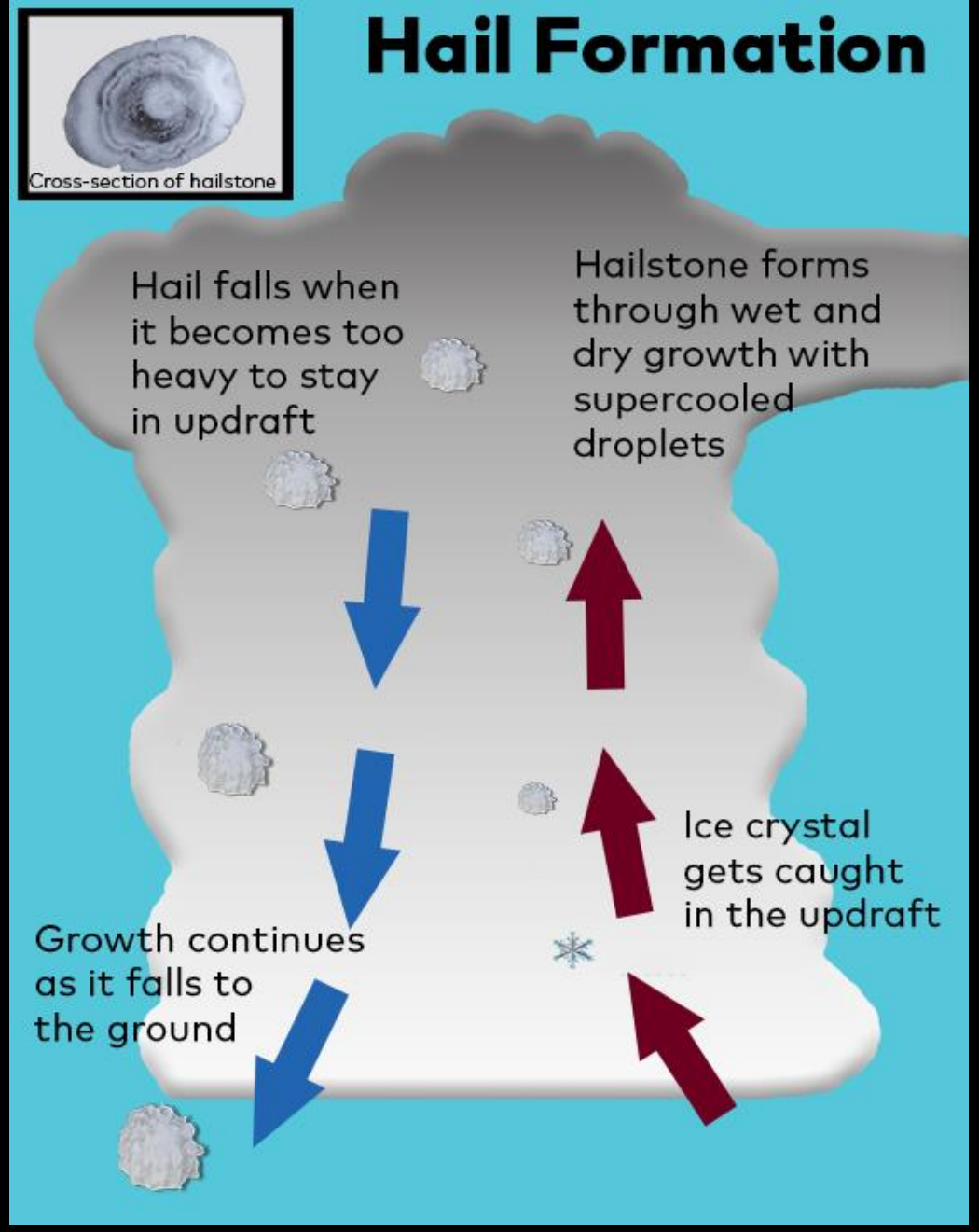
(d) Convergent

# FORMS OF PRECIPITATION




SLEET
Precipitation begins to fall as rain (liquid), but encounters freezing conditions, causing the rain-drops to freeze before hitting the earth's surface.
Above-freezing atmospheric temperature
Below-freezing atmospheric temperature
Sleet
Ground Level
www.eschooltoday.com

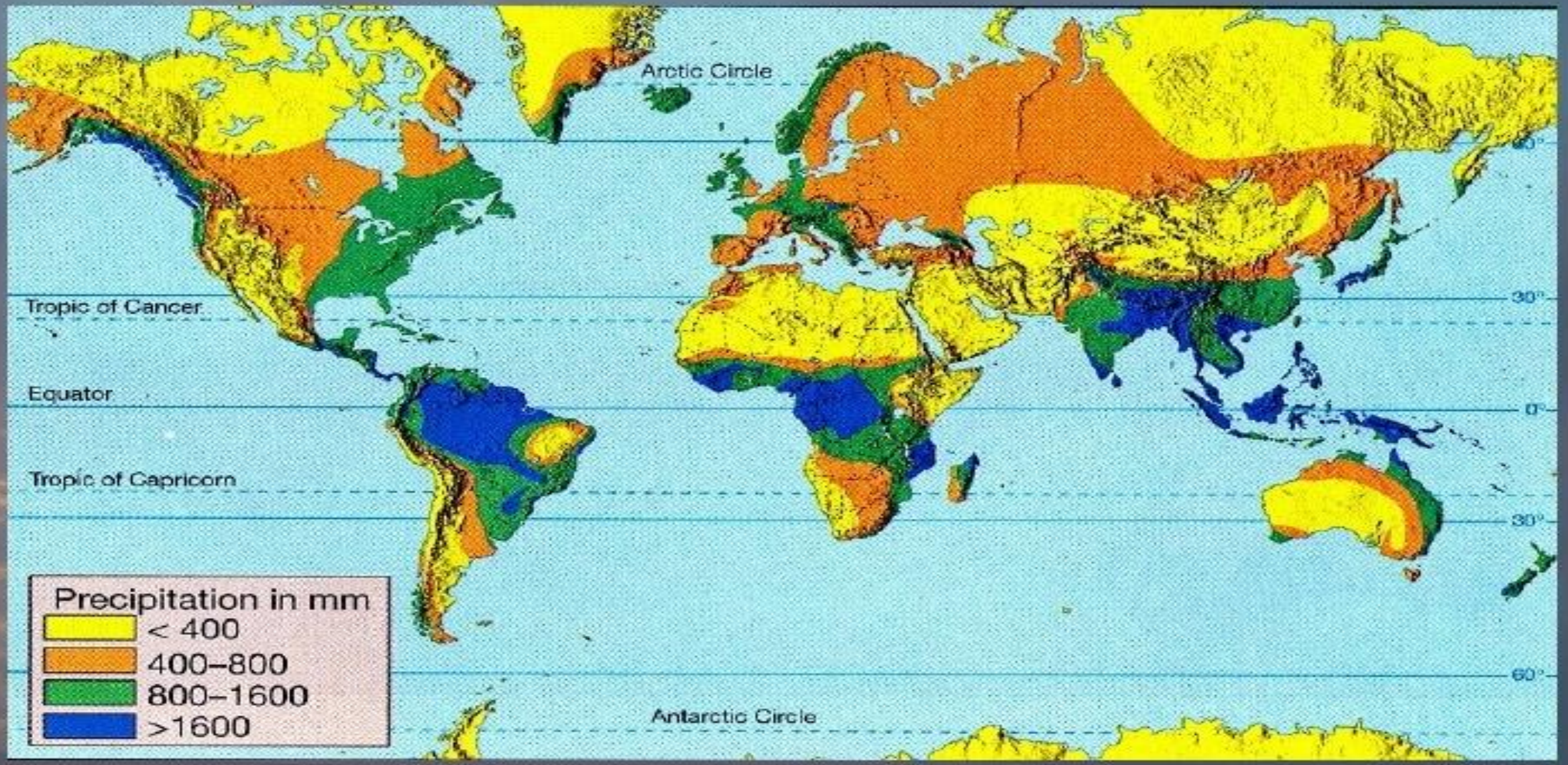



Hail Formation
Cross-section of hailstone
Hail falls when it becomes too heavy to stay in updraft
Hailstone forms through wet and dry growth with supercooled droplets
Ice crystal gets caught in the updraft
Growth continues as it falls to the ground





# Global Distribution of Precipitation

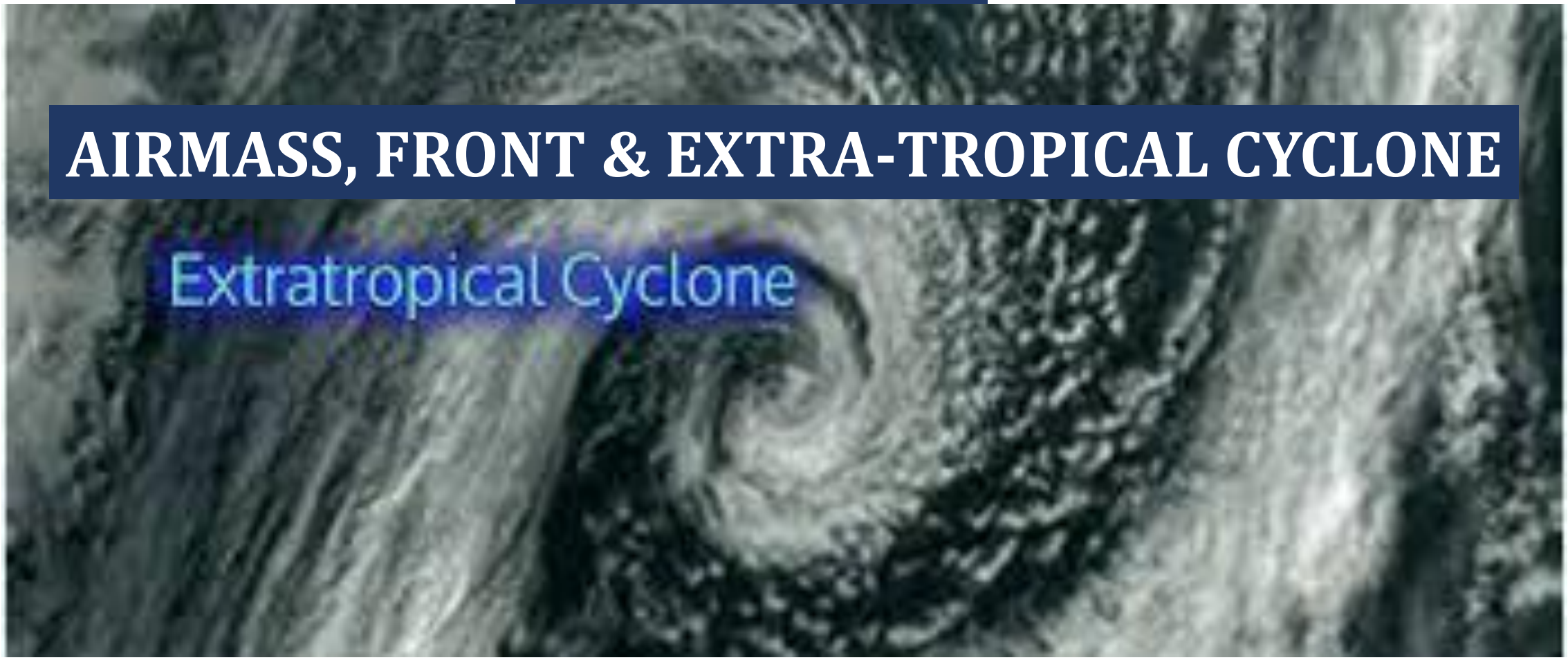


# FACTORS OF PRECIPITATION

- Low Pressure belt receives heavy rainfall
- Distance from sea
- Low Latitude receives heavy rainfall
- Windward and Leeward Side
- Trade winds are onshore in the eastern margin
- Westerlies are onshore in the western margin
- Desert Formation
- Ocean Current

# CLIMATOLOGY

## AIRMASS, FRONT & EXTRA-TROPICAL CYCLONE



# AIRMASS

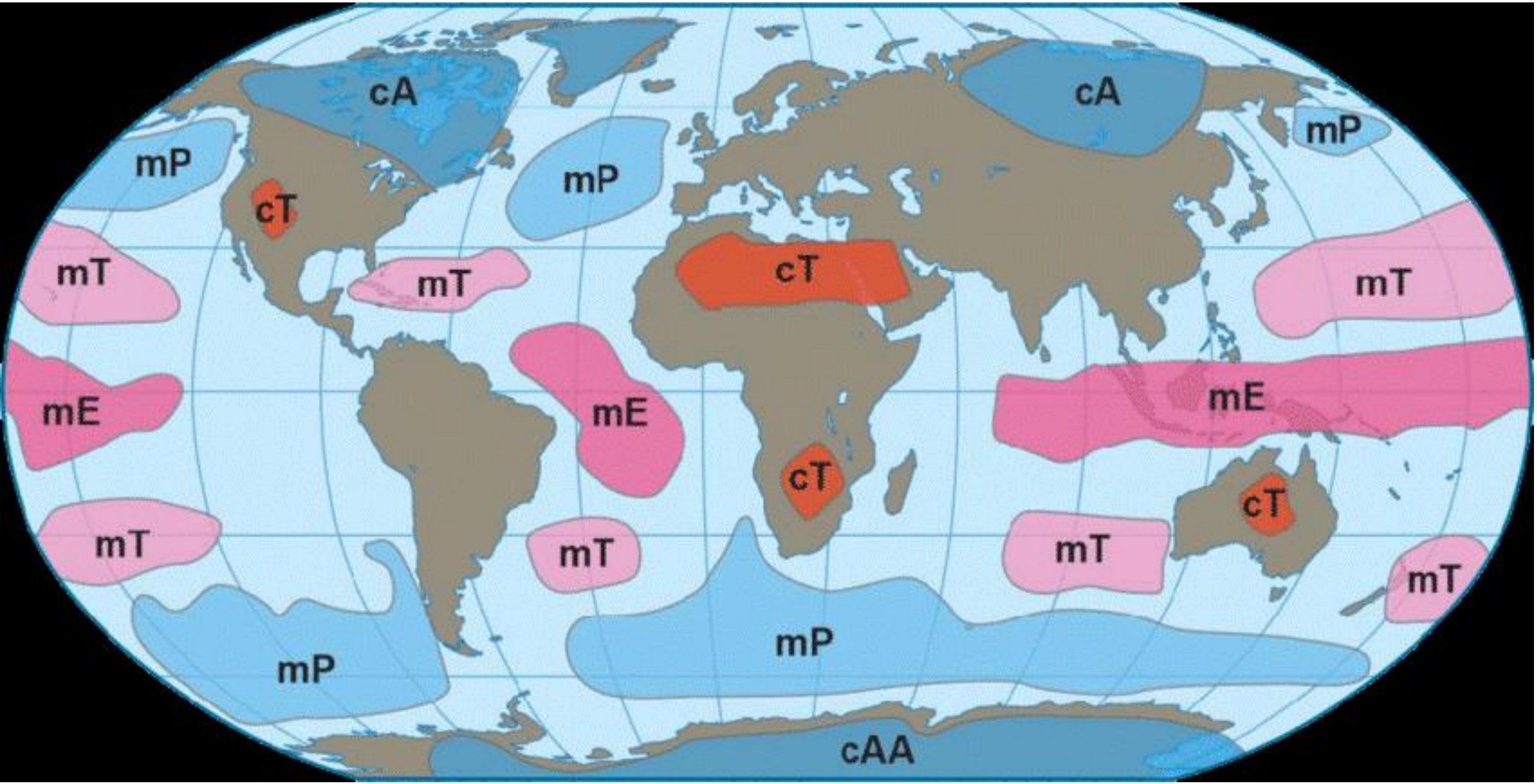
- Little horizontal variation in temperature, moisture and pressure
- Homogenous region
- Large scale subsidence

# CLASSIFICATION

- **Based on HUMIDITY**
  - **Continental (dry)**
  - **Maritime (moist)**

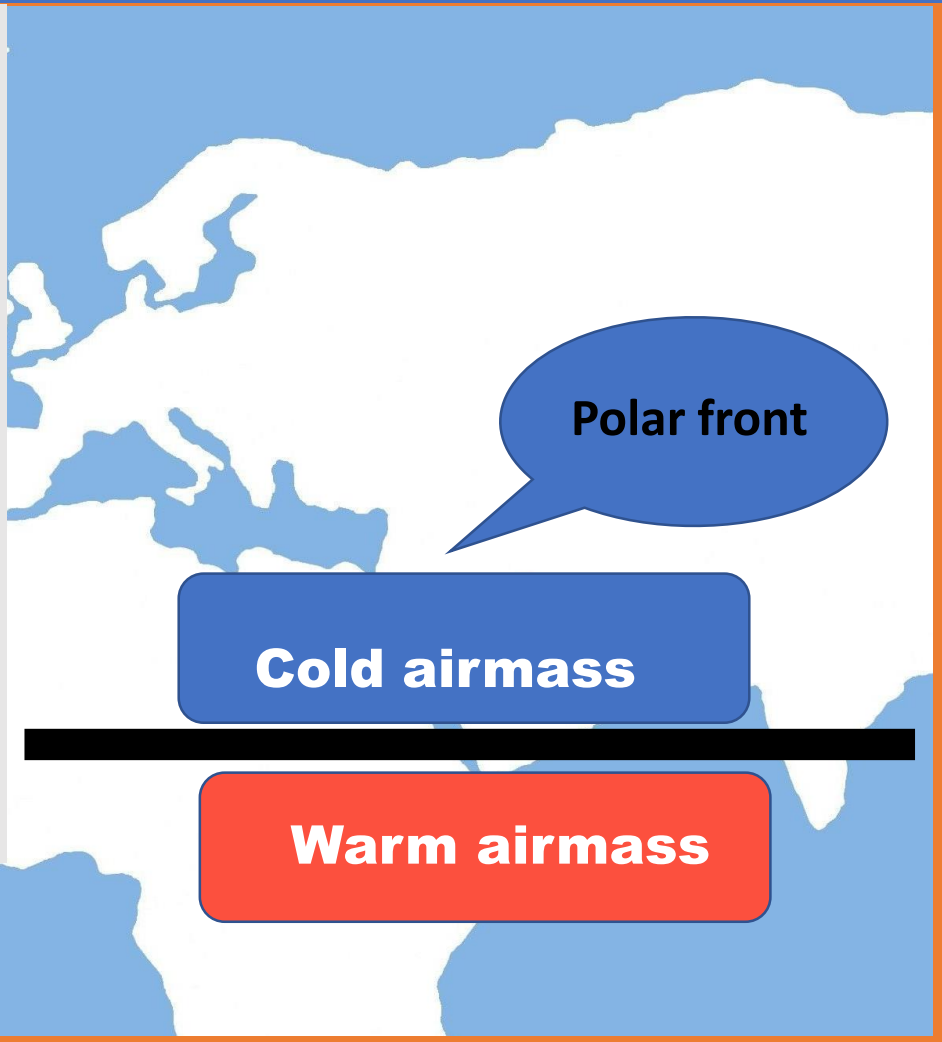
- **Based on TEMPERATURE**
  - **Tropical (warm)**
  - **Polar (cold)**
  - **Arctic (extremely cold)**

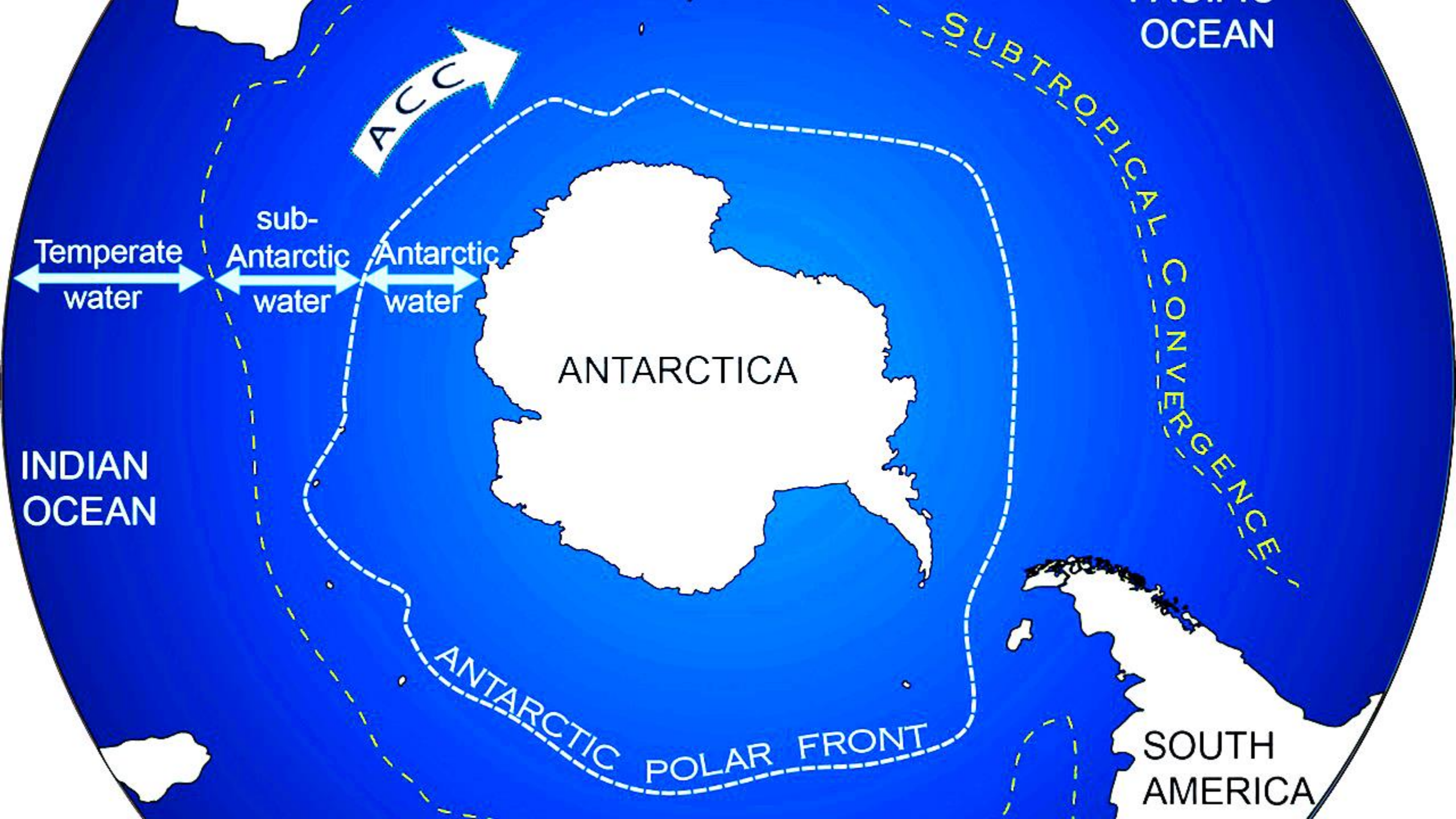
| AIR MASSES | SOURCE REGION | CHARACTERISTICS |
|---|---|---|
| **Continental Arctic (cA)** | Greenland, Antarctica, Highest latitudes of Asia and North America | Very cold and very dry, extremely stable, very little cloud cover. |
| **Continental Polar (cP)** | High latitudes, continental interiors | Cold and dry, very stable, very little cloud cover |
| **Maritime Polar (mP)** | High-latitude oceans | Cold, moist and cloudy, somewhat unstable |
| **Continental Tropics (cT)** | Low-latitude deserts | Hot and dry, very unstable |
| **Maritime Tropics (mT)** | Subtropical oceans | Warm and humid |


cA
cA
mP
mP
mP
mP
cT
cT
mT
mT
mT
mT
mE
mE
mE
cT
cT
mT
mT
mT
mT
mP
mP
cAA

# FRONTS

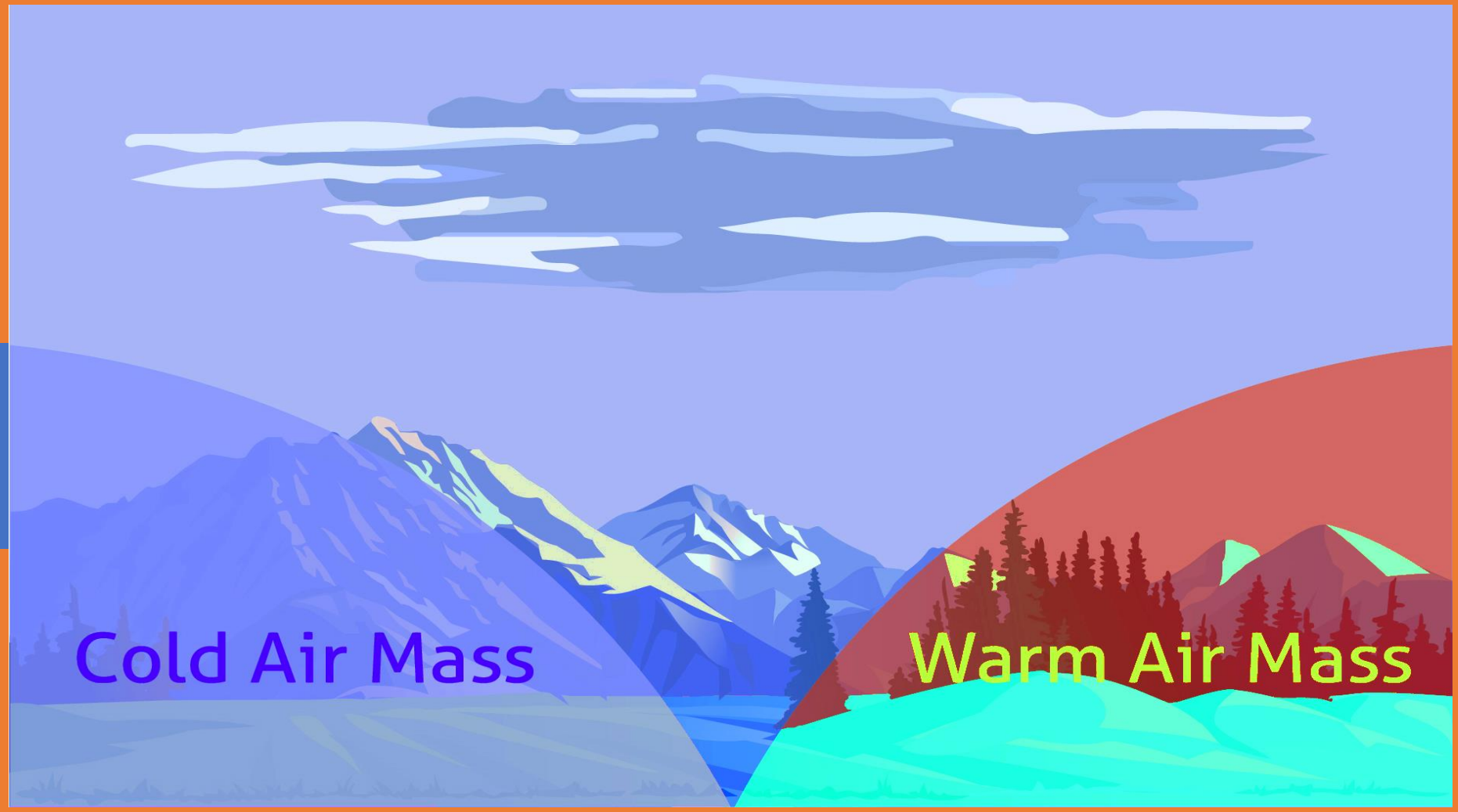
- Boundary zone of convergence
- High difference in temperature and pressure
- Polar front




ACC
SUBTROPICAL CONVERGENCE
Temperate water
sub-Antarctic water
Antarctic water
ANTARCTICA
INDIAN OCEAN
ANTARCTIC POLAR FRONT
SOUTH AMERICA

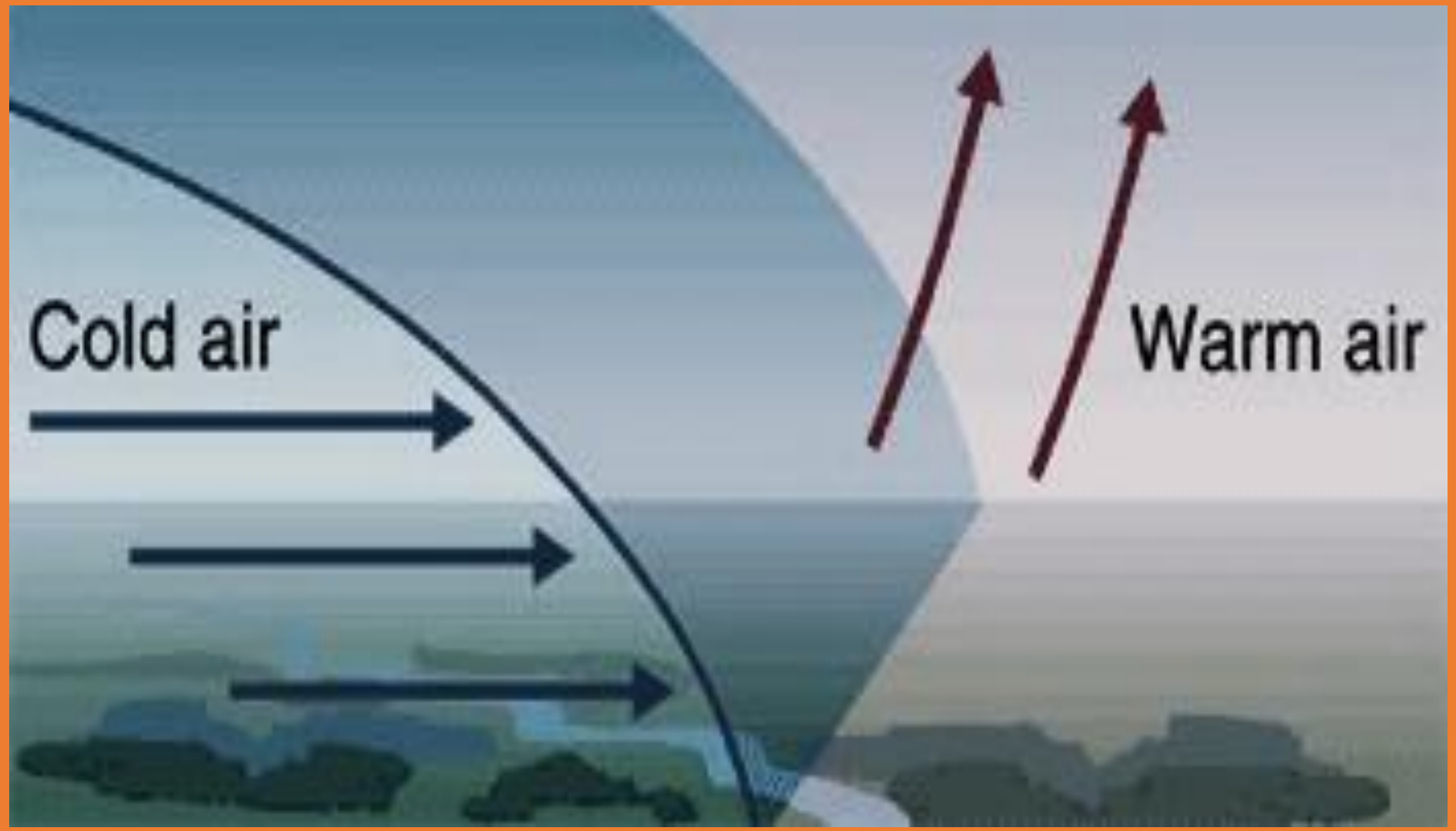
# CLASSIFICATION

## STATIONARY FRONT



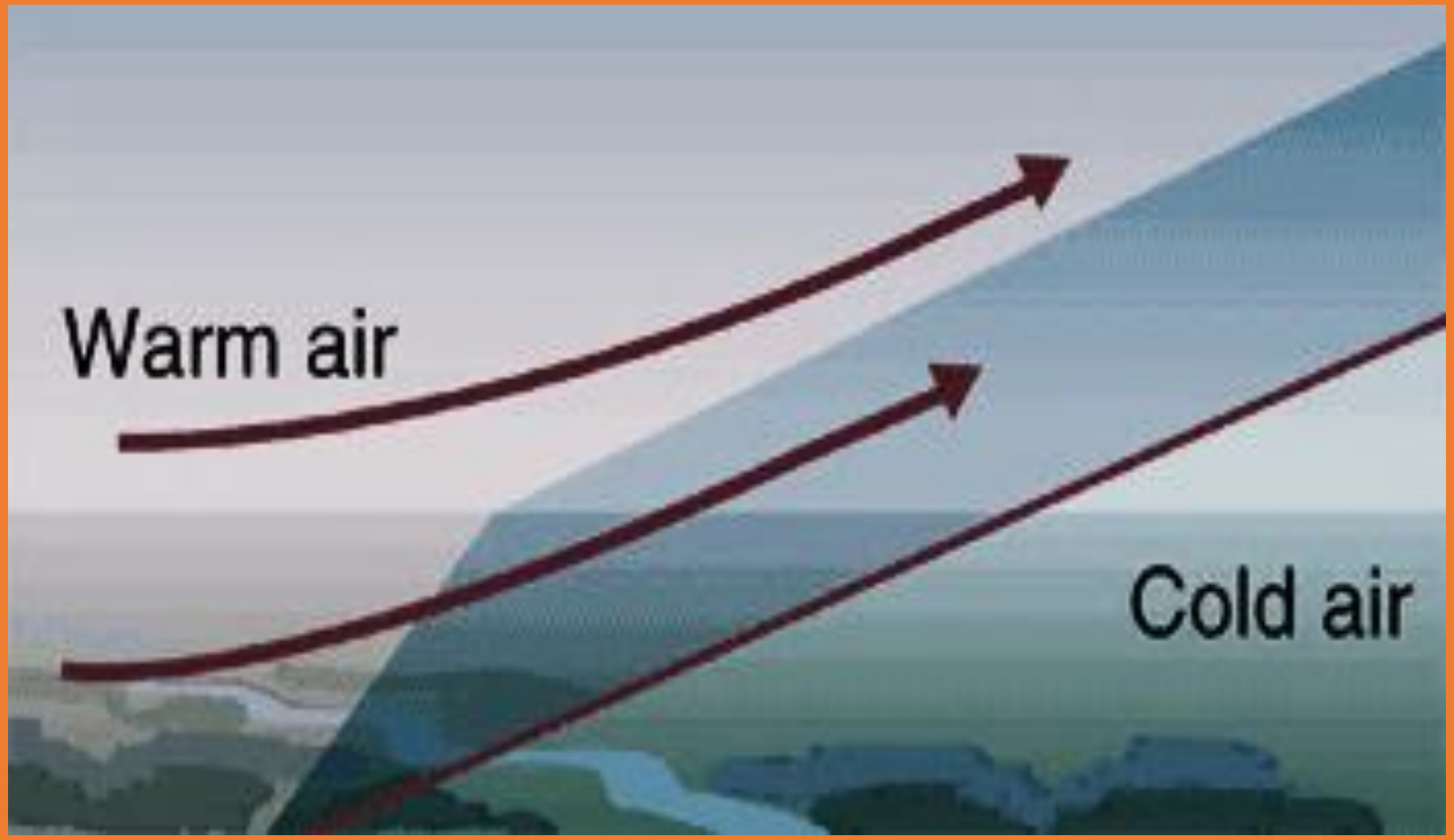
# CLASSIFICATION

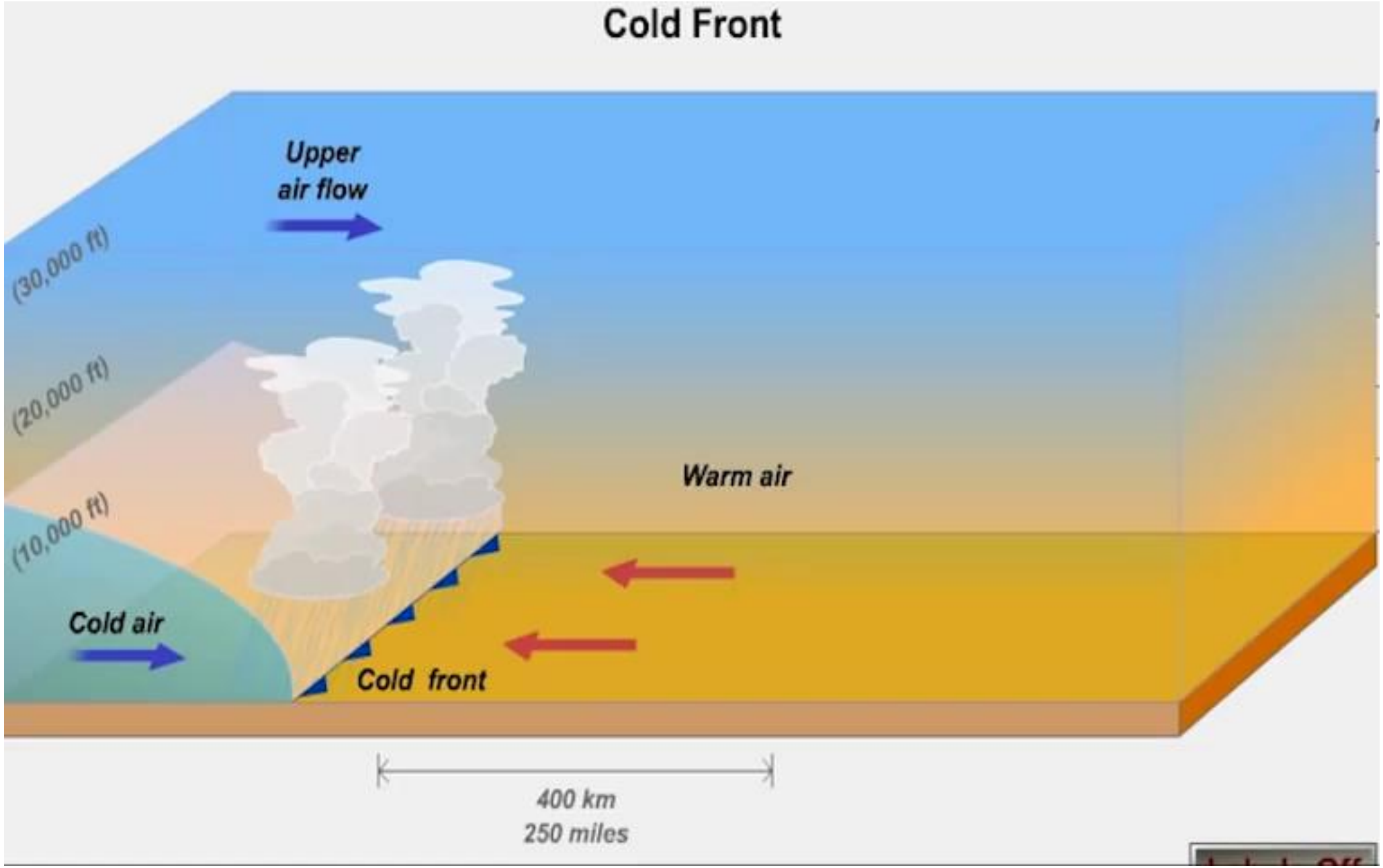
## COLD FRONT



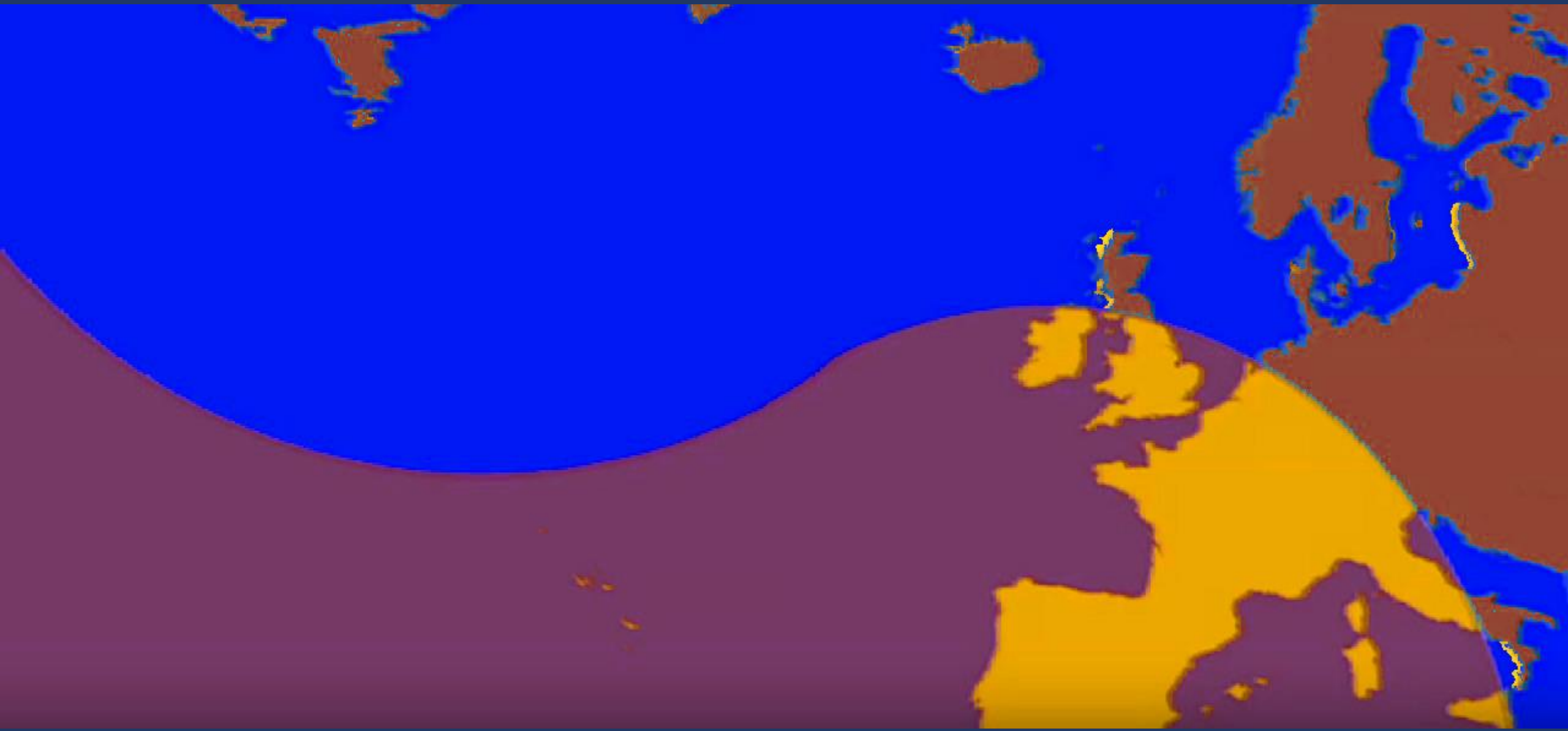
# CLASSIFICATION

## WARM FRONT



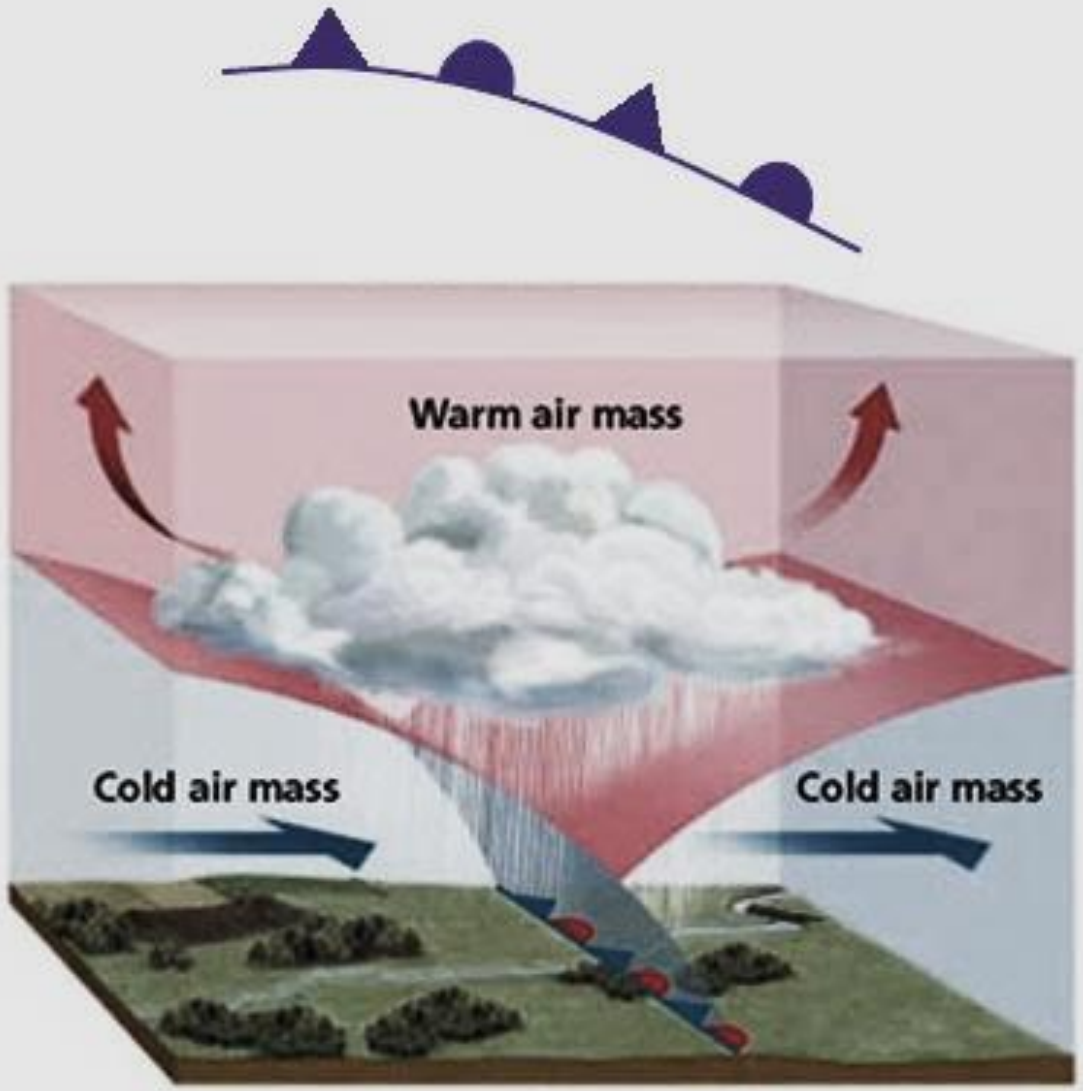

Cold Front
Upper
air flow
(30,000 ft)
(20,000 ft)
(10,000 ft)
Warm air
Cold air
Cold front
400 km
250 miles





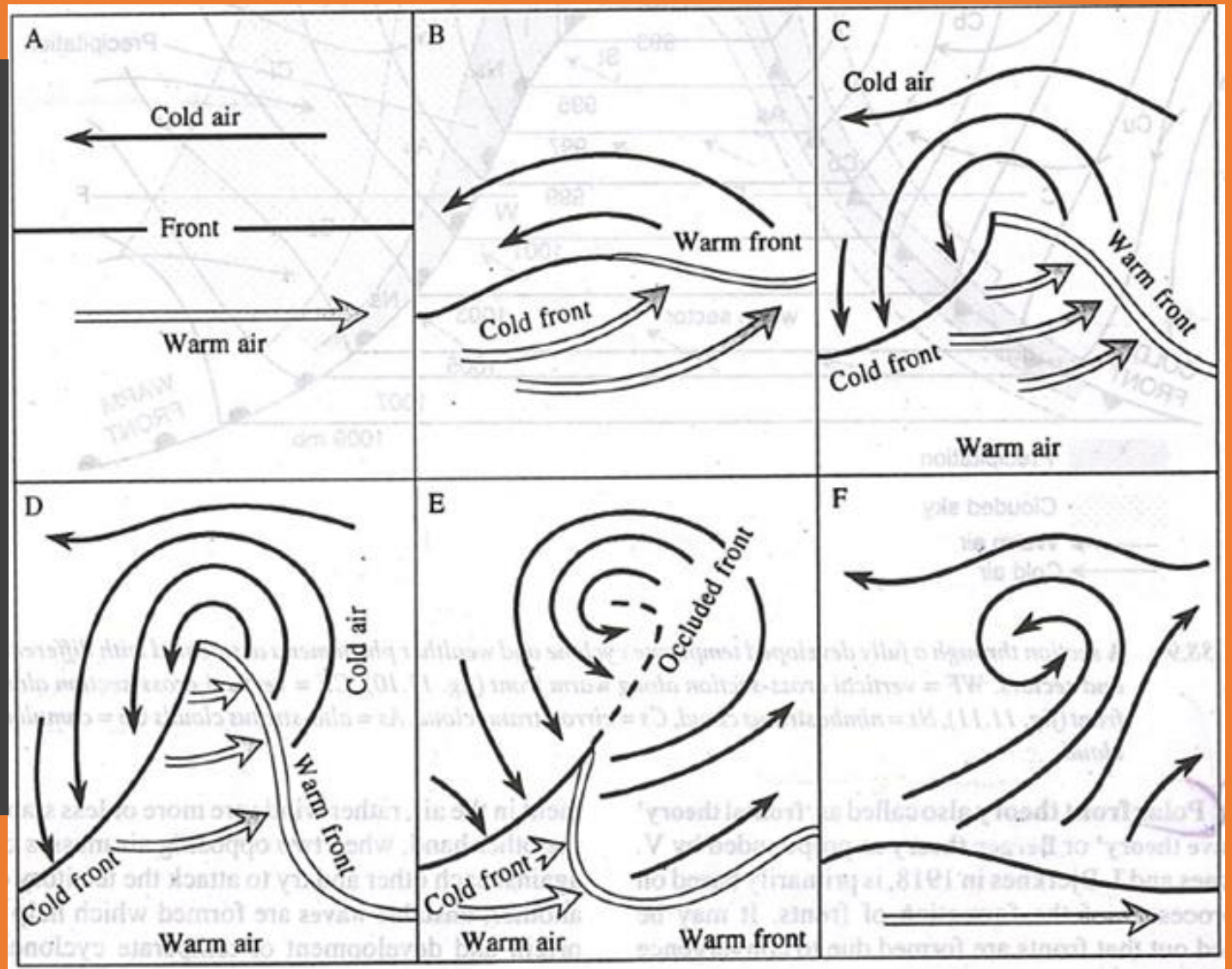
# CLASSIFICATION

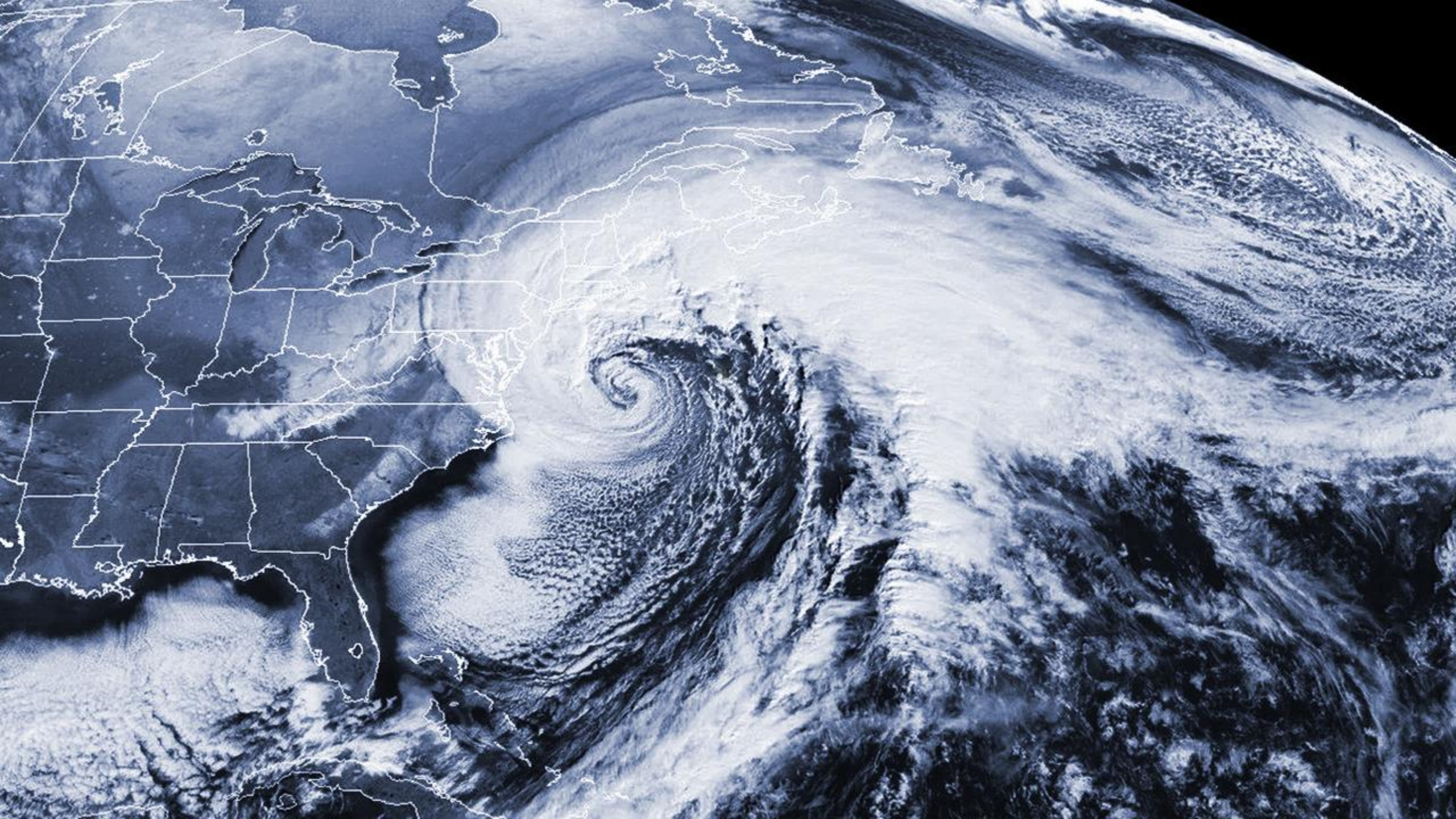
## OCCLUDED FRONT



# TEMPERATE CYCLONE

- $35^0$ and $65^0$ in both hemispheres
- Vertical thickness - 9 to 11 km
- Diameter - 1000 km
- Polar front theory
- Bomb cyclone

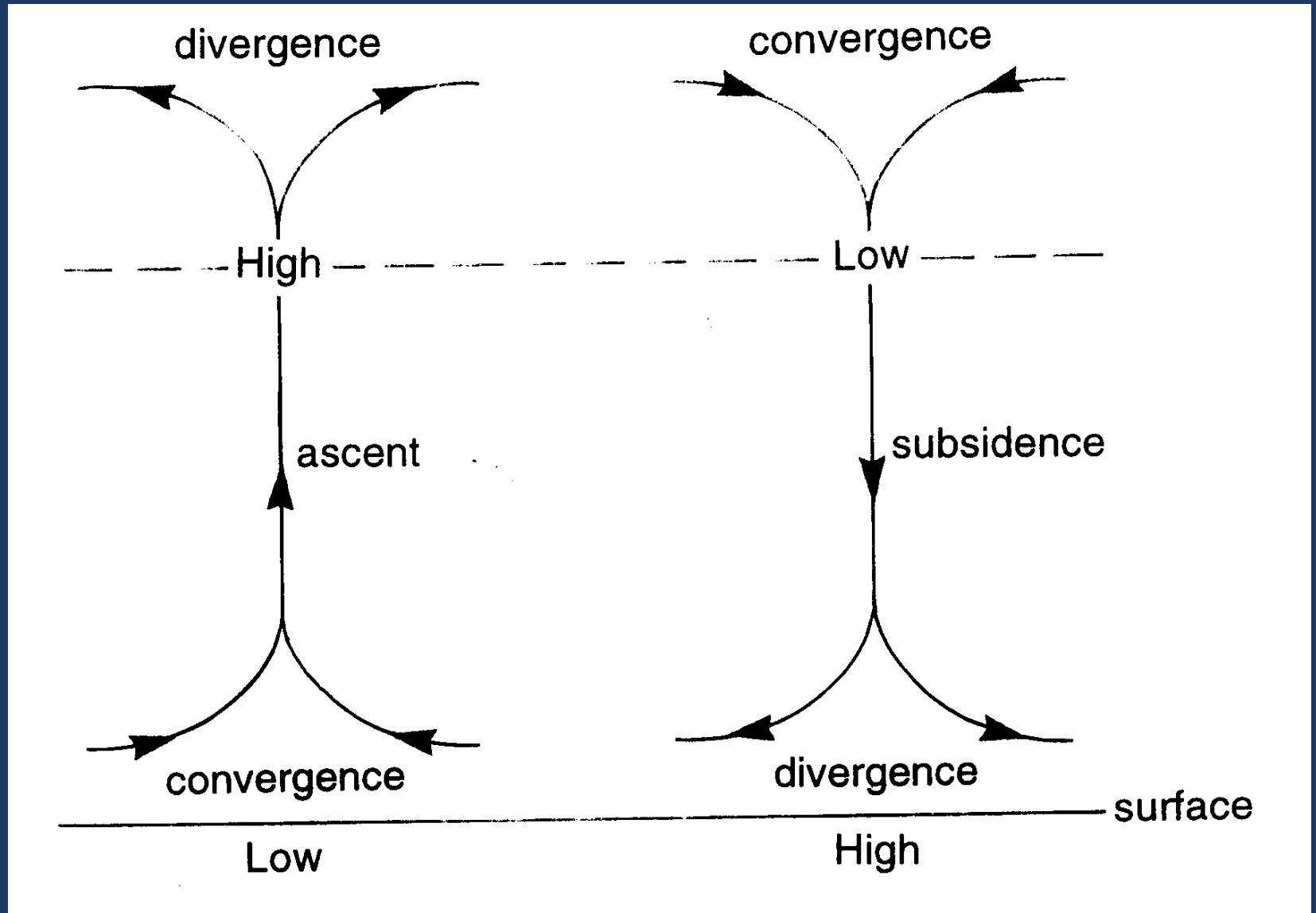




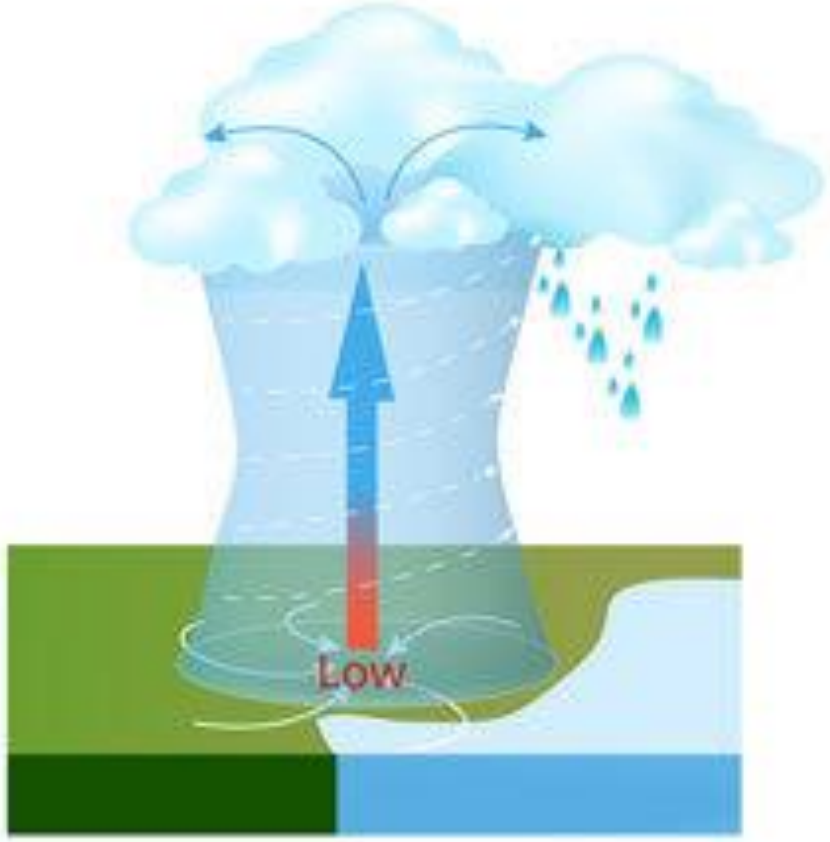
# CLIMATOLOGY

## TROPICAL CYCLONE

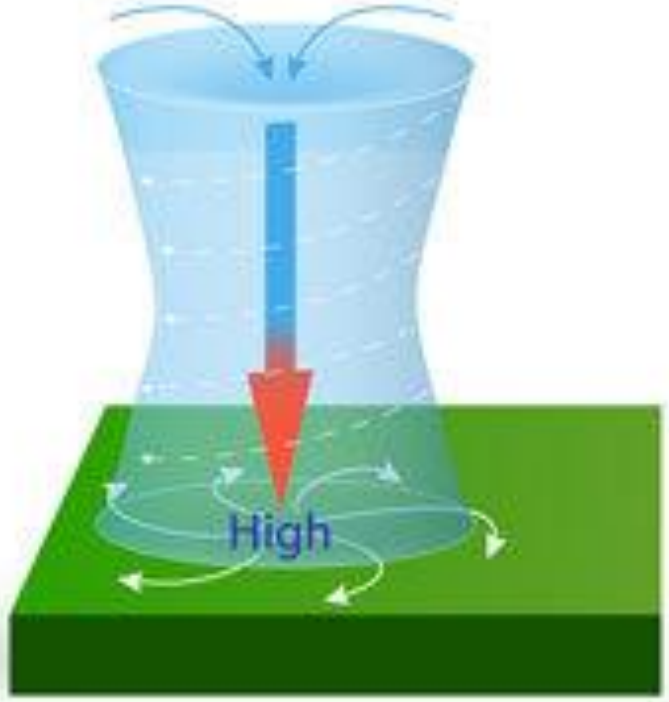
# TROPICAL CYCLONES



# CYCLONES

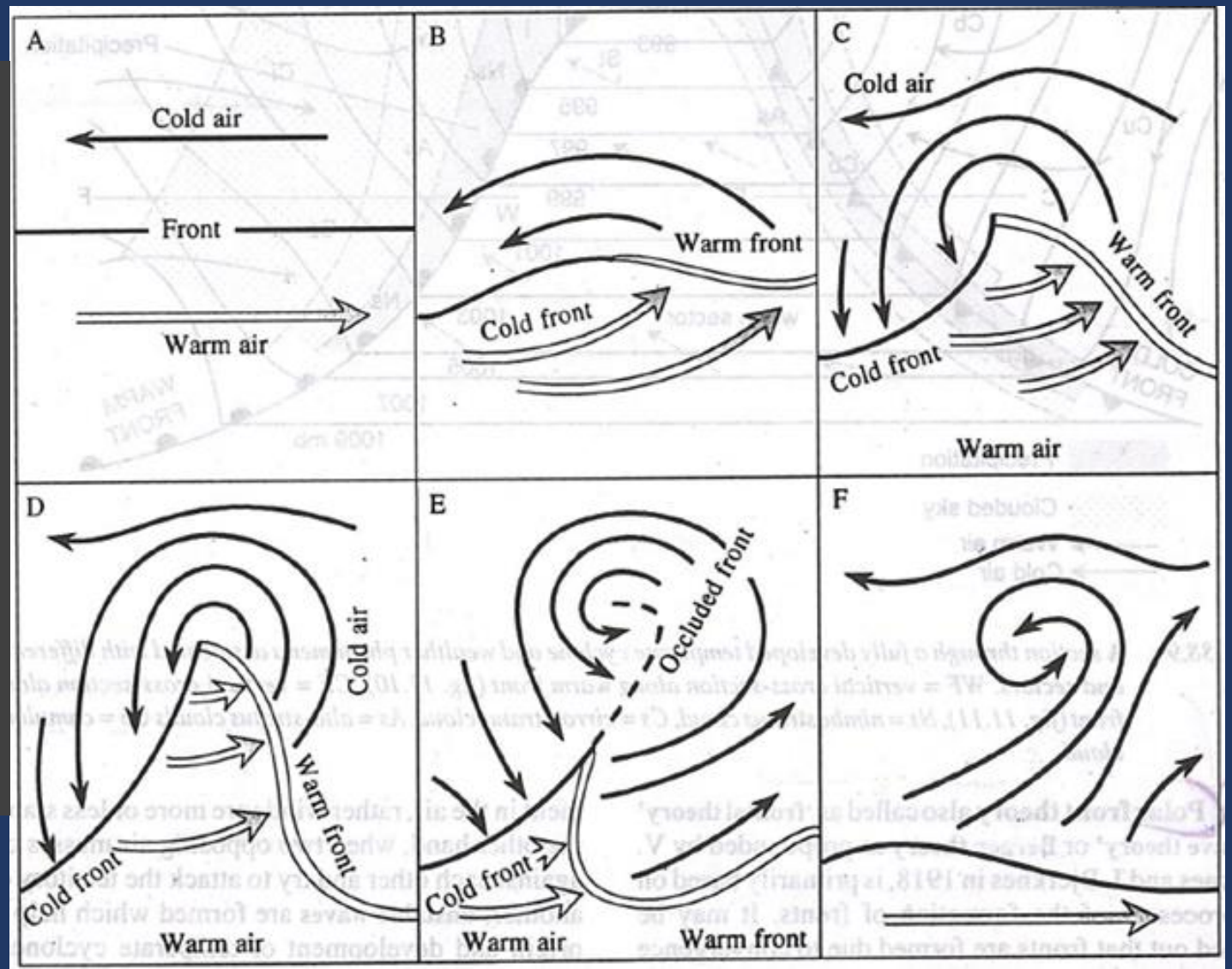


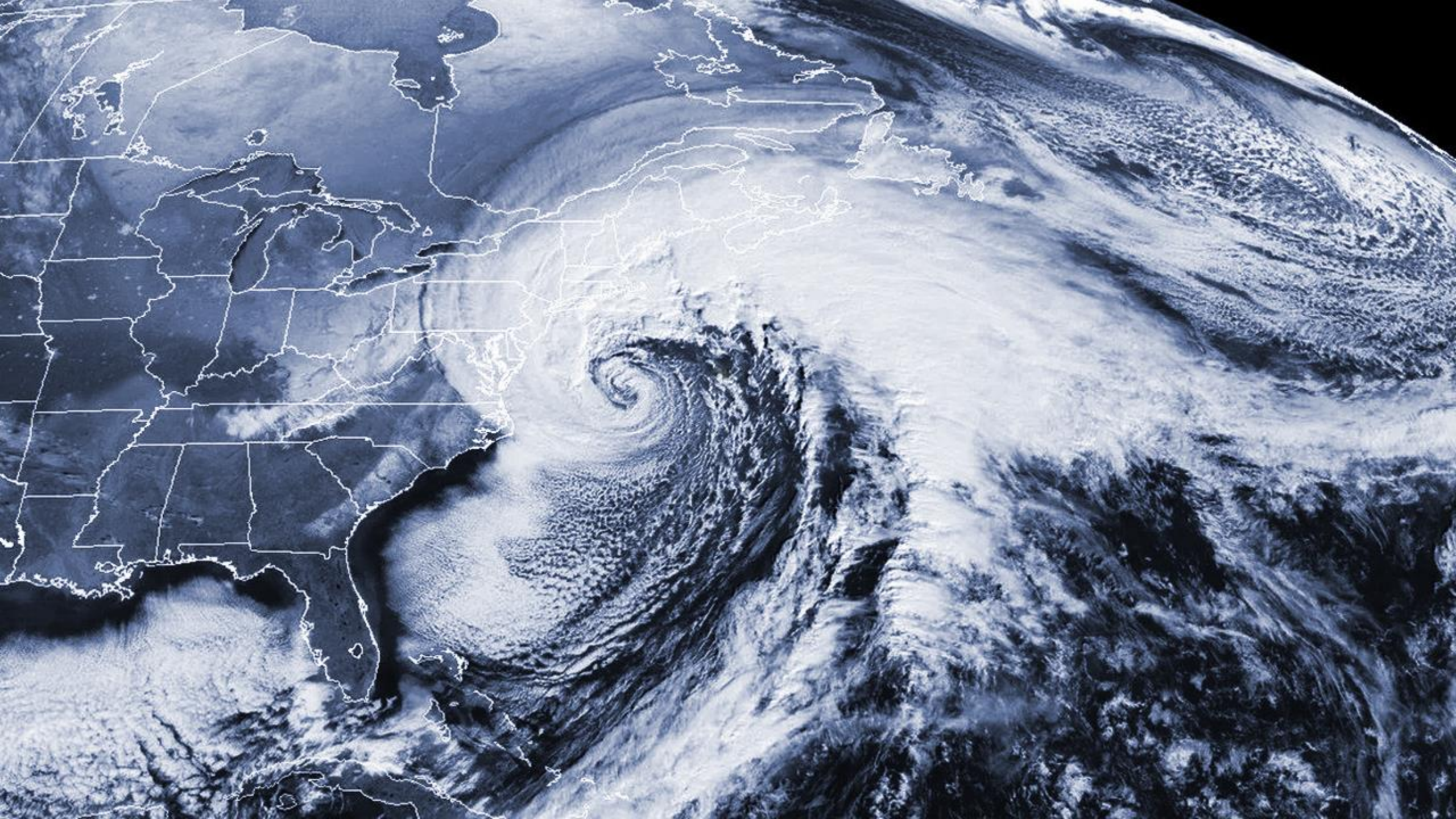

# ANTICYCLONES



# TEMPERATE CYCLONE/EXTRA TROPICAL CYCLONES

- $35^0$ and $65^0$ in both hemispheres
- Vertical thickness - 9 to 11 km
- Diameter - 1000 km
- Polar front theory
- Bomb cyclone





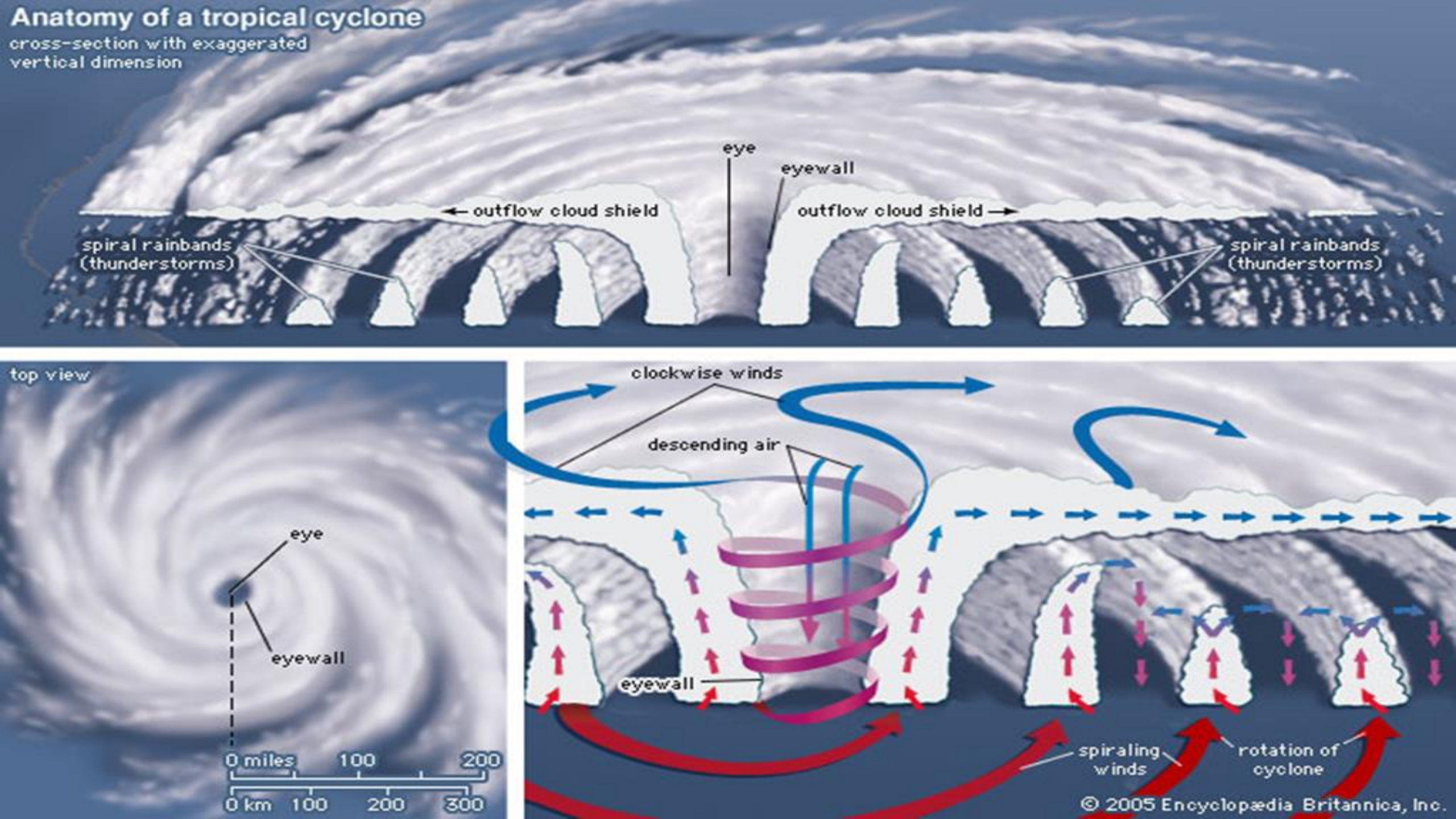
# FACTORS INFLUENCING TROPICAL CYCLONE FORMATION

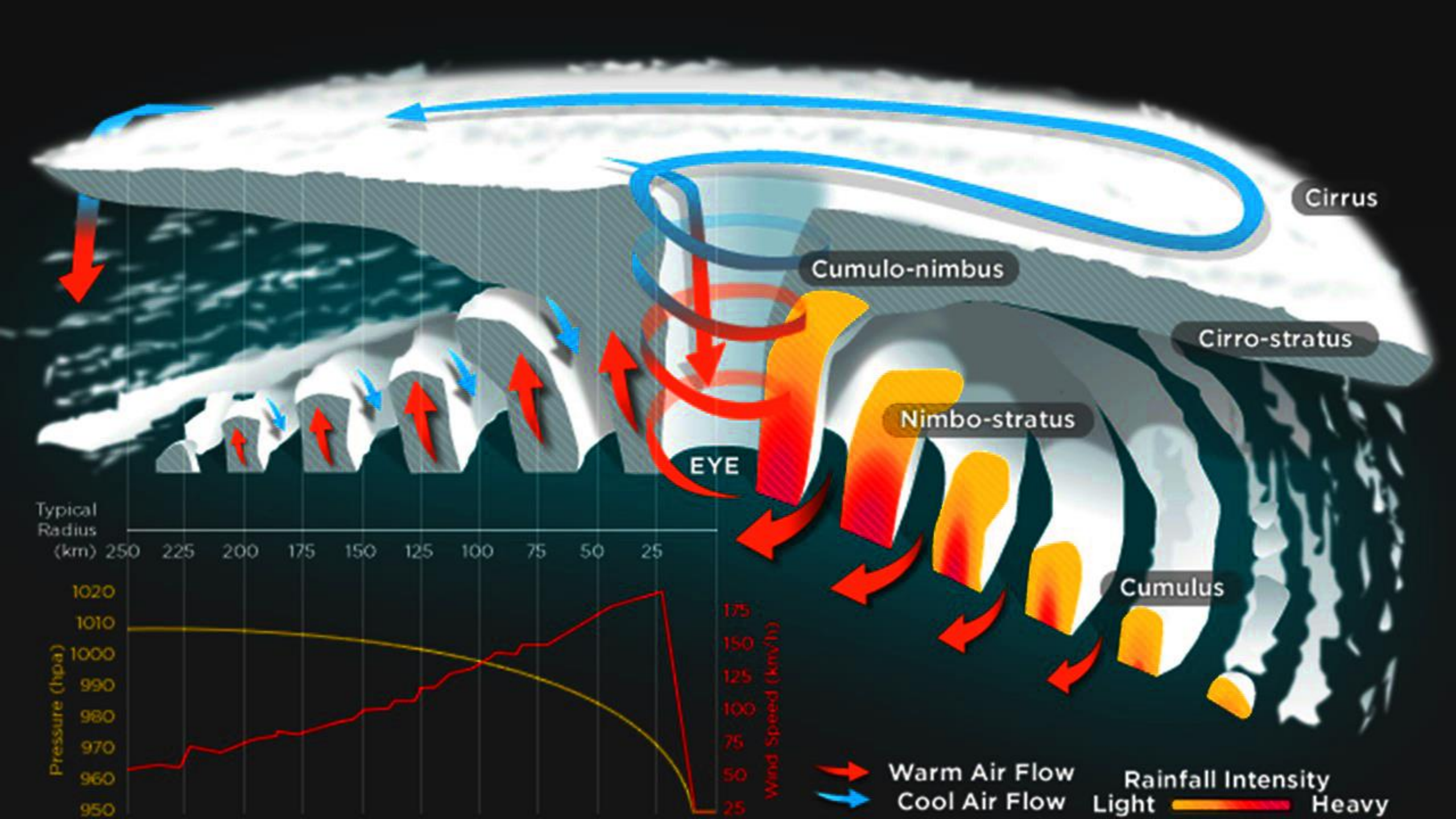
- Atmospheric moisture
- Warm ocean waters (Sea Surface Temperature)
- Coriolis force (8 to 20 degree N and S latitudes)
- Inter-Tropical Convergence Zone (ITCZ)
- Low values of vertical wind shear
- Pre-existing disturbance

# EYE & EYE WALL

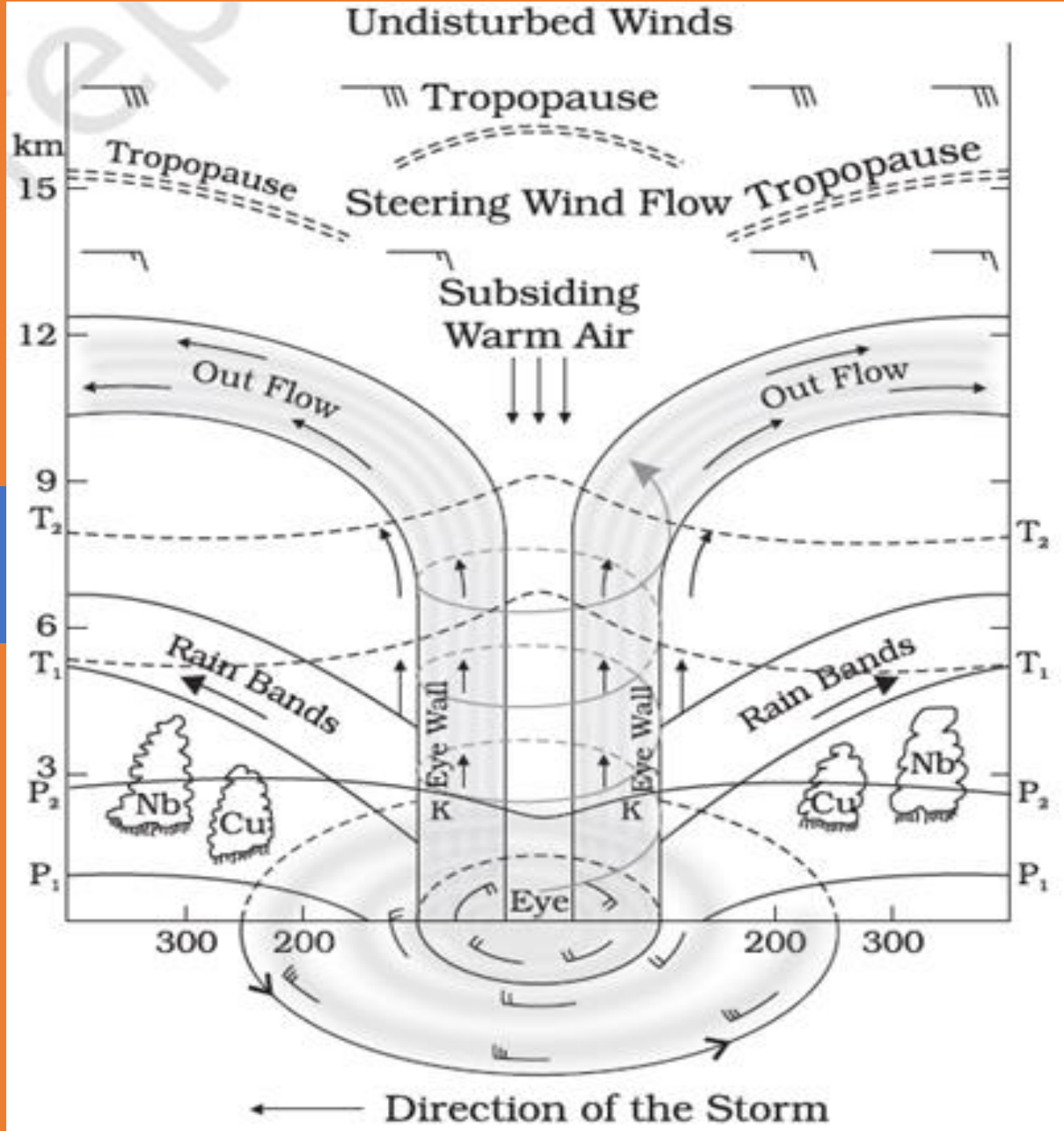
- INTENSIFIED LOW PRESSURE REGION
- THE SKY WILL BE CLEAR
- WIND SPEED IS LEAST
- SUBSIDING WINDS AT THE CENTRE OF THE CYCLONE
- REGION WILL BE CALM

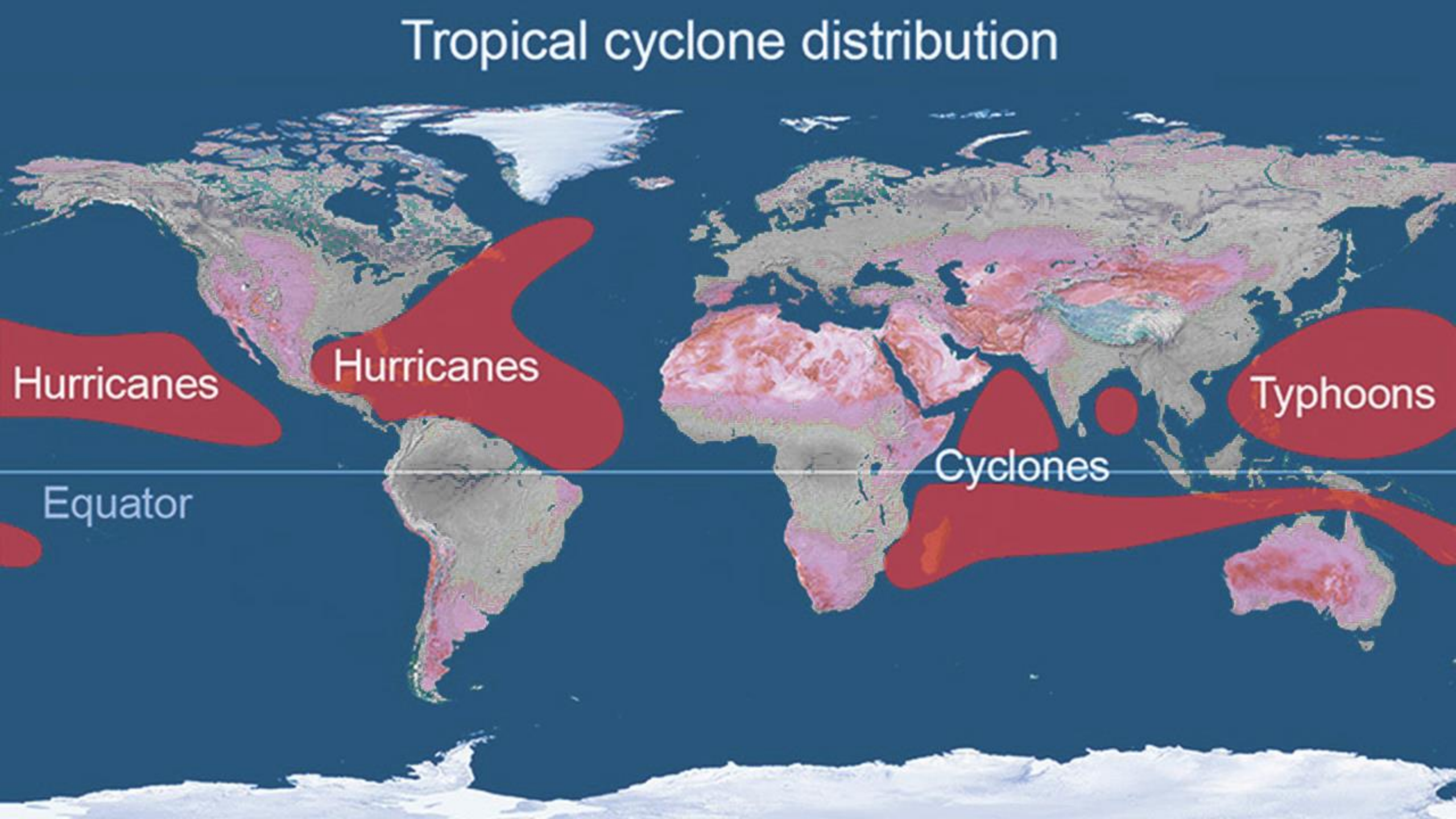
- MADE UP OF CUMULONIMBUS CLOUDS
- MAXIMUM RAINFALL
- MAXIMUM WIND SPEED
- MAXIMUM DESTRUCTION REGION


Anatomy of a tropical cyclone
cross-section with exaggerated vertical dimension
eye
eyewall
outflow cloud shield
outflow cloud shield
spiral rainbands (thunderstorms)
spiral rainbands (thunderstorms)
top view
eye
eyewall
0 miles 100 200
0 km 100 200 300
clockwise winds
descending air
eyewall
spiraling winds
rotation of cyclone
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Cirrus
Cumulo-nimbus
Cirro-stratus
Nimbo-stratus
EYE
Cumulus
Typical Radius (km)
250 225 200 175 150 125 100 75 50 25
Pressure (hpa)
1020 1010 1000 990 980 970 960 950
Wind Speed (km/h)
175 150 125 100 75 50 25
Warm Air Flow
Cool Air Flow
Rainfall Intensity
Light
Heavy

# VERTICAL STRUCTURE




Tropical cyclone distribution
Hurricanes
Hurricanes
Typhoons
Cyclones
Equator

# DIFFERENCE BETWEEN EXTRA-TROPICAL CYCLONES AND TROPICAL CYCLONES

- Frontal system
- Temperature contrast
- Land and sea
- Larger area
- West to east
- Low wind velocity
- Jetstream intensifies it

- Condensation
- Only over oceans
- East to west
- Higher wind velocity
- Jetstream weakens it

# CLIMATOLOGY

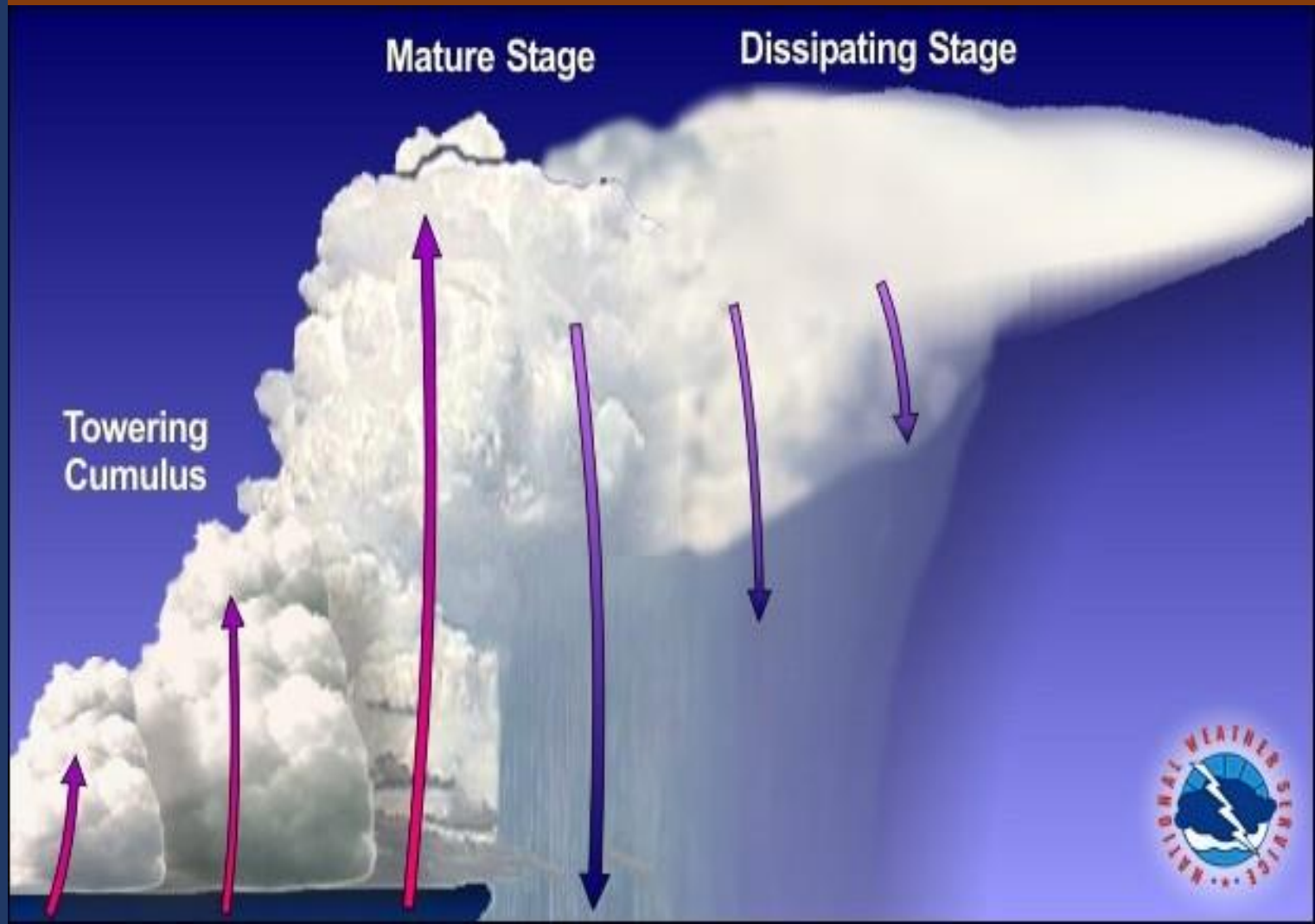
## THUNDERSTORM, JETSTREAM, ANTI-CYCLONE & WESTERN DISTURBANCE

# THUNDERSTORMS

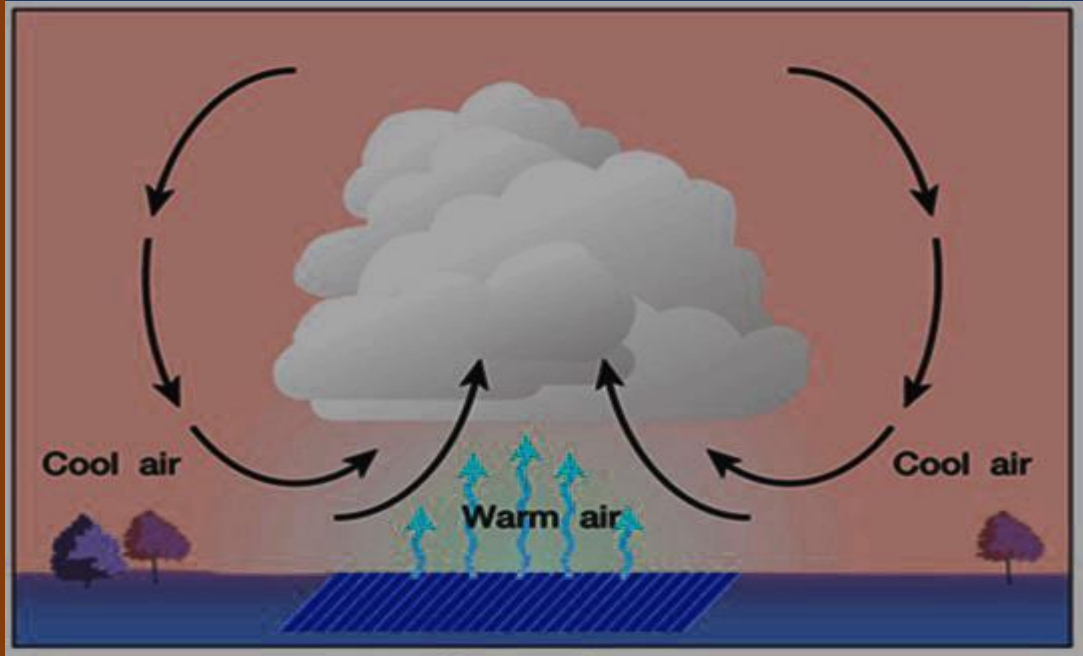
- Cumulonimbus cloud producing thunder and lightning
- Warm moist air
- Uplifting mechanism
- Hailstorm

➢ **THUNDERSTORMS IN INDIA**

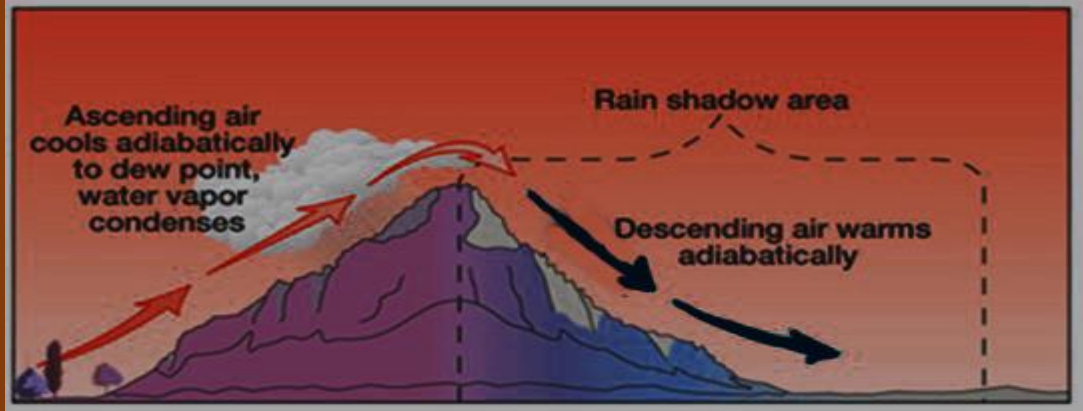
- Western disturbances
- Nor Westers (Kalbaisakhi or Bordoisila)



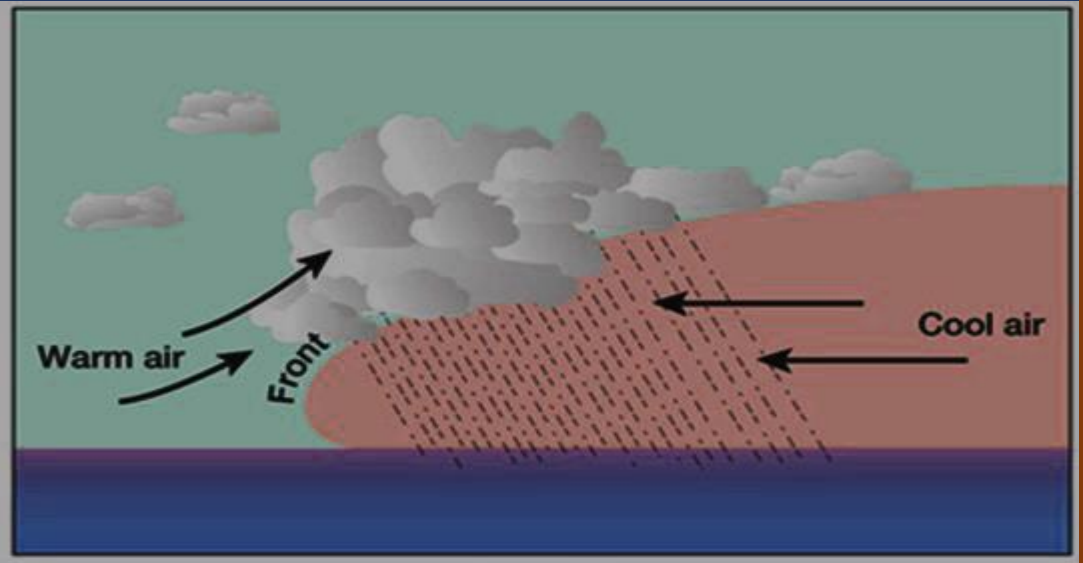
# UPLIFTING MECHANISM



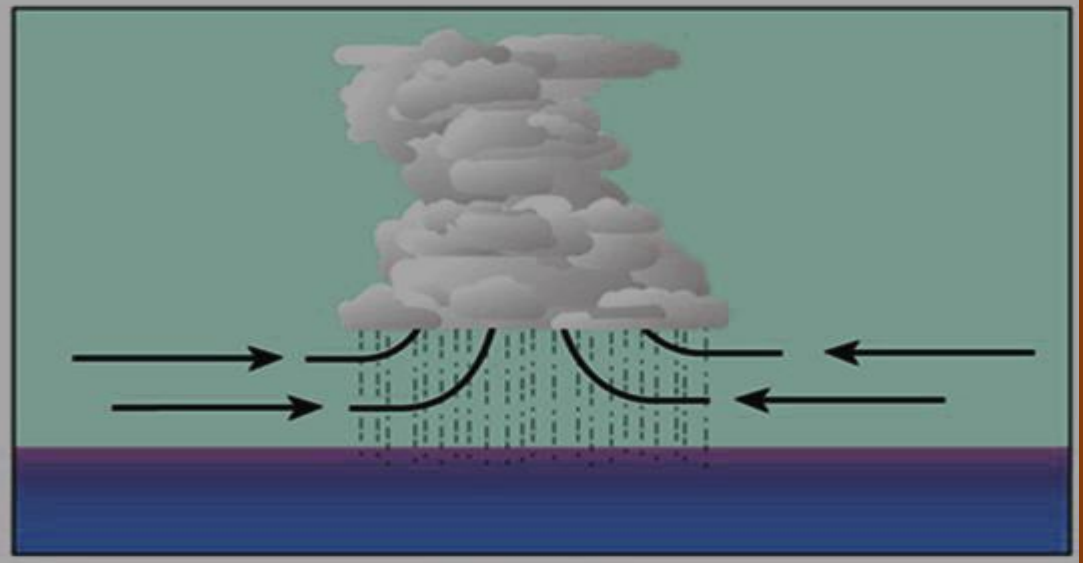

(a) Convective




(b) Orographic



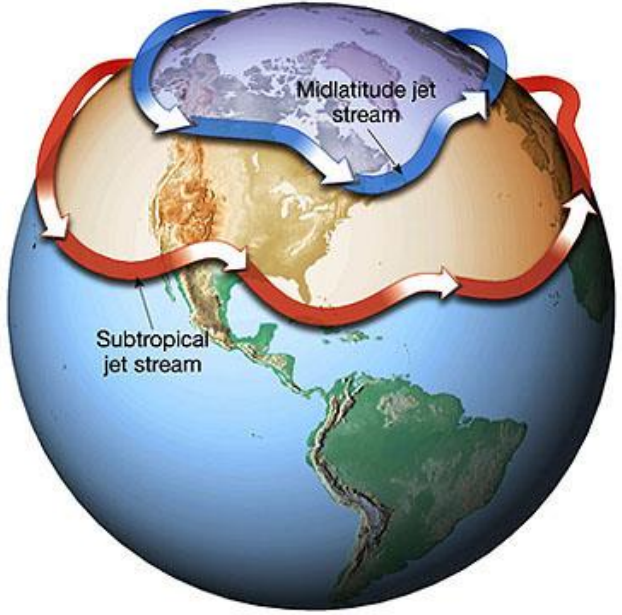

(c) Frontal

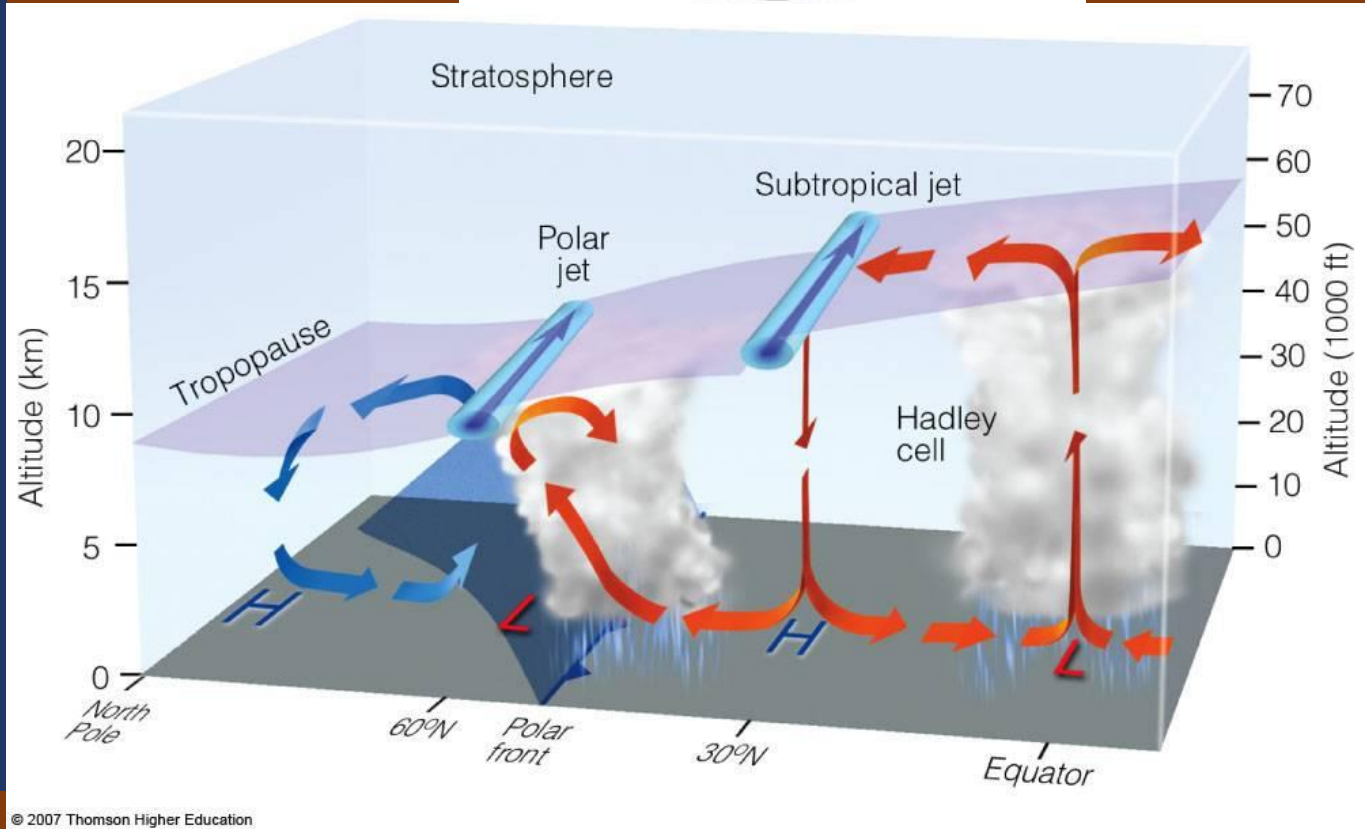


(d) Convergent

# JETSTREAMS

- High-speed winds
- West to east
- Upper troposphere/tropopause
- Meandering bands of swift winds
- Very strong vertical wind shear




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# WESTERN DISTURBANCE

## FEATURES

- Low pressure area
- Remnants of extra-tropical cyclones
- Originates in Caspian Sea or Mediterranean Sea
- Influenced by Westerlies and Sub-tropical Jetstream
- Moves west to east

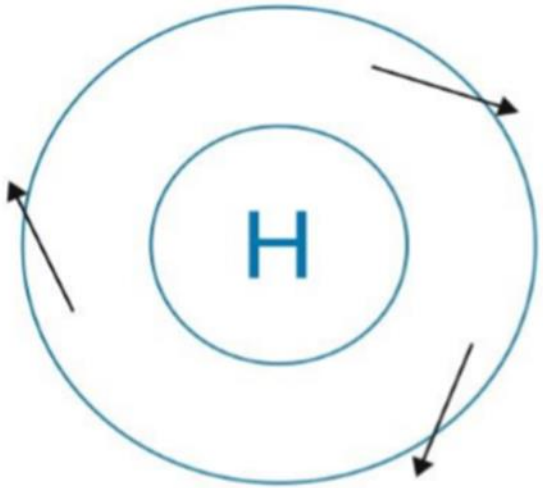
## EFFECTS

- Minimal Effect during the monsoon months in India
- Winter and pre-monsoon rainfall in Northwest India
- Snowfall in J & K
- Rabi crop
- Thunderstorms and dust storms

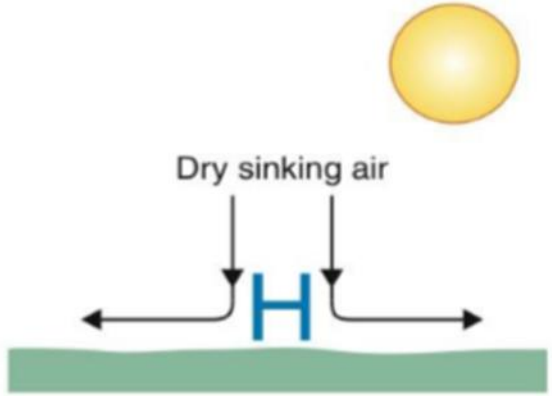


# ANTI-CYCLONES

Surface winds blow clockwise around an anticyclone (high pressure) and diverge.




View from above



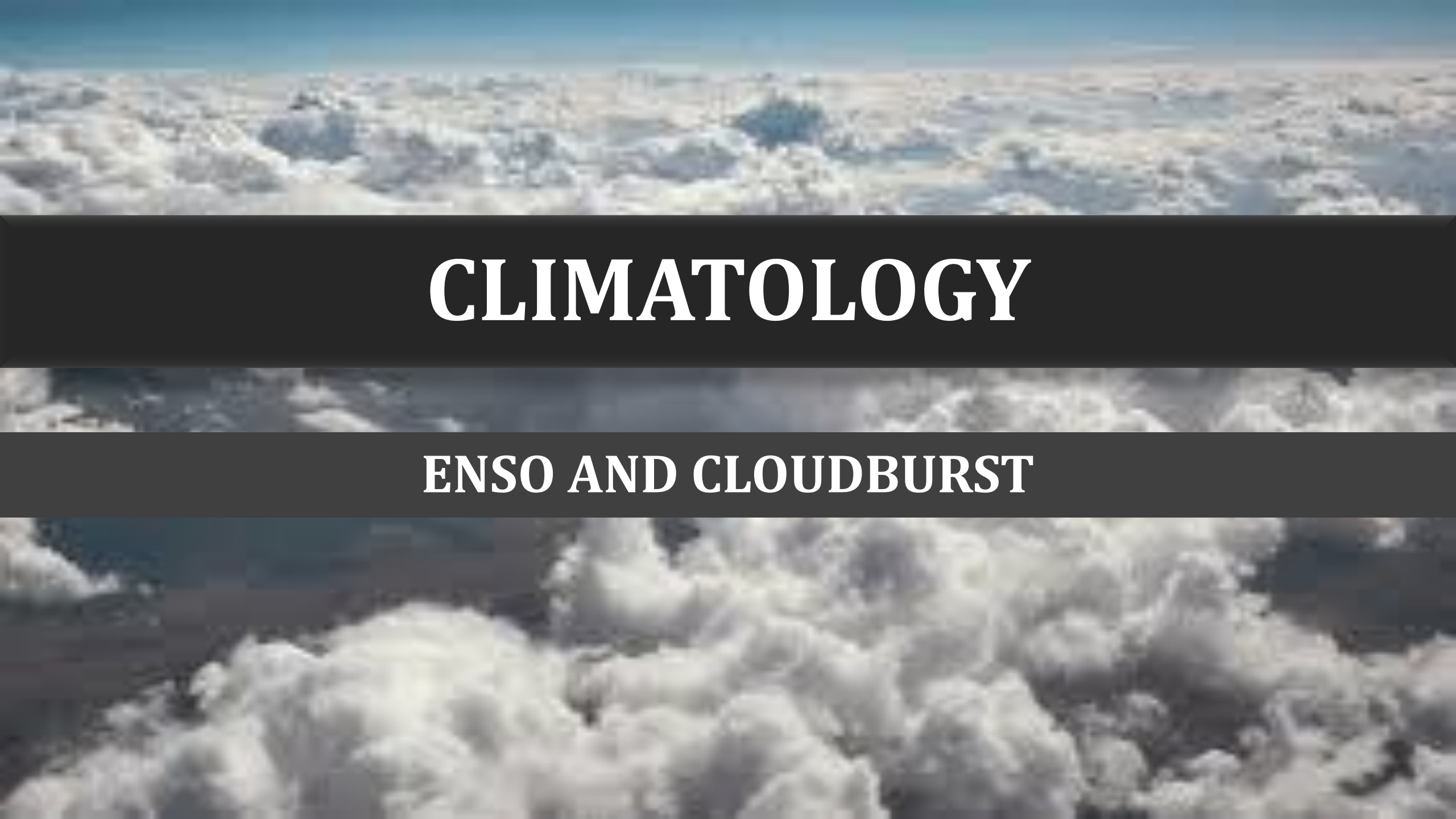

View from side

**4.** Consider the following statements: **(2001)**

1. Anti-cyclonic conditions are formed in winter season when atmospheric pressure is high and air temperatures are low.
2. Winter rainfall in Northern India causes development of Anticyclonic conditions with low temperatures.

Which of the statement(s) given above is/are correct?

(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2

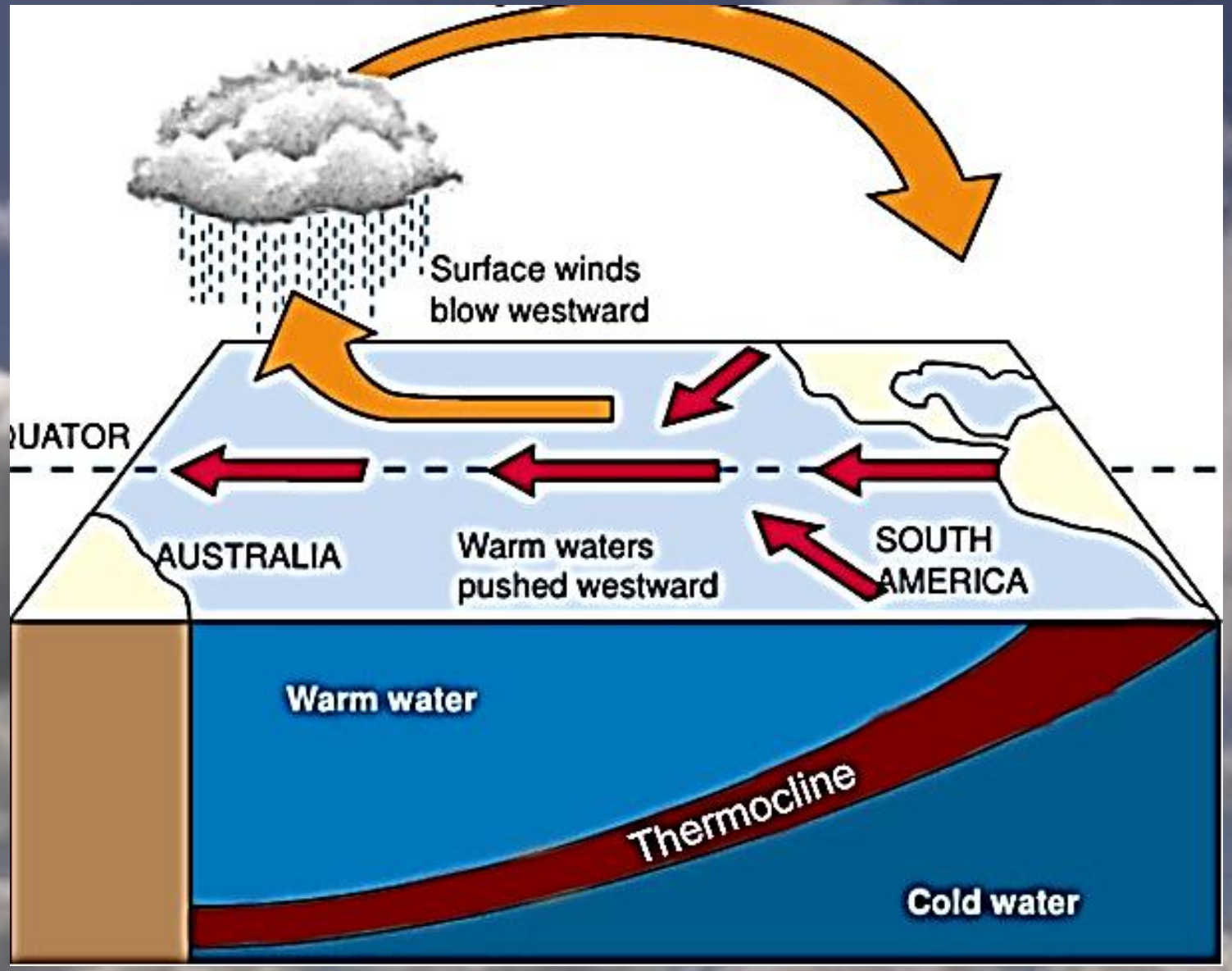


# CLIMATOLOGY

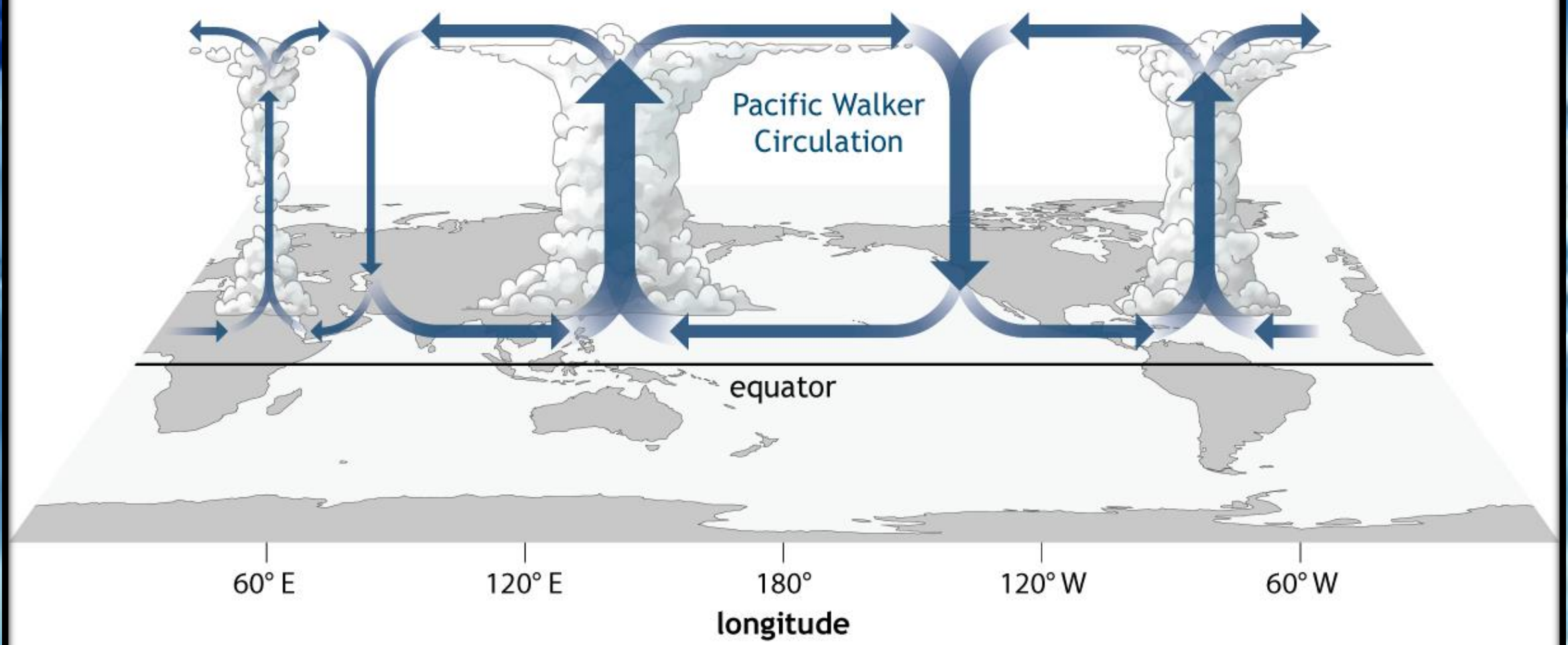
## ENSO AND CLOUDBURST

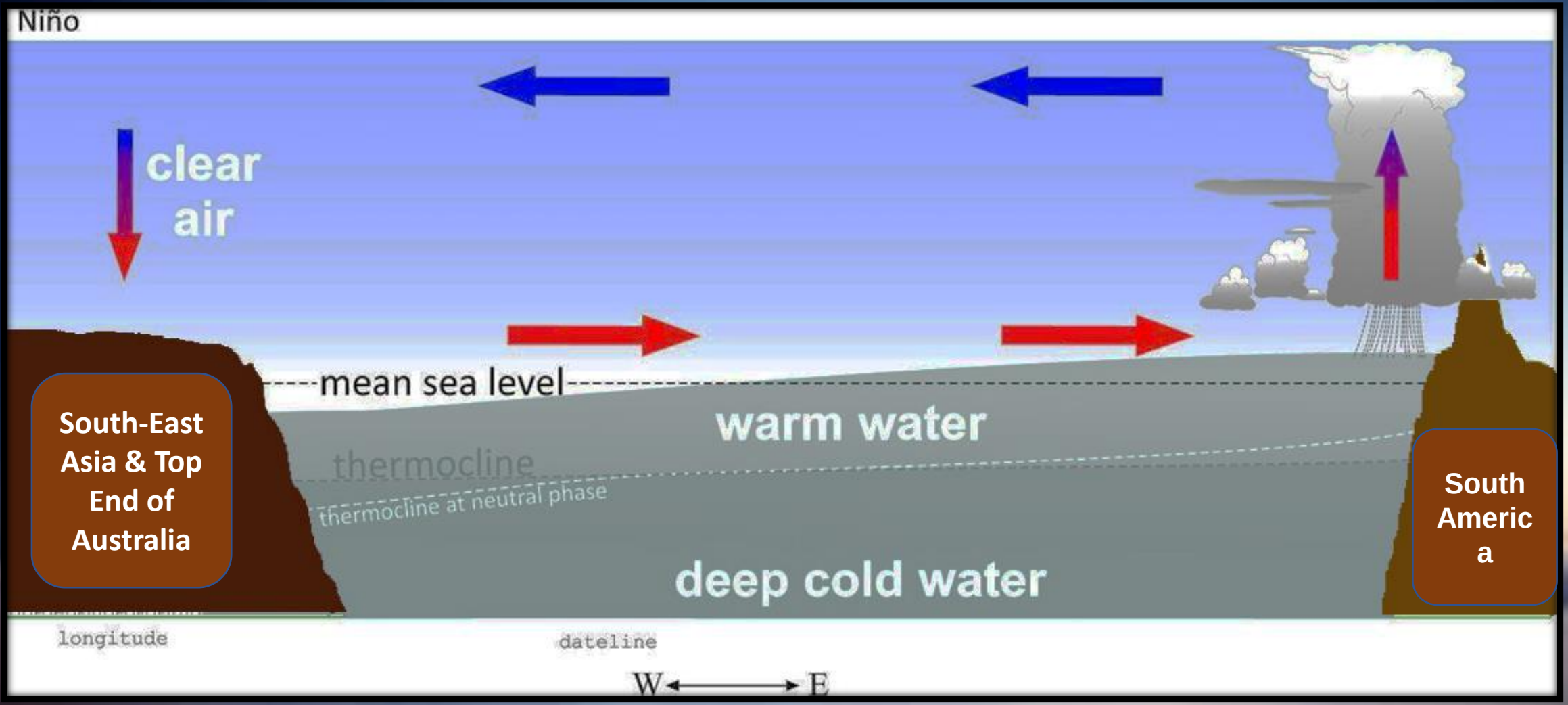

El Niño–Southern Oscillation

# NEUTRAL YEAR



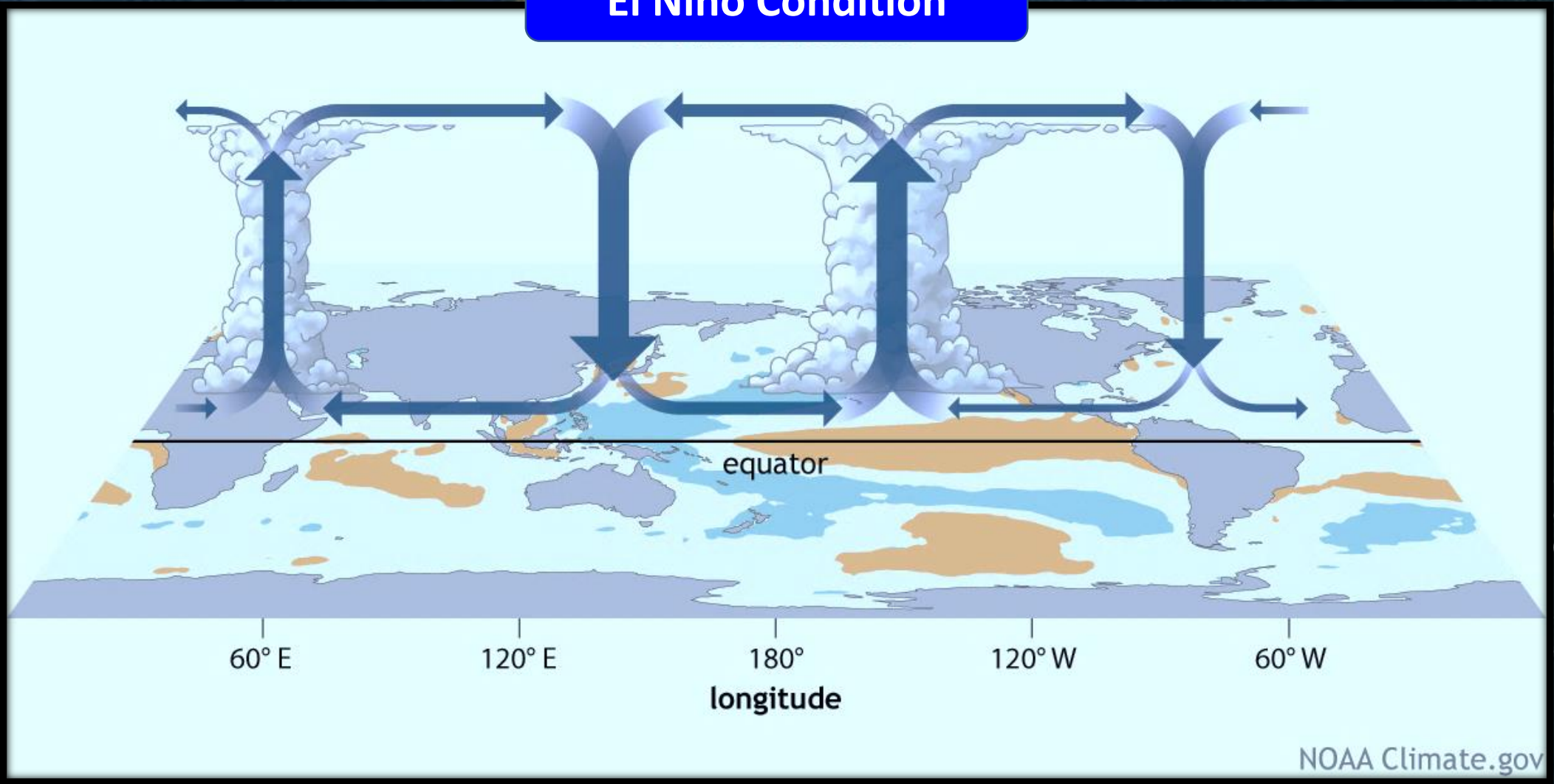
# Neutral Condition



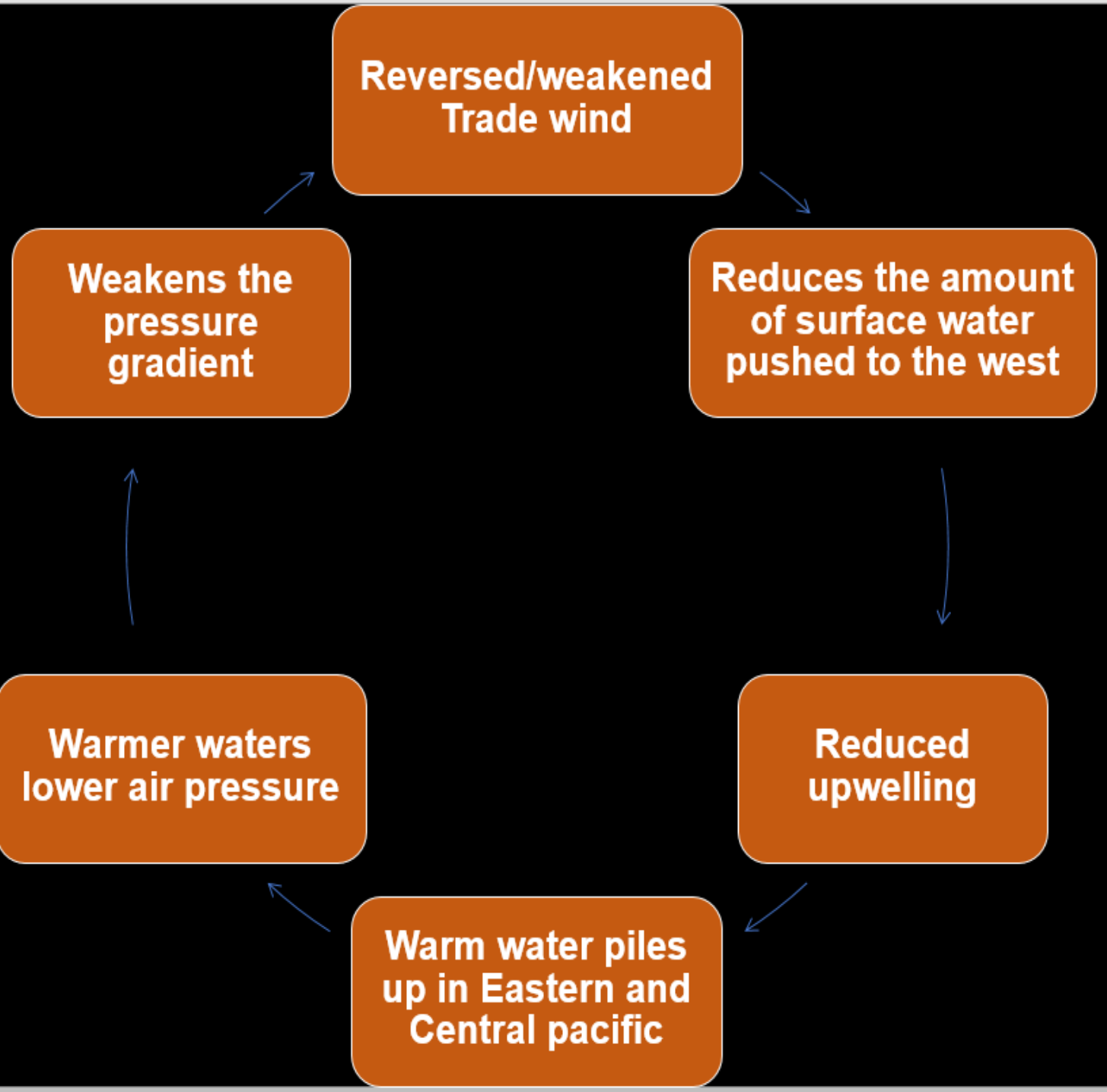

Niño
clear air
mean sea level
warm water
thermocline
thermocline at neutral phase
deep cold water
South-East Asia & Top End of Australia
South Americ a
longitude
dateline
W
E

# EL NINO

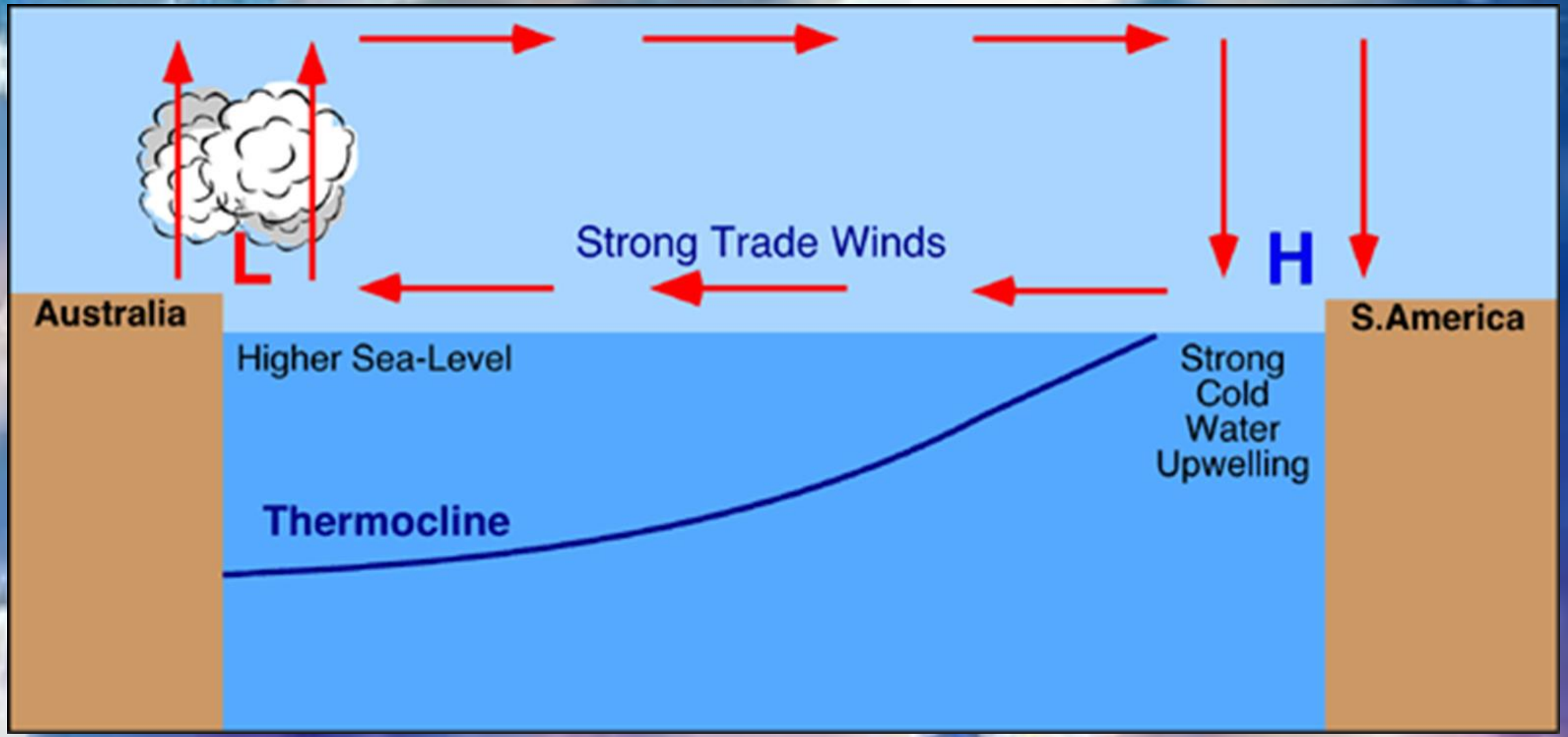
# El Nino Condition



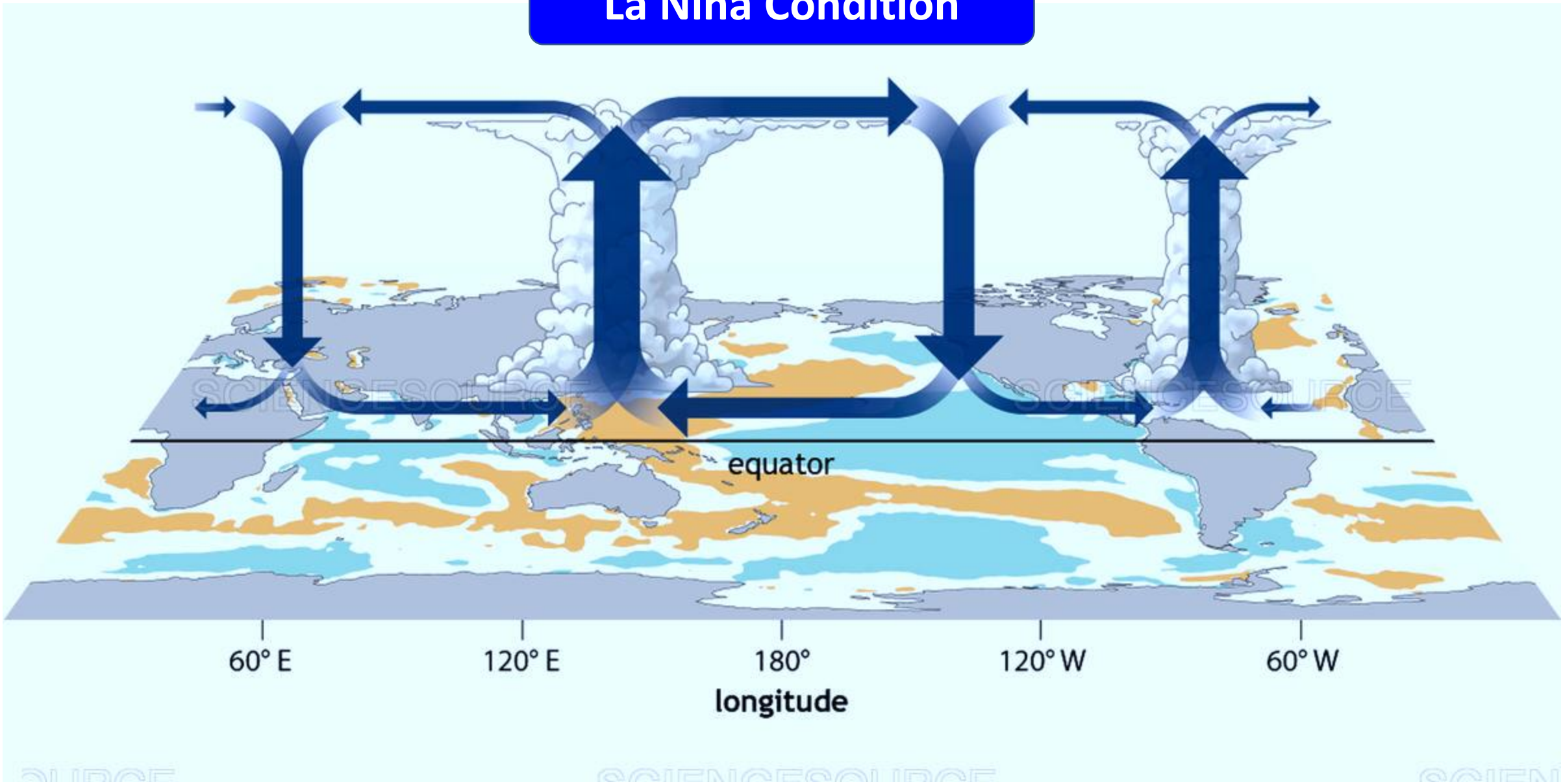
# FORMATION


Reversed/weakened Trade wind
Reduces the amount of surface water pushed to the west
Reduced upwelling
Warm water piles up in Eastern and Central pacific
Warmer waters lower air pressure
Weakens the pressure gradient

# LA NINA


L
Strong Trade Winds
H
Australia
S.America
Higher Sea-Level
Strong
Cold
Water
Upwelling
Thermocline

# La Nina Condition



| FEATURES | EL NINO | LA NINA |
|---|---|---|
| Trade winds | Reversed or weakened | Unusually hard trade winds |
| Sea Surface Temperature | Central and eastern pacific -> Warmer<br>Western Pacific -> Colder | Western Pacific -> Warmer than normal<br>Central and eastern pacific -> Very cold |
| Air pressure | Eastern pacific -> Low pressure<br>Western pacific -> High pressure | Western pacific -> Low pressure<br>Eastern pacific -> Very high pressure |
| Upwelling | Reduced upwelling | Increased upwelling |
| Rainfall | Eastern Pacific – high<br>Western Pacific – low | Eastern Pacific – low<br>Western Pacific – high |
| Effect on India | Below normal monsoon and droughts | Above normal rainfall and floods |


CLOUDBURST

- ✓ Sudden Heavy Rainfall (100 mm Per Hour)
- ✓ Short Duration
- ✓ Small Geographical Area
- ✓ Hilly Areas
- ✓ Cloud’s Burst?

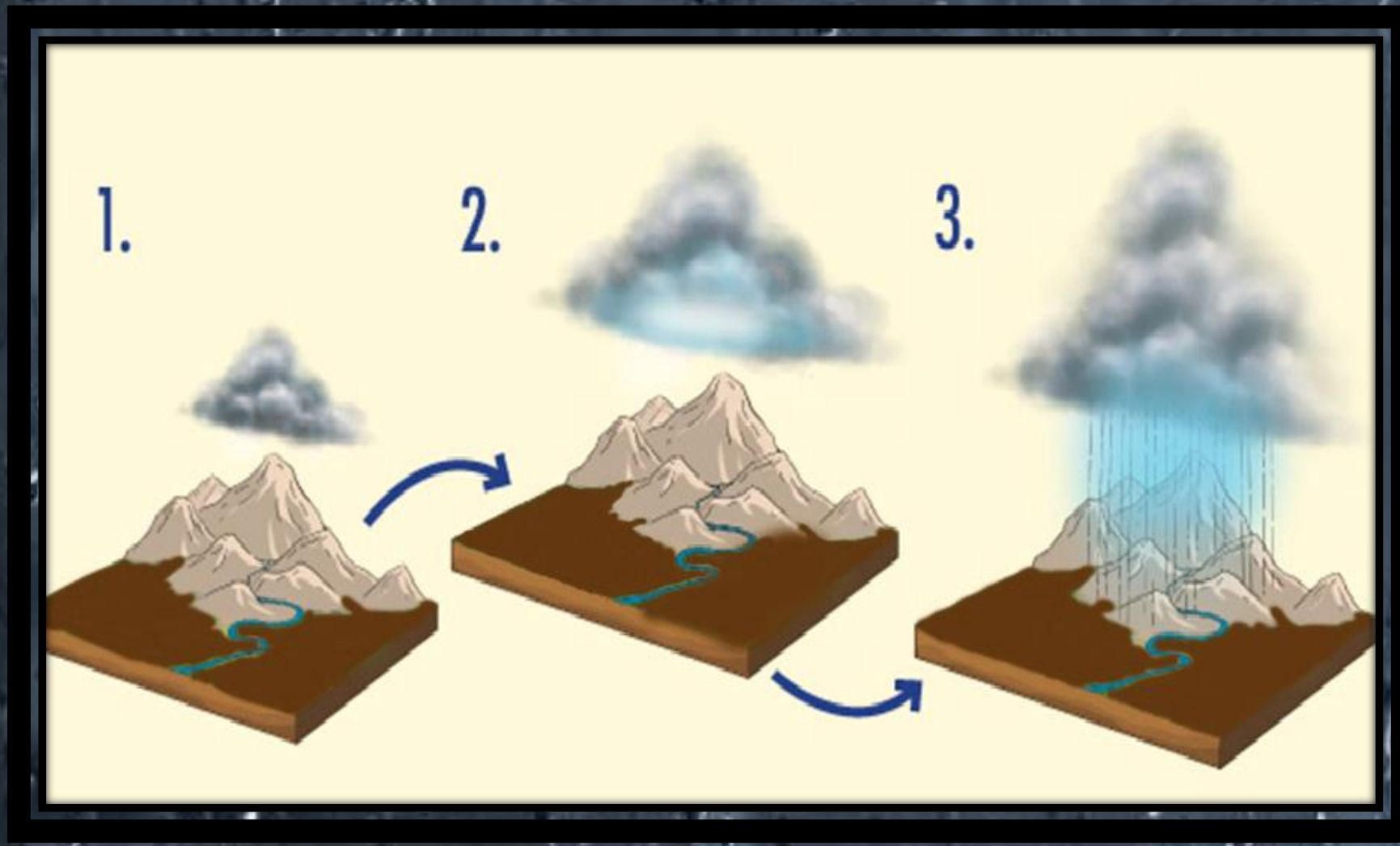


## ❑FORMATION

- **Vertical winds**
- **Coalescing rain droplets**
- **Hilly terrain**
- **Monsoon clouds**
- **Vertical and high clouds**

## ❑EFFECTS

- **Flash floods**
- **Landslide and Mudslide**
- **Thunderstorms and hail formation**



# MODEL QUESTION (PRELIMS)

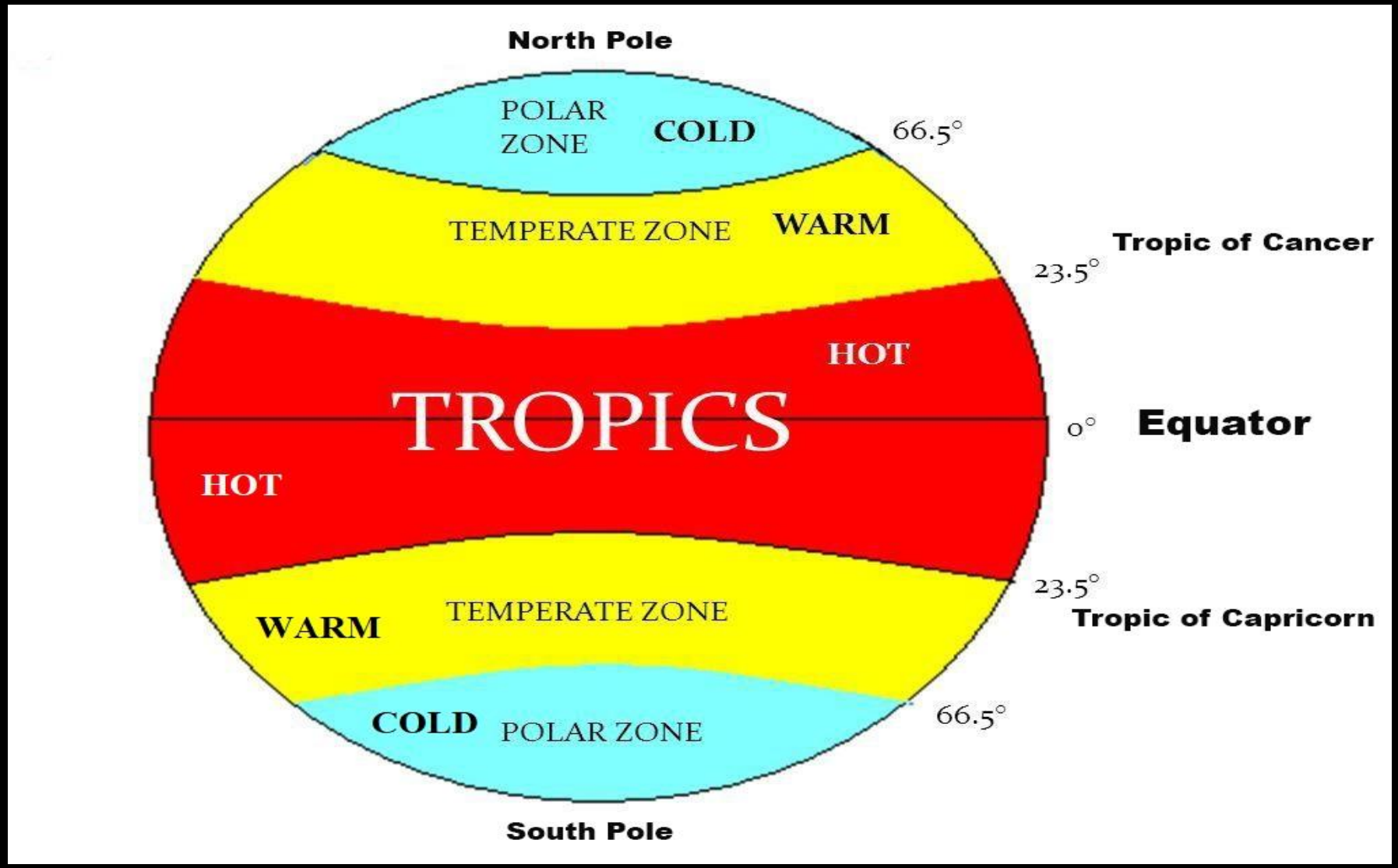
With reference to ‘Cloudbursts’, consider the following statements:

1. It refers to sudden and copious rainfall over a small area.
2. They are generally associated with thunderstorms.
3. It refers to breaking open of a cloud resulting in release of huge amounts of water.
4. They are formed by orographic lift.

Which of the statements given above are correct?

(a) 1, 2 and 3 only (b) 2 and 4 only (c) 1 and 3 only (d) 1, 2 and 4 only


IMPORTANT CLIMATIC
TYPES OF THE WORLD


North Pole
POLAR ZONE
COLD
66.5°
TEMPERATE ZONE
WARM
Tropic of Cancer
23.5°
HOT
TROPICS
0°
Equator
HOT
23.5°
Tropic of Capricorn
WARM
TEMPERATE ZONE
COLD
POLAR ZONE
66.5°
South Pole

# THE EQUATORIAL CLIMATE

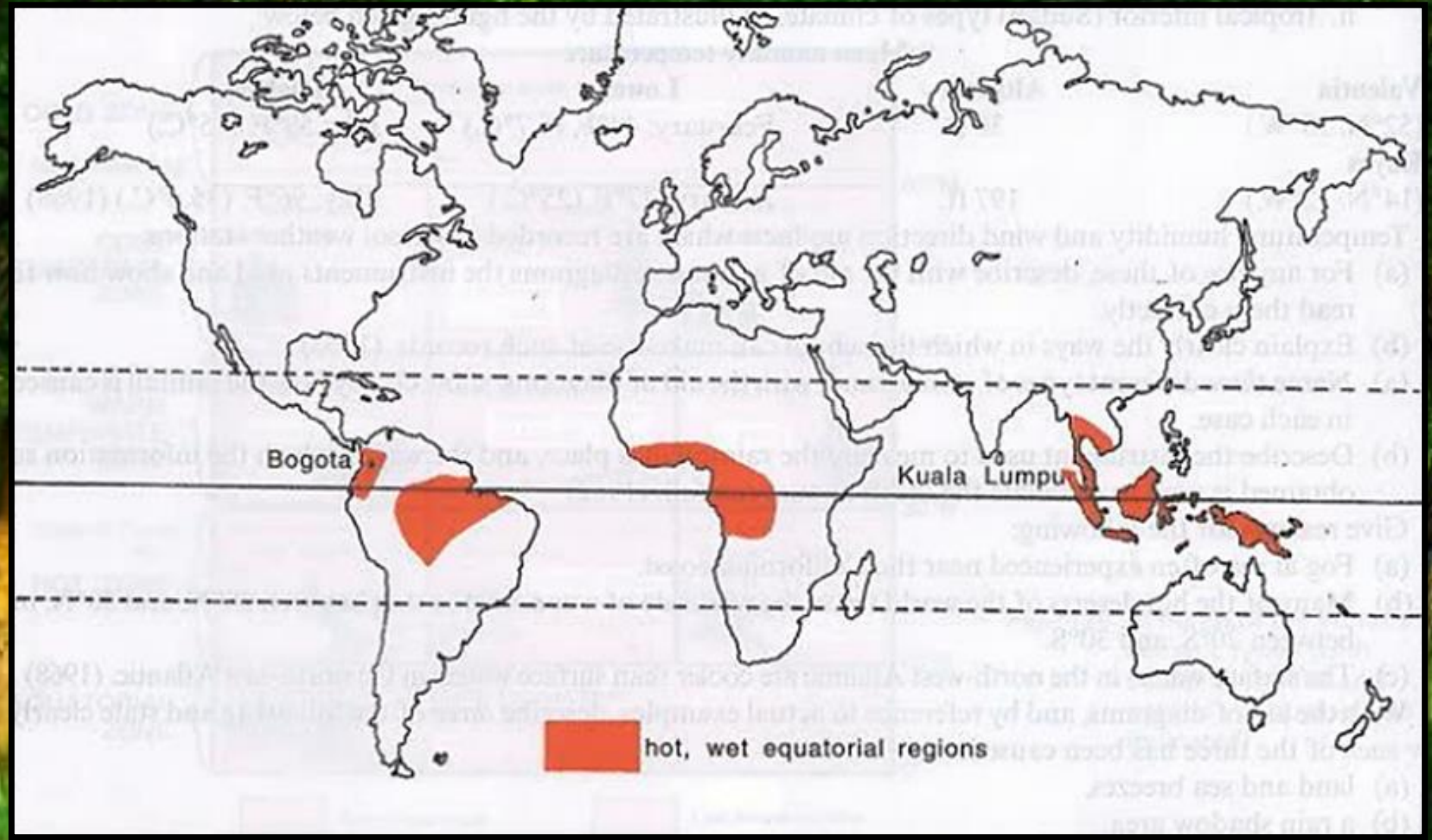
- UNIFORMITY OF TEMPERATURE
- CLOUDINESS AND HEAVY PRECIPITATION (60 - 100 Inches)
- WELL DISTRIBUTED RAINFALL (CONVECTIONAL)
- NO WINTER AND DRY SEASON
- DOUBLE RAINFALL PEAKS
- MORNING ARE BRIGHT AND SUNNY
- CUMULONIMBUS CLOUDS AT AFTERNOON

## VEGETATION

- TROPICAL RAIN FORESTS (SELVAS)



- FOUND IN THE LOWLANDS OF THE AMAZON, THE CONGO, MALAYSIA AND THE EAST INDIES
- LUXURIANT TYPE OF VEGETATION
- EVERGREEN TREES THAT YIELD TROPICAL HARDWOOD
- MAHOGANY,EBONY, GREENHEART,CABINET WOOD.
- LIANAS, EPIPHYTIC AND PARASITIC PLANTS ARE ALSO FOUND
- SHIFTING CULTIVATION. MANIOC(TAPIOCA), YAMS, MAIZE, BANANAS AND GROUNDNUTS
- WILD RUBBER IN AMAZON BASINS, NUTS, CANE IN MALAYSIA
- mangrove forests: In the coastal areas and brackish swamps

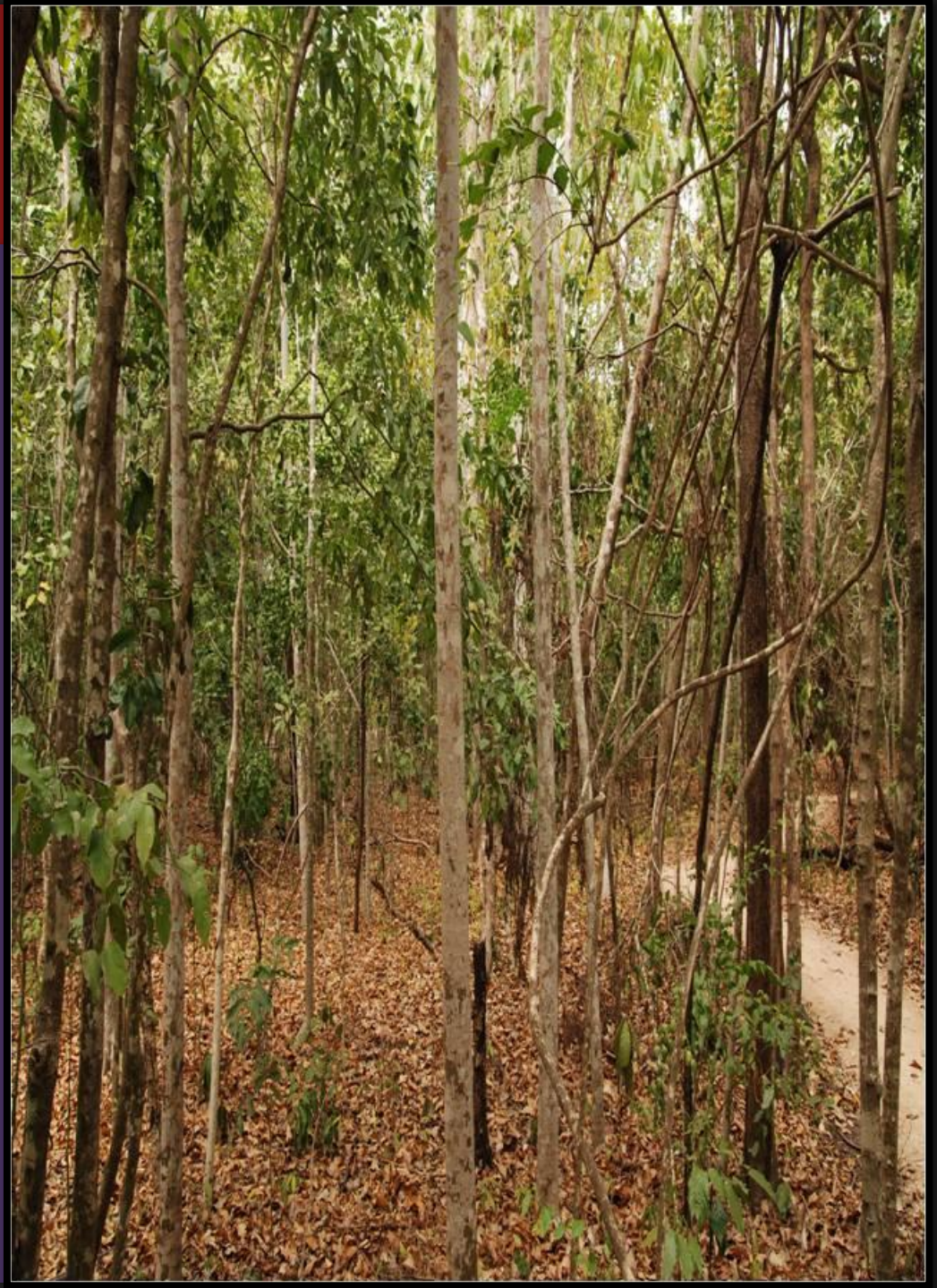

Bogota
Kuala Lumpur
hot, wet equatorial regions

# TROPICAL MONSOON CLIMATE

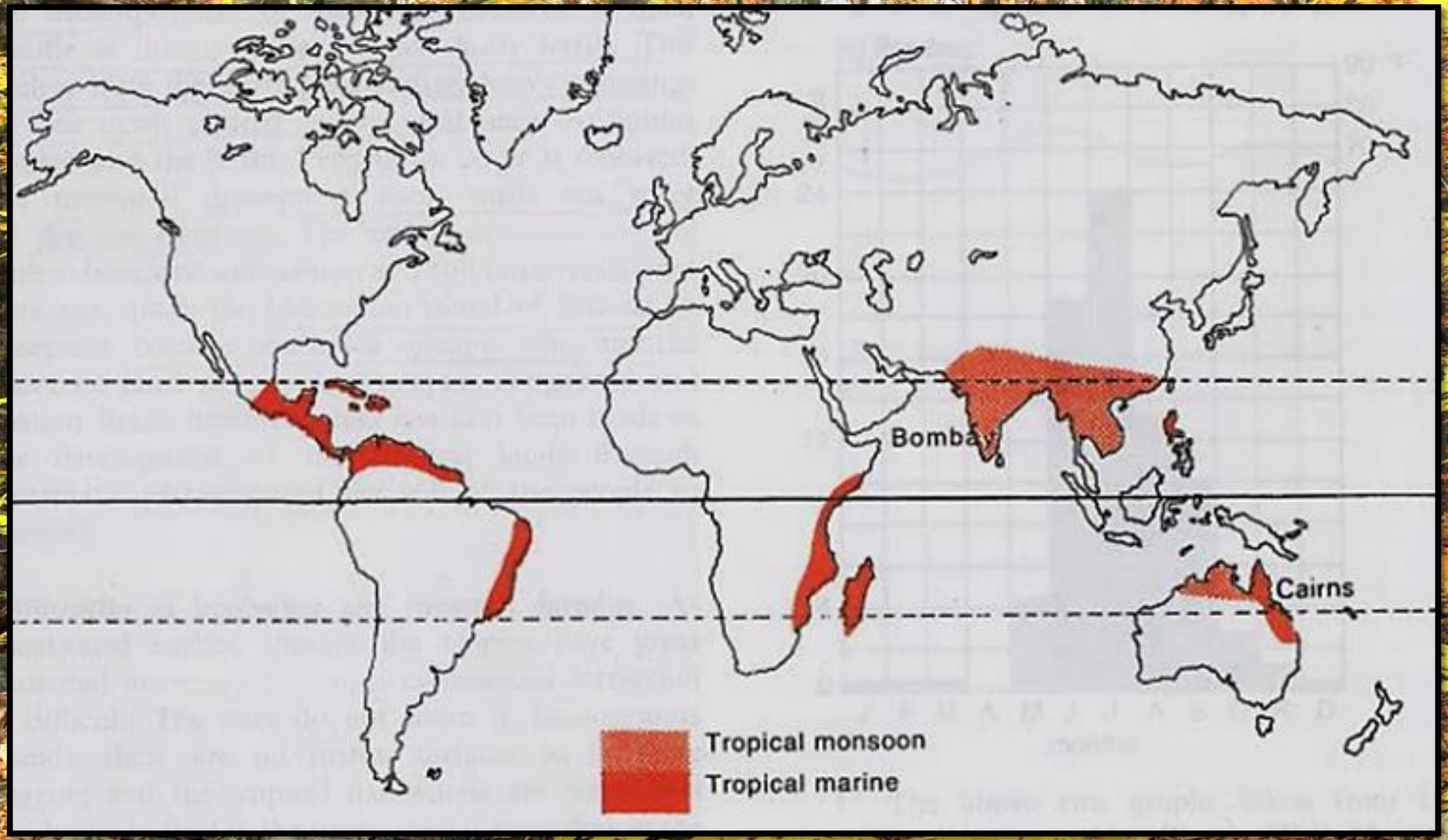
- ON SHORE WET MONSOON (SUMMER)
- OFF SHORE DRY MONSOON (WINTER)
- COOL DRY SEASON (OCTOBER TO FEBRUARY)
  - HOT DRY SEASON (MARCH TO MID-JUNE)
  - RAINY SEASON (MID-JUNE TO SEPTEMBER)
- CONCENTRATED HEAVY RAINFALL IN SUMMER

## VEGETATION

- MONSOON FORESTS (DECIDUOUS)



- FOUND IN INDIAN SUB-CONTINENT, BURMA, THAILAND, LAOS, CAMBODIA, PARTS OF VIETNAM, SOUTH CHINA AND NORTHERN AUSTRALIA
- TROPICAL MARINE CLIMATE IN CENTRAL AMERICA, WEST INDIES, NORTH – EASTERN AUSTRALIA, THE PHILLIPPINES, PARTS OF EAST AFRICA, MADAGASCAR, THE GUINEA COAST AND EASTERN BRAZIL.
- MAINLY AGRICULTURE, CROPS LIKE RICE, CANE SUGAR, JUTE etc


Bombay
Cairns
Tropical monsoon
Tropical marine

# TROPICAL MARINE CLIMATE

- EASTERN COAST OF TROPICAL LANDS
- INFLUENCE OF ON - SHORE TRADE WINDS
- MAXIMUM RAINFALL DURING SUMMER
- NO DRY PERIOD
- CYCLONIC ACTIVITIES

# SAVANNAH OR SUDAN CLIMATE

- TRANSITIONAL TYPE OF CLIMATE
- ALTERNATE WET SUMMERS WITH DRY WINTER

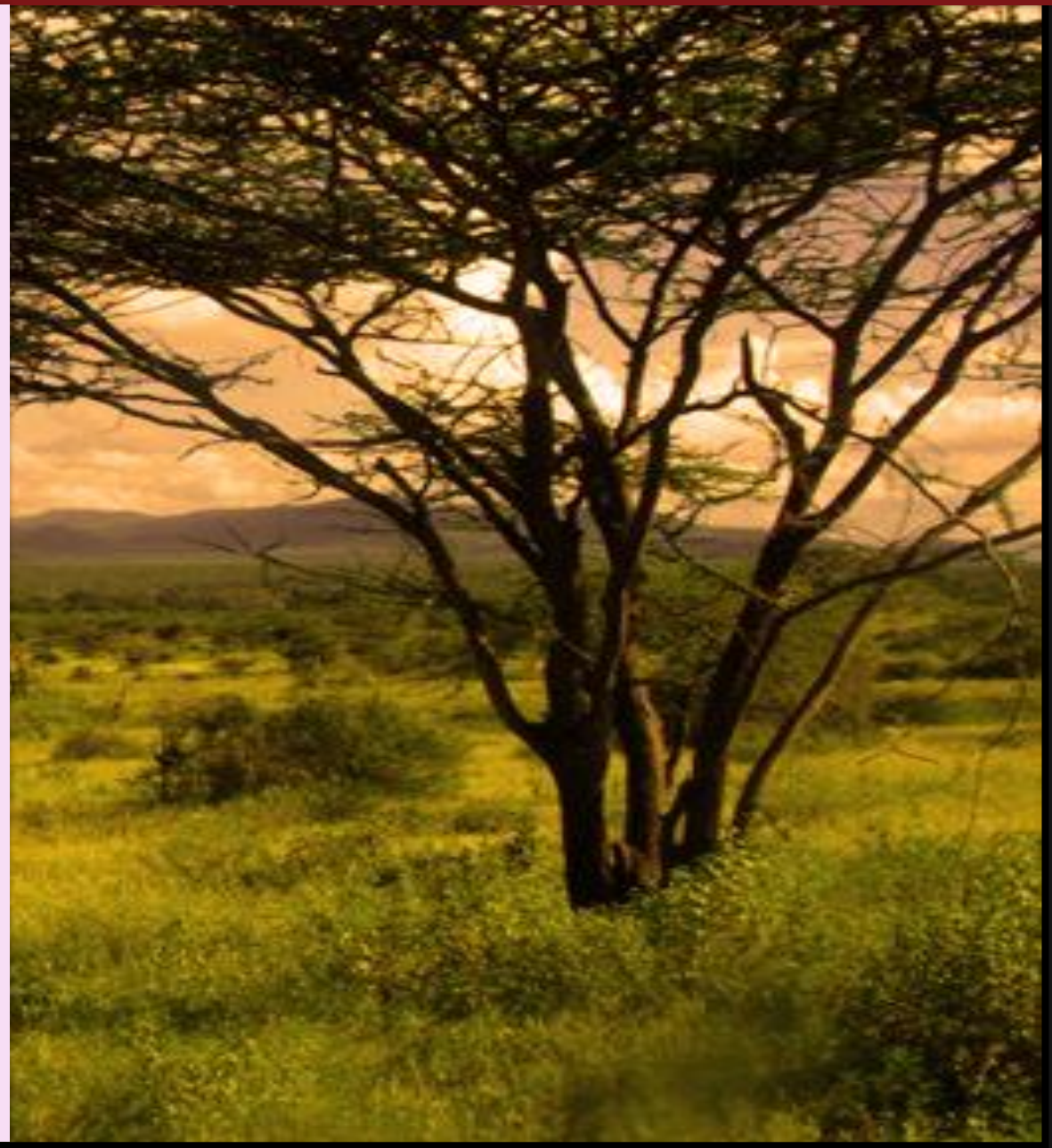
↓ CONVECTIONAL RAIN

↓ OFF SHORE TRADES

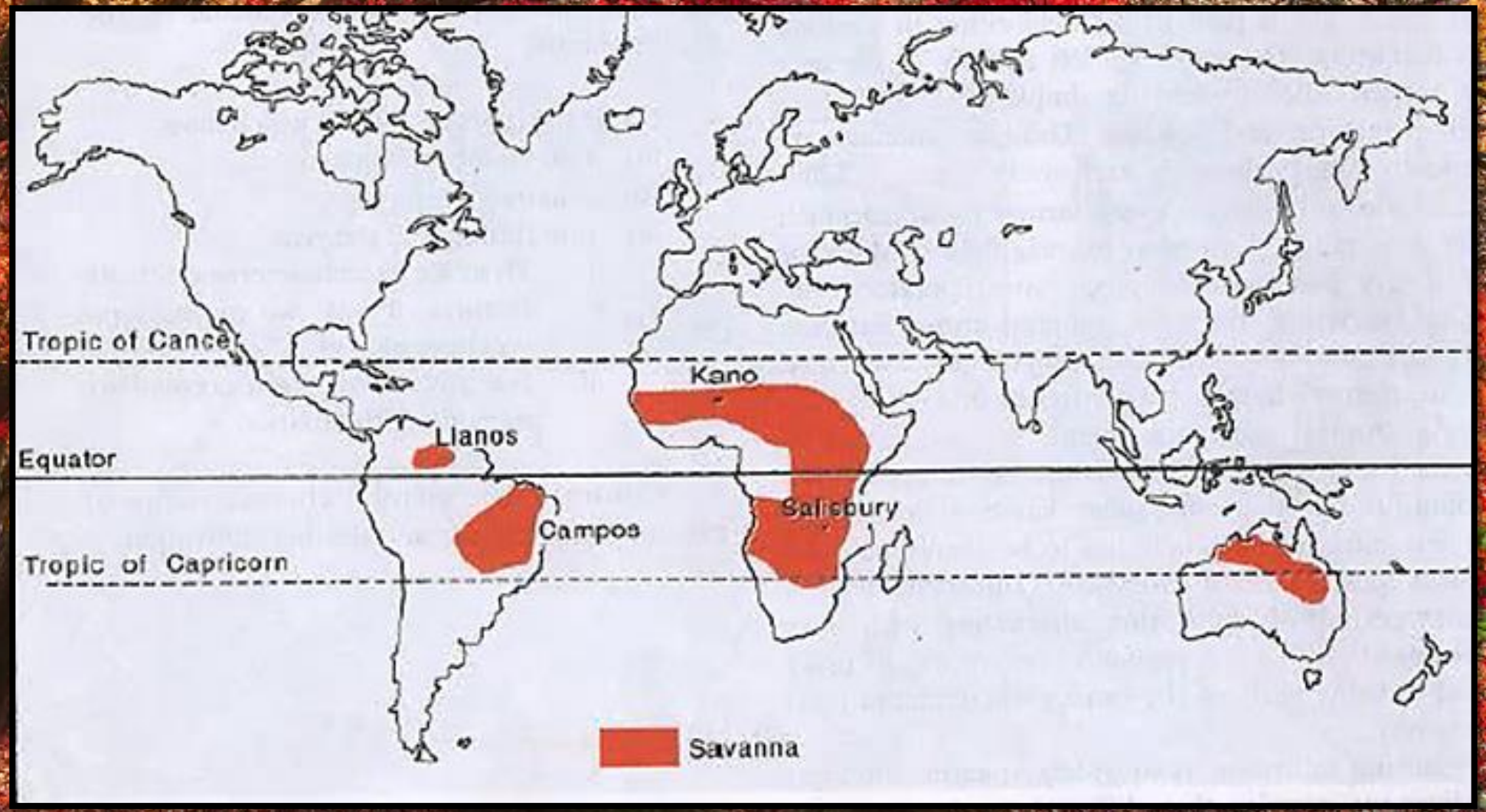
- FLOODS AND DROUGHTS
- EXTREME DIURNAL RANGE OF TEMPERATURE
- HARMATTAN

**VEGETATION**

- TALL GRASS AND SHORT TREES (TROPICAL GRASS LAND)



- BELT INCLUDES WEST AFRICAN SUDAN, SOUTHWARDS INTO EAST AFRICA, SOUTHERN AFRICA NORTH OF THE TROPIC OF CAPRICORN
- LLANOS OF THE ORINOCO BASIN AND THE CAMPOS OF THE BRAZILIAN HIGHLANDS IN SOUTH AMERICA
- ANNUAL RATE OF TEMPERATURE  IS $3^0$C AND $8^0$C
- AVERAGE ANNUAL RAINFALL RANGES BETWEEN 100 cm AND 150 cm .
- LANDSCAPE ALSO KNOWN AS ’PARKLAND’ OR ‘BUSH-VELD’
- AGRICULTURE IS NOT MUCH DEVELOPED


Tropic of Cancer
Kano
Llanos
Equator
Salisbury
Campos
Tropic of Capricorn
Savanna

# HOT DESERT AND MID-LATITUDE DESERT CLIMATE

- SCARCITY OF WATER
- EFFECTIVE PRECIPITATION
- HIGH DIURNAL RANGE OF TEMPERATURE
- FROST FORMATION
- NO COLD SEASON

## HOT DESERTS

- OFF SHORE TRADE WINDS
- COLD OCEANIC CURRENTS

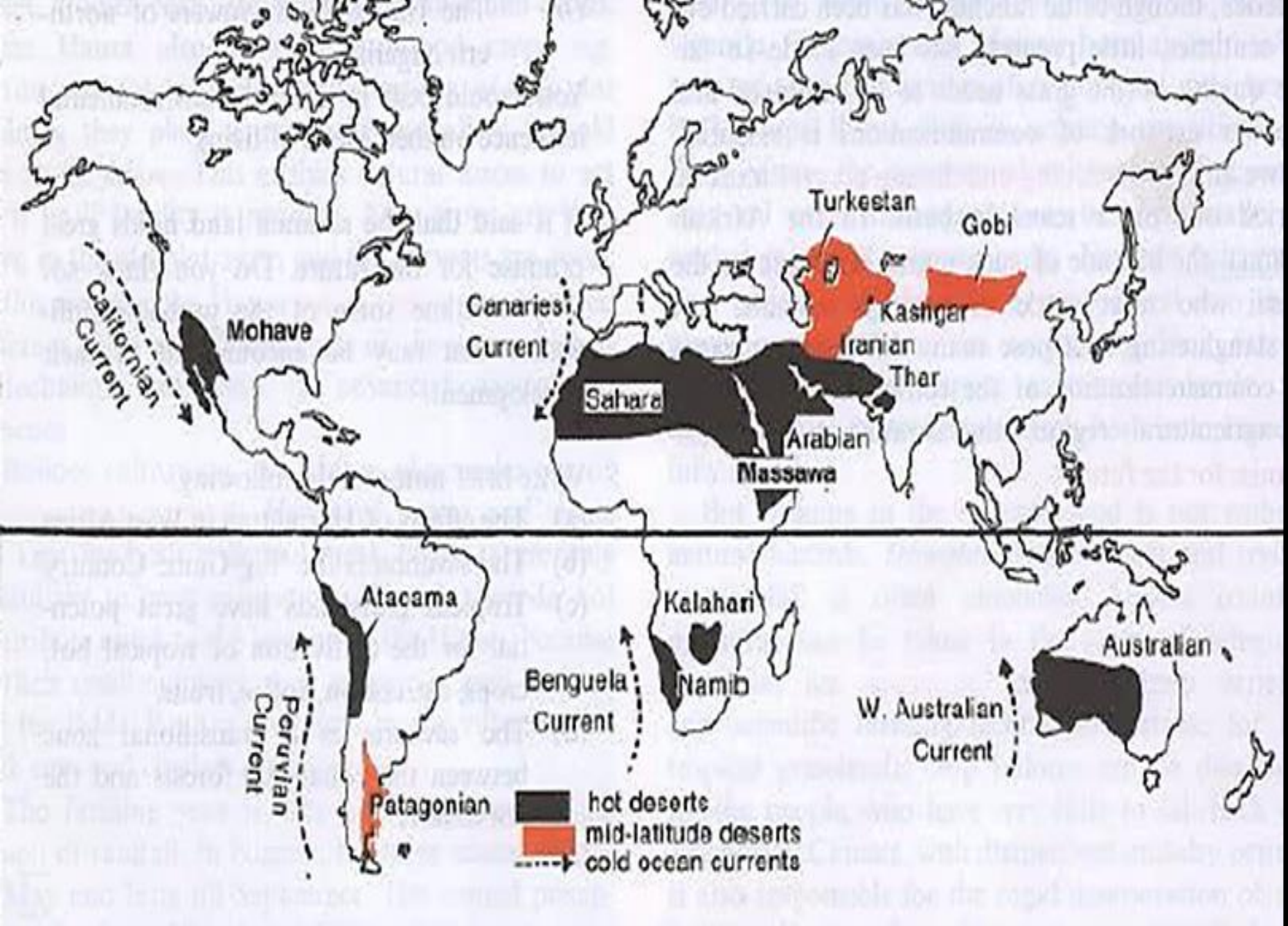
  EXAMPLES : ATACAMA DESERT, PERU AND CHILE
- SUBSIDING AIR

## MID LATITUDE DESERTS

- INTERIOR LOCATION( LADAKH, TURKESTAN,TAKLIMAKAN, GOBI
- RAIN SHADOW REGION



- THE WESTERN COASTS OF CONTINENTS BETWEEN $15^0$-$30^0$ N AND S LATITUDES(SAHARA DESERT, GREAT AUSTRALIAN DESERT, ARABIAN DESERT, IRANIAN DESERT, THAR DESERT, KALAHARI AND NAMIB DESERTS).
- NORTH AMERICA: EXTENDS FROM MEXICO TO USA (MOHAVE SONORAN, CALIFORNIAN AND MEXICAN DESERTS)
- SOUTH AMERICA : (ATACAMA OR PERUVIAN DESERT,PATAGONIAN DESERT)
- ANNUAL PRECIPITATION MORE THAN 0.02- 10 INCHES.
- AVERAGE SUMMER TEMPERATURE $30^0$ C.
- PREDOMINANT VEGETATION: XEROPHYTES OR DROUGHT RESISTANT SHRUB- BULBOUS CACTI, THORNY BUSHES, LONG ROOT WIRY GRASSES AND SCATTERED DWARF ACACIA. SOME FORM OF VEGETATION: GRASS SHRUB, HERBS, WEEDS, ROOTS OR BULBS ETC.


Turkestan
Gobi
Kashgar
Iranian
Thar
Canaries
Current
Californian
Current
Mohave
Sahara
Arabian
Massawa
Atacama
Kalahari
Namib
Benguela
Current
Peruvian
Current
Patagonian
Australian
W. Australian
Current
hot deserts
mid-latitude deserts
cold ocean currents



# MEDITERRANEAN CLIMATE

- WESTERN PORTION OF CONTINENTAL MASSES (30º-45º)
- SHIFTING OF WIND BELTS
- WINTER RAINFALL
- TRANSITIONAL CLIMATE
  - TOWARDS NORTH, COOL TEMPERATE MARITIME CLIMATE
  - TOWARDS SOUTH, TRADE WIND HOT DESERTS
- DRY WARM SUMMER WITH OFF-SHORE TRADERS; WINTER RAINFALL WITH ON-SHORE WESTERLIES; PROMINENCE OF LOCAL WINDS (SIROCCO, MISTRAL, BORA);

## VEGETATION

- XEROPHYTIC SHRUBS

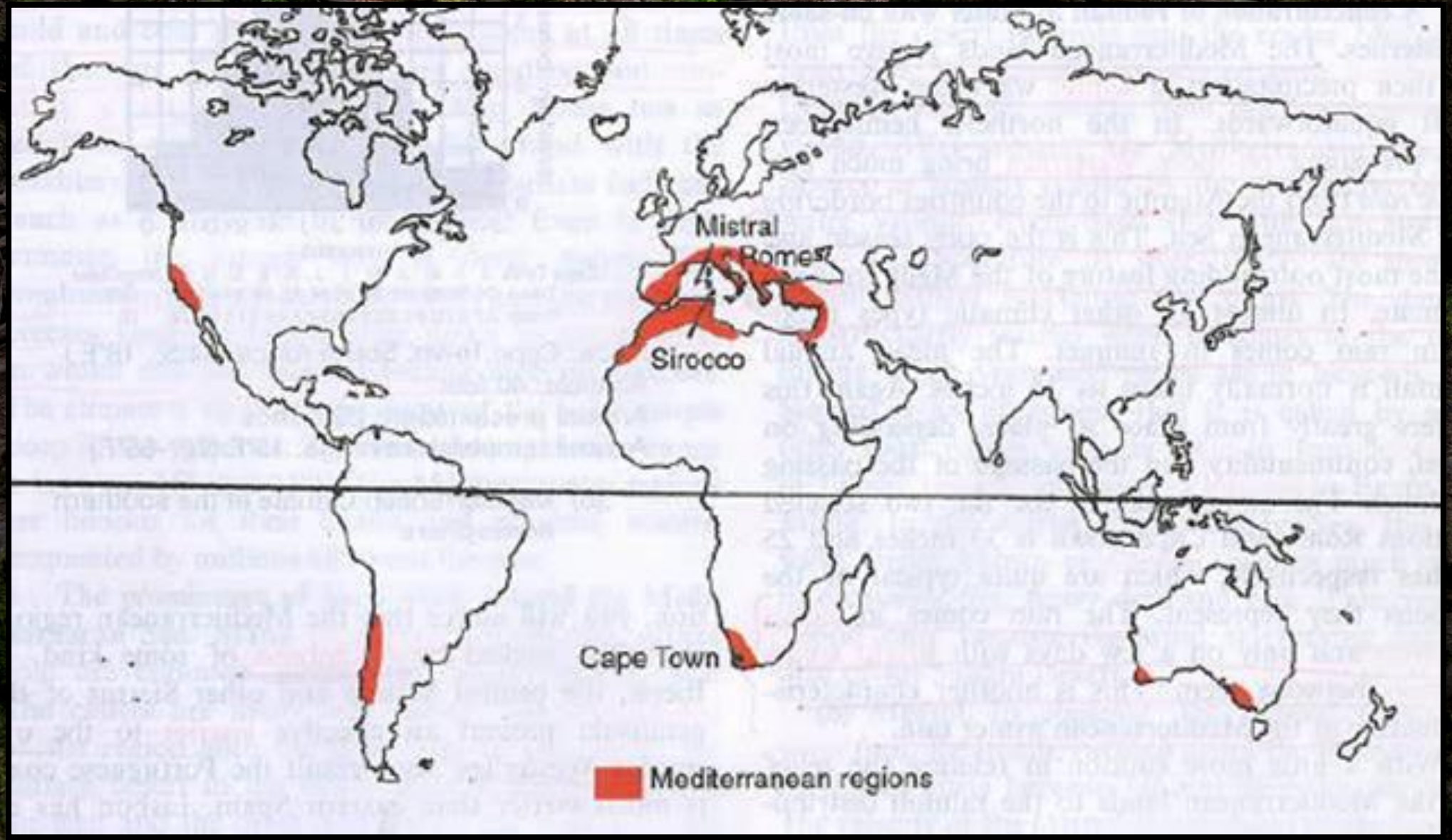


- **DISTRIBUTION:** Confined To The Western Portion Of Continental Masses,30º–40ºn And S Of The Equator.

- **MEDITERRANEAN REGIONS**: California, South-western Tip Of Africa, Southern Australia And Southwest Australia.

- **CLIMATIC FEATURES**: Bright, Sunny Weather With Hot Dry Summers And Wet, Mild Winters With Prominence Of Local Winds (Sirocco,mistral).

- **VEGETATION**: Citrus Fruits Such As Oranges, Lemons, Limes, Citrons, Grapefruit Etc.


Mistral
Rome
Sirocco
Cape Town
Mediterranean regions

# STEPPE CLIMATE

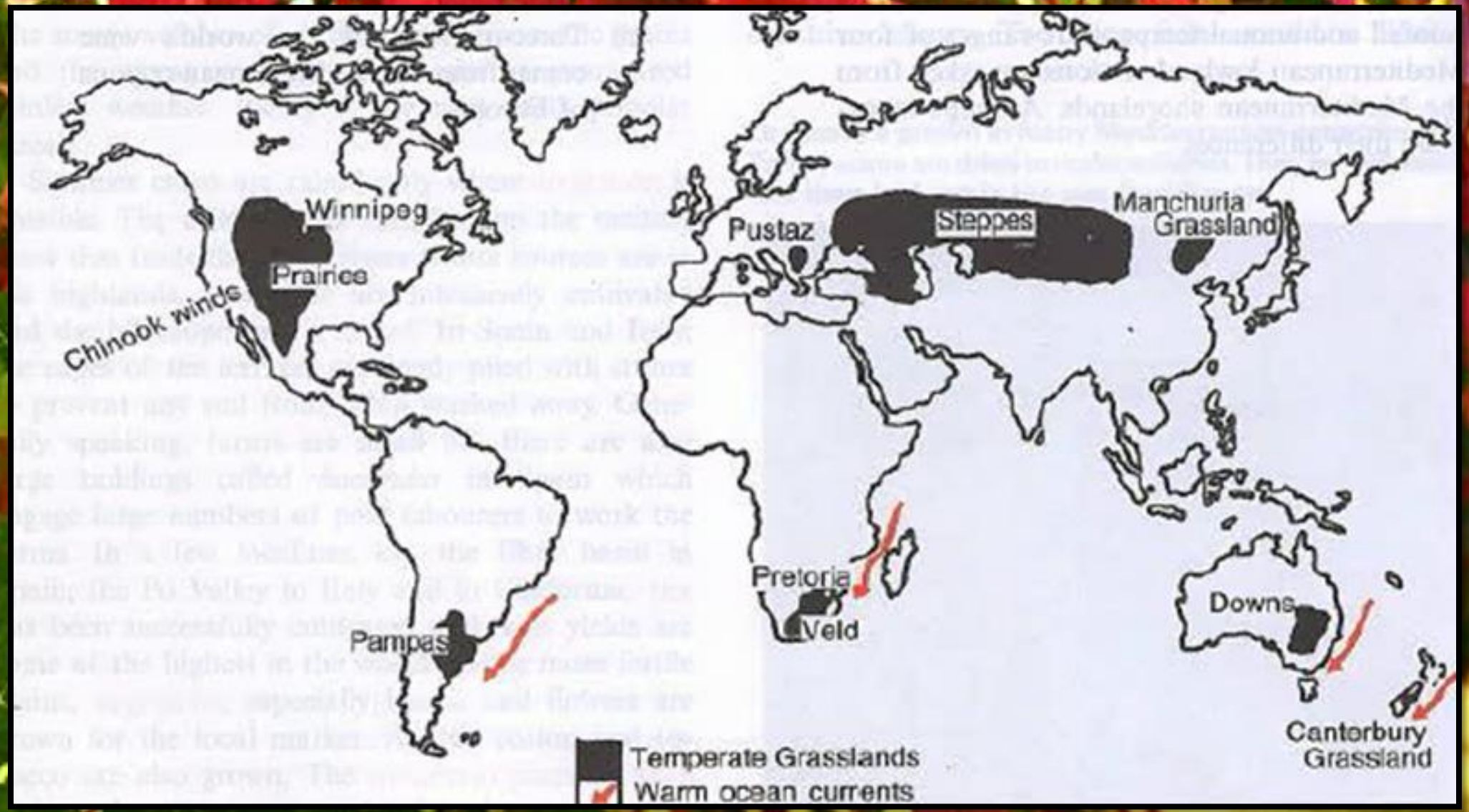
- EURASSIA- STEPPES; NORTH AMERICA- PRAIRIES
- DEEP INTERIOR POSITIONS, MOUNTAIN BARRIERS
- MEARGE AND UNRELIABLE PRECIPITATION
- NORTHERN HEMISPHERE
  - SUMMERS VERY WARM
  - WINTERS VERY COLD
- SOUTHERN HEMISPHERE
  - NEVER SEVERE (MARITIME INFLUENCE)



**VEGETATION**

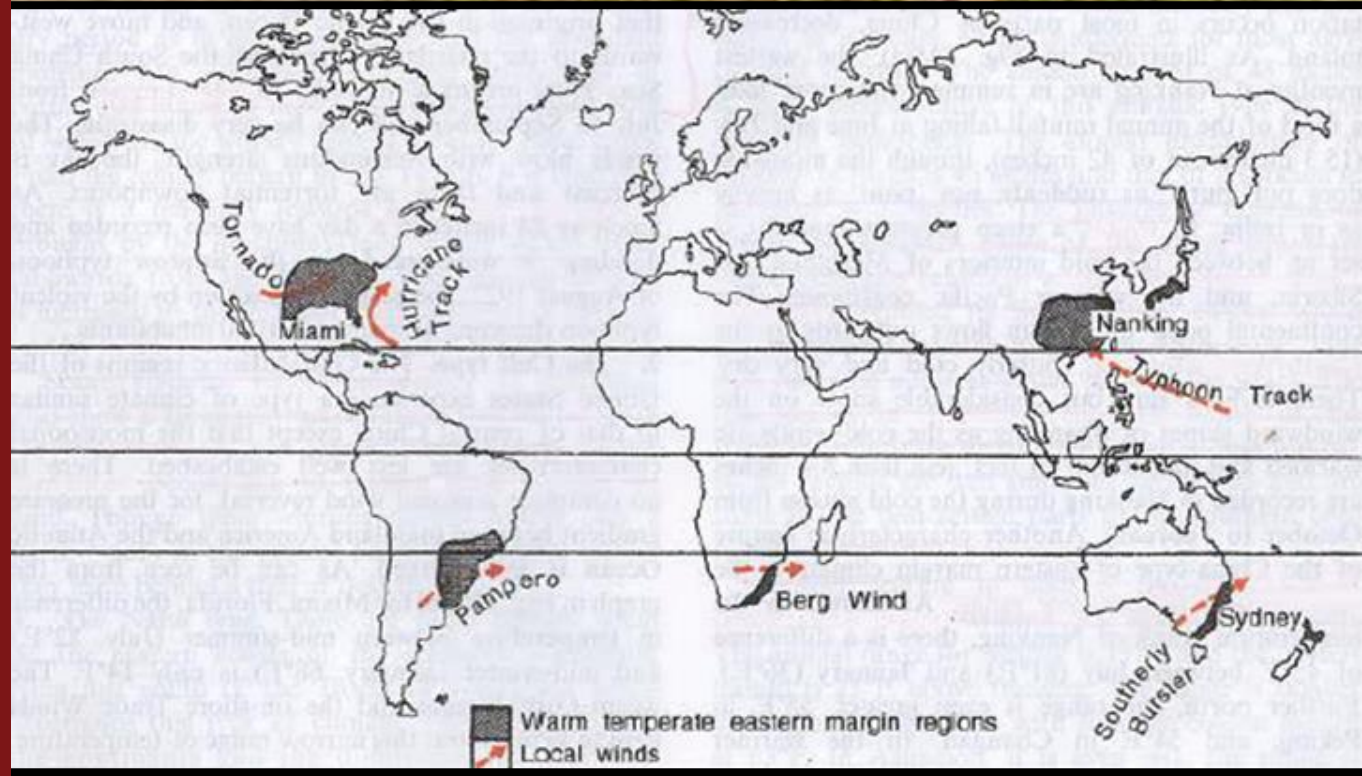
- TEMPERATE GRASSLANDS

- DISTRIBUTION: Grasslands Are More Extensive.
- IN EURASSIA GRASSLANDS ARE CALLED AS STEPPES, NORTH AMERICA-PRAIRIES, ARGENTINA AND URUGUAY-PAMPAS, SOUTH AFRICA- VELD.
- CLIMATE: Summers Are Very Warm Over $19^0$c. Winters Are Very Cold.
- AVERAGE RAINFALL-20 INCHES.


Winnipeg
Prairies
Chinook winds
Pustaz
Steppes
Manchuria
Grassland
Pretoria
Veld
Downs
Pampas
Canterbury
Grassland
Temperate Grasslands
Warm ocean currents

# CHINA TYPE CLIMATE

- **Eastern margins of continents** between **25°** and **45°**
- **Gulf & Natal Type Climate**
- **Rainfall** mainly in the **summer (more than the Mediterranean climate)**
- Typhoons



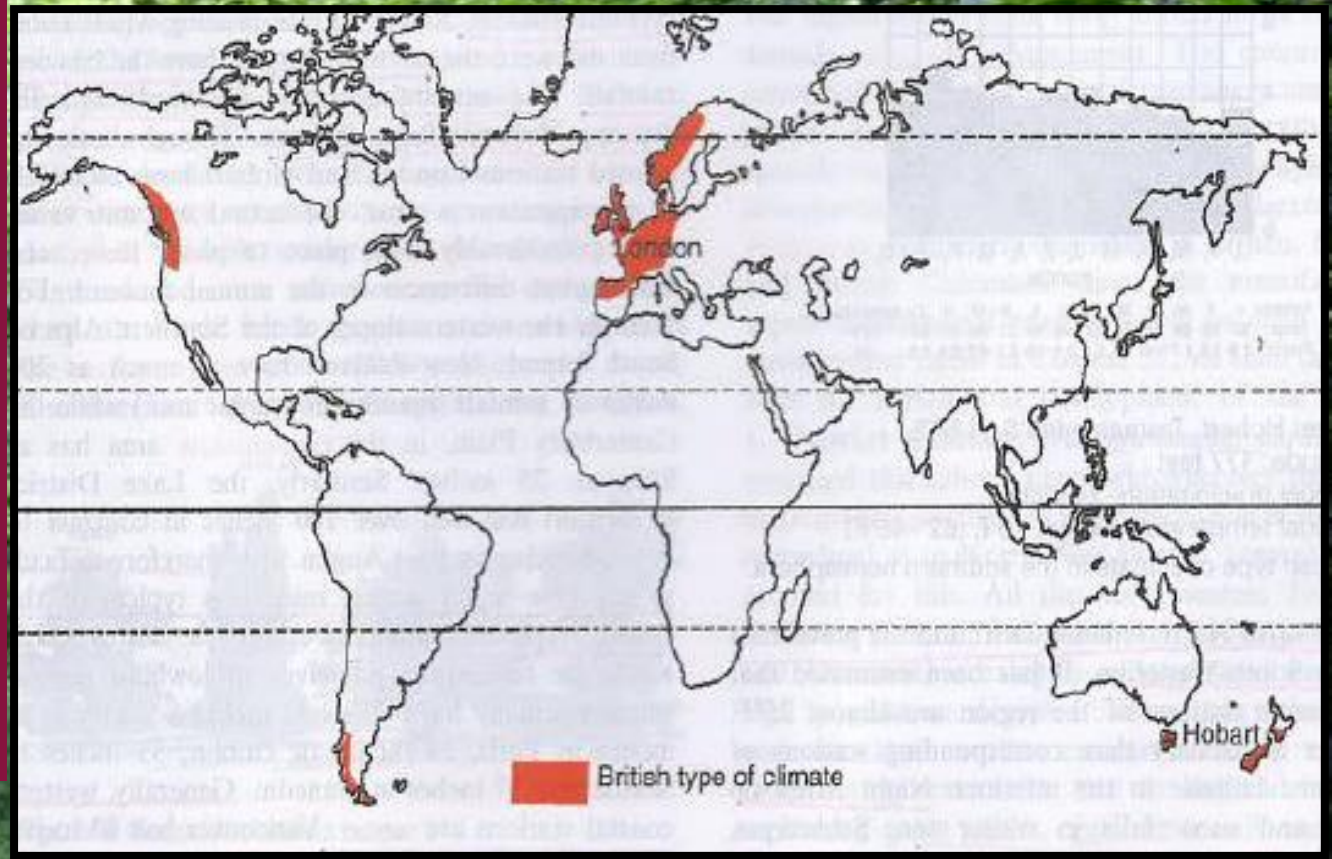
- DISTRIBUTION: China, Japan, South-eastern Usa, Gulf Of Mexico, New South Wales, Parana, Paraguay, Uruguay, Argentina, Natal, Australia.

- CLIMATIC CONDITION: Warm Moist Summer And Cool, Dry Winter.
- AVERAGE TEMPERATURE $5^0$- $24^0$ C.
- RAINFALL 25-60 INCHES.

- VEGETATION: Evergreen Broad -Leaved Forest And Deciduous Tree, Conifers Etc.

# BRITISH TYPE CLIMATE

- Under the permanent influence of the Westerlies
- Oceanic influence
- cyclonic activity
- Summers are never very warm
- winters are abnormally mild



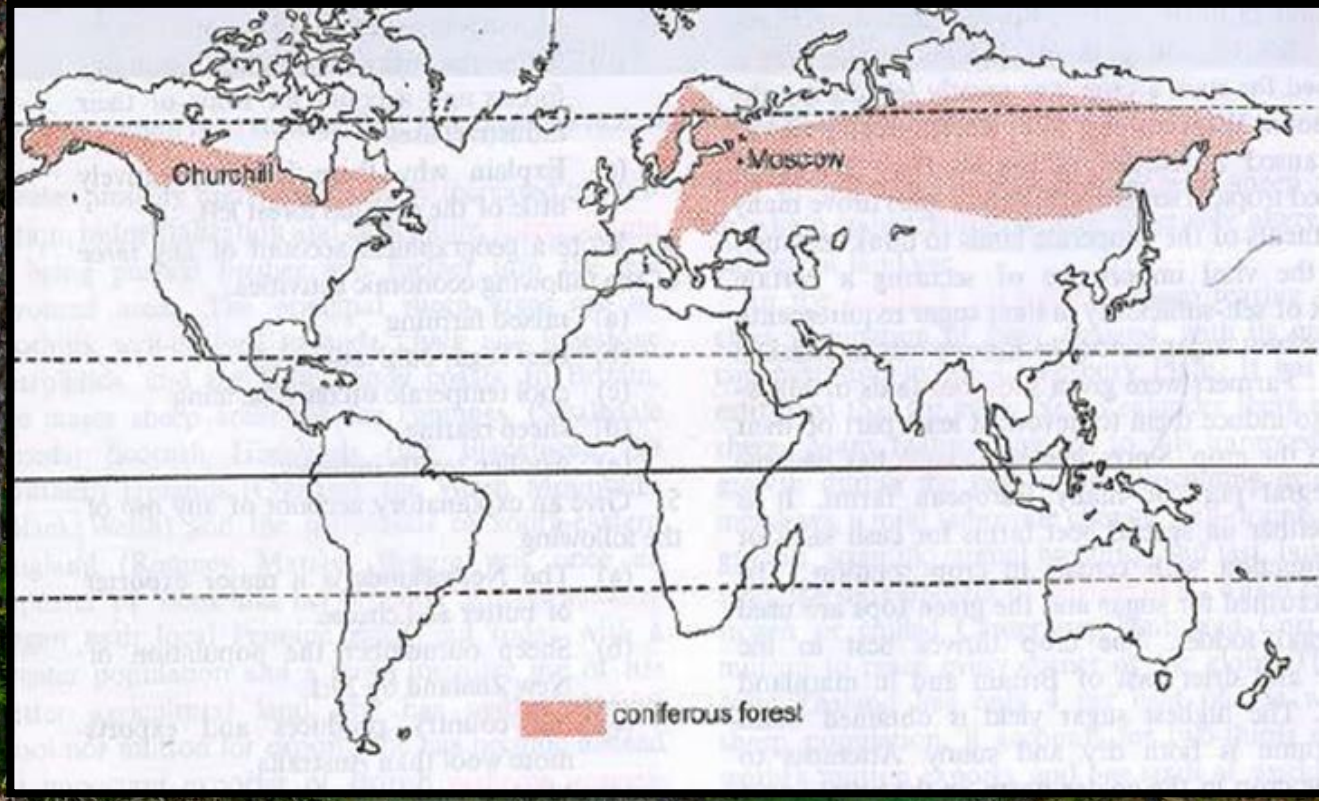
- DISTRIBUTION: Britain, Northern And Western France,belgium, Netherlands, Denmark, Western Norway North- Western Iberia., Southern Chike, Tasmania, New Zealand.

- CLIMATIC CONDITION: Average Annual Temperature $5^0$-$15^0$c.
- ADEQUATE RAINFALL THROUGHOUT THE YEAR.

- VEGETATION: Deciduous Forest, Oak, Elm, Ash, Birch, Beech, Poplar, Hornbeam Etc.

# SIBERIAN CLIMATE

- Only in the northern hemisphere in high latitudes
- Evergreen coniferous forest (Taiga)
- Absent in the southern hemisphere
- Long cold winter
- Summers are short
- Precipitation is low



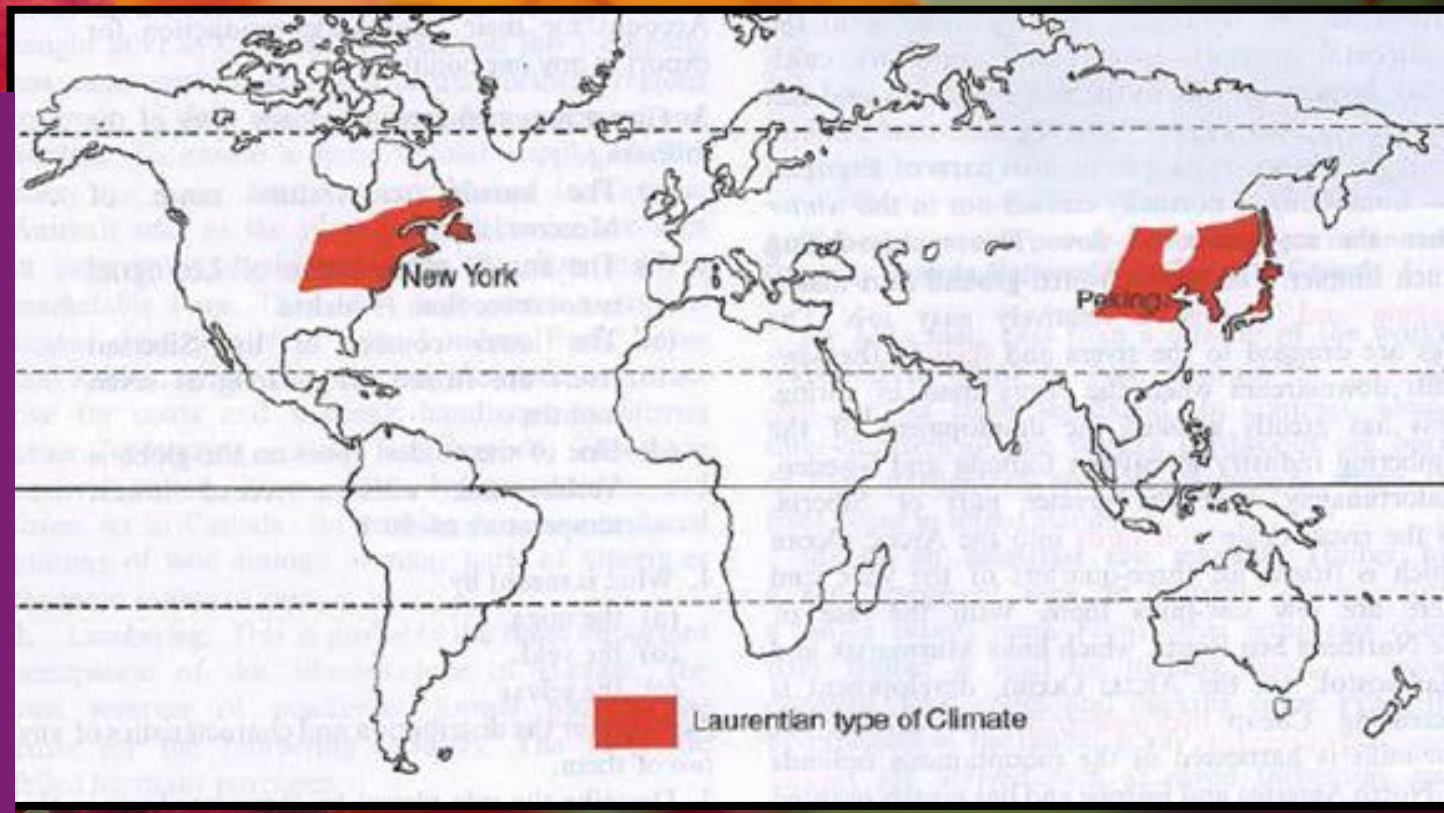
- DISTRIBUTION: Eurasia, North America.

- CLIMATIC CONDITION: Bitterly Cold Winter Of Long Duration And A Cool Brief Summer.
- AVERAGE ANNUAL TEMPERATURE $5^0$- $15^0$ C.
- ANNUAL RAINFALL 15-25 INCHES

- VEGETATION: Coniferous Forest.

# LAURENTIAN CLIMATE

- Intermediate type of climate between the **British and the Siberian type of climate**
- **Cold dry winter and warm wet summer**
- **Rainfall high in summer**

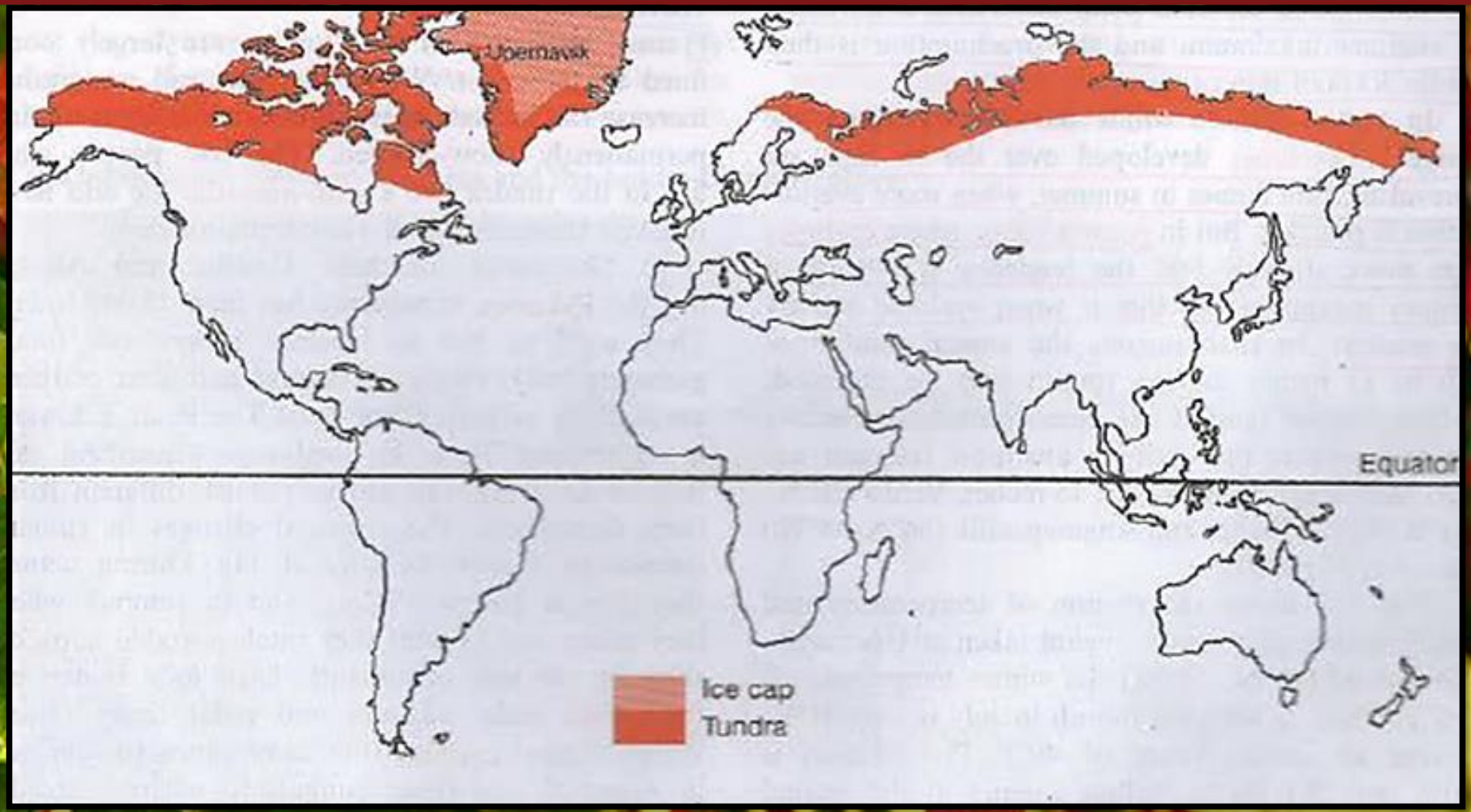


- DISTRIBUTION: North-eastern North America, Eastern Canada, North-east U.S.A. Newfoundland, Eastern Siberia, North China, Manchuria, Korea And Northern Japan.

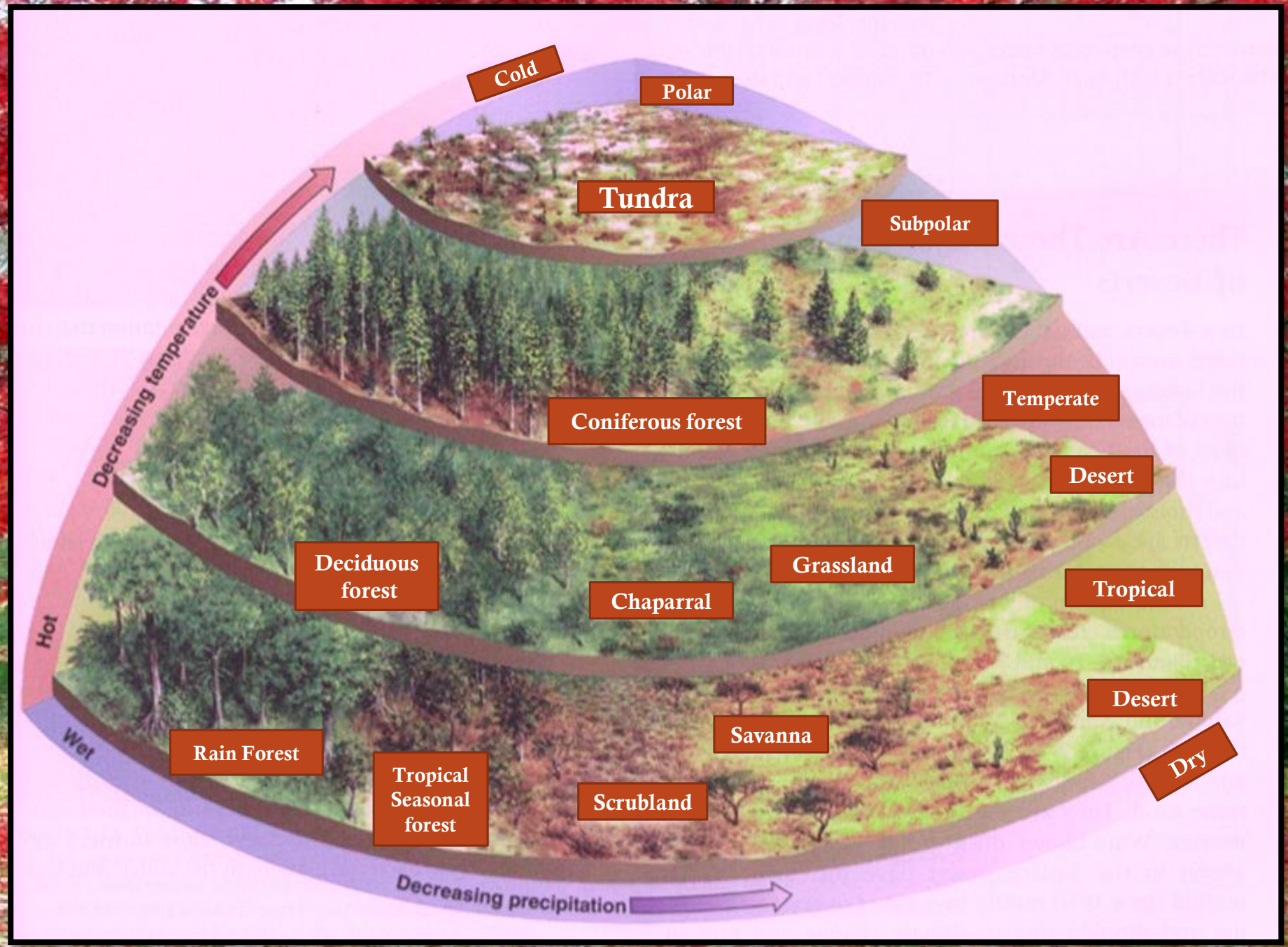
- CLIMATIC CONDITION: Cold, dry Winters And Warm, Wet Summers.
- SUMMER TEMPERATURE $21^0$- $27^0$ C.
- ANNUAL RAINFALL 30-60 INCHES

- VEGETATION:OAK, BEECH, MAPLE, BIRCH ETC.

# THE ARCTIC OR POLAR CLIMATE



- DISTRIBUTION: Arctic Circle, Greenland, Northern Canada , Alaska, Arctic Seaboard Of Eurasia.
- CLIMATIC CONDITION:Very Low Mean Annual Temperature ($-35^0$) And Warmest Month($10^0$) In June.
- PRECIPITATION IS MAINLY IN THE FORM OF SNOW.
- VEGETATION: Mosses, Lichens, Sedges Etc.


Cold
Polar
Tundra
Subpolar
Decreasing temperature
Coniferous forest
Temperate
Desert
Deciduous forest
Grassland
Chaparral
Tropical
Hot
Desert
Savanna
Wet
Rain Forest
Tropical Seasonal forest
Scrubland
Dry
Decreasing precipitation

# CLIMATIC REGIONS IN INDIA



# KOPPEN CLIMATE CLASSIFICATION

**FIRST LETTER:**

A---------- TROPICAL HUMID---------- LOW LATITUDE WARM + WET.

B---------- DRY---------- EVAPORATION IS GREATER PRECIPITATION.

C---------- MILD MIDLATITUDES------- MILD WINTERS WARM/HOT SUMMER.

D---------- SEVERE MIDLATITUDES---- SEVERE, COLD, WINTERS.

E---------- POLAR---------- VERY HIGH LATITUDES, COLD CLIMATES.

H---------- HIGHLAND---------- HIGH MOUNTAINS CLIMATE CONTROLLED BY ELEVATION

**SECOND LETTER: (A, C & D CLIMATES)**

f- WET ALL YEAR.

m- MONSOONAL SUMMERS, VERY WET SUMMER.

w- WINTER DRY SEASON.

s- SUMMERS DRY SEASON.

# B CLIMATES

W------ Deserts---------- Extremely arid.

S--------Steppes----------Semi-arid.

**E Climates**

T----- Tundra-------- 1 month temperature are above freeze.

F----- Ice Caps------ All month average below freeze.

**Third Letter: ( C+D Climates)**

a Hot Summers

b warm Summers

c Cool Summers

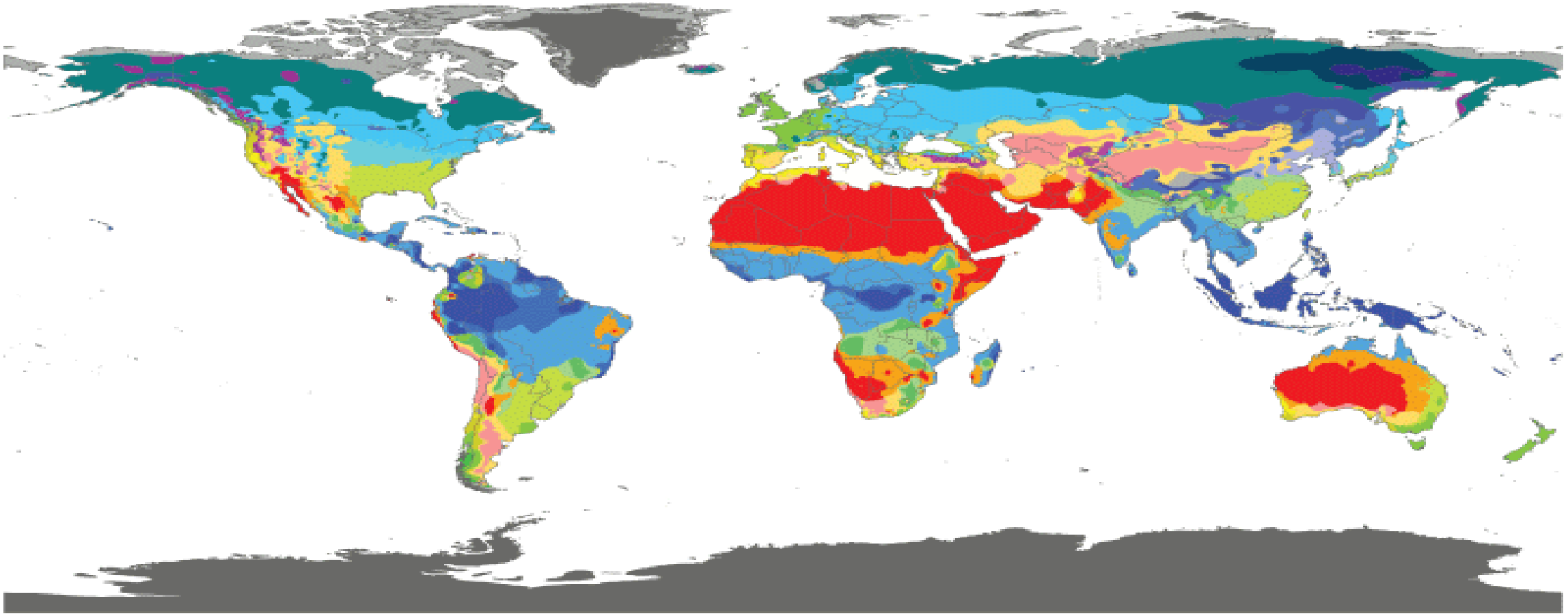
d Very Cold Winters

**B Climates**

h Hot Desert/ Steppe

k Cold Desert or Steppe.

# World map of Köppen-Geiger climate classification



| Tropical (A) | Dry (B) | Temperate (C) | Continental (D) | Polar Alpine (E) |
|---|---|---|---|---|
| Af | BWh | Csa | Cwa | Cfa | Dsa | Dwa | Dfa | ET |
| Am | BWk | Csb | Cwb | Cfb | Dsb | Dwb | Dfb | EF |
| Aw | BSh | | Cwc | Cfc | Dsc | Dwc | Dfc | |
| | BSk | | | | Dsd | Dwd | Dfd | |

THE UNIVERSITY OF MELBOURNE

**Contact** : Murray C. Peel (mpeel@unimelb.edu.au) for further information

**DATA SOURCE** : GHCN v2.0 station data
Temperature (N = 4,844) and
Precipitation (N = 12,396)

**PERIOD OF RECORD** : All available

**MIN LENGTH** : ≥30 for each month.

**RESOLUTION** : 0.1 degree lat/long

# OCEANOGRAPHY

# WATER DISTRIBUTION

- 43 percent lies in northern hemisphere and 57 percent in the southern hemisphere
- 97% resides in the oceans - 3% of water on the surface is fresh

➢ **Freshwater**

- 69% resides in glaciers
- 30% underground
- less than 1% is located ON surface

➢ **Usable quantity**

| *Reservoir* | *Volume (Million Cubic km)* | *Percentage of the Total* |
|---|---|---|
| Oceans | 1,370 | 97.25 |
| Ice Caps and Glaciers | 29 | 2.05 |
| Groundwater | 9.5 | 0.68 |
| Lakes | 0.125 | 0.01 |
| Soil Moisture | 0.065 | 0.005 |
| Atmosphere | 0.013 | 0.001 |
| Streams and Rivers | 0.0017 | 0.0001 |
| Biosphere | 0.0006 | 0.00004 |

On the planet earth, most of the freshwater exists as ice caps and glaciers. Out of the remaining freshwater, the largest proportion

(a) is found in atmosphere as moisture and clouds
(b) is found in freshwater lakes and rivers
(c) exists as groundwater
(d) exists as soil moisture

Consider the following statements:

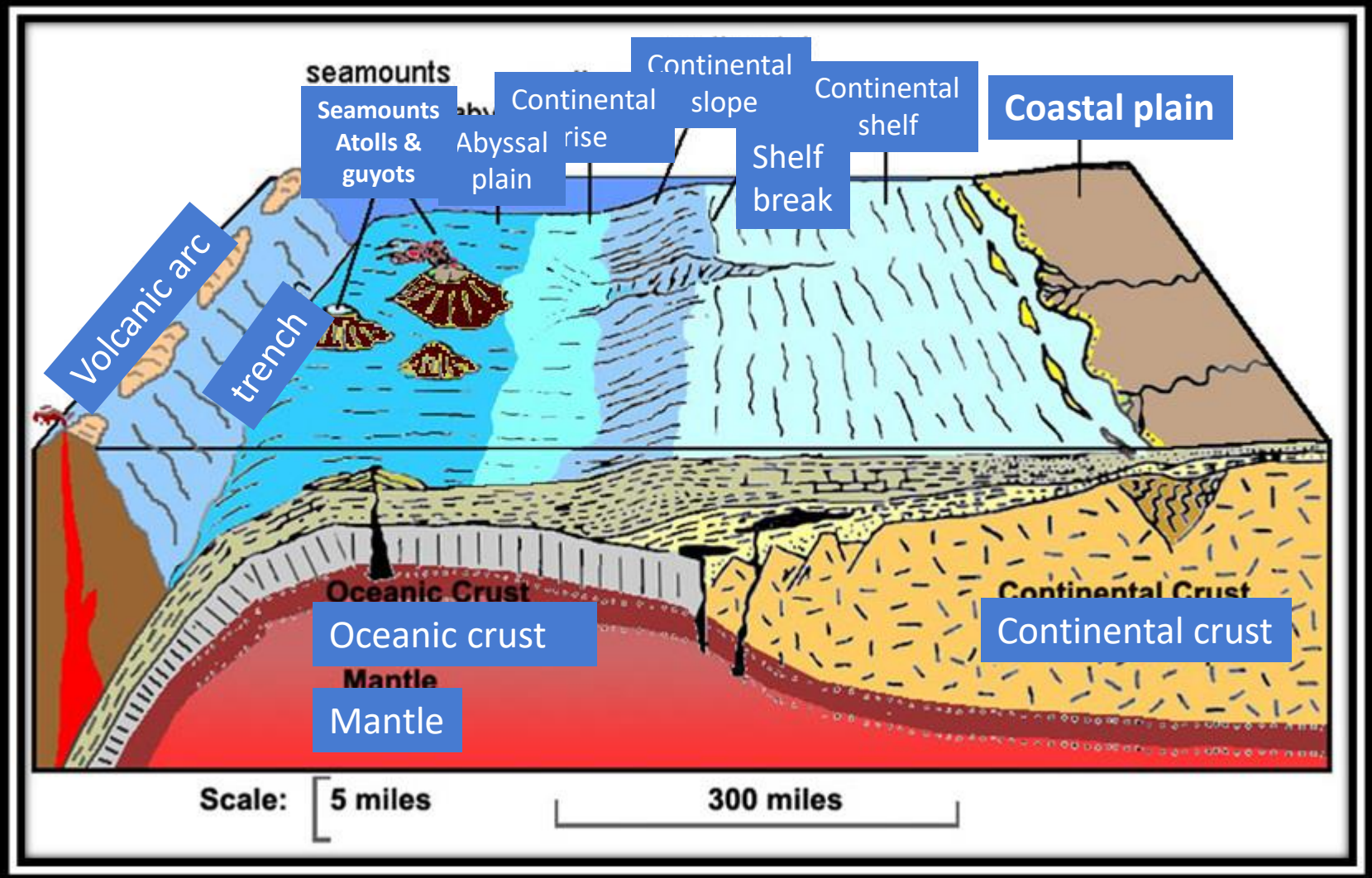
1. On the planet Earth, the fresh water available for use amounts to about less than 1% of the total water found.
2. Of the total fresh water found on planet Earth 95% is bound up in polar ice caps and glaciers.

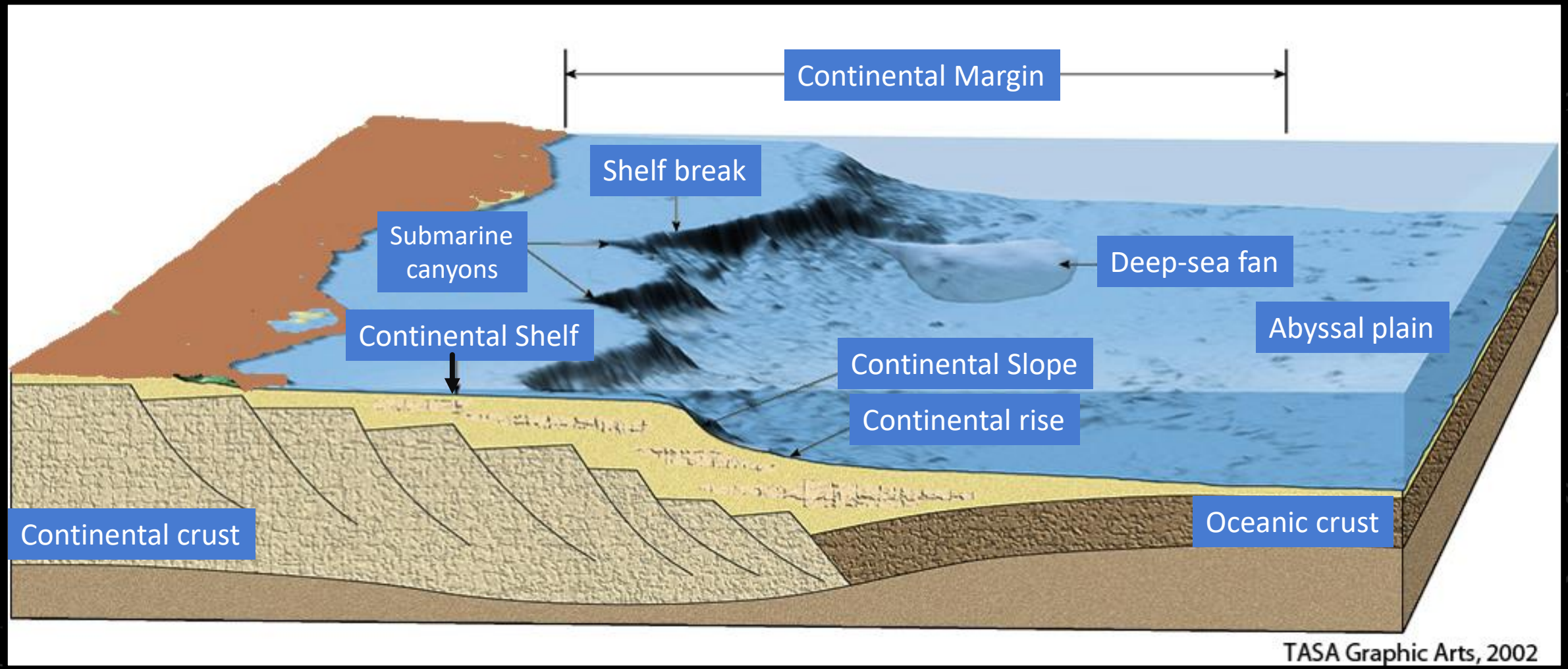
Which of the statements is given above is/are correct?

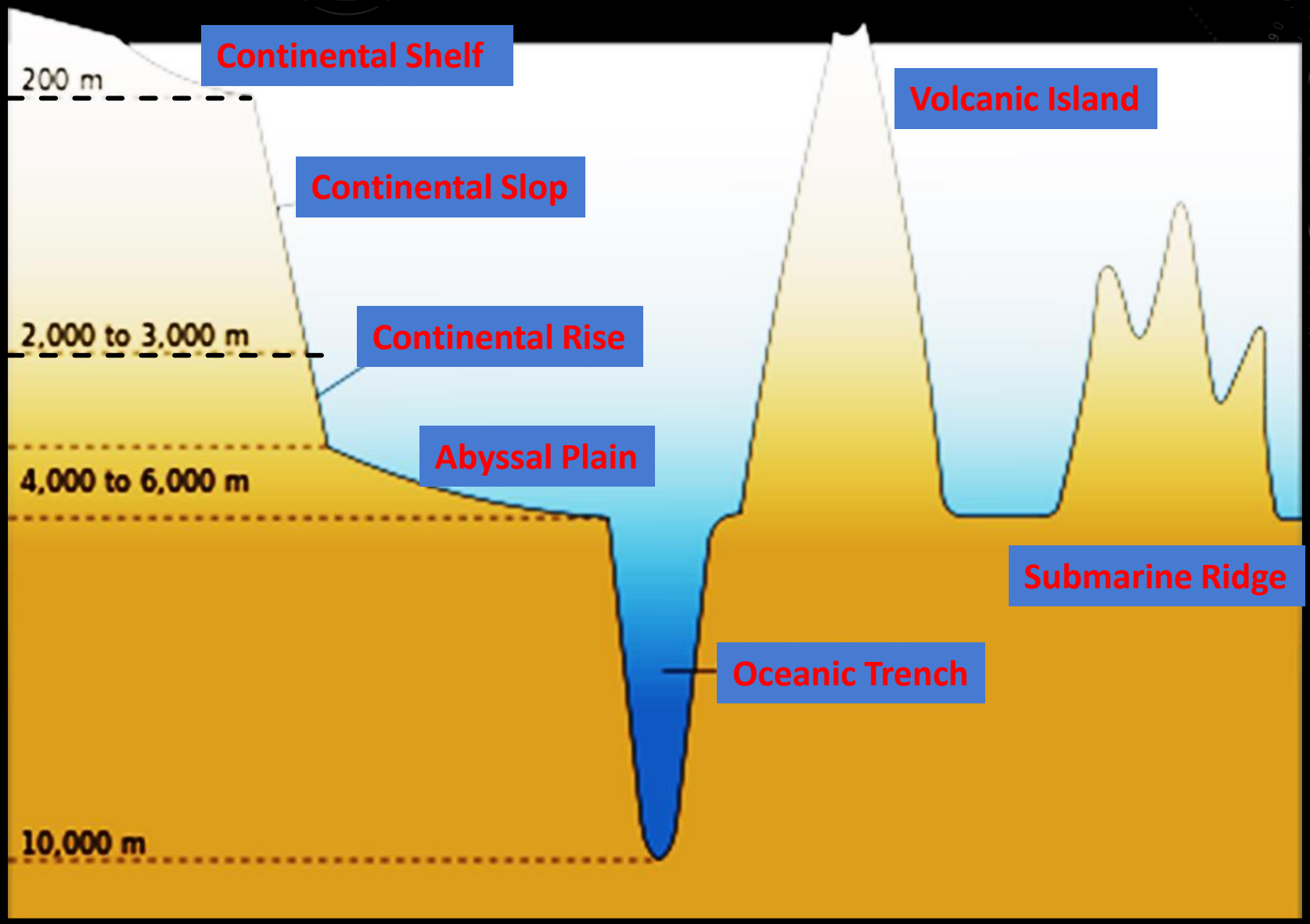
(a) 1 only (b) 2 only (c) both 1 and 2 (d) Neither 1 nor 2

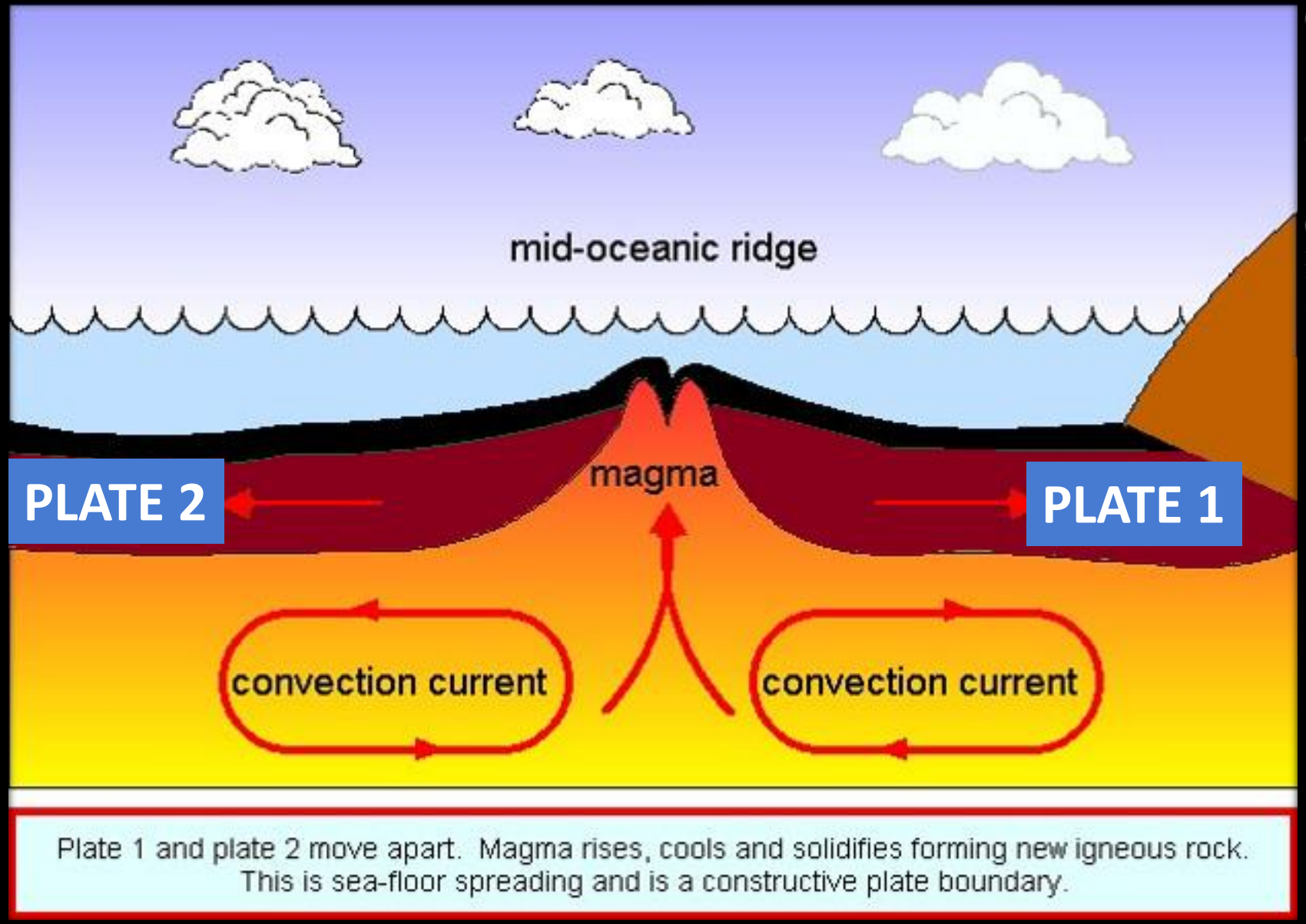
# RELIEF OF THE OCEAN FLOOR

- Continental shelf
- Continental slope
- Deep sea plain
- Trenches
- Mid-oceanic ridges
- Seamount
- Guyots
- Submarine canyons
- Atoll



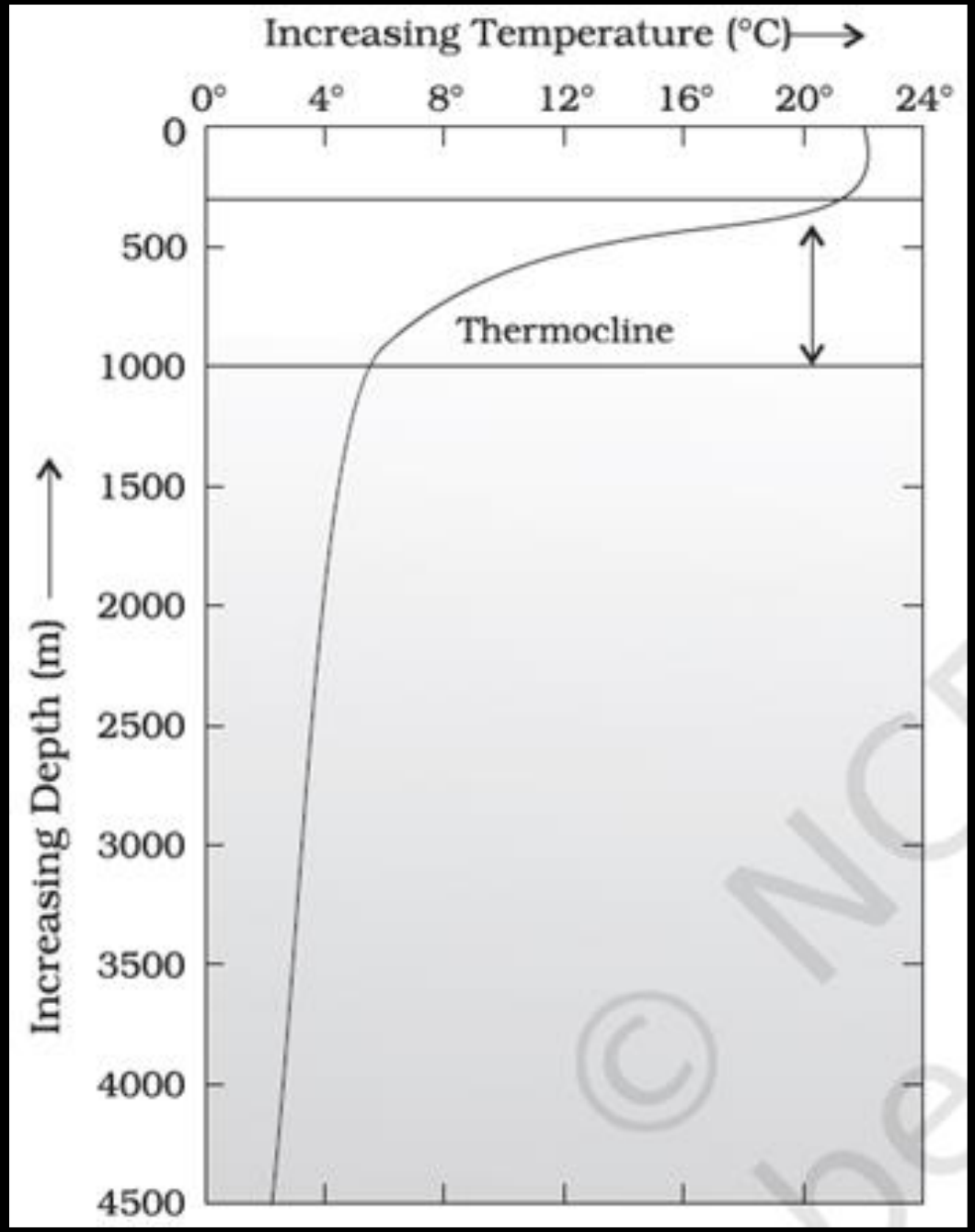

Continental Margin
Shelf break
Submarine canyons
Deep-sea fan
Continental Shelf
Abyssal plain
Continental Slope
Continental rise
Continental crust
Oceanic crust
TASA Graphic Arts, 2002

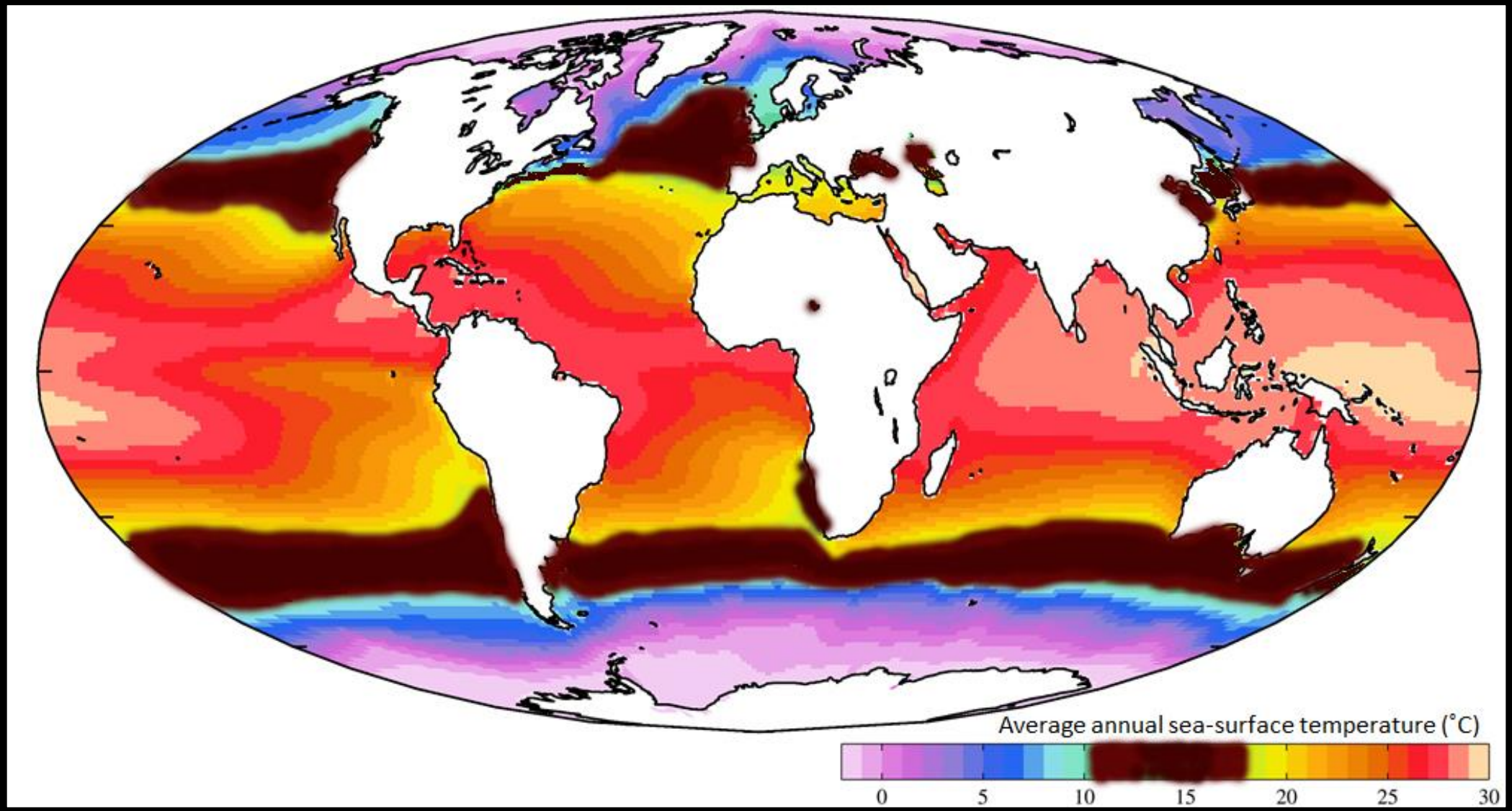

Continental Shelf
200 m
Continental Slop
2,000 to 3,000 m
Continental Rise
Abyssal Plain
4,000 to 6,000 m
Volcanic Island
Submarine Ridge
Oceanic Trench
10,000 m


mid-oceanic ridge
PLATE 2
magma
PLATE 1
convection current
convection current
Plate 1 and plate 2 move apart. Magma rises, cools and solidifies forming new igneous rock.
This is sea-floor spreading and is a constructive plate boundary.

# TEMPERATURE

- **FACTORS**
  - **Latitude**
  - **Unequal distribution of land and water**
  - **Prevailing wind**
  - **Ocean currents**

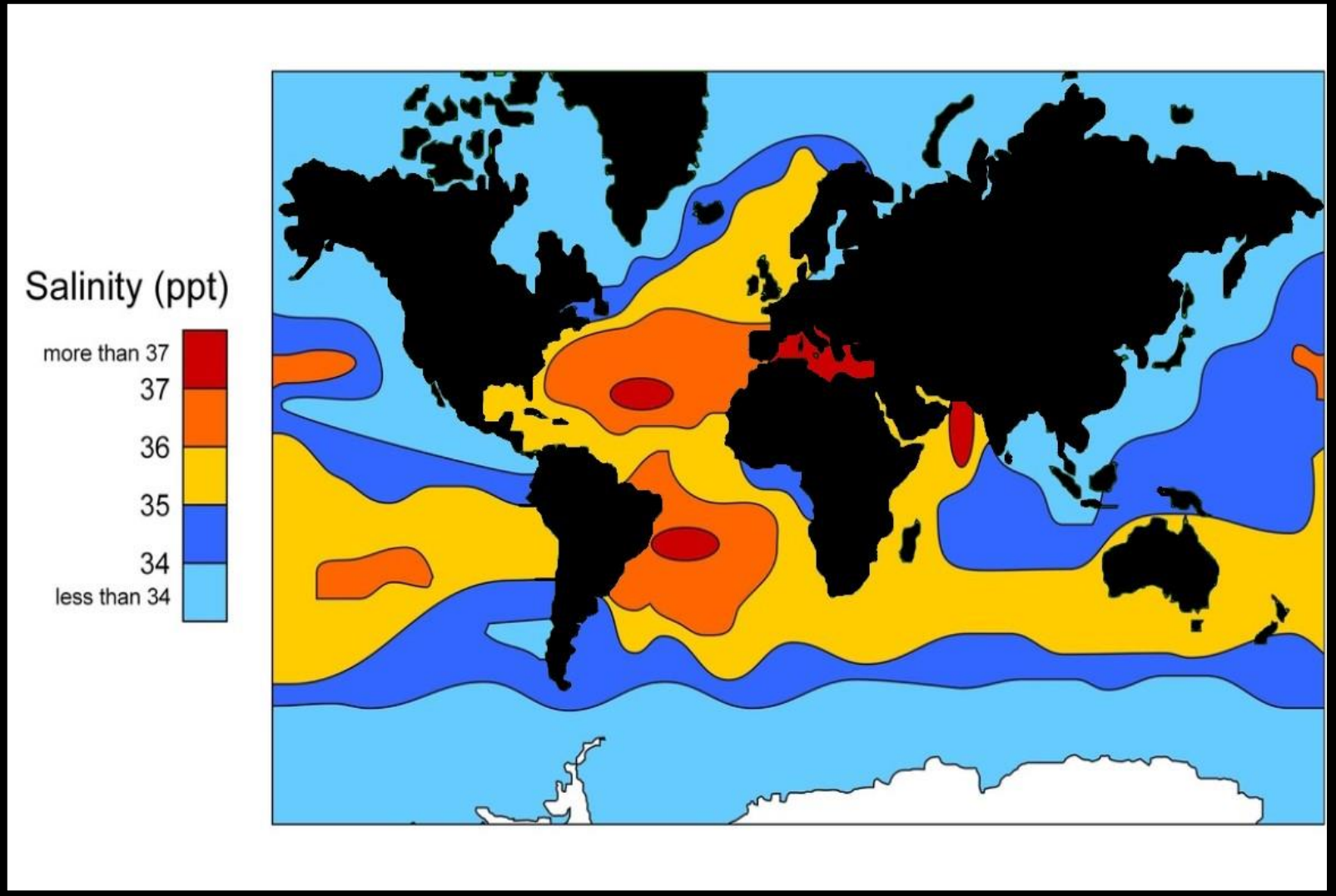

Increasing Temperature (°C)
0°
4°
8°
12°
16°
20°
24°
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Thermocline
Increasing Depth (m)


Average annual sea-surface temperature (˚C)
0
5
10
15
20
25
30

# SALINITY

## ❑ FACTORS

- Evaporation
- Precipitation
- River discharge
- Wind
- Ocean currents
- Temperature



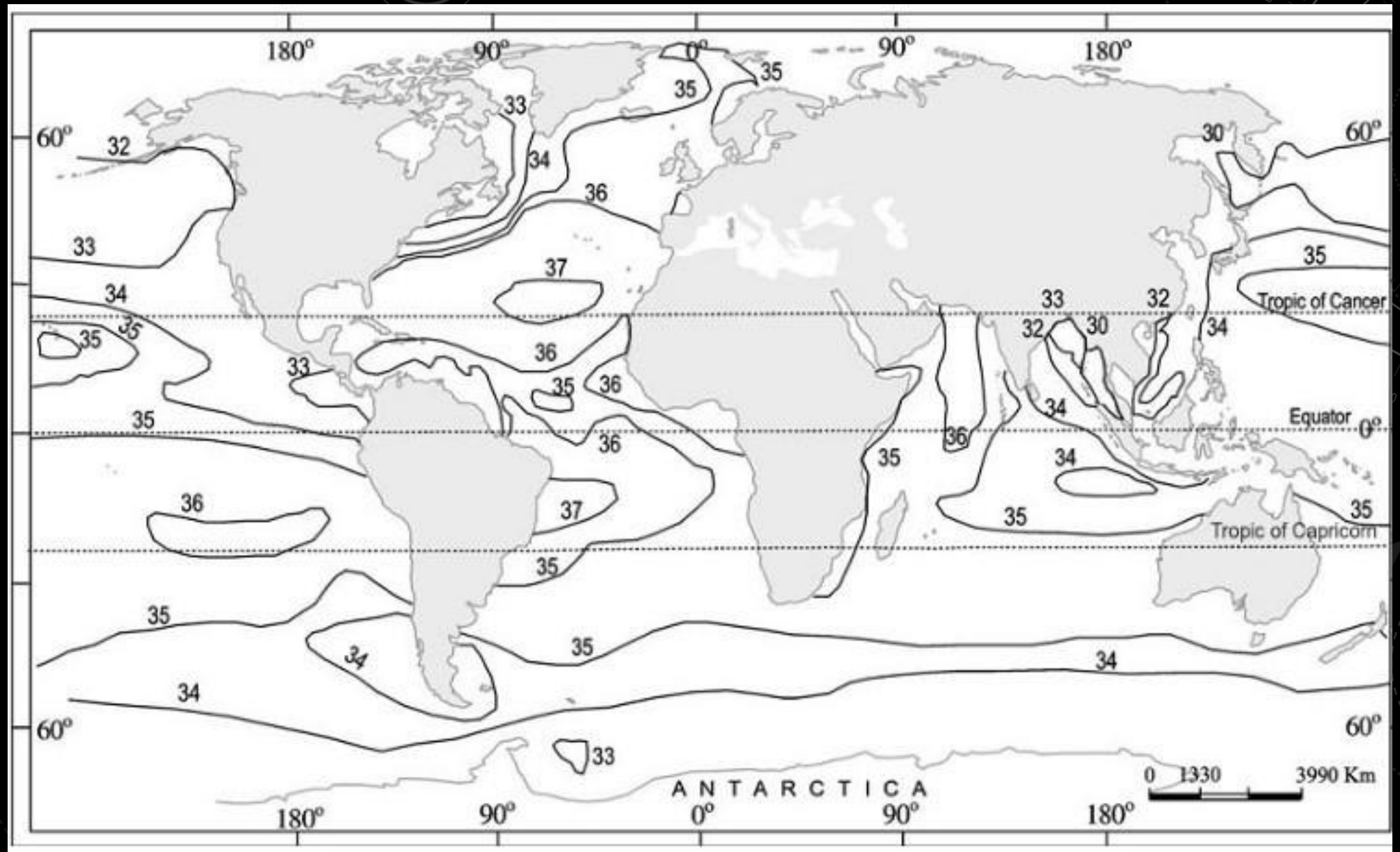



**Figure13.5 : Surface salinity of the World's Oceans**

Salinity in ocean water decreases when

(a) evaporation is more

(b) wind velocity is high

(c) humidity is high

(d) rainfall is high

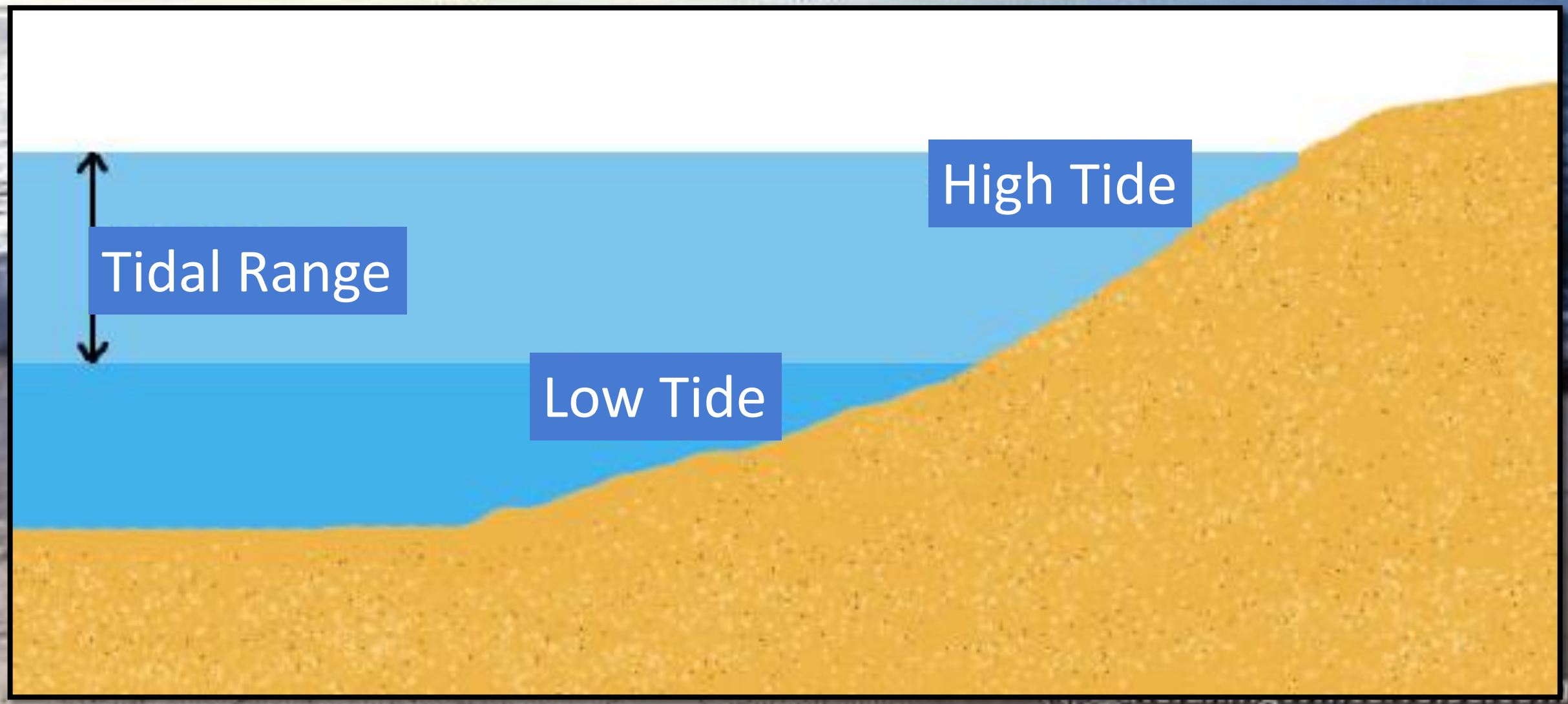
# OCEAN TIDE

- Periodic rise and fall of sea level
- Flood tide - Ebb tide

## ❑ FACTORS

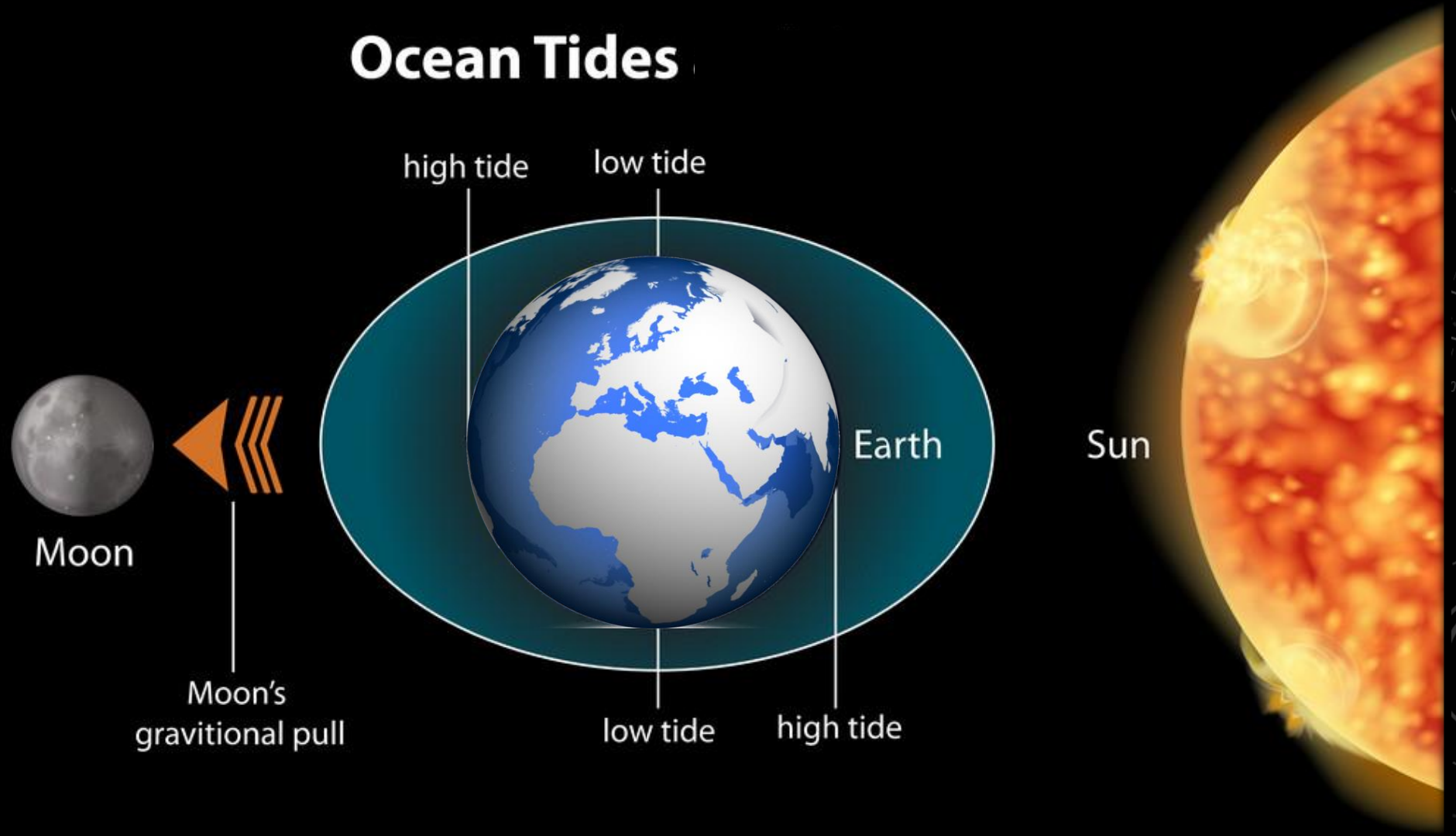
- Moon’s gravitational pull
- Sun’s gravitational pull
- Centrifugal force
- Relative position of the moon and the sun with respect to the earth
- Distribution of land and ocean
- Irregularities in configuration of oceans

# TIDAL RANGE

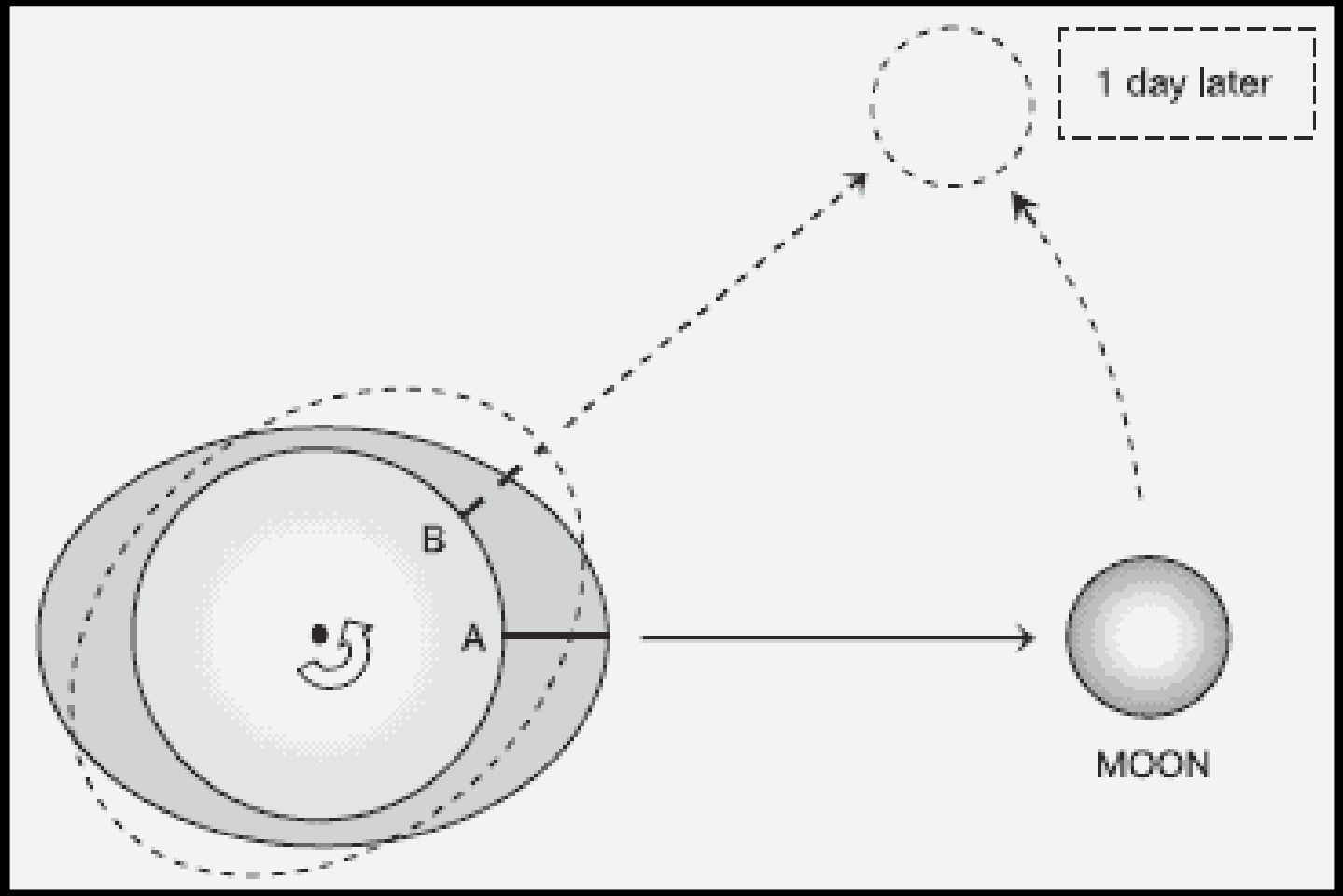



Ocean
Earth's Rotation
Tidal
bulge offset
Moon
Direction of motion

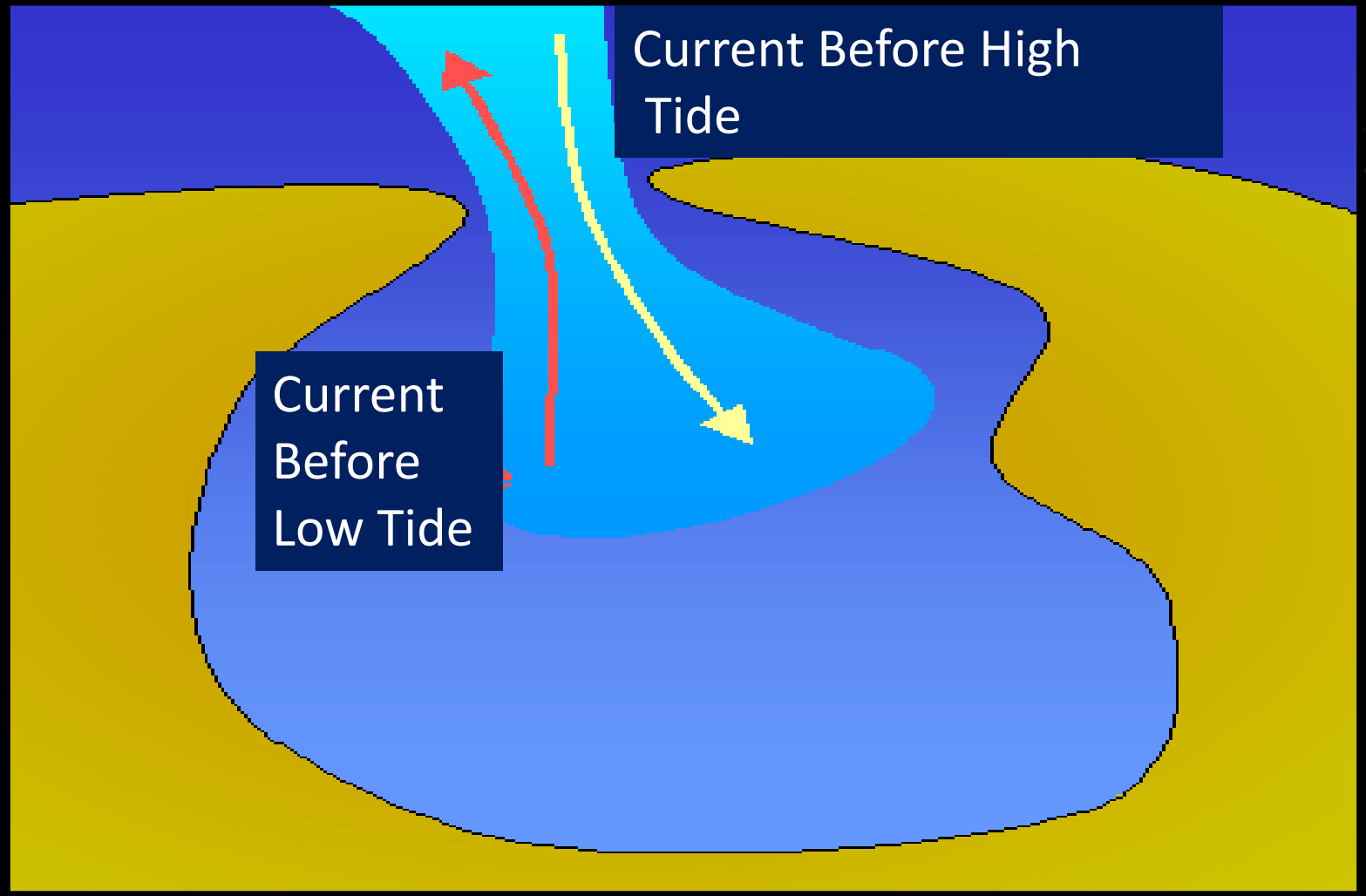
# Ocean Tides


high tide
low tide
Moon
Earth
Sun
Moon's
gravitional pull
low tide
high tide

# TIME OF TIDES

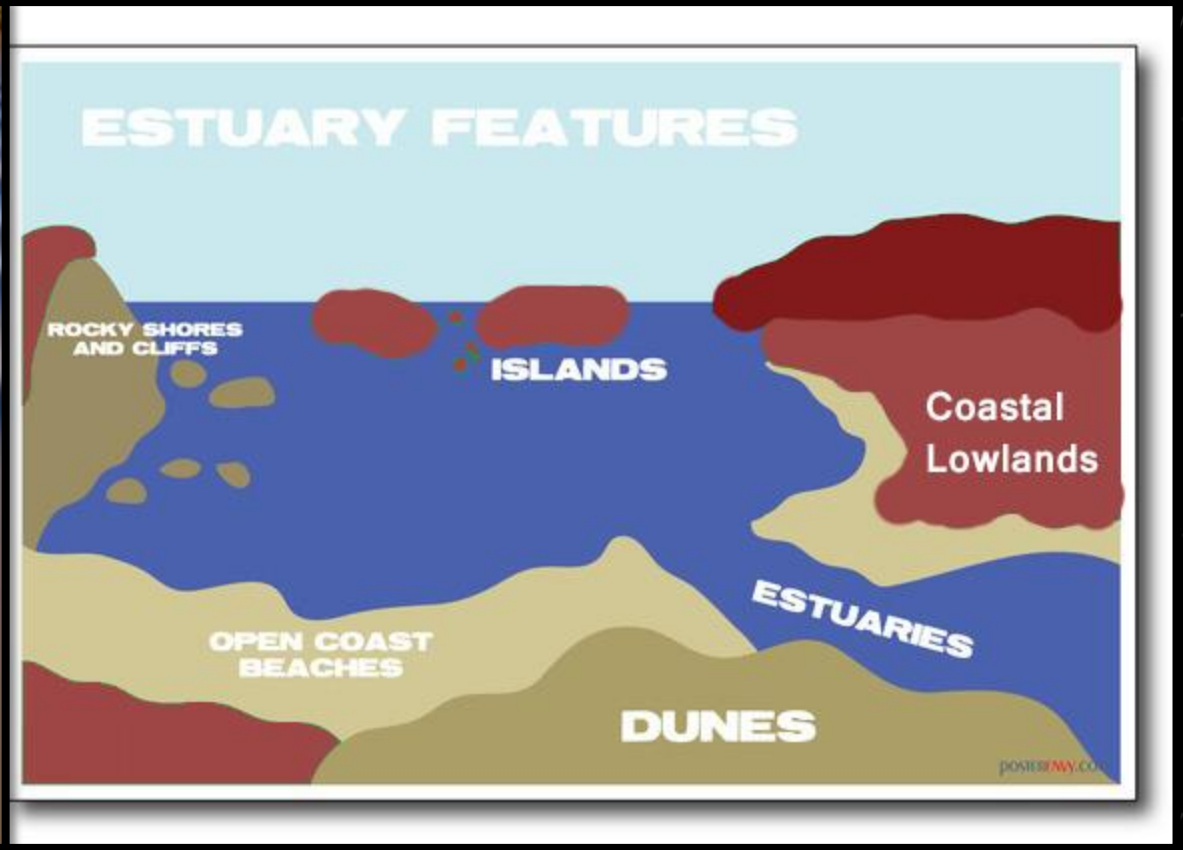


# TIDAL CURRENT



# TIDAL BORE




ESTUARY FEATURES
ROCKY SHORES AND CLIFFS
ISLANDS
Coastal Lowlands
ESTUARIES
OPEN COAST BEACHES
DUNES

# TIDAL PORT


Deendayal Port Trust (Kandla)
GUJARAT
Bharuch
Bhavnagar
Porbander
Surat
Veraval
DADRA & NAGAR HAVELI
MADHYA PRADESH
JHARKHAND
WEST BENGAL
Haldia
CHHATTISGARH
ODISHA
Paradip
MAHARASHTRA
Mumbai
Jawaharlal Nehru Port
Visakhapatanam
TELANGANA
Ratnagiri
Kakinada
Machillipatnam
Panaji
GOA
Marmagoa
ANDHRA PRADESH
KARNATAKA
Ennore (Kamarajar Port)
Chennai
Mangalore
LAKSHADWEEP (INDIA)
KERALA
TAMIL NADU
Nagapattanam
Kochi
Alappuzha
Tuticorin

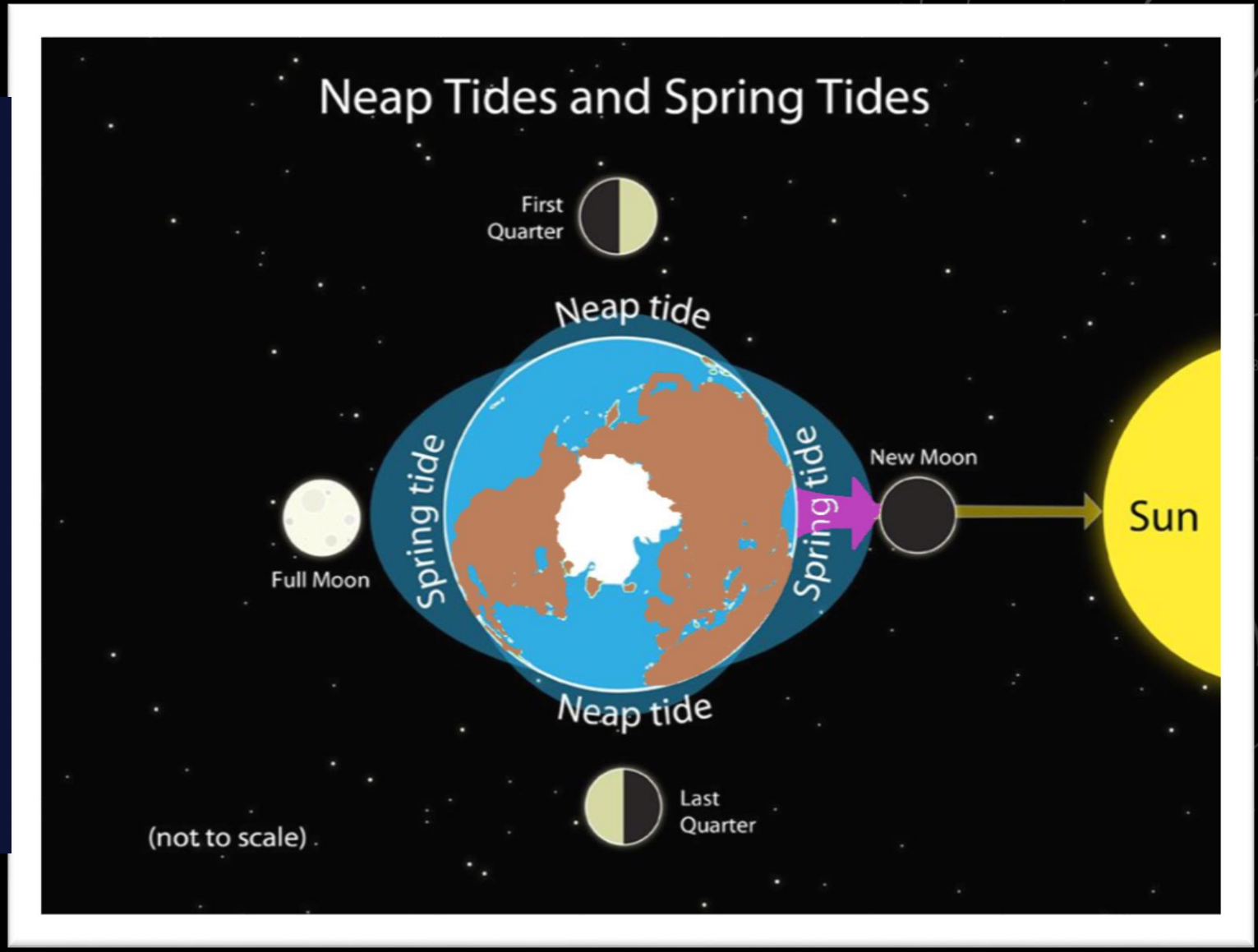
# TYPES OF TIDE

## ❑SPRING TIDE

- Straight line
- Twice a Month - full moon; new moon
- High tides are higher
- Low tides are lower

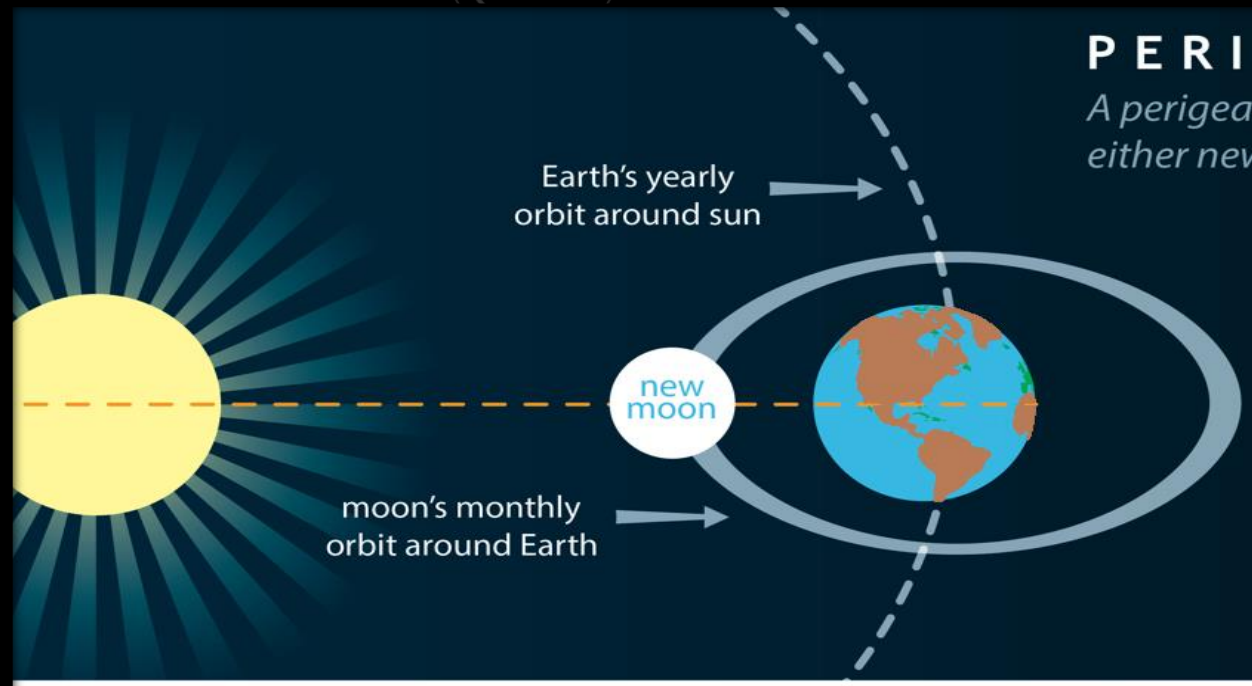
## ❑NEAP TIDE

- Right angles
- First and third quater
- High tides are lower than usual
- Low tides are higher than usual



# PERIGEAN-SPRING TIDE

*A perigean spring tide occurs when the moon is either new or full and closest to Earth.*

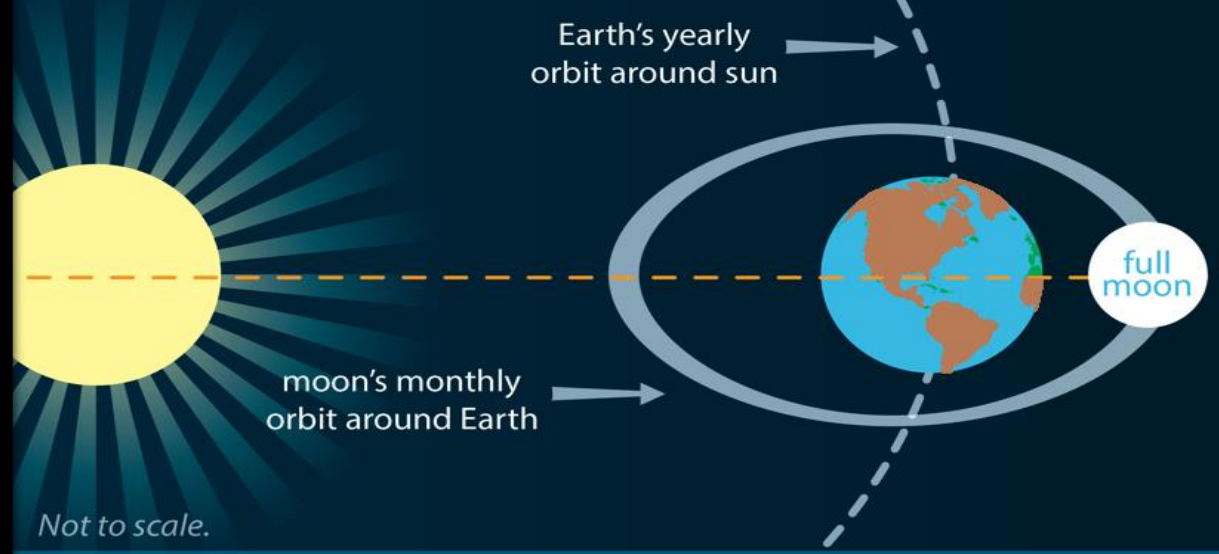



## NEW MOON

Moon closest to Earth in monthly orbit (perigee)

Moon in alignment with sun

Moon between Earth and sun




## FULL MOON

Moon closest to Earth in monthly orbit (perigee)

Moon in alignment with sun

Earth between moon and sun

oceanservice.noaa.gov

# IMPORTANCE OF TIDES

- Navigation
- Fishing
- Clear away the sediments
- Source for generating electricity

At one of the places in India, if you stand on the seashore and watch the sea, you will find that the sea water recedes from the shore line a few kilometers and comes back to the shore, twice a day, and you can actually walk on the sea floor when the water recedes. This unique phenomenon is seen at

(a) Bhavnagar,  (b) Bheemunipatnam ,  (c) Chandipur ,  (d) Nagapattinam.



Tides occur in the oceans and seas due to which among the following?

1. Gravitational force of the Sun
2. Gravitational force of the Moon
3. Centrifugal force of the Earth

Select the correct answer using the code given below.

(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3

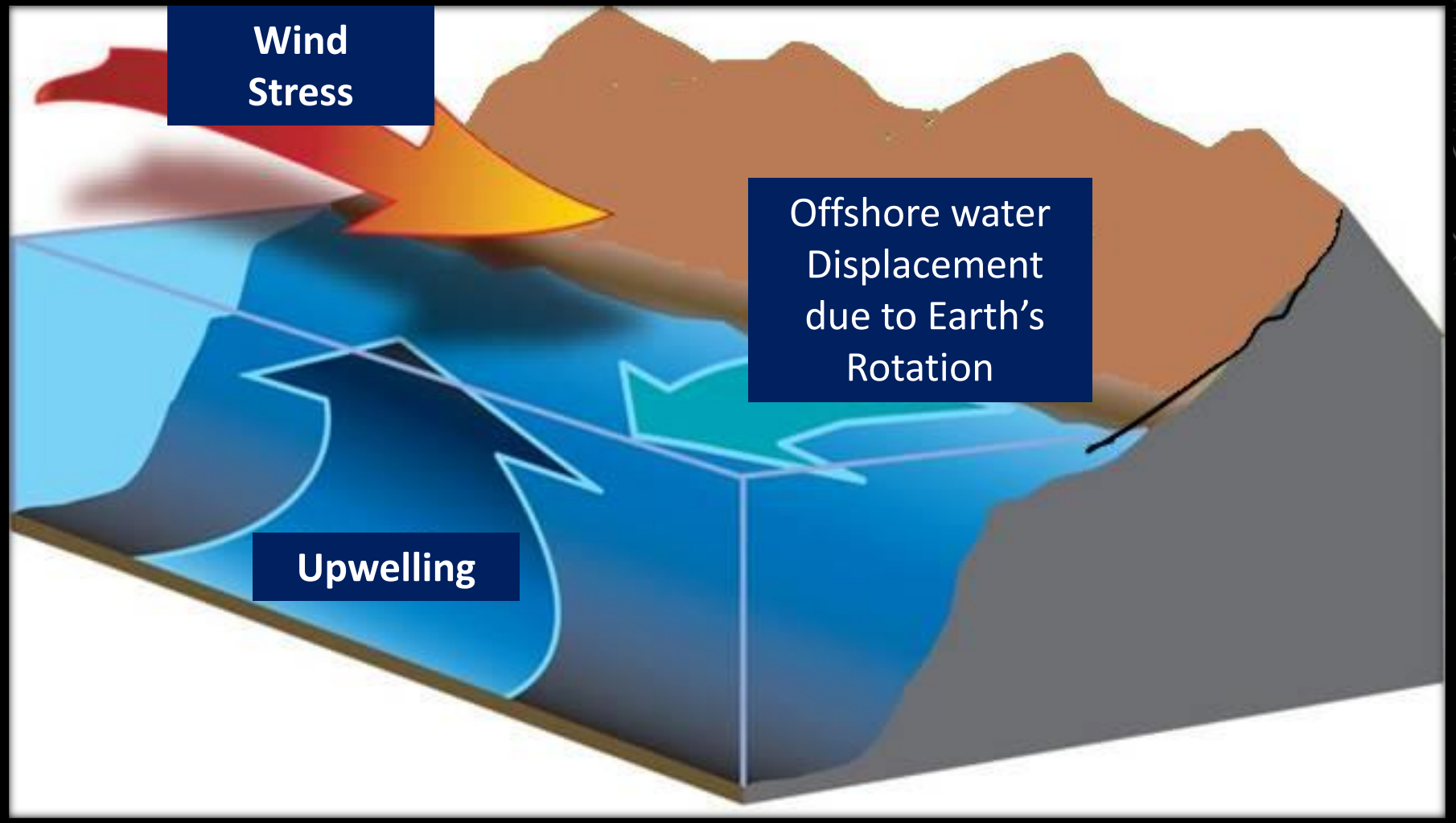
Which one of the following statements is not correct?

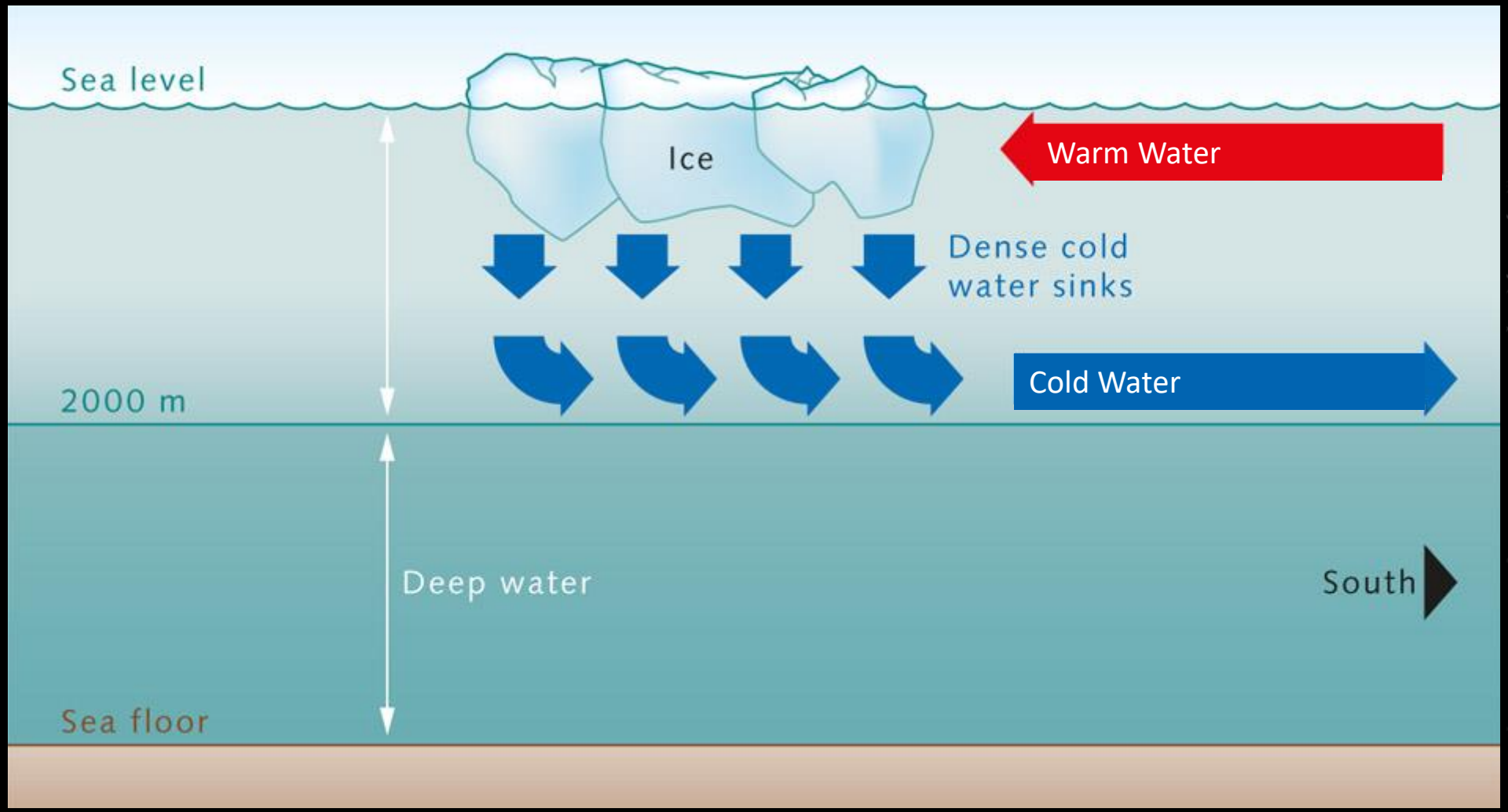
a) Gulf with narrow fronts and wider rears experience high tides.
b) Tidal currents take place when a gulf is connected with the open sea by a narrow channel.
c) Tidal bore occurs when a tide enters the narrow and shallow estuary of a river.
d) The tidal nature of the mouth of the river Hooghly is of crucial importance to Kolkata as port.

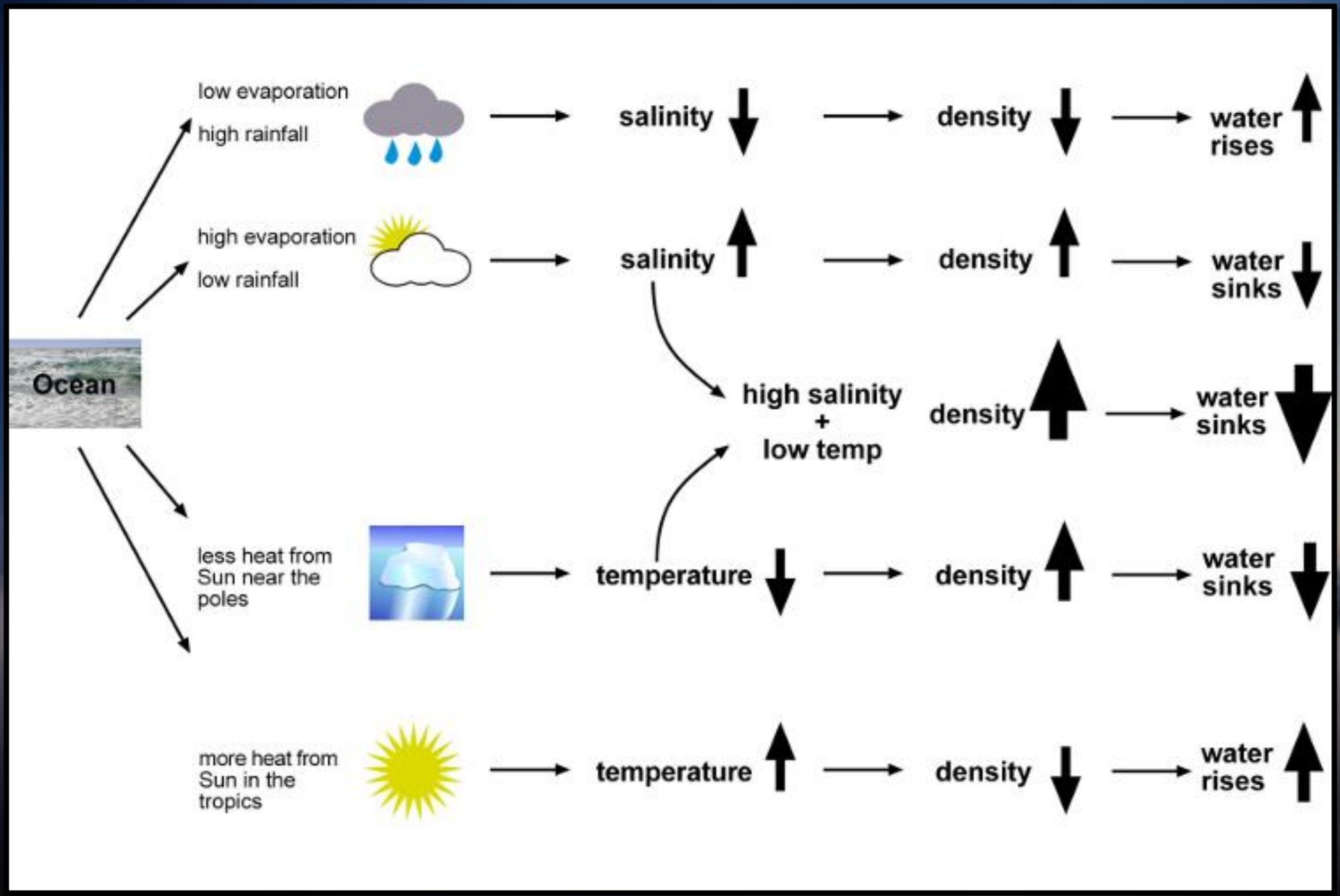
# OCEAN CURRENTS

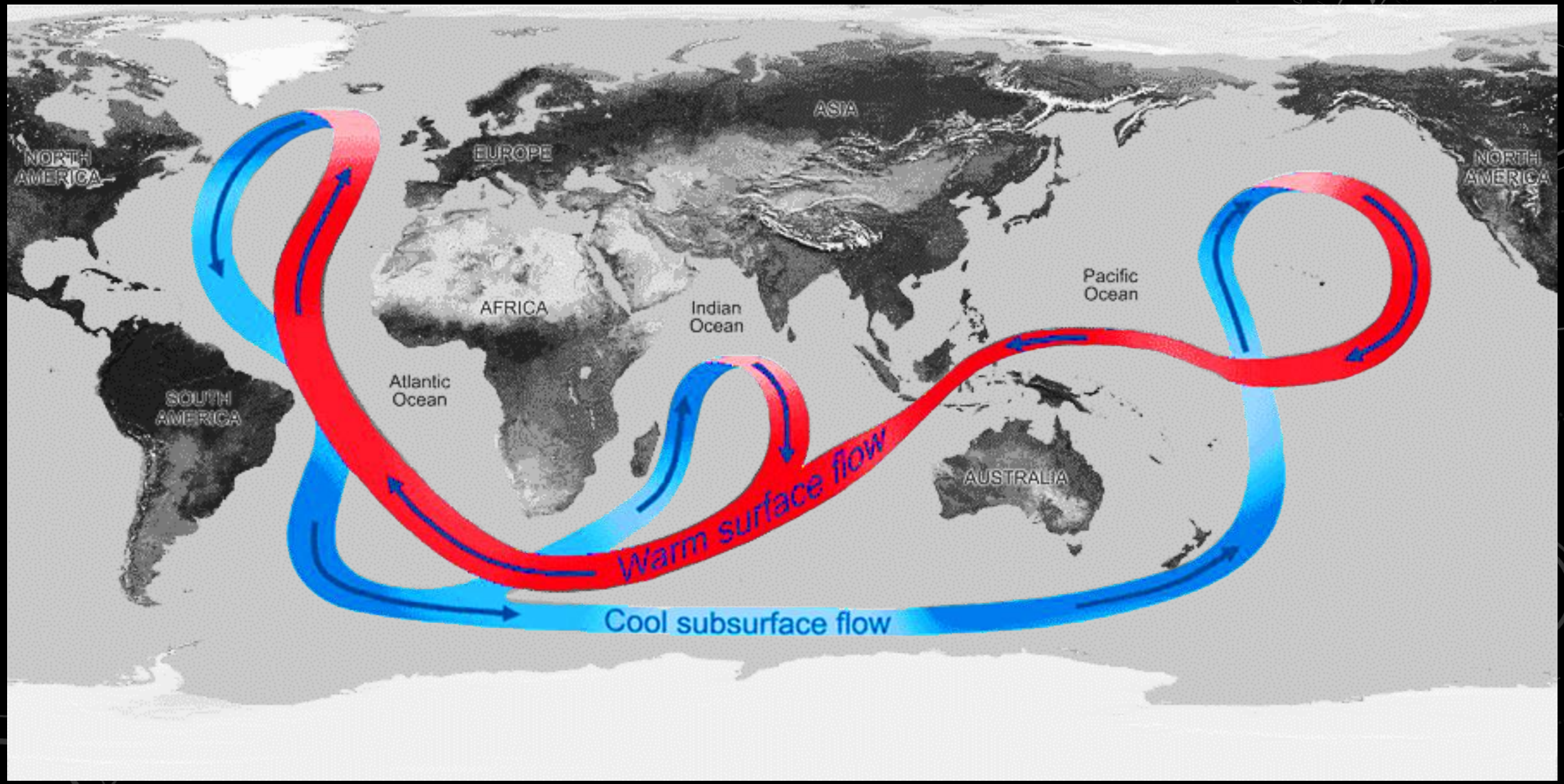
## ❑FACTORS

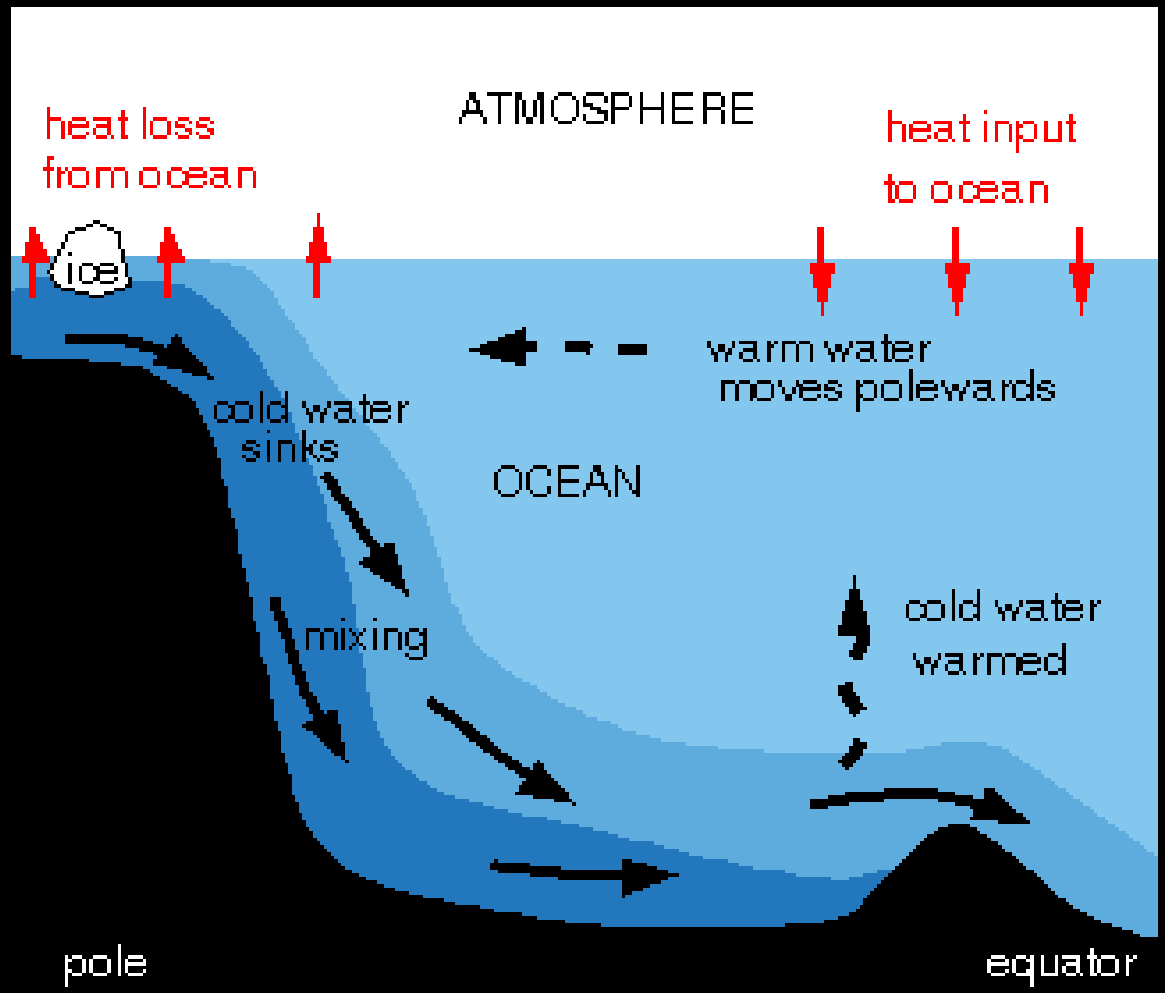
- Heating by solar energy
- Wind
- Gravity
- Coriolis force
- Differences in **water density**
- **Salinity**
- Ocean relief features

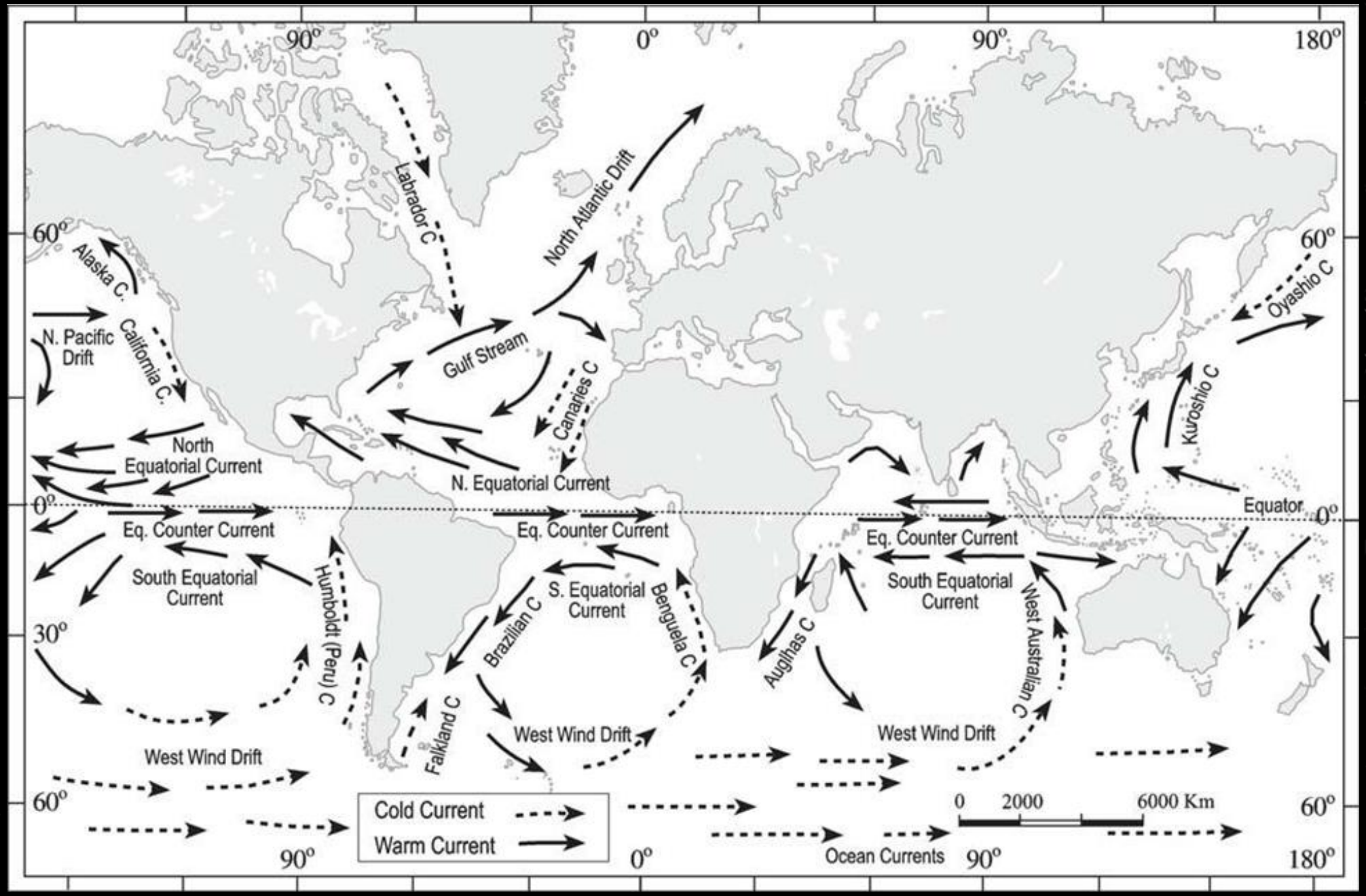

Wind Stress
Offshore water Displacement due to Earth's Rotation
Upwelling

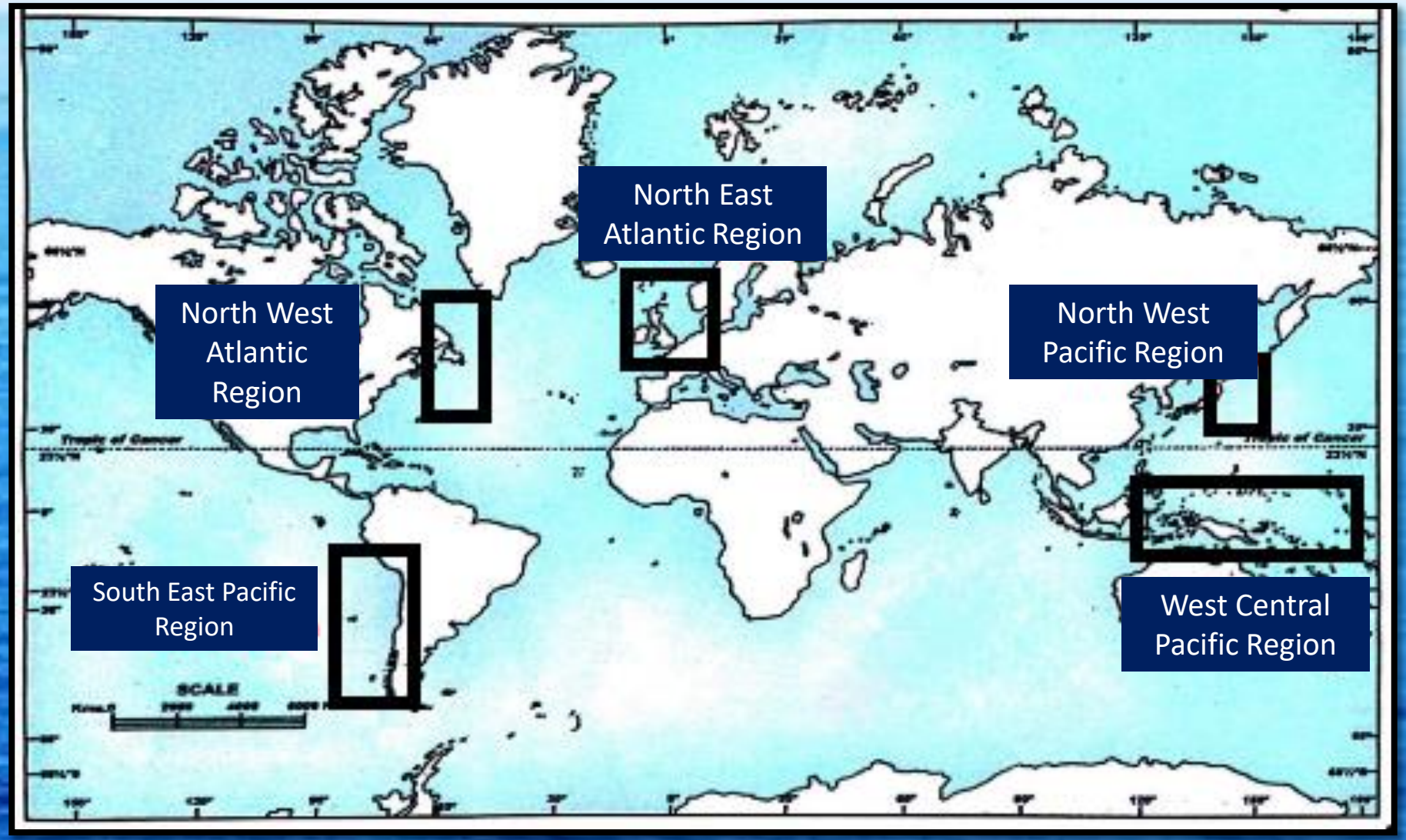

Sea level
Ice
Warm Water
Dense cold
water sinks
Cold Water
2000 m
Deep water
South
Sea floor


low evaporation
high rainfall
salinity
density
water rises
high evaporation
low rainfall
salinity
density
water sinks
Ocean
high salinity + low temp
density
water sinks
less heat from Sun near the poles
temperature
density
water sinks
more heat from Sun in the tropics
temperature
density
water rises


NORTH AMERICA
EUROPE
ASIA
NORTH AMERICA
AFRICA
Indian Ocean
Pacific Ocean
Atlantic Ocean
SOUTH AMERICA
AUSTRALIA
Warm surface flow
Cool subsurface flow


heat loss
from ocean
ATMOSPHERE
heat input
to ocean
ice
warm water
moves polewards
cold water
sinks
OCEAN
mixing
cold water
warmed
pole
equator


90°
0°
90°
180°
60°
60°
Labrador C
North Atlantic Drift
Alaska C.
N. Pacific Drift
California C.
Gulf Stream
Canaries C
Oyashio C
Kuroshio C
North Equatorial Current
N. Equatorial Current
Equator
0°
0°
Eq. Counter Current
Eq. Counter Current
Eq. Counter Current
South Equatorial Current
S. Equatorial Current
South Equatorial Current
Humboldt (Peru) C
Brazilian C
Benguela C
Aughas C
West Australian C
30°
Falkland C
West Wind Drift
West Wind Drift
West Wind Drift
60°
60°
Cold Current
Warm Current
0 2000 6000 Km
90°
0°
Ocean Currents
90°
180°


North East Atlantic Region
North West Atlantic Region
North West Pacific Region
South East Pacific Region
West Central Pacific Region
SCALE

# EFFECTS OF OCEAN CURRENTS

- Modification in the coastal climate
- Effects on fishing
- Effects on trade and navigation

The most important fishing grounds of the world are found in the regions where

(a) warm and cold atmospheric currents meet
(b) rivers drain out large amounts of freshwater into the sea
(c) warm and cold oceanic currents meet
(d) continental shelf is undulating

**What explains the eastward flow of the equatorial counter-current?**

(a) The Earth’s rotation on its axis
(b) Convergence of the two equatorial currents
(c) Difference in salinity of water
(d) Occurrence of the belt of calm near the equator

Consider the following factors:

1. Rotation of the Earth
2. Air Pressure and wind
3. Density of ocean water
4. Revolution of the Earth

Which of the above factors influence the ocean currents?
(a) 1 and 2 only (b) 1, 2 and 3 (c) 1 and 4 (d) 2, 3 and 4

Consider the following statements:

1. Ocean currents are the slow-surface movement of water in the ocean
2. Ocean currents assist in maintaining the Earth’s heat balance
3. Ocean currents are set in motion primarily by prevailing winds
4. Ocean currents are affected by the configuration of the ocean

Which of these statements are correct?

(a) 1 and 2 (b) 2, 3 and 4 (c) 1, 3 and 4 (d) 1, 2, 3 and 4

**Which one of the following factors is responsible for the change in the regular direction of the ocean currents in the Indian Ocean?**

(a) Indian Ocean is ‘half an ocean’
(b) Indian Ocean has Monsoon drift
(c) Indian Ocean is a land-locked Ocean
(d) Indian Ocean has greater variation in salinity

# PREVIOUS YEAR QUESTION (MAINS)

**1.** Explain the factors responsible for the origin of ocean currents. How do they influence regional climates, fishing and navigation? **(2015)**

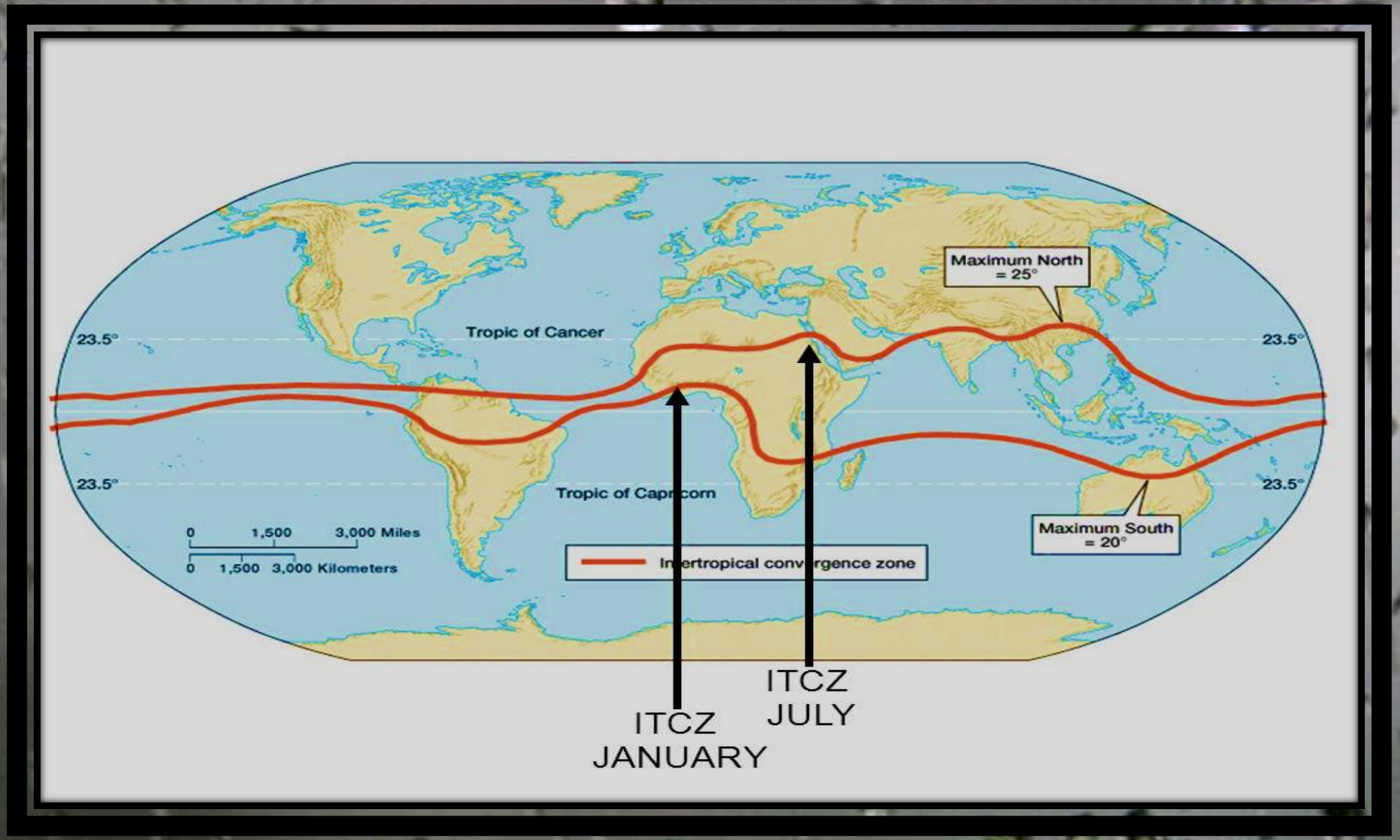


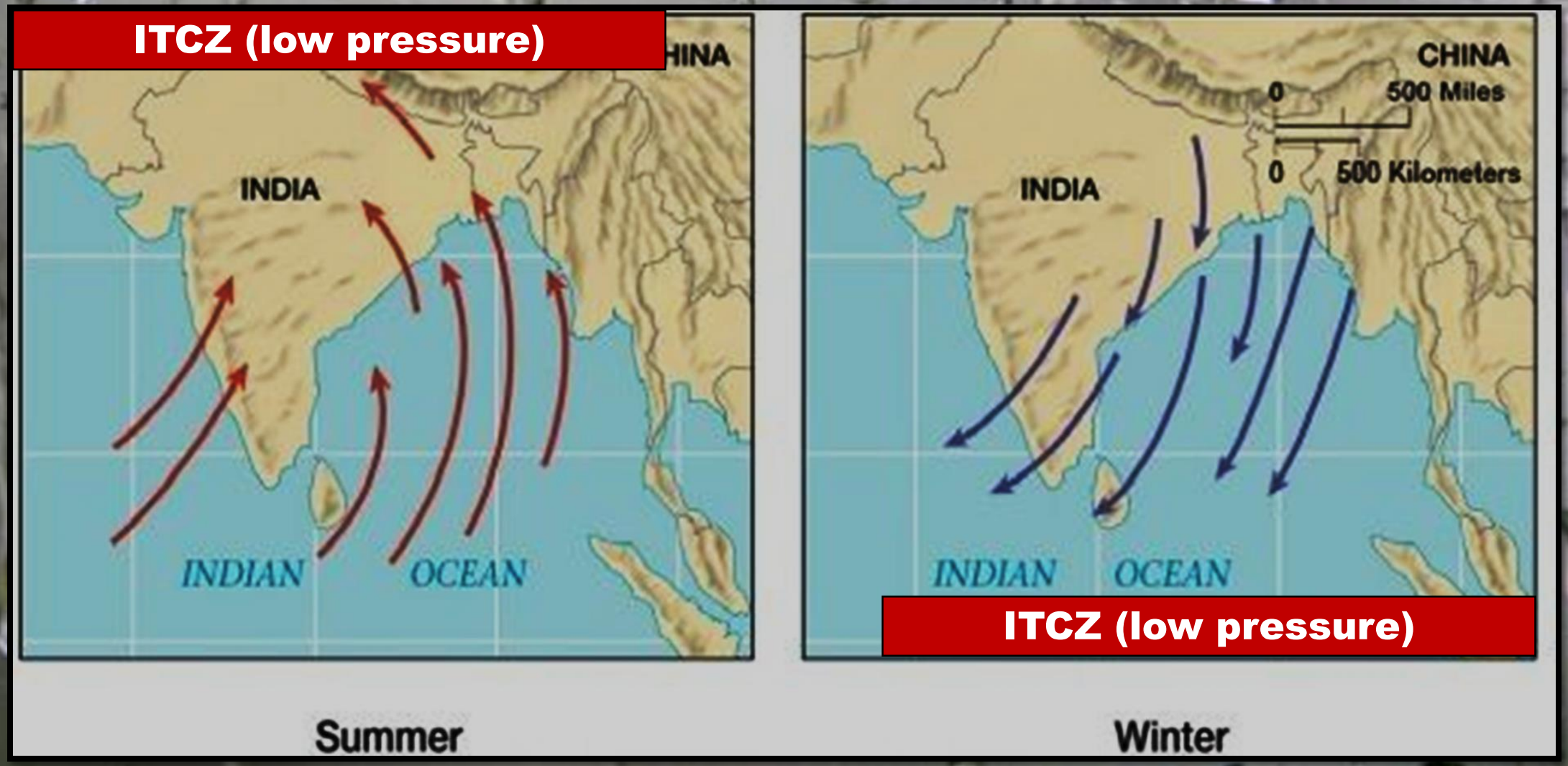
# INDIAN MONSOON

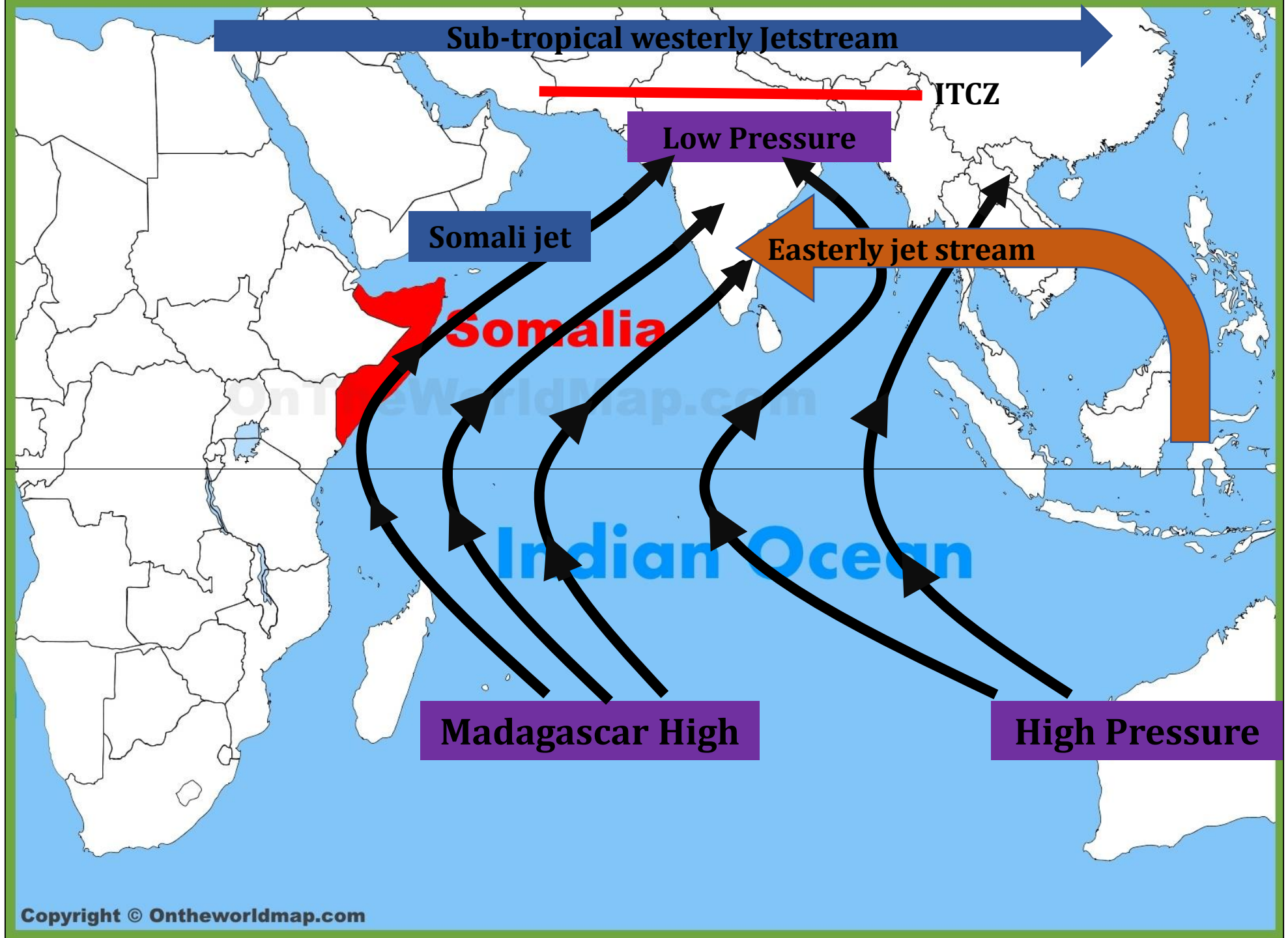
# ORIGIN OF MONSOON

- ITCZ
- THERMAL DIFFERENCE BETWEEN LAND AND OCEAN
- MADAGASCAR HIGH

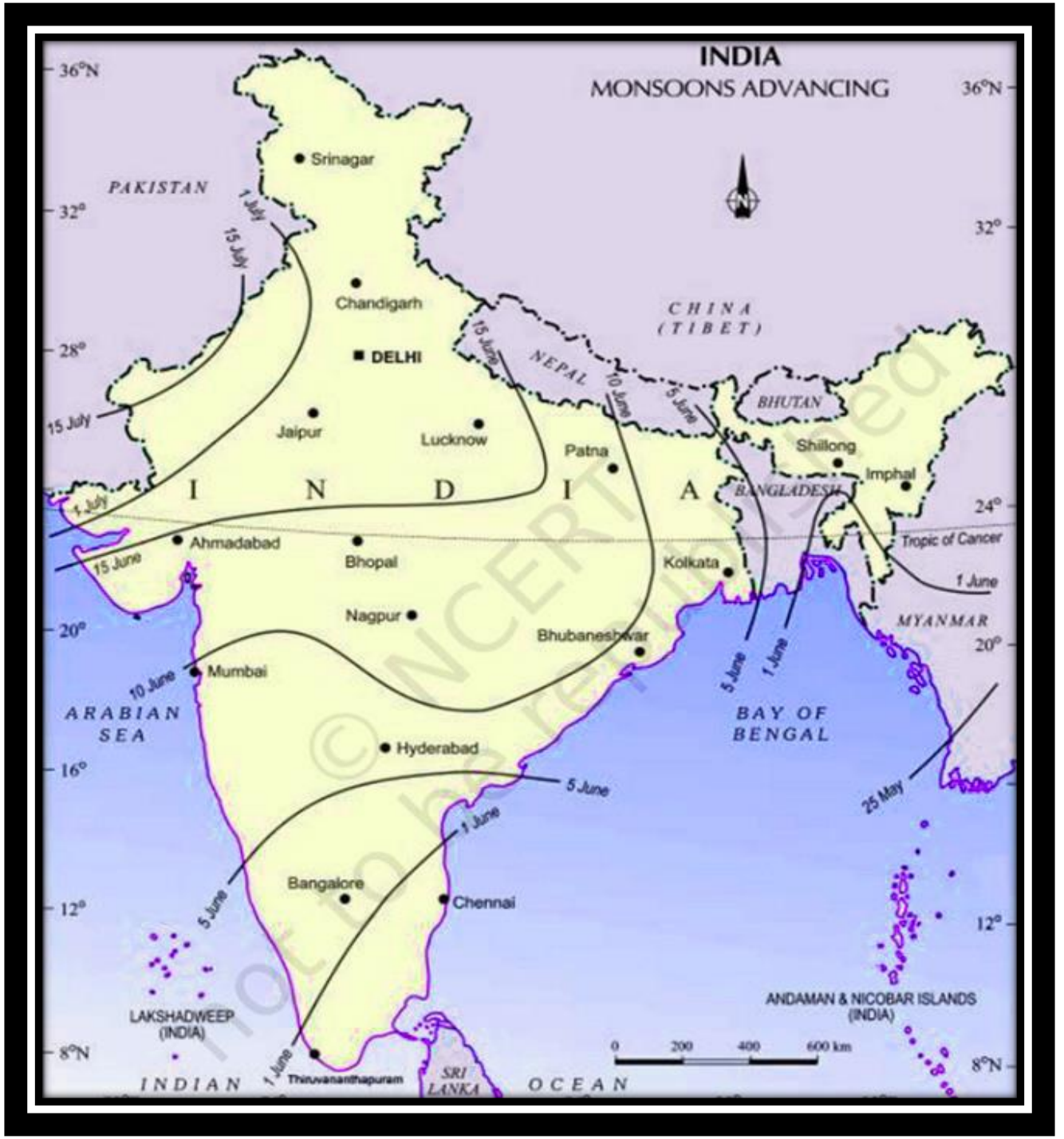
# Inter Tropical Convergence Zone (ITCZ)




ITCZ (low pressure)
INDIA
INDIAN
OCEAN
Summer
CHINA
0
500 Miles
0
500 Kilometers
INDIA
INDIAN
OCEAN
ITCZ (low pressure)
Winter


Sub-tropical westerly Jetstream
ITCZ
Low Pressure
Somali jet
Easterly jet stream
Somalia
Indian Ocean
Madagascar High
High Pressure
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# ADVANCING MONSOON



# RETREATING MONSOON

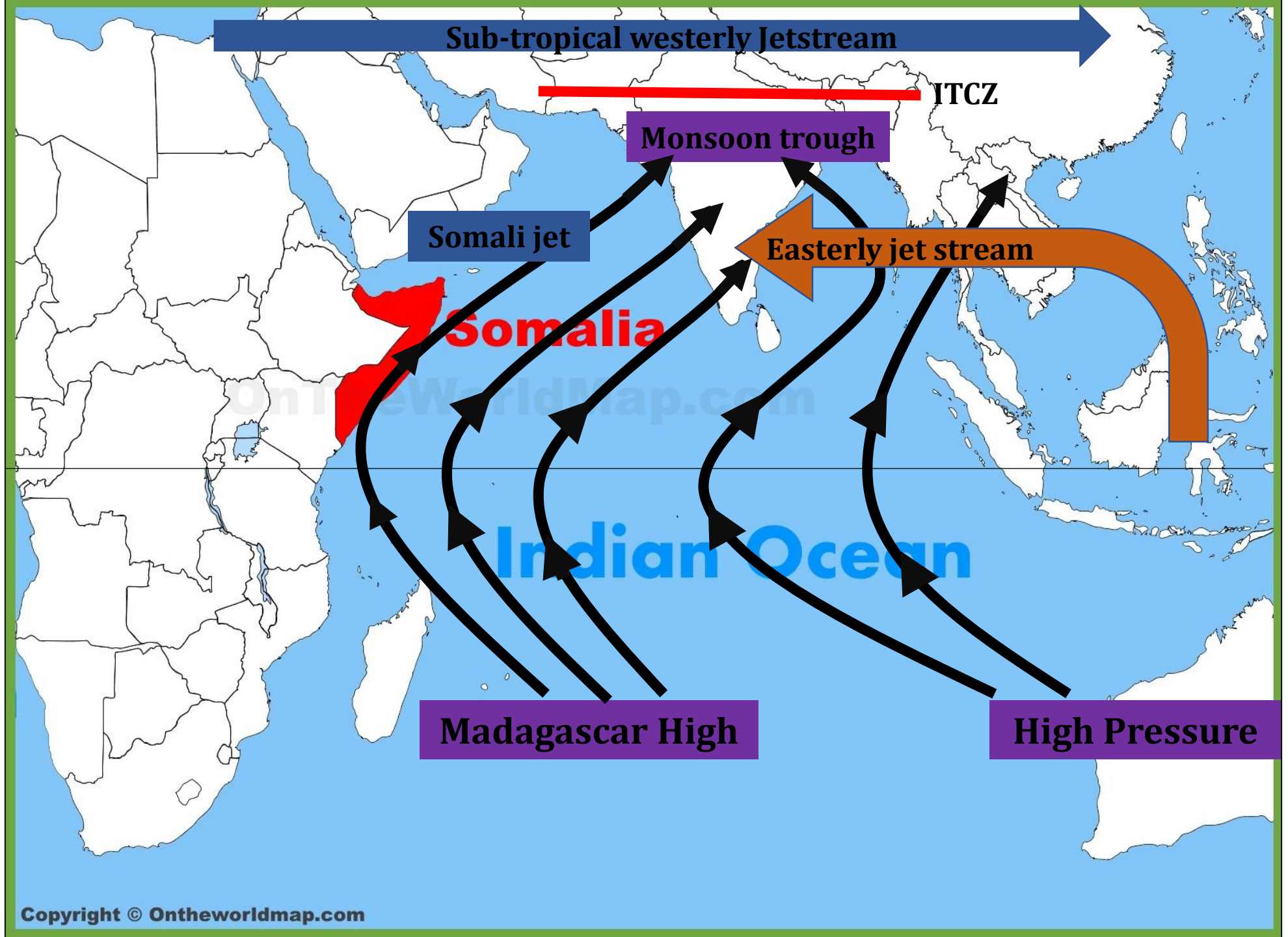


# IMPORTANT TERMS RELATED WITH MONSOON

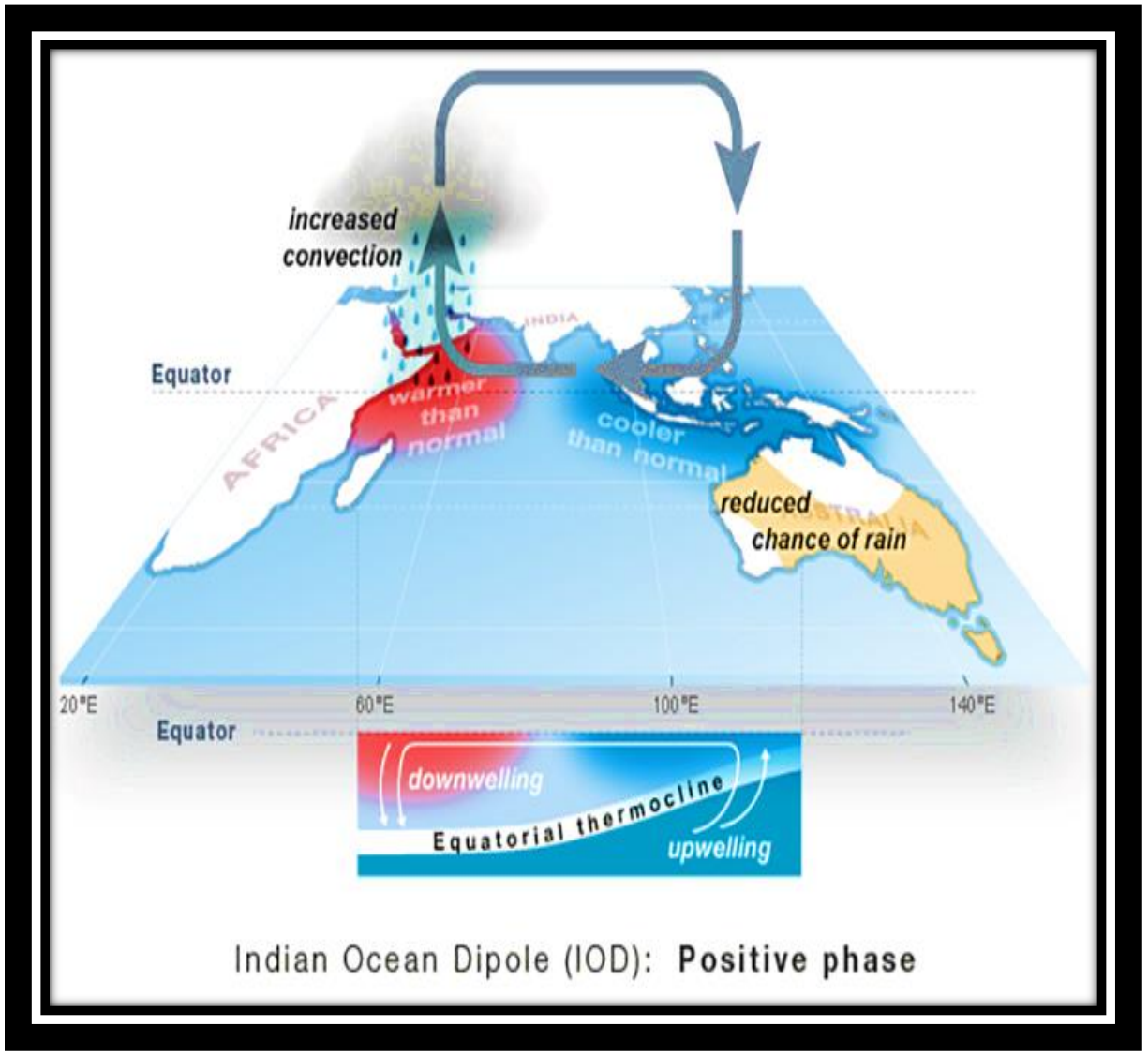
- ✓The onset of the monsoon
- ✓Rain-bearing systems
- ✓Break in the monsoon
- ✓Burst of monsoon
- ✓Monsoon trough
- ✓Normal monsoon

# FACTORS AFFECTING MONSOON

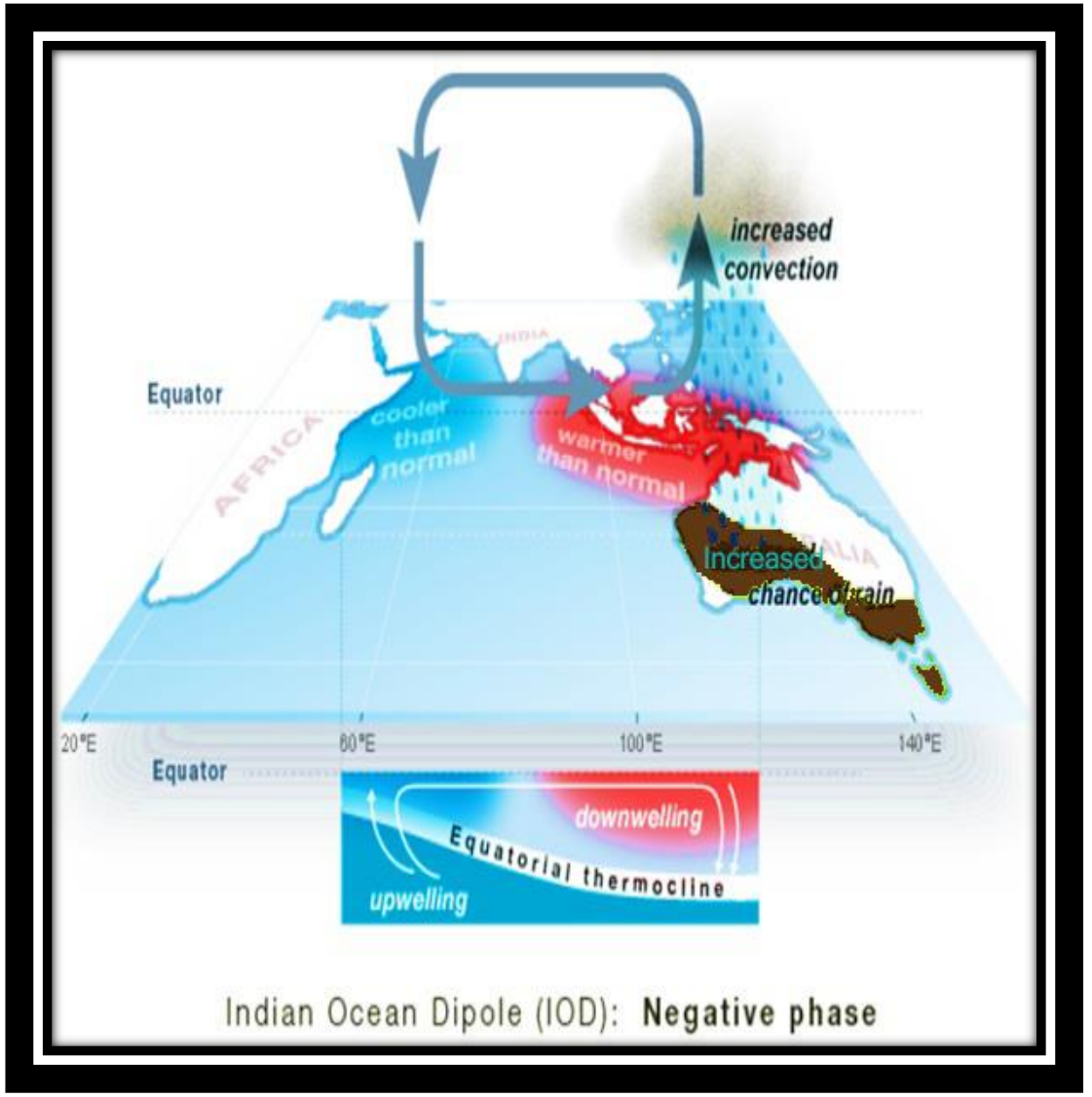
- SEASONS
- CORIOLIS FORCE
- ENSO
- TROPICAL DEPRESSIONS
- INDIAN OCEAN DIPOLE
- UPPER AIR CIRCULATION
- LANDSCAPE
- ITCZ
- AEROSOLS


Sub-tropical westerly Jetstream
ITCZ
Monsoon trough
Somali jet
Easterly jet stream
Somalia
Indian Ocean
Madagascar High
High Pressure
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# INDIAN OCEAN DIPOLE

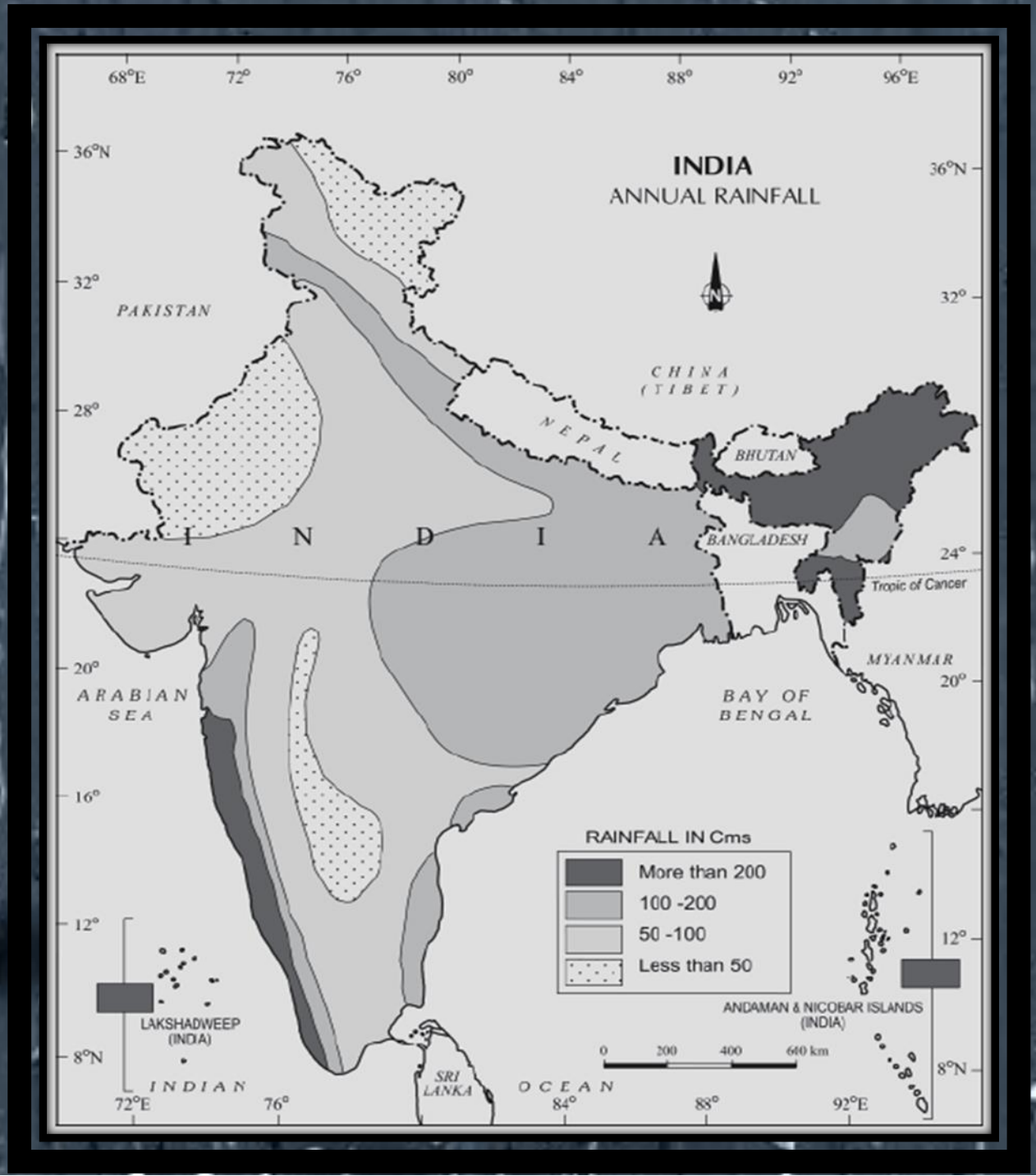



Indian Ocean Dipole (IOD): **Positive phase**

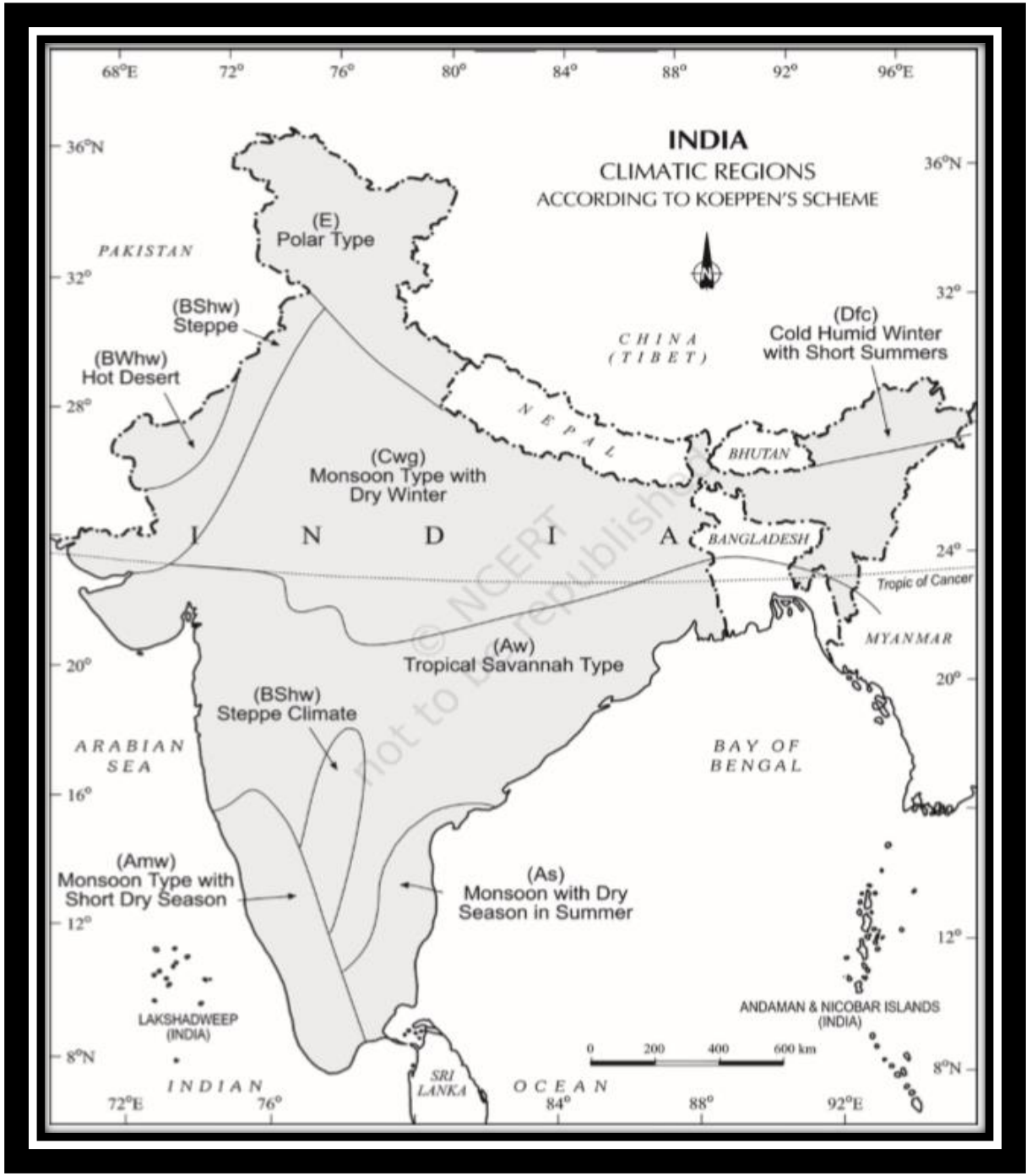



Indian Ocean Dipole (IOD): **Negative phase**

# ANNUAL RAINFALL



# CLIMATIC REGIONS IN INDIA



ACADEMY OF CIVIL SERVICES

Be the Best - Be the Change

**INDIAN AND WORLD GEOGRAPHY**

**UPSC PREVIOUS YEARS PRELIMS QUESTIONS – Chapter Wise (2011-2020)**

## EARTH AND UNIVERSE

1. **Recently, scientists observed the merger of giant 'blackholes' billions of light-years away from the Earth. What is the significance of this observation? (2019)**
   a. **'Higgs boson particles' were detected.**
   b. **'Gravitational waves' were detected.**
   c. **Possibility of inter-galactic space travel through 'wormhole' was confirmed.**
   d. **It enabled the scientist to understand 'singularity'.**
2. **Consider the following statements: (2018)**
   1. **The Earth's magnetic field has reversed every few hundred thousand years.**
   2. **When the Earth was created more than 4000 million years ago, there was 54% oxygen and no carbon dioxide.**
   3. **When living organisms originated, they modified the early atmosphere of the Earth.**

   **Which of the statements given above is/are correct?**
   **(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

3. **Consider the following phenomena: (2018)**
   1. **Light is affected by gravity**
   2. **The Universe is constantly expanding.**
   3. **Matter warps its surrounding space-time.**

   **Which of the above is/are the prediction/predictions of Albert Einstein's General Theory of Relativity, often discussed in media?**
   **(a) 1 and 2 only (b) 3 only (c) 1 and 3 only (d) 1, 2 and 3**

4. **What is the purpose of 'evolved Laser Interferometer Space Antenna (eLISA)' project? (2017)**
   (a) **To detect neutrinos**
   (b) **To detect gravitational waves**
   (c) **To detect the effectiveness of missile defence system**
   (d) **To study the effect of solar flares on our communication systems**
5. **The terms 'Event Horizons' 'Singularity', 'String Theory' and 'Standard model' are sometimes seen in the news in the context of (2017)**
   (a) **Observation and understanding of the Universe**
   (b) **Study of the solar and the lunar eclipses**
   (c) **Placing satellites in the orbit of the Earth**
   (d) **Origin and evolution of living organisms on the Earth**

**6. The term 'Goldilocks Zone' is often seen in the news in the context of (2015)**
**(a) The limits of habitable zone above the surface of the Earth**
**(b) Regions inside the Earth where shale gas is available**
**(c) Search for the Earth-like planets in outer space**
**(d) Search for meteorites containing precious metals**

**7. Which of the following is/are cited by the scientists as evidence/evidences for the continued expansion of universe? (2012)**
**1. Detection of microwaves in space**
**2. Observation of red shift phenomenon in space**
**3. Movement of asteroids in space**
**4. Occurrence of supernova explosions in space**
**Select the correct answer using the codes given below:**
**(a) 1 and 2 (b) 2 only**
**(c) 1, 3 and 4 (d) None of the above can be cited as evidence**

**8. Which of the following sets of elements was primarily responsible for the origin of life on the Earth? (2012)**
**(a) Hydrogen, Oxygen, Sodium**
**(b) Carbon, Hydrogen, Nitrogen**
**(c) Oxygen, Calcium, Phosphorus**
**(d) Carbon, Hydrogen, Potassium**

**9. What is the difference between asteroids and comets? (2011)**
1. **Asteroids are small rocky planetoids, while comets are formed of frozen gases held together by rocky and metallic material**
2. **Asteroids are found mostly between the orbits of Jupiter and Mars, while comets are found mostly between Venus and Mercury.**
3. **Comets show a perceptible glowing tail, while asteroids do not.**

**Which of the statements given above is/are correct?**
**(a) 1 and 2 only (b) 1 and 3 only**
**(c) 3 only (d) 1, 2 and 3**

**10. In order of distances from the Sun, which of the following planets lie between Mars and Uranus? (2008)**
**(a) Earth and Jupiter (b) Jupiter and Saturn**
**(c) Saturn and Earth (d) Saturn and Neptune**

**11. What is the average distance (approximate) between the sun and the Earth? (2007)**
**(a) $70 \times 10^5$ km (b) $100 \times 10^5$ km (c) $110 \times 10^6$ km (d) $150 \times 10^6$ km**

**12. Assertion (A): To orbit around Sun, the planet Mars takes lesser time than time taken by the Earth. (2006)**
**Reason (R): The diameter of the planet Mars is less than that of the Earth.**
**(a) Both A and R are true, and R is the correct explanation of A**
**(b) Both A and R are true, but R is not a correct explanation of A**
**(c) A is true but R is false**
**(d) A is false but R is true**

**13. Assertion (A): Existence of human life on Venus is highly improbable. Reason (R): Venus has extremely high level of carbon dioxide in its atmosphere. (2005)**
**(a) Both A and R are true, and R is the correct explanation of A**
**(b) Both A and R are true, but R is not a correct explanation of A**
**(c) A is true but R is false**
**(d) A is false but R is true**

**14. Among the following which planet takes maximum time for one revolution around the Sun? (2003)**
**(a) Earth (b) Jupiter (c) Mars (d) Venus**

**15. Which one of the following statements is correct with reference to our solar system? (2002)**
(a) **The Earth is the densest of all the planets in our solar system**
(b) **The predominant element in the composition of Earth is silicon.**
(c) **The Sun contains 75 percent of the mass of the solar system.**
(d) **The diameter of the Sun is 190 times that of the Earth.**

**16. A 'black hole' is a body in space which does not allow any radiation to come out. This property is due to its (2000)**
**(a) very small size (b) very large size**
**(c) very high density (d) very low density**

**17. Consider the following statements regarding asteroids: (1998)**
**1. Asteroids are rocky debris of varying sizes orbiting the sun**
**2. Most of the asteroids are small but some have diameter as large as 1000km**
**3. The orbit of asteroids lies between the orbits of Jupiter and Saturn.**
**Which of these statements are correct?**
**(a) 1, 2 and 3 (b) 2, and 3 (c) 1 and 2 (d) 1 and 3**

**18. The group of small pieces of rock revolving round the sun between the orbits of Mars and Jupiter are called (1997)**
**(a) meteors (b) comets (c) meteorites (d) asteroids**

**19. Which one of the following stars is nearest to the Earth? (1997)**
**(a) Polaris (b) Alpha Centauri (c) Sun (d) Sirius**

**20. Which one of the following conditions is most relevant for the presence of life on Mars? (1997)**
**(a) Atmospheric composition**
**(b) Thermal conditions**
**(c) Occurrence of ice cape and frozen water**
**(d) Occurrence of Ozone**

**21. A meteor is: (1995)**
**(a) a rapidly moving star.**
**(b) a piece of matter which has entered the earth's atmosphere from outer space.**
**(c) a part of a constellation.**
**(d) a comet without a tail**

**22. On 21st June, the Sun (2019)**
a) **does not set below the horizon at the Arctic Circle**
b) **does not set below the horizon at Antarctic Circle**
c) **shines vertically overhead at noon on the Equator**
d) **shines vertically overhead at the Tropic of Capricorn**

**23. Among the following cities, which one lies on a longitude closes to that of Delhi? (2018)**
**(a) Bengaluru**
**(b) Hyderabad**
**(c) Nagpur**
**(d) Pune**

**24. Variations in the length of daytime and night-time from season to season are due to (2013)**

(a) **The earth's rotation on its axis**

(b) **The earth's revolution round the sun in an elliptical manner**

(c) **Latitudinal position of the place**

(d) **Revolution of the earth on a tilted axis**

**25. A person stood alone in a desert on a dark night and wanted to reach his village which was situated 5 km east of the point where he was standing. He had no instruments to find the direction, but he located the polestar. The most convenient way now to reach his village is to walk in the (2012)**

**(a) direction facing the polestar**

**(b) direction opposite to the polestar**

**(c) direction keeping the polestar to his left**

**(d) direction keeping the polestar to his right**

**26. Consider the following countries (2009)**

**1. Australia 2. Namibia 3. Brazil 4. Chile**

**Through which of the above does the Tropic of Capricorn pass?**

**(a) 1 only (b) 2, 3 and 4 (c) 1, 2 and 3 (d) 1, 2, 3 and 4**

**27. Which one of the following straits is nearest to the International Date Line? (2008)**

**(a) Malacca Strait (b) Bering Strait**

**(c) Strait of Florida (d) Strait of Gibraltar**

**28. Which one of the following cities does not have the same clock time as that of the other three cities at any given instant? (2007)**

**(a) London (U.K) (b) Lisbon (Portugal)**

**(c) Accra (Ghana) (d) Addis Ababa (Ethiopia)**

**29. What is the average distance (approximate) between the sun and the Earth? (2007)**

**(a) 70 x $10^5$ km(b) 100 x $10^5$ km (c) 110 x $10^6$ km (d) 150 x $10^6$ km**

**30. What is the approximate mean velocity with which the Earth moves round the sun in its orbit? (2006)**

**(a) 20 km/s (b) 30 km/s (c) 40 km/s (d) 50 km/s**

**31. Consider the following statements: (2005)**

1. **Total land area of Earth is approximately 1475 lakh square kilometres**
2. **Ratio of land area to water area of Earth is approximately 1:4**
3. **Maximum percentage of Earth's water is in the Pacific Ocean**

**Which of the statements given above is/are correct?**

**(a) 1 and 3 (b) 2 and 3 (c) 1 only (d) 3 only**

**32. Consider the following statements: (2005)**

1. **The axis of the earth's magnetic field is inclined at 23 ½ $^0$ to the geographic axis of the earth**
2. **The earth's magnetic pole in the northern hemisphere is located on a peninsula in northern Canada.**
3. **Earth's magnetic equator passes through Thumba in South India.**

**Which of the statements given above is/are correct?**

**(a) 1, 2 and 3 (b) 2 and 3 (c) 2 only (d) 3 only**

**33. Assertion (A): The same face of the Moon is always presented to the Earth**
**Reason (R): The Moon rotates about its own axis in 23 ½ days which is about the same time that it takes to orbit the Earth. (2005)**

**(a) Both A and R are true, and R is the correct explanation of A**
**(b) Both A and R are true, but R is not a correct explanation of A**
**(c) A is true but R is false**
**(d) A is false but R is true**

**34. If it is 10.00 a.m. at I.S.T. then what would be the local time at Shillong on $92^0$E longitude? (1999)**

**(a) 9.38 a.m. (b) 10.38 a.m. (c) 10.22 a.m. (d) 9.22 a.m.**

**35. A ship sailing from the eastern extremity of the Aleutian Islands to Dutch crosses $180^0$ meridian at 23.30 hrs on January 1, 1999. What time and date will be recorded by the captain of the ship in his diary after one-hour journey from the point of crossing of the meridian? (1999)**

**(a) January 1, 0030 hrs (b) January 2, 0030 hrs**
**(c) January 3, 0030 hrs (d) January 4, 0030 hrs**

**36. When there is noon at I.S.T meridian people on another place of the Earth are taking their 6 O'clock morning tea. The longitude of the place is: (1998)**

**(a) $17^0$ 30'E (b) $7^0$ 30' W (c) $172^0$ 30' E (d) $90^0$ W**

**37. If the earth's direction of rotation is reversed, what would be the IST when it is noon at the International Date Line? (1997)**

**(a) 06.30 hrs (b) 05.30 hrs (c) 18.30 hrs (d) 17.30 hrs**

## ATMOSPHERE

**1. The increasing amount of carbon dioxide in the air is slowly raising the temperature of the atmosphere, because it absorbs (2012)**

**(a) the water vapour of the air and retains its heat**
**(b) the ultraviolet part of the solar radiation**
**(c) all the solar radiations**
**(d) the infrared part of the solar radiation**

**2. Electrically charged particles from space travelling at speeds of several hundred km/sec can severely harm living beings if they reach the surface of the Earth. What prevents them from reaching the surface of the Earth? (2012)**

**(a) The Earth's magnetic field diverts them towards its poles**
**(b) Ozone layer around the Earth reflects them back to outer space**
**(c) Moisture in the upper layers of atmosphere prevents them from reaching the surface of the Earth**
**(d) None of the statements (a), (b) and (c) given above is correct**

**3. The jet aircrafts fly very easily and smoothly in the lower stratosphere. What could be the appropriate explanation? (2011)**

1. **There are no clouds or water vapour in the lower stratosphere**
2. **There are no vertical winds in the lower stratosphere.**

**Which of the statements given above is/are correct?**

**(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**

**4. A layer in the Earth's atmosphere called Ionosphere facilitates radio communication. Why? (2011)**

**1. The presence of ozone causes the reflection of radio waves to Earth.**

**2. Radio waves have a very long wavelength.**

**Which of the statements given above is/are correct?**

**(a) 1only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**

**5. Consider the following which can be found in the ambient atmosphere: (2010)**

**1. Soot 2. Sulphur hexafluoride 3. Water vapour**

**Which of the above contribute to the warming up of the atmosphere?**

**(a) 1 and 2 only (b) 3 only (c) 2 and 3 only (d) 1, 2 and 3**

**6. Assertion (A): The thickness of the atmosphere is maximum over the Equator.**
**Reasons (R): High insolation and strong convection currents occur over the Equator. (2004)**

**(a) Both A and R are true, and R is the correct explanation of A**

**(b) Both A and R are true, but R is not a correct explanation of A**

**(c) A is true but R is false**

**(d) A is false but R is true**

**7. The correct sequence of different layers of the atmosphere from the surface of the Earth upwards (1998)**

**(a) Troposphere, Stratosphere, Ionosphere, Mesosphere**

**(b) Stratosphere, Troposphere, Ionosphere, Mesosphere**

**(c) Troposphere, Stratosphere, Mesosphere, Ionosphere**

**(d) Stratosphere, Troposphere, Mesosphere, Ionosphere**

**8. Which one of the following layers of the atmosphere is responsible for the deflection of radio waves? (1996)**

**(a) Troposphere (b) Stratosphere(c) Mesosphere (d) Ionosphere**

## INSOLATION AND TEMPERATURE

**1) The annul range of temperature in the interior of the continents is high as compared to coastal areas. What is/are the reason/reasons? (2013)**

1. **Thermal difference between land and water**
2. **Variation in altitude between continents and oceans**
3. **Presence of strong winds in the interior.**
4. **Heavy rains in the interior as compared to coasts.**

**Select the correct answer using the codes given below.**

a) **1 only**
b) **1 and 2**
c) **2 and 3**

d) 1, 2, 3 and 4

2) Which one of the following reflects back more sunlight as compared to other three? (2010)
   a) Sand desert
   b) Paddy crop land
   c) Land covered with fresh snow
   d) Prairie land
3) Consider the following statements: (2008)
   1. The albedo of an object determines its visual brightness when viewed with reflected light.
   2. The albedo of Mercury is much greater than the albedo of the Earth

   Which of the statements given above is/are correct?
   a) 1 only
   b) (b) 2 only
   c) Both 1 and 2
   d) Neither 1 nor 2
4) Consider the following statements: (2005)
   1. The annual range of temperature is greater in the Pacific Ocean than that in the Atlantic Ocean
   2. The annual range of temperature is greater in the Northern Hemisphere than that in the Southern Hemisphere

   Which of the statements given above is/are correct?
   a) 1 only
   b) 2 only
   c) Both 1 and 2
   d) Neither 1 nor 2
5) Cloudy nights are warmer compared to clear cloudless nights because clouds: (2001)
   a) Prevent cold waves from the sky from descending on earth
   b) Reflect back the heat given off by earth
   c) Produce heat and radiate it towards earth
   d) Absorb heat from the atmosphere and send it towards earth

## PRESSURE AND WIND

1. Consider the following statements: (2015)
   1. The winds which blow between $30^0$N and $60^0$S latitudes throughout the year are known as westerlies.
   2. The moist air masses that cause winter rains in North-Western region of India are part of westerlies.

   Select the correct answer using the code given below.
   (a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2
2. Normally, the temperature decreases with the increase in height from the Earth's surface, because (2012)
   1. the atmosphere can be heated upwards only from the Earth's surface
   2. there is more moisture in the upper atmosphere
   3. the air is less dense in the upper atmosphere

**Select the correct answer using the codes given below:**

**(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

3. **Westerlies in southern hemisphere are stronger and persistent than in northern hemisphere. Why? (2011)**
   1. **Southern hemisphere has less landmass as compared to northern hemisphere.**
   2. **Coriolis force is higher in southern hemisphere as compared to northern hemisphere**

   **Which of the statements given above is/are correct?**

   **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**
4. **What could be the main reason/reasons for the formation of African and Eurasian desert belt? (2011)**
   1. **It is located in the sub-tropical high-pressure cells.**
   2. **It is under the influence of warm ocean currents.**

   **Which of the statements given above is/are correct?**

   **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**
5. **What causes wind to deflect toward left in the Southern hemisphere? (2010)**

   **(a) Temperature b) Magnetic field (c) Rotations of the earth (d) Pressure**
6. **Consider the following statements: (2009)**
   1. **In the world, the tropical deserts occur along the western margins of continents within the trade wind belt**
   2. **In India, the East Himalayan region gets high rainfall from north-east winds.**

   **Which of the statement(s) given above is/are correct?**

   **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**
7. **Assertion (A): Wind patterns are clockwise in the northern hemisphere and anti-clockwise in the southern hemisphere**

   **Reason (R): The directions of wind patterns in the northern and the southern hemisphere are governed by the Coriolis Effect. (2005)**

   **(a) Both A and R are true, and R is the correct explanation of A**

   **(b) Both A and R are true, but R is not a correct explanation of A**

   **(c) A is true but R is false**

   **(d) A is false but R is true**
8. **Consider the following statements: (2005)**
   1. **Either of the two belts over the oceans at about $30^0$ to $35^0$ N and Latitudes is known as Horse Latitude.**
   2. **Horse latitudes are low pressure belts.**

   **Which of the statements given above is/are correct?**

   **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**
9. **Assertion (A): $60^0$-$65^0$ latitudes in both the hemispheres have a low-pressure belt instead of high pressure.**

   **Reason (R): The low-pressure areas are permanent over oceans rather than on land (2002)**

   **(a) Both A and R are true, and R is the correct explanation of A**

   **(b) Both A and R are true, but R is not a correct explanation of A**

   **(c) A is true but R is false**

(d) A is false but R is true

10. Match List-I with List-II and select the correct answer using the codes given below the lists: (2001)

| List-I (Local Wind) | List-II (Region) |
|---|---|
| A. Foehn | 1. Argentina |
| B. Sarmun | 2. Kurdistan |
| C. Santa Ana | 3. California |
| D. Zonda | 4. Alps |

Codes:

| | A | B | C | D | | A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|
| (a) | 2 | 4 | 1 | 3 | (b) | 4 | 2 | 3 | 1 |
| (c) | 2 | 4 | 3 | 1 | (d) | 4 | 2 | 1 | 3 |

11. Consider the following statements about the Roaring Forties: (2000)
    1. They blow uninterrupted in the Northern and Southern Hemispheres
    2. They blow with great strength and constancy
    3. Their direction is generally from North-West to East in the Southern Hemisphere
    4. Overcast skies, rain and raw weather are generally associated with them

    Which of these statements are correct?

    (a) 1, 2 and 3 (b) 2, 3 and 4 (c) 1, 3 and 4 (d) 1, 2 and 4

## ATMOSPHERE AND MOISTURE

1. Why are dewdrops not formed on a cloudy night? (2019)
   (a) Clouds absorb the radiation released from the Earth's surface.
   (b) Clouds reflect back the Earth's radiation.
   (c) The Earth's surface would have low temperature on cloudy nights.
   (d) Clouds deflect the blowing wind to ground level.
2. Which one of the following statements is correct? (2004)
   (a) Cirrus clouds are composed of ice crystals
   (b) Cirrus clouds exhibit a flat base and have the appearance of rising domes
   (c) Cumulus clouds are white and thin and form delicate patches and give a fibrous and feathery appearance
   (d) Cumulus clouds are classified as high clouds
3. Assertion (A): The amount of moisture in the atmosphere is related to latitude.
   Reason (R): The capacity to hold moisture in the form of water vapour related to temperature. (2003)
   a) Both A and R are individually true, and R is the correct explanation of A
   b) Both A and R are individually true, but R is not the correct explanation of A
   c) A is true, but R is false
   d) A is false, but R is true
4. Consider the following climatic and geographical phenomena: (2002)
   1. Condensation 2. High temperature and humidity
   3. Orography 4. Vertical wind

   Thunder Could development is due to which of these phenomena?

   (a) 1 and 2 (b) 2, 3 and 4 (c) 1, 3 and 4 (d) 1, 2, 3 and 4

**5. The clouds float in the atmosphere because of their low (1995)**
**(a) temperature (b) velocity (c) pressure (d) density**

## WEATHER EVENTS

**1. Consider the following statements: (2020)**
**1. Jet streams occur in the Northern Hemisphere only.**
**2. Only some cyclones develop an eye**
**3. The temperature inside the eye of a cyclone is nearly 10°C lesser than that of the surroundings.**
**Which of the statements given above is/are correct?**
**(a) 1 only (b) 2 and 3 only**
**(c) 2 only (d) 1 and 3 only**

**2. Consider the following statements: (2015)**
**1. The winds which blow between $30^0$N and $60^0$S latitudes throughout the year are known as westerlies.**
**2. The moist air masses that cause winter rains in North-Western region of India are part of westerlies.**
**Select the correct answer using the code given below.**
**(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**

**3. In the South Atlantic and South-Eastern Pacific regions in tropical latitudes, cyclone does not originate. What is the reason? (2015)**
**(a) Sea surface temperature are low**
**(b) Inter-Tropical Convergence Zone seldom occurs**
**(c) Coriolis force is too weak**
**(d) Absence of land in those regions**

**4. During a thunderstorm, the thunder in the skies is produced by the (2013)**
**1. meeting of cumulonimbus clouds in the sky.**
**2. lightening that separates the nimbus clouds.**
**3. violent upward movement of air and water particles.**
**Select the correct answer using the codes given below:**
**(a) 1 only (b) 2 and 3 (c) 1 and 3 (d) None of the above produces the thunder**

**5. Consider the following names: (2009)**
**1. Ike 2. Kate 3. Gustav**
**Which of the above are the names of hurricanes that had occurred very recently?**
**(a) 1 and 2 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

**6. Consider the following statements: (2001)**
**1. Anti-cyclonic conditions are formed in winter season when atmospheric pressure is high and air temperatures are low.**
**2. Winter rainfall in Northern India causes development of Anticyclonic conditions with low temperatures.**
**Which of the statement(s) given above is/are correct?**
**(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**

7. **Consider the following climatic and geographical phenomena:(2002)**
   **1. Condensation 2. High temperature and humidity**
   **3. Orography 4. Vertical wind**
   **Thunder cloud development is due to which of these phenomena?**
   **(a) 1 and 2 (b) 2, 3 and 4 (c) 1, 3 and 4 (d) 1, 2, 3 and 4**
8. **Which one of the following weather conditions is indicated a sudden fall in barometer reading? (2001)**
   **(a) Stormy (b) Calm weather**
   **(c) Cold and dry weather (d) Hot and sunny weather**
9. **Willy Willy is: (1995)**
   **(a) a type of tree grown in temperate regions**
   **(b) a wind that blows in a desert**
   **(c) a tropical cyclone of the north-west Australia**
   **(d) a kind of common fish found near Lakshadweep islands**

## INDIA'S CLIMATE

1. **With reference to 'Indian Ocean Dipole (IOD)' sometimes mentioned in the news while forecasting Indian monsoon, which of the following statements is/are correct? (2017)**
   **1. IOD phenomenon is characterised by a difference in sea surface temperature between tropical Western Indian Ocean and tropical Eastern Pacific Ocean.**
   **2. An IOD phenomenon can influence an EI Nino's impact on the monsoon.**
   **Select the correct answer using the code given below:**
   **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**
2. **Consider the following statements: (2012)**
   **1. The duration of the monsoon decreases from southern Indian to northern India**
   **2. The amount of annual rainfall in the northern plains of India decreases from east to west**
   **Which of the statements given above is/are correct?**
   **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**

## WORLD CLIMATE

1. **Each day is more or less the same, the morning is clear and bright with a sea breeze; as the Sun climbs high in the sky, heat mounts up, dark clouds form, then rain comes with thunder and lightning. But rain is soon over." (2015)**
   **Which of the following regions is described in the above passage?**
   **(a) Savannah (b) Equatorial (c) Monsoon (d) Mediterranean**
2. **The seasonal reversal of winds is the typical characteristics of (2014)**
   **(a) Equatorial climate (b) Mediterranean climate**
   **(c) Monsoon climate (d) All of the above climates**
3. **"Climate is extreme, rainfall is scanty, and the people used to be nomadic herders". The above statement best describes which of the following regions? (2013)**
   **(a) African Savannah**

**(b) Central Asian Steppe**
**(c) North American Prairie**
**(d) Siberian Tundra**

**4. Which one of the following is the characteristic climate of the Tropical Savannah Region? (2012)**
**(a) Rainfall throughout the year**
**(b) Rainfall in winter only**
**(c) An extremely short dry season**
**(d) A definite dry and wet season**

**5. A geographic region has the following distinct characteristics: (2010)**
**1. Warm and dry climate**
**2. Mild and Wet winter**
**3. Evergreen oak trees**
**The above features are the distinct characteristics of which one of the following regions.**
**(a) Mediterranean**
**(b) Eastern China**
**(c) Central Asia**
**(d) Atlantic coast of North America**

## OCEANOGRAPHY

**1. With reference to Ocean Mean Temperature (OMT), which of the following statements is/are correct? (2020)**
**1. OMT is measured up to a depth of 26°C isotherm which is 129 meters in the south-western Indian Ocean during January- March**
**2. OMT collected during January-March can be used in assessing whether the amount of rainfall in monsoon will be less or more than a certain long-term mean.**
**Select the correct answer using the code given below:**
(a) **1 only** **(b) 2 only**
**(c) Both 1 and 2** **(d) Neither 1 nor 2**

**2. On the planet earth, most of the freshwater exists as ice caps and glaciers. Out of the remaining freshwater, the largest proportion (2013)**
**(a) is found in atmosphere as moisture and clouds**
**(b) is found in freshwater lakes and rivers**
**(c) exists as groundwater**
**(d) exists as soil moisture**

**3. Consider the following statements: (2010)**
**1. On the planet Earth, the fresh water available for use amounts to about less than 1% of the total water found.**
**2. Of the total fresh water found on planet Earth 95% is bound up in polar ice caps and glaciers.**
**Which of the statements is given above is/are correct?**

**(a) 1 only (b) 2 only (c) both 1 and 2 (d) Neither 1 nor 2**

6. **What explains the eastward flow of the equatorial counter-current? (2015)**
   - **(a) The Earth's rotation on its axis**
   - **(b) Convergence of the two equatorial currents**
   - **(c) Difference in salinity of water**
   - **(d) Occurrence of the belt of calm near the equator**
7. **Tides occur in the oceans and seas due to which among the following? (2015)**
   1. **Gravitational force of the Sun**
   2. **Gravitational force of the Moon**
   3. **Centrifugal force of the Earth**

   **Select the correct answer using the code given below.**
   **(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**
8. **The most important fishing grounds of the world are found in the regions where (2013)**
   - **(a) warm and cold atmospheric currents meet**
   - **(b) rivers drain out large amounts of freshwater into the sea**
   - **(c) warm and cold oceanic currents meet**
   - **(d) continental shelf is undulating**
9. **Consider the following factors: (2012)**

   **1. Rotation of the Earth 2. Air Pressure and wind**
   **3. Density of ocean water 4. Revolution of the Earth**

   **Which of the above factors influence the ocean currents?**
   **(a) 1 and 2 only (b) 1, 2 and 3 (c) 1 and 4 (d) 2, 3 and 4**
10. **Which one of the following statements is not correct? (2004)**
    - **(a) Gulf with narrow fronts and wider rears experience high tides.**
    - **(b) Tidal currents take place when a gulf is connected with the open sea by a narrow channel.**
    - **(c) Tidal bore occurs when a tide enters the narrow and shallow estuary of a river.**
    - **(d) The tidal nature of the mouth of the river Hooghly is of crucial importance to Kolkata as port.**
11. **Consider the following statements: (2002)**
    1. **Ocean currents are the slow-surface movement of water in the ocean**
    2. **Ocean currents assist in maintaining the Earth's heat balance**
    3. **Ocean currents are set in motion primarily by prevailing winds**
    4. **Ocean currents are affected by the configuration of the ocean**

    **Which of these statements are correct?**
    **(a) 1 and 2 (b) 2, 3 and 4 (c) 1, 3 and 4 (d) 1, 2, 3 and 4**
12. **Assertion (A): During the Neap Tides, the high tide is lower, and the low tide is higher than usual.**

    **Reason (R): The Neap Tide, unlike the Spring Tide, occurs on the New Moon instead of on the Full Moon. (2001)**
    - **a) Both A and R are true, and R is the correct explanation of A**
    - **b) Both A and R are true, but R is not the correct explanation of A**
    - **c) A is true, but R is false**
    - **d) A is false, but R is true**
13. **Consider the following statements: (2000)**
    1. **Tides are of great help in navigation and fishing**
    2. **High tide enables big ships to enter or leave the harbour safely**

3. Tide prevents siltation in the harbours
4. Kandla and Diamond Harbour are tidal ports

Which of these statements are correct?

(a) 1 and 4 (b) 2, 3 and 4 (c) 1, 2 and 3 (d) 1, 2, 3 and 4

14. Which one of the following factors is responsible for the change in the regular direction of the ocean currents in the Indian Ocean? (1997)
    (a) Indian Ocean is 'half an ocean'
    (b) Indian Ocean has Monsoon drift
    (c) Indian Ocean is a land-locked Ocean
    (d) Indian Ocean has greater variation in salinity

## INTERIOR TO TECTONICS

1. Which of the following phenomena might have influenced the evolution of organisms? (2014)
    1. Continental drift
    2. Glacial cycles

    Select the correct answer using the code given below.

    (a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2
2. Consider the following: (2013)
    1. Electromagnetic radiation
    2. Geothermal energy
    3. Gravitational force
    4. Plate movements
    5. Rotation of the earth
    6. Revolution of the earth

    Which of the above are responsible for bringing dynamic changes on the surface of the earth?

    (a) 1, 2, 3 and 4 only (b) 1, 3, 5 and 6 only
    (c) 2, 4, 5 and 6 only (d) 1, 2, 3, 4, 5 and 6
3. Consider the following statements made about the sedimentary rocks: (2001)
    1. Sedimentary rocks are formed at earth's surface by the hydrological system
    2. The formation of sedimentary rocks involves the weathering of pre-existing rocks
    3. Sedimentary rocks contain fossils
    4. Sedimentary rocks typically occur in layers

    Which of these statements are correct?

    (a)1 and 2 (b)1 and 4 (c) 2, 3 and 4 (d) 1, 2, 3 and 4
4. Quartzite is metamorphosed from (2001)
    (a) limestone (b) obsidian (c) sandstone (d) shale
5. Which one of the following types of coal contains a higher percentage of carbon than the rest? (1999)
    (a) Bituminous coal (b) Lignite (c) Peat (d) Anthracite
6. Which one of the following is present in the largest amount in terms of percent by mass in the earth's crust? (1997)
    a) Silicon (b) Oxygen (c) Carbon (d) Calcium

## GEOPHYSICAL PHENOMENON

1. **Consider the following statements regarding the earthquakes: (2006)**
   1. **The Richter scale is a logarithmic scale and so an increase of 1 magnitude unit represents a factor of 10 times in amplitude.**
   2. **Each integer reading of the Richter scale has energy 100 times that of the previous integer reading.**

   **Which of the statements given above is/are correct?**

   **(a) 1 only (b) 2 only**

   **(c) Both 1 and 2 (d) neither 1 nor 2**

2. **Consider the following geophysical phenomena: (2004)**
   1. **Development of a fault**
   2. **Movement along a fault**
   3. **Impact produced by a volcanic eruption**
   4. **Folding of rocks**

   **Which of the above cause earthquakes?**

   **(a) 1, 2 and 3 (b) 2 and 4**

   **(c) 1, 3 and 4 (d) 1, 2, 3 and 4**

3. **Seismic gaps are (2003)**

   **(a) parts of plate boundaries in oceans where tsunami's occur frequently.**

   **(b) sections of plate boundaries that have ruptured repeatedly in the recent part.**

   **(c) sections of plate boundaries that have not ruptured in the recent past.**

   **(d) plate boundaries having no volcanic activity.**

4. **Consider the following statements regarding the earthquakes: (2001)**
   1. **The intensity of earthquake is measured on Mercalli Scale**
   2. **The magnitude of an earthquake is a measure of energy released.**
   3. **Earthquake magnitudes are based on direct measurements of the amplitude of seismic waves.**
   4. **In the Richter Scale, each whole number demonstrates a hundredfold increase in the amount of energy released.**

   **Which of these statements are correct?**

   **(a) 1, 2 and 3 (b) 2, 3 and 4**

   **(c) 1 and 4 (d) 1 and 3**

## VOLCANOES

1. **Consider the following statements: (2018)**
   1. **The Barren island volcano is an active volcano located in the Indian Territory.**
   2. **Barren Island lies about 140 km east of Great Nicobar.**
   3. **The last time the Barren Island volcano erupted was in 1991 and it has remained inactive since then.**

   **Which of the statements given above is/are correct?**

**(a) 1 only (b) 2 and (c) 3 only (d) 1 and 3**

2. **Consider the following statements: (2001)**
   1. **Most magmas are a combination of liquid, solid, and gas.**
   2. **Water vapour and carbon dioxide are the principal gases dissolved in a magma**
   3. **Basaltic magma is hotter than the silicic magma.**
   4. **The magma solidified between sedimentary rocks in a horizontal position is known as dike.**

   **Which of these statements are correct?**
   **(a) 1, 2 and 3 (b) 2, 3 and 4**
   **(c) 1 and 4(d) 1, 2 and 4**

## SOILS

1. **In India, the problem of soil erosion is associated with which of the following? (2014)**
   **1. Terrace cultivation 2. Deforestation 3. Tropical climate**
   **Select the correct answer using the code given below.**
   **(a) 1 and 2 only (b) 2 only (c) 1 and 3 only (d)1, 2 and 3**
2. **Which of the following statements regarding laterite soils of India are correct? (2013)**
   1. **They are generally red in colour.**
   2. **They are rich in nitrogen and potash.**
   3. **They are well-developed in Rajasthan and UP.**
   4. **Tapioca and cashew nuts grow well in these soils.**

   **Select the correct answer using the codes given below.**
   **(a) 1, 2 and 3 (b) 2, 3 and 4 (c) 1 and 4 (d) 2 and 3**
3. **Contour bunding is a method of soil conservation used in (2013)**
   **(a) Desert margins, liable to strong wind action**
   **(b) Low flat plains, close to stream course, liable to flooding**
   **(c) Scrublands, liable to spread of weed growth**
   **(d) None of the above**
4. **With reference to soil conservation, consider the following practices: (2010)**
   **1. Crop rotation 2. Sand fences 3.Terracing 4. Wind breaks**
   **Which of the above are considered appropriate methods for soil conservation in India?**
   **(a) 1, 2 and 3 only (b) 2 and 4 only**
   **(c) 1, 3 and 4 only (d) 1, 2, 3 and 4**
5. **When you travel in certain parts of India, you will notice red soil. (2010)**
   **What is the main reason for this colour?**
   **(a) Abundance of magnesium (b) Accumulated humus**
   **(c) Presence of ferric oxides (d) Abundance of phosphates**
6. **Identify the correct order of the processes of soil-erosion the following: (2001)**
   **(a) Splash erosion, Sheet erosion, Rill erosion, Gully erosion**
   **(b) Sheet erosion, Splash erosion, Gully erosion, Rill erosion**
   **(c) Rill erosion, Gully erosion, Sheet erosion, Splash erosion**
   **(d) Gully erosion, Rill erosion, Sheet erosion, Splash erosion**

## STRUCTURE AND PHYSIOGRAPHY

**1) Siachen Glacier is situated to the (2020)**

**(a) East of Aksai Chin**
**(b) East of Leh**
**(c) North of Gilgit**
**(d) North of Nubra Valley**

**2. Consider the following pairs: (2014)**

| Hills | | Region |
|---|---|---|
| 1. Cardamom Hills | : | Coromandel Coast |
| 2. Kaimur Hills | : | Konkan Coast |
| 3. Mahadeo Hills | : | Central India |
| 4. Mikir Hills | : | North-East India |

**Which of the above pairs are correctly matched?**

**(a) 1 and 2 (b) 2 and 3 (c) 3 and 4 (d) 2 and 4**

**3. Which one of the following pairs of islands is separated from each other by the "Ten Degree Channel"? (2014)**

**(a) Andaman and Nicobar**
**(b) Nicobar ad Sumatra**
**(c) Maldives and Lakshadweep**
**(d) Sumatra and Java**

**4. Consider the following statements: (2013)**

**1. Natural gas occurs in the Gondwana beds.**
**2. Mica occurs in abundance in Kodarma.**
**3. Dharwars are famous for petroleum.**

**Which of the statements given above is/are correct?**

**(a) 1 and 2 (b) 2 only (c) 2 and 3 (d) None**

**5. When you travel in Himalayas, you will see the following: (2012)**

**1. Deep gorges 2. U-turn river courses**
**3. Parallel mountain ranges 4. Steep gradients causing land sliding**

**Which of the above can be said to be the evidences for Himalayas being young fold mountains?**

**(a) 1 and 2 only (b) 1, 2 and 4 only (c) 3 and 4 only (d) 1, 2, 3 and 4**

**6. If there were no Himalayan ranges, what would have been the most likely geographical impact on India? (2010)**

**1. Much of the country would experience the cold waves from Siberia**
**2. Indo-Gangetic plain would be devoid of such extensive alluvial soils**
**3. The pattern of monsoon would be different from what it is at present.**

**Which of the statements given above is/are correct?**

**(a) 1 only (b) 1 and 3 only (c) 2 and 3 only (d) 1, 2 and 3**

**7. Which of the following hills are found where the Eastern Ghats and the Western Ghats meet? (2008)**

**(a) Annamalai Hills (b) Cardamom Hills**
**(c) Nilgiri Hills (d) Shevaroy Hills**

**8. In which State is the Shikhar Peak located? (2007)**
**(a) Rajasthan (b) Gujarat (c) Madhya Pradesh (d) Maharashtra**

**9. Where were Shevaroy Hills located? (2007)**
**(a) Karnataka (b) Kerala (c) Andhra Pradesh (d) Tamil Nadu**

**10. Which one of the following statements is not correct? (2005)**
**(a) The western Ghats are relatively higher in their northern region**
**(b) The Anai Mudi is the highest peak in the Western Ghats**
**(c) Tapi river lies to the south of Satpura**
**(d) The Narmada and the Tapi river valleys are said to be old rift valleys.**

**11. Which one of the following is the correct sequence of the given hills starting from the north and going towards the south? (2005)**
**(a) Nallamalai Hills—Nilgiri Hills—Javadi Hills—Annamalai Hills**
**(b) Annamalai Hills—Javadi Hills—Nilgiri Hills—Nallamalai Hills**
**(c) Nallamalai Hills—Javadi Hills—Nilgiri Hills—Annamalai Hills**
**(d) Annamalai Hills—Nilgiri Hills—Javadi Hills—Nallamalai Hills**

## RIVERS

## HIMALAYAN RIVERS

**1. Consider the following pairs: (2019)**

| *Glacier* | | *River* |
|---|---|---|
| **Bandarpunch** | **:** | **Yamuna** |
| **1. Bara Shigri** | **:** | **Chenab** |
| **2. Milam** | **:** | **Mandakini** |
| **3. Siachen** | **:** | **Nubra** |
| **4. Zemu** | **:** | **Manas** |

**Which of the pairs given above are correctly matched?**
**(a) 1, 2 and 4 (b) 1, 3 and 4 (c) 2 and 5 (d) 3 and 5**

**2. Consider the following pairs: (2019)**

| *Famous place* | *River* |
|---|---|
| **Pandharpur** | **: Chandrabhaga** |
| **1. Tiruchirapalli** | **: Cauvery** |
| **2. Hampi** | **: Malaprabha** |

**Which of the pairs given above are correctly matched?**
**(a) 1 and 2 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

**3. With reference to river Teesta, consider the following statements: (2017)**
**1. The source of river Teesta is the same as that of Brahmaputra, but it flows through Sikkim.**
**2. River Rangeet originates in Sikkim and it is a tributary of river Teesta.**
**3. River Teesta flows into Bay of Bengal on the border of India and Bangladesh.**
**Which of the statements given above is/are correct?**
**(a) 1 and 3 only (b) 2 only (c) 2 and 3 only (d) 1, 2 and 3**

**4. Which of the following is/are tributary/tributaries of Brahmaputra? (2016)**
1. **Dibang**
2. **Kameng**
3. **Lohit**

**Select the correct answer using the code given below.**

**(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

**5. Consider the following rivers: (2014)**

**1. Barak**
**2. Lohit**
**3. Subansiri**

**Which of the above flows / flow through Arunachal Pradesh?**

**(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

**6. Consider the following pair: (2013)**

| | *National Park* | | *River flowing through the Park* |
|---|---|---|---|
| **1.** | **Corbett National Park** | **:** | **Ganga** |
| **2.** | **Kaziranga National Park** | **:** | **Manas** |
| **3.** | **Silent Valley National Park** | **:** | **Kaveri** |

**Which of the above pairs is/are correctly matched?**

**(a) 1 and 2 (b) 3 only (c) 1 and 3 (d) None**

**7. The Brahmaputra, Irrawaddy and Mekong rivers originates in Tibet and flow through narrow and parallel mountain ranges in their upper reaches. Of these rivers, Brahmaputra makes a "U" turn in its course of flow into India. This "U" turn is due to: (2011)**

**(a) Uplift of folded Himalayan series**
**(b) Syntaxial bending of geologically young Himalayas**
**(c) Geo-tectonic disturbance in the tertiary folded mountain chains**
**(d) Both (a) and (b) above.**

**8. Rivers that pass-through Himachal Pradesh are (2010)**

**(a) Bea and Chenab only**
**(b) Beas and Ravi only**
**(c) Chenab, Ravi and Satluj only**
**(d) Beas, Chenab, Ravi, Satluj and Yamuna.**

**9. Which one of the following pairs is not correctly matched? (2010)**

| **Dam/Lake** | **River** |
|---|---|
| **(a) Govind Sagar** | **: Satluj** |
| **(b) Kolleru Lake** | **: Krishna** |
| **(c) Ukai Reservoir** | **: Tapi** |
| **(d) Wular Lake** | **: Jhelum** |

**10. Which one of the following rivers does not originate in India? (2009)**

**(a) Beas (b) Chenab (c) Ravi (d) Sutlej**

**11. On which one of the following rivers is the Tehri Hydropower Complex located? (2008)**

**(a) Alaknanda (b) Bhagirathi (c) Dhauliganga (d) Mandakini**

**12. From north towards south, which one of the following is the correct sequence of the given rivers in India? (2006)**

**(a) Shyok--Spiti—Zaskar---Satluj**
**(b) Shyok—Zaskar—Spiti—Satluj**
**(c) Zaskar—Shyok—Satluj—Spiti**
**(d) Zaskar—Satluj—Shyok—Spiti**

**13. Consider the following statements:(2004)**

1. Damodar Valley Corporation is the first multipurpose river valley project of independent India
2. Damodar Valley Corporation includes thermal and gas power stations

Which of the statements given above is/are correct?

(a) 1 only (b) 2 only (c) both 1 and 2 (d) Neither 1 nor 2

14. Consider the following statements: (2000)
    1. Ganga Plain is the most densely populated part of India
    2. Ganga is the most harnessed River of India

    Which of the statements given above is/are correct?

    (a) 1 only (b) 2 only (c) both 1 and 2 (d) Neither 1 nor 2

15. Match List-I with List-II and select the correct answer using the codes given below the lists: (1999)

| List-I (Rivers) | List-II (Dams) |
|---|---|
| A. Cauvery | 1. Alamatti |
| B. Krishna | 2. Mettur |
| C. Narmada | 3. Gandhi Nagar |
| D. Chambal | 4. Sardar Sarovar |

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 1 | 4 | 2 | 3 |
| (b) | 2 | 1 | 4 | 3 |
| (c) | 2 | 1 | 3 | 4 |
| (d) | 1 | 3 | 4 | 2 |

16. The Alamatti is on river (1998)

    (a) Godavari (b) Cauvery (c) Krishna (d) Mahanadi

17. Between which of the following was the ancient town of Takshasila located? (2006)

    (a) Indus and Jhelum (b) Jhelum and Chenab
    (c) Chenab and Ravi (d) Ravi and Beas

## PENINSULAR RIVERS

1. Consider the following pairs: (2019)

   *Wildlife* *Naturally found in*
   1. Blue-finned Mahseer : Cauvery River
   2. Irrawaddy Dolphin : Chambal River
   3. Rusty-spotted Cat : Eastern Ghats

   Which of the pairs given above are correctly matched?

   (a) 1 and 2 only (b) 2 and 3 only
   (c) 1 and 3 only (d) 1, 2 and 3

2. Consider the following rivers: (2015)

   1. Vamsadhara 2. Indravati 3. Pranahita 4. Pennar

   Which of the above are tributaries of Godavari?

   (a) 1, 2 and 3 (b) 2, 3 and 4 (c) 1, 2 and 4 (d) 2 and 3 only

3. The Narmada River flows to the west, while most other large peninsular Rivers flow to the east. Why? (2013)
   1. It occupies a linear rift valley.
   2. It flows between the Vindhyas and the Satpuras.
   3. The land slopes to the west from Central India.

   Select the correct answer using the codes given below:

   (a) 1 only (b) 2 and 3 (c) 1 and 3 (d) None

4. **Two important Rivers- one with its source in Jharkhand (and known by a different name in Odisha), and another, with its source in Odisha- merge at a place only a short distance from the coast of Bay of Bengal before flowing into the Sea. This is an important site of wildlife and biodiversity and a protected area. Which one of the following could be this? (2011)**
   **(a) Bhitarkanika (b) Chandipur-on-sea**
   **(c) Gopalpur-on-sea (d) Simlipal**
5. **With reference to the River Luni, which one of the following statements is correct? (2010)**
   **(a) It flows into Gulf of Khambhat**
   **(b) It flows into Gulf of Kutchch**
   **(c) It flows into Pakistan and merges with a tributary of Indus**
   **(d) It is lost in the marshy land of the Rann of Kuchch**
6. **Consider the following statements (2009)**
   **1. There are no east flowing Rivers in Kerala**
   **2. There are no west flowing Rivers in Madhya Pradesh**
   **Which of the above statements is/are correct?**
   **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**
7. **At which one of the following places do two important Rivers of India originate; while one of them flows towards north and merges with another important River flowing towards Bay of Bengal, the other one flows towards Arabian Sea? (2009)**
   **(a) Amarkantak (b) Badrinath (c) Mahabaleshwar (d) Nasik**
8. **Consider the following pairs: (2008)**

| Tributary River | | Main River |
|---|---|---|
| 1. Chambal | : | Narmada |
| 2. Son | : | Yamuna |
| 3. Manas | : | Brahmaputra |

   **Which of the pairs above is/are correctly matched?**
   **(a) 1, 2 and 3 (b) 1 and 2 only (c) 2 and 3 only (d) 3 only**
9. **With which one of the following Rivers is the Omkareshwar Project associated? (2008)**
   **(a) Chambal (b) Narmada (c) Tapi (d) Bhima**
10. **In India, how many States share the coastline? (2008)**
    **(a) 7 (b) 8 (c) 9 (d) 10**
11. **Which one of the following Rivers originates at Amarkantak? (2007)**
    **(a) Damodar (b) Mahanadi (c) Narmada (d) Tapti**
12. **Consider the following statements: (2007)**
    1. **River Kalinadi is an east-flowing River in the southern part of India**
    2. **The Deccan Plateau is higher along its western edge and gently slopes towards the Bay of Bengal in the east.**

    **Which of the above statements is/are correct?**
    **(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**
13. **Which one of the following statements is not correct? (2006)**
    **(a) Mahanadi River rises in Chhattisgarh**
    **(b) Godavari River rises in Maharashtra**
    **(c) Cauvery River rises in Andhra Pradesh**

**(d) Tapti River rises in Madhya Pradesh**

**14. Which one of the following statements is not correct? (2005)**
**(a) The Western Ghats are relatively higher in their northern region**
**(b) The Anai Mudi is the highest peak in the Western Ghats**
**(c) Tapi River lies to the south of Satpura**
**(d) The Narmada and the Tapi River valleys are said to be old rift valleys.**

**15. What is the correct sequence of the River Godavari, Mahanadi, Narmada, and Tapi in the descending order of their lengths? (2003)**
**(a) Godavari—Mahanadi—Narmada—Tapi**
**(b) Godavari—Narmada—Mahanadi—Tapi**
**(c) Narmada—Godavari—Tapi—Mahanadi**
**(d) Narmada—Tapi—Godavari—Mahanadi**

**16. The correct sequences of the eastward flowing Rivers of the peninsular from north to south is (2002)**
**(a) Subarnarekha, Mahanadi, Godavari, Krishna, Pennar, Cauvery and Vaigai**
**(b) Subarnarekha, Mahanadi, Krishna, Godavari, Cauvery, Vaigai, and Pennar**
**(c) Mahanadi, Subarnarekha, Godavari, Krishna, Cauvery, Pennar and Vaigai**
**(d) Mahanadi, Subarnarekha, Krishna, Godavari, Cauvery, Vaigai, and Pennar**

**17. Which one of the following statements is not true? (2000)**
**(a) Gaggar's water is utilized in the Indira Gandhi Canal**
**(b) Narmada rises from Amarkantak region**
**(c) Nizam Sagar is situated on the Manjira River**
**(d) Penganga is a tributary of the Godavari**

**18. Which one of the following east flowing rivers of India has rift valley due to down warping? (1998)**
**(a) Damodar (b) Mahanadi (c)Son (d) Yamuna**

**19. Which one of the following Rivers thrice forks into two streams and reunites a few miles farther on, thus forming the islands of Srinagapattanam, Sivasamudram and Srinagam? (1996)**
**(a) Cauvery (b) Tungabhadra (c) Krishna (d) Godavari**

**20. Consider the following Rivers: (1996)**
**1. Kishenganga 2. Ganga 3. Wainganga 4. Penganga**
**The correct sequence of these Rivers when arranged in the north-south direction is**
**(a) 1, 2, 3, 4 (b) 2, 1, 3, 4 (c) 2, 1, 4, 3 (d) 1, 2, 4, 3**

## AGRICULTURE

**1) What is use of biochar in farming? (2020)**
**1. Biochar can be used as a part of the growing medium in vertical farming.**
**2. When biochar is a part of the growing medium, it promotes the growth of nitrogen-fixing microorganisms.**
**3. When biochar is a part of the growing medium, it enables the growing medium to retain water for longer time.**
**Which of the statements given above is/are correct?**
**(a) 1 and 2 only (b) 2 only**
**(c) 1 and 3 only (d) 1, 2 and 3**

**2) What is/are the advantage/advantages of zero tillage in agriculture? (2020)**

1. **Sowing of wheat is possible without burning the residue of previous crop.**
2. **Without the need for nursery of rice saplings, direct planting of paddy seeds in the wet soil is possible.**
3. **Carbon sequestration in the soil is possible.**

**Select the correct answer using the code given below:**

**(a) 1 and 2 only (b) 2 and 3 only**

**(c) 3 only (d) 1, 2 and 3**

3) **"The crop is sub-tropical in nature. A hard frost is injurious to it. It requires at least 210 frost-free days and 50 to 100 centimeters of rainfall for its growth. A light well-drained soil capable of retaining moisture is ideally suited for cultivation of the crop". Which one of the following is that crop? (2020)**

**(a) Cotton (b) Jute (c) Sugarcane (d) Tea**

4) **With reference to the current trends in the cultivation of sugarcane in India, consider the following statements: (2020)**
   1. **A substantial saving in seed material is made when 'bud chip settlings' are raised in a nursery and transplanted in the main field.**
   2. **When direct planting of setts is done, the germination percentage is better with single-budded setts as compared to setts with many buds.**
   3. **If bad weather conditions prevail when setts are directly planted, single-budded setts have better survival as compared to large setts.**
   4. **Sugarcane can be cultivated using settlings prepared from tissue culture.**

   **Which of the statements given above is/are correct?**

   **(a) 1 and 2 only (b) 3 only**

   **(c) 1 and 4 only (d) 2, 3 and 4 only**

5) **In the context of India, which of the following is/are considered to be practice(s) of eco-friendly agriculture? (2020)**
   1. **Crop diversification**
   2. **Legume intensification**
   3. **Tensiometer use**
   4. **Vertical farming**

   **Select the correct answer using the code given below:**

   **(a) 1, 2 and 3 only (b) 3 only**

   **(c) 4 only (d) 1, 2, 3 and 4**

6) **What are the advantages of fertigation in agriculture? (2020)**
   1. **Controlling the alkalinity of irrigation water is possible.**
   2. **Efficient application of Rock Phosphate and all other phosphatic fertilizers is possible.**
   3. **Increased availability of nutrients to plants is possible.**
   4. **Reduction in the leaching of chemical nutrients is possible.**

   **Select the correct answer using the code given below:**

   **(a) 1, 2 and 3 only (b) 1, 2 and 4 only**

   **(c) 1, 3 and 4 only (d) 2, 3 and 4 only**

7) **With reference to chemical fertilizers in India, consider the following statements: (2020)**
   1. **At present, the retail price of chemical fertilizers is market-driven and not administered by the Government.**
   2. **Ammonia, which is an input of urea, is produced from natural gas.**
   3. **Sulphur, which is a raw material for phosphoric acid fertilizer is a by-product of oil refineries.**

   **Which of the statements given above is/are correct?**

a) 1 only
b) 2 and 3 only
c) 2 only
d) 1, 2 und 3

8) With reference to the cultivation of Kharif crop in India in the last five years, consider the following statements: (2019)

1. Area under rice cultivation is the highest.
2. Area under the cultivation of jowar is more than that of oilseeds.
3. Area of cotton cultivation is more than that of sugarcane.
4. Area under sugarcane cultivation has steadily decreased.

Which of the statements given above are correct?
(a) 1 and 3 only (b) 2, 3 and 4 (c) 2 and 4 only (d) 1, 2, 3 and 4

9) Consider the following statements: (2019)

1. Agricultural soils release nitrogen oxides into environment.
2. Cattle release ammonia into environment.
3. Poultry industry releases reactive nitrogen compounds into environment.

Which of the statements given above is/are correct?
(a) 1 and 3 only (b) 2 and 3 only (c) 2 only (d) 1, 2 and 3

10) With reference to the circumstances in Indian agriculture, the concept of "Conservation Agriculture" assumes significance. Which of the following fall under the Conservation Agriculture? (2018)

1. Avoiding the monoculture practices
2. Adopting minimum tillage
3. Avoiding the cultivation of plantation crops
4. Using crop residues to cover soil surface
5. Adopting spatial and temporal crop sequencing/crop rotations

Selecting the correct answer using the code given below:
(a) 1, 3 and 4 (b) 2, 3, 4 and 5 (c) 2, 4 and 5 (d) 1, 2, 3 and 5

11) With reference to agricultural soils, consider the following statements: (2018)

1. A high content of organic matter in soil drastically reduces its water holding capacity.
2. Soil does not play any role in the sulphur cycle.
3. Irrigation over a period of time can contribute to the salinization of some agricultural lands.

Which of the statements given above is/are correct?
(a) 1 and 2 only (b) 3 only (c) 1 and 3 only (d) 1, 2 and 3

12) Which of the following practices can help in water conservation in agriculture? (2017)

1. Reduced or Zero tillage of the land
2. Applying gypsum before irrigating the field
3. Allowing crop residue to remain in the field

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 3 only (c) 1 and 3 only (d) 1, 2 and 3

13) Which of the following is/are the advantages / advantages of practising drip irrigation? (2016)

1. Reduction in weed.
2. Reduction in soil salinity
3. Reduction in soil erosion

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) None of the above is an advantages of practising drip irrigation

14) Why does the Government of India promote the use of 'Neem-coated urea' in agriculture? (2016)
(a) Release of neem oil in the soil increases nitrogen fixation by the soil microorganisms
(b) Neem coating slows down the rate of dissolution of urea in the soil
(c) Nitrous oxide, which is a greenhouse gas, is not at all released into atmosphere by crop fields
(d) It is a combination of a weedicide and a fertilizer for particular crops

15) In India, cluster bean (Guar) is traditionally used as a vegetable or animal feed, but recently the cultivation of this has assumed significance. Which one of the following statements is correct in this context? (2014)
(a) The oil extracted from seeds is used in the manufacture of biodegradable plastics
(b) The gum made from its seeds is used in the extraction of shale gas
(c) The leaf extract of this plant has the properties of anti-histamines
(d) It is a source of high-quality biodiesel

16) Consider the following crops: (2013)
1. Cotton
2. Groundnut
3. Rice
4. Wheat
Which of these are Kharif crops?
(a) 1 and 4 (b) 2 and 3 (c) 1, 2 and 3 (d) 2, 3 and 4

17) Which of the following is the chief characteristic of 'mixed farming'? (2012)
(a) Cultivation of both cash crops and food crops
(b) Cultivation of two or more crops in the same field
(c) Rearing of animals and cultivation of crops together
(d) None of the above

18) Consider the following crops of India: (2012)
1. Cowpea
2. Green gram
3. Pigeon pea
Which of the above is/are used as pulse, fodder, and green manure?
(a) 1 and 2 (b) 2 only (c) 1 and 3 (d) 1, 2, and 3

19) Consider the following crops of India: (2012)
1. Groundnut
2. Sesamum
3. Pearl millet
Which of the above is/are predominantly rainfed crop/crops?
(a) 1 and 2 (b) 2 and 3 (c) 3 only (d) 1, 2, and 3

20) The lower Gangetic plain is characterized by humid climate with high temperature throughout the year. Which one among the following pairs of crops is the most suitable for this region? (2011)
(a) Paddy and cotton (b) Wheat and Jute
(c) Paddy and Jute (d) Wheat and cotton

**21) Among the following States, which one has the most suitable climatic conditions for the cultivation of a large variety of orchids with minimum cost of production, and can develop an export-oriented industry in this field? (2011)**

**(a) Andhra Pradesh**
**(b) Arunachal Pradesh**
**(c) Madhya Pradesh**
**(d) Uttar Pradesh**

**22) With reference to micro-irrigation, which of the following statements is/are correct? (2011)**

**1. Fertilizer/nutrient loss can be reduced.**
**2. It is the only means of irrigation in dry land farming.**
**3. In some areas of farming, receding of ground water table can be checked.**

**Select the correct answer using the codes given below:**
**(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

**23) Salinization occurs when the irrigation water accumulated in the soil evaporates, leaving behind salts and minerals. What are the effects of salinization on the irrigated land? (2011)**

**(a) It greatly increases the crop production**
**(b) It makes some soils impermeable**
**(c) It raises the water table**
**(d) It fills the air spaces in the soil with water**

## MAP BASED QUESTIONS

### 2020

**1) Consider the following pairs:**

| River | | Flows into |
|---|---|---|
| 1. Mekong | -- | Andaman Sea |
| 2. Thames | -- | Irish Sea |
| 3. Volga | -- | Caspian Sea |
| 4. Zambezi | -- | Indian Ocean |

**Which of the pairs given above is/are correctly matched?**
**(a) 1 and 2 only (b) 3 only**
**(c) 3 and 4 only (d) 1, 2 and 4 only**

**2) Siachen Glacier is situated to the**

**(a) East of Aksai Chin**
**(b) East of Leh**
**(c) North of Gilgit**
**(d) North of Nubra Valley**

### 2019

**1. What is common to the places known as Aliyar, Isapur and Kangsabati?**

**(a) Recently discovered uranium deposits**
**(b) Tropical rain forests**

**(c) Underground cave systems**
**(d) Water reservoirs**

**2. Consider the following pairs:**

| *Sea* | | *Bordering country* |
|---|---|---|
| **1. Adriatic Sea** | **:** | **Albania** |
| **2. Black Sea** | **:** | **Croatia** |
| **3. Caspian Sea** | **:** | **Kazakhstan** |
| **4. Mediterranean Sea** | **:** | **Morocco** |
| **5. Red Sea** | **:** | **Syria** |

**Which of the pairs given above are correctly matched?**
**(a) 1, 2 and 4 only (b) 1, 3 and 4 only**
**(c) 2 and 5 only (d) 1, 2, 3, 4 and 5**

**3. Consider the following pairs:**

| *Glacier* | | *River* |
|---|---|---|
| **1. Bandarpunch** | **:** | **Yamuna** |
| **2. Bara Shigri** | **:** | **Chenab** |
| **3. Milam** | **:** | **Mandakini** |
| **4. Siachen** | **:** | **Nubra** |
| **5. Zemu** | **:** | **Manas** |

**Which of the pairs given above are correctly matched?**
**(a) 1, 2 and 4 (b) 1, 3 and 4 (c) 2 and 5 (d) 3 and 5**

**2018**

**1. Consider the following statements:**
1. **The Barren island volcano is an active volcano located in the Indian Territory.**
2. **Barren Island lies about 140 km east of Great Nicrobar.**
3. **The last time the Barren Island volcano erupted was in 1991 and it has remained inactive since then.**

**Which of the statements given above is/are correct?**
**(a) 1 only (b) 2 only (c) 3 only (d) 1 and 3**

**2. Which of the following has/ have shrunk immensely/dried up in the recent past due to human activities?**
**1. Aral Sea**
**2. Black sea**
**3. Lake Baikal**
**Select the correct answer using the code given below:**
**(a) 1 only (b) 2 and 3 (c) 2 only (d) 1 and 3**

**3. Very recently, in which of the following countries have lakhs of people either suffered from severe famine / acute malnutrition or died due to starvation caused by war / ethnic conflicts**
**(a) Angola and Zambia**
**(b) Morocco and Tunisia**
**(c) Venezuela and Colombia**
**(d) Yemen and South Sudan**

**4. Among the following cities, which one lies on a longitude closest to that of Delhi?**

**(a) Bengaluru**
**(b) Hyderabad**
**(c) Nagpur**
**(d) Pune**

**5. Consider the following pairs:**

| *Towns sometimes mentioned in news* | *Country* |
|---|---|
| **1. Aleppo** | **- Syria** |
| **2. Kirkuk** | **- Yemen** |
| **3. Mosul** | **- Palestine** |
| **4. Mozar-i-sharif** | **- Afghanistan** |

**Which of the pairs given above are correctly matched?**
**(a) 1 and 2 (b) 1 and 4 (c) 2 and 3 (d) 3 and 4**

**6. Which one of the following is an artificial lake?**
**(a) Kodaikanal (Tamil Nadu)**
**(b) Kolleru (Andhra Pradesh)**
**(c) Nainital (Uttarakhand**
**(d) Renuka (Himachal Pradesh)**

**2017**

**1. If you travel by road from Kohima to Kottayam, what is the minimum number of States within India through which you can travel, including the origin and the destination?**
**(a) 6 (b) 7 (c) 8 (d) 9**

**2. At one of the places in India, if you stand on the seashore and watch the sea, you will find that the sea water recedes from the shore line a few kilometres and comes back to the shore, twice a day, and you can actually walk on the sea floor when the water recedes. This unique phenomenon is seen at**
**(a) Bhavnagar (b) Bheemunipatnam**
**(c) Chandipur (d) Nagapattinam**

**3. Which of the following is geographically closet to Great Nicobar?**
**(a) Sumatra**
**(b) Borneo**
**(c) Java**
**(d) Sri Lanka**

**4. Mediterranean Sea is a border of which of the following countries?**
**1. Jordan 2. Iraq 3. Lebanon 4. Syria**
**Select the correct answer using the code given below:**
**(a) 1, 2 and 3 only (b) 2 and 3 only (c) 3 and 4 only (d) 1, 3 and 4 only**

**5. Consider the following statements:**
**1. In India, the Himalayas are spread over five States only.**
**2. Western Ghats are spread over five States only.**
**3. Pulicat Lake is spread over two States only.**
**Which of the statements given above is/are correct?**
**(a) 1 and 2 only (b) 3 only (c) 2 and 3 only (d) 1 and 3 only**

## 2016

**1. In which of the following regions of India are shale gas resources found?**

**1. Cambay Basin**
**2. Cauvery Basin**
**3. Krishna-Godavari Basin**

**Select the correct answer using the code given below.**

**(a) 1 and 2 only (b) 3 only (c) 2 and 3 only (d) 1, 2 and 3**

## 2015

**1. Which one of the following pairs of States of India indicates the eastern most and western most State?**

**(a) Assam and Rajasthan**
**(b) Arunachal Pradesh and Rajasthan**
**(c) Assam and Gujarat**
**(d) Arunachal Pradesh and Gujarat**

**2. Which one of the following countries of South-West Asia does not open out to the Mediterranean Sea?**

**(a) Syria (b) Jordan (c) Lebanon (d) Israel**

## 2014

**1. Which one of the following pairs of islands is separated from each other by the "Ten Degree Channel"?**

**(a) Andaman and Nicobar**
**(b) Nicobar ad Sumatra**
**(c) Maldives and Lakshadweep**
**(d) Sumatra and Java**

**2. Turkey is located between**

**(a) Black Sea and Caspian Sea**
**(b) Black Sea and Mediterranean Sea**
**(c) Gulf of Suez and Mediterranean Sea**
**(d) Gulf of Aqaba and Dead Sea**

**3. What is the correct sequence of occurrence of the following cities in South-East Asia as one proceeds from south to north?**

**1. Bangkok 2. Hanoi 3. Jakarta 4. Singapore**

**Select the correct answer using the code given below.**

**(a) 4 – 2 – 1 – 3 (b) 3 – 2 – 4 – 1 (c) 3 – 4 – 1 – 2 (d) 4 – 3 – 2 – 1**

**4. Consider the following pairs:**

| Region often in news | | Country |
|---|---|---|
| 1. Chechnya | : | Russian Federation |

**2. Darfur : Mali**
**3. Swat Valley : Iraq**

**Which of the above pairs is / are correctly matched?**

**(a) 1 only (b) 2 and 3 only (c) 1 and 3 only (d) 1, 2 and 3**

**5. Consider the following pairs:**

| *Hills* | | *Region* |
|---|---|---|
| **1. Cardamom Hills** | **:** | **Coromandel Coast** |
| **2. Kaimur Hills** | **:** | **Konkan Coast** |
| **3. Mahadeo Hills** | **:** | **Central India** |
| **4. Mikir Hills** | **:** | **North-East India** |

**Which of the above pairs are correctly matched?**

**(a) 1 and 2 (b) 2 and 3 (c) 3 and 4 (d) 2 and 4**

**6. Consider the following pairs:**

| *National Highway* | | *Cities connected* |
|---|---|---|
| **1. NH 4** | **:** | **Chennai and Hyderabad** |
| **2. NH 6** | **:** | **Mumbai and Kolkata** |
| **3. NH 15** | **:** | **Ahmedabad and Jodhpur** |

**Which of the above pairs is / are correctly matched?**

**(a) 1 and 2 only (b) 3 only (c) 1, 2 and 3 (d) None**

**2013**

**1. Which one of the following pairs is correctly matched?**

| *Geographical Feature* | | *Region* |
|---|---|---|
| **(a) Abyssinian Plateau** | **:** | **Arabia** |
| **(b) Atlas Mountains** | **:** | **North-Western Africa** |
| **(c) Guiana Highlands** | **:** | **South-Western Africa** |
| **(d) Okavango Basin** | **:** | **Patagonia** |

**2012**

**1. A particular State in India has the following characteristics:**

**1. It is located on the same latitude which passes through northern Rajasthan.**
**2. It has over 80% of its area under forest cover.**
**3. Over 12% of forest cover constitutes Protected Areas Network in this State.**

**Which one among the following States has all the above characteristics?**

**(a) Arunachal Pradesh (b) Assam**
**(c) Himachal Pradesh (d) Uttarakhand**

**2011**

**1. Between India and East Asia, the navigation-time and distance can be greatly reduced by which of the following?**

**1. Deepening the Malacca straits between Malaysia and Indonesia.**
**2. Opening a new canal across the Kra isthmus between the Gulf of Siam and Andaman Sea.**

**Which of the statements given above is/are correct?**

**(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2**

**2. A state in India has the following characteristics**

1. **Its northern part is arid and semi-arid**
2. **Its central part produces cotton.**
3. **Cultivation of cash crops is predominant over food crops.**

**Which one of the following states has all of the above characteristics?**

**(a) Andhra Pradesh** **(b) Gujarat**

**(c) Karnataka** **(d) Tamil Nadu**