PLATE TECTONIC THEORY

- The Earth's crust and upper mantle (i.e lithosphere)are broken into sections called plates.

TECTONIC PLATES/ LITHOSPHERIC PLATES

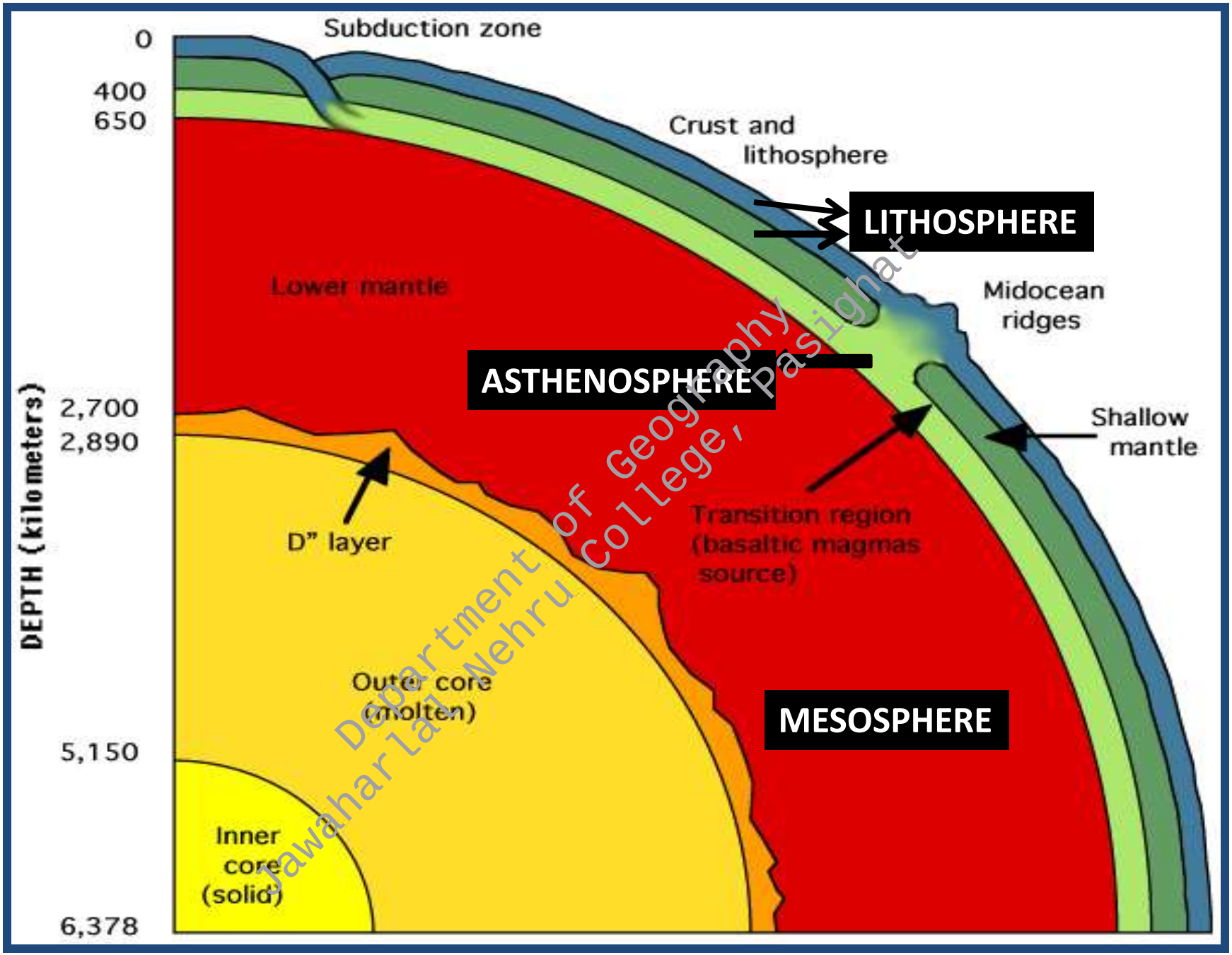
❖ These are massive, irregularly-shaped slab of solid rock, generally composed of both continental and oceanic **lithosphere**

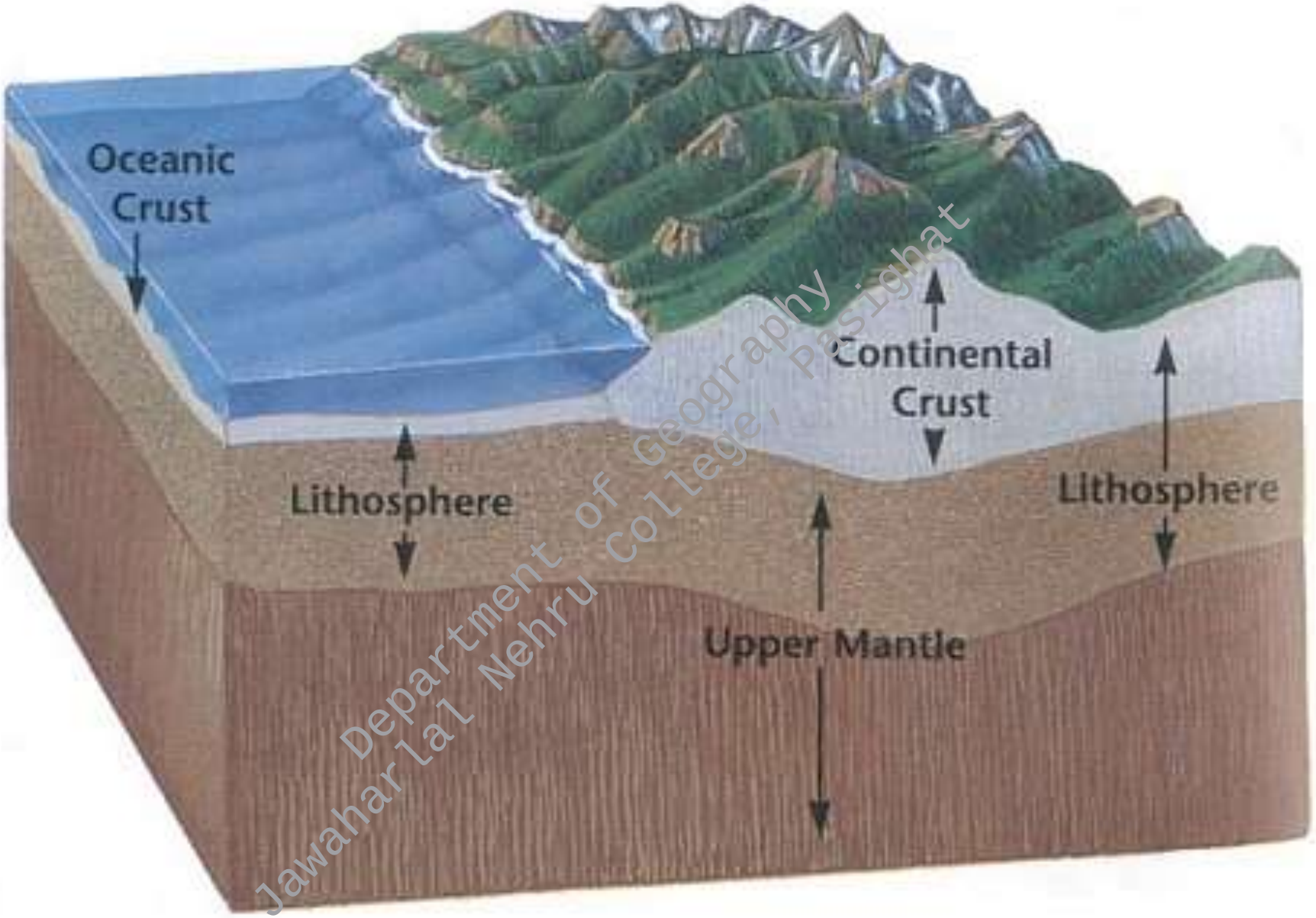
The crust and part of the upper mantle = **lithosphere**

- ✓5-100 km thick in oceanic areas
- ✓ 200 km thickness in continental areas
- ✓Less dense than the material below it, so it "floats"

What is the **Asthenoshere**?

- The plastic/ductile layer below the lithosphere = asthenosphere
- The plates of the lithosphere float on the asthenosphere





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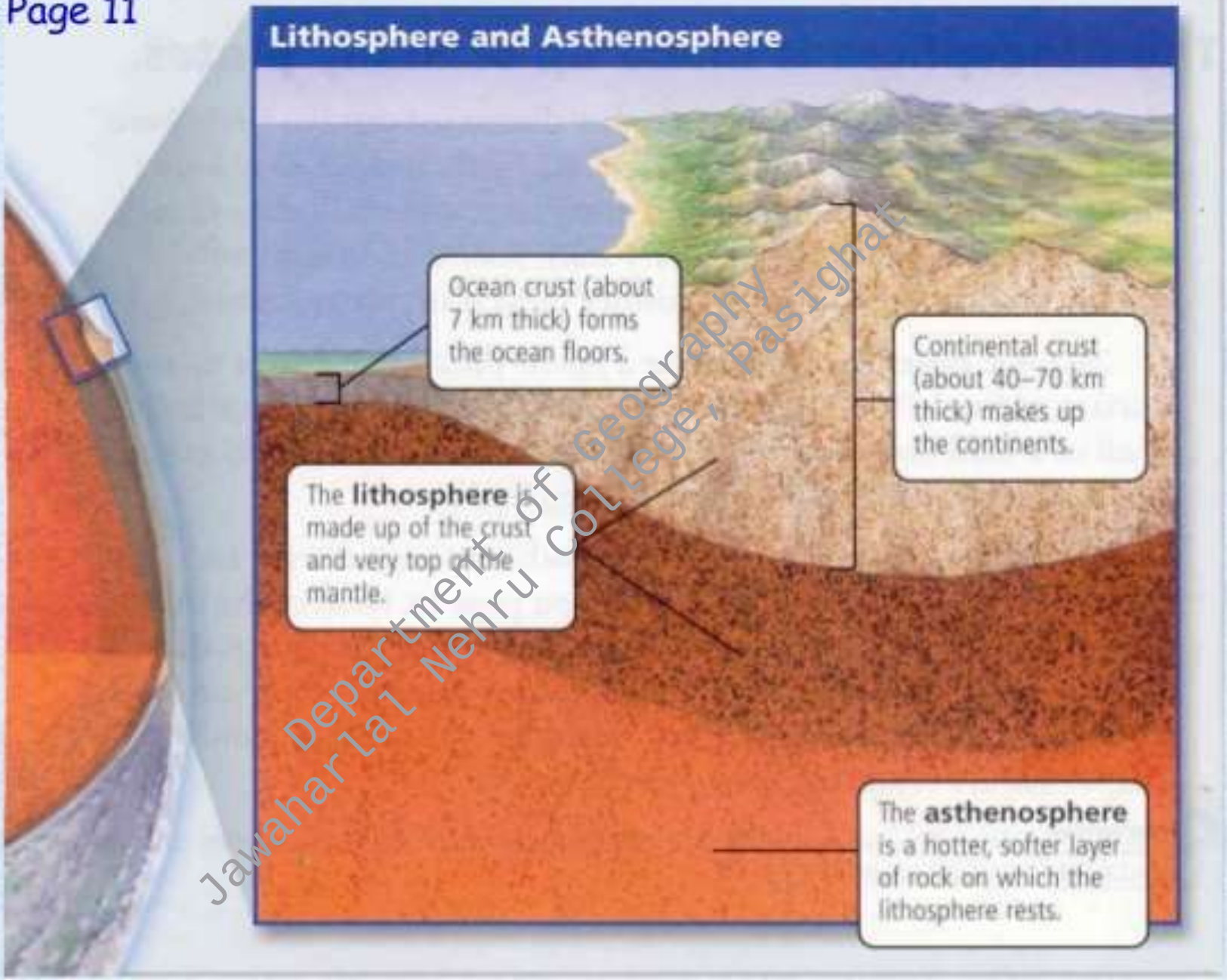

Principles of plate tectonics

- The Earth is composed of a mosaic of thin rigid plates (pieces of lithosphere) that move horizontally with respect to one another
- Plates interact with each other along their plate boundaries
- Plate boundaries associated with tectonic activity (mountain building, earthquakes, active volcanoes)

2 Types of Plates

- **Oceanic plates** - plates below the oceans
- **Continental plates** - plates below the continents

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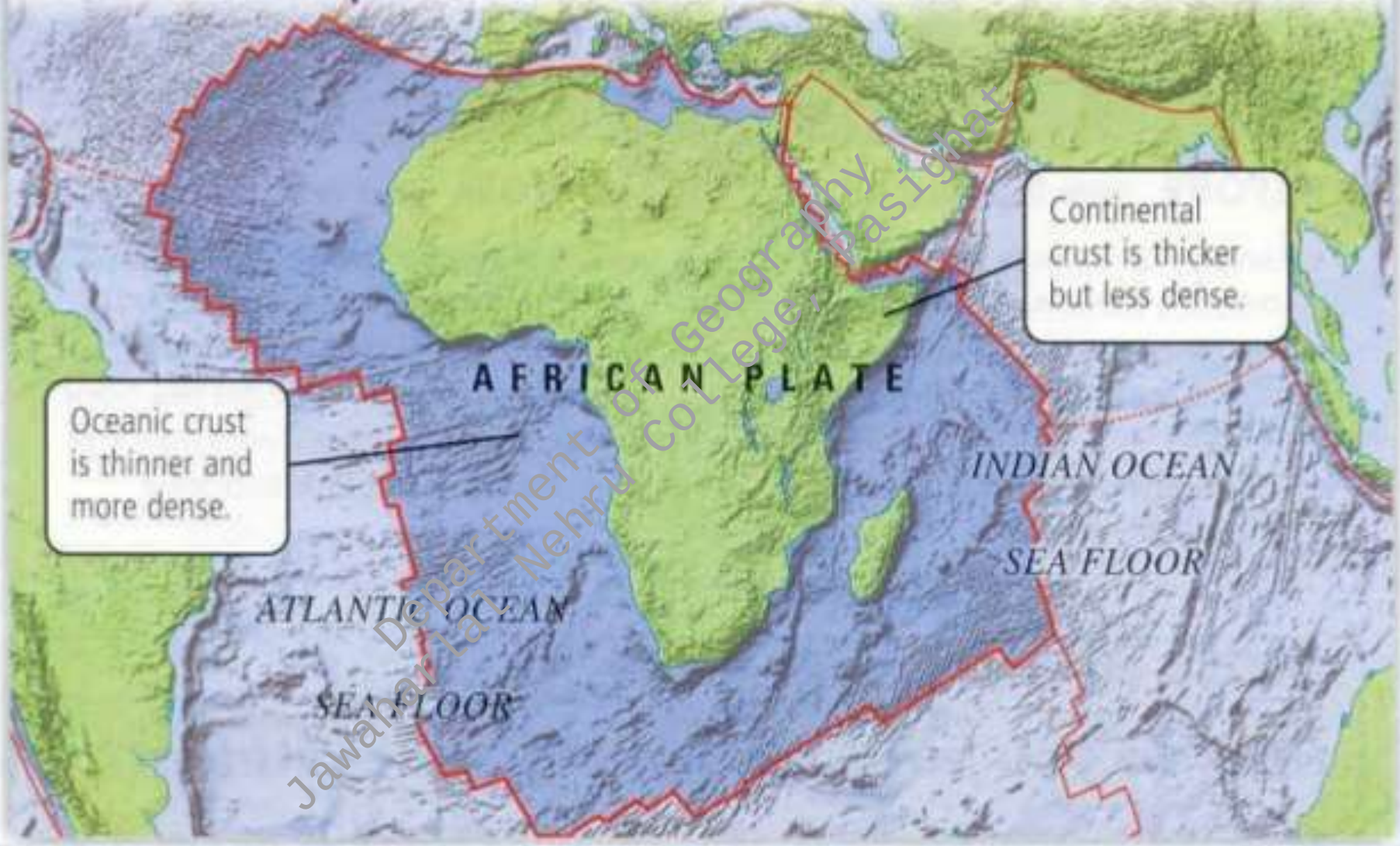
African Plate

Most tectonic plates have both continental and oceanic crust.



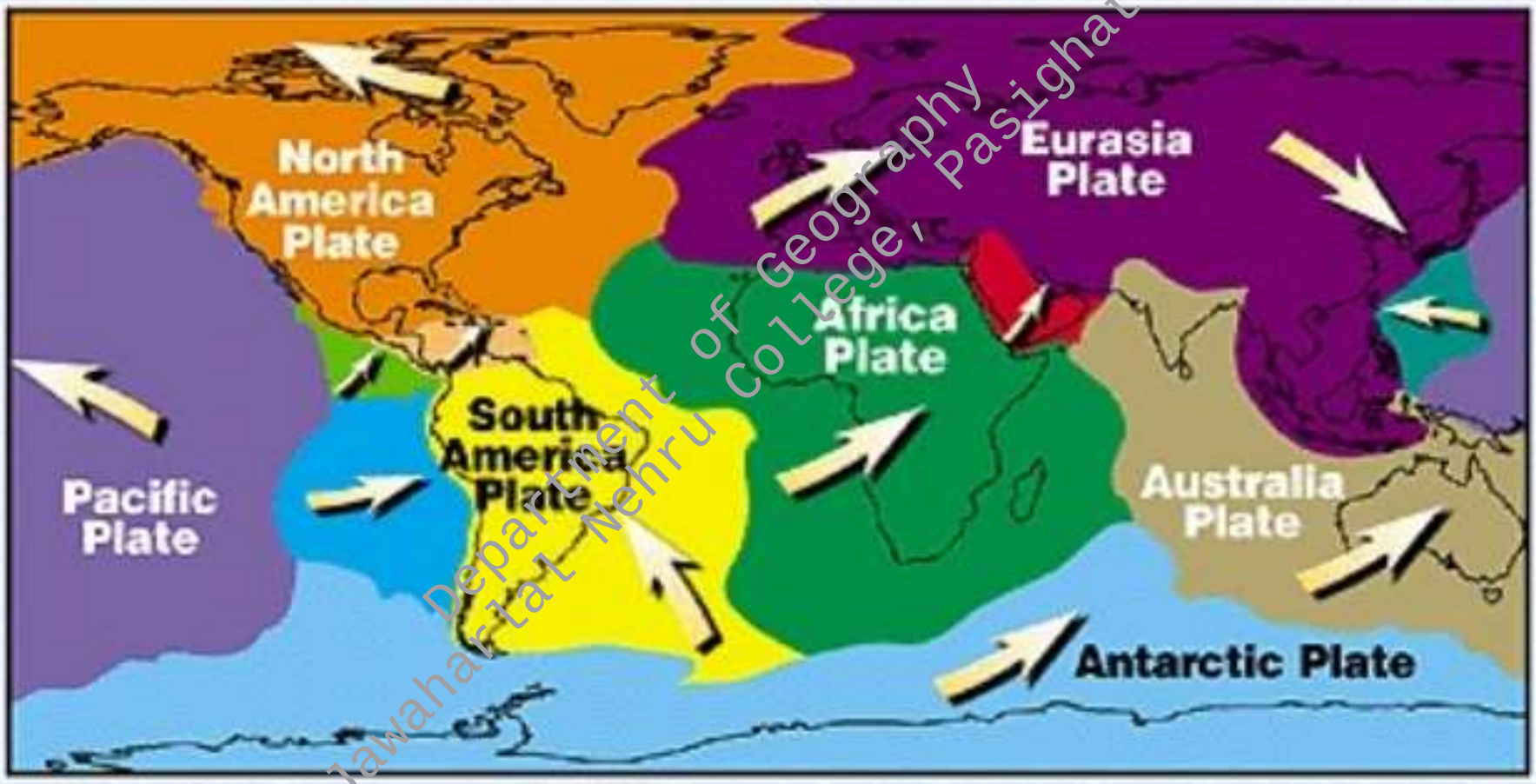
Major tectonic plates

- Antarctica and the surrounding oceanic plate
- North American plate
- South American plate
- Pacific plate
- India-Australia-New Zealand plate
- Africa with the eastern Atlantic floor plate
- Eurasia and the adjacent oceanic plate

Minor tectonic plates

- Cocos plate: Between Central America and Pacific plate
- Nazca plate: Between South America and Pacific plate
- Arabian plate: Mostly the Saudi Arabian landmass
- Philippine plate: Between the Asiatic and Pacific plate
- Caroline plate: Between the Philippine and Indian plate (North of New Guinea)
- Fuji plate: North-east of Australia.
- Turkish plate,
- Aegean plate (Mediterranean region),
- Caribbean plate,
- Juan de Fuca plate (between Pacific and North American plates)
- Iranian plate.

The lithosphere is made up of many plates.



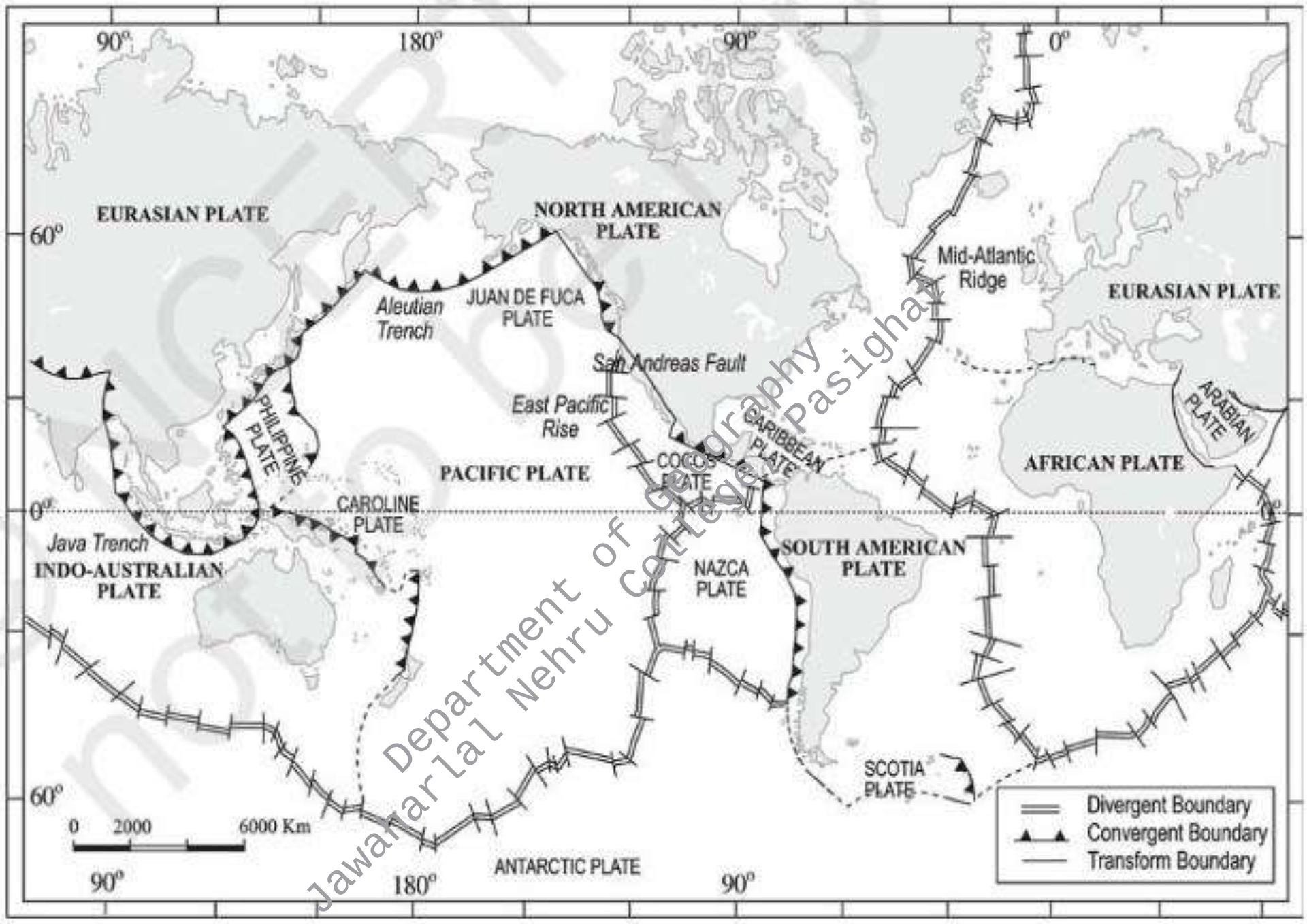
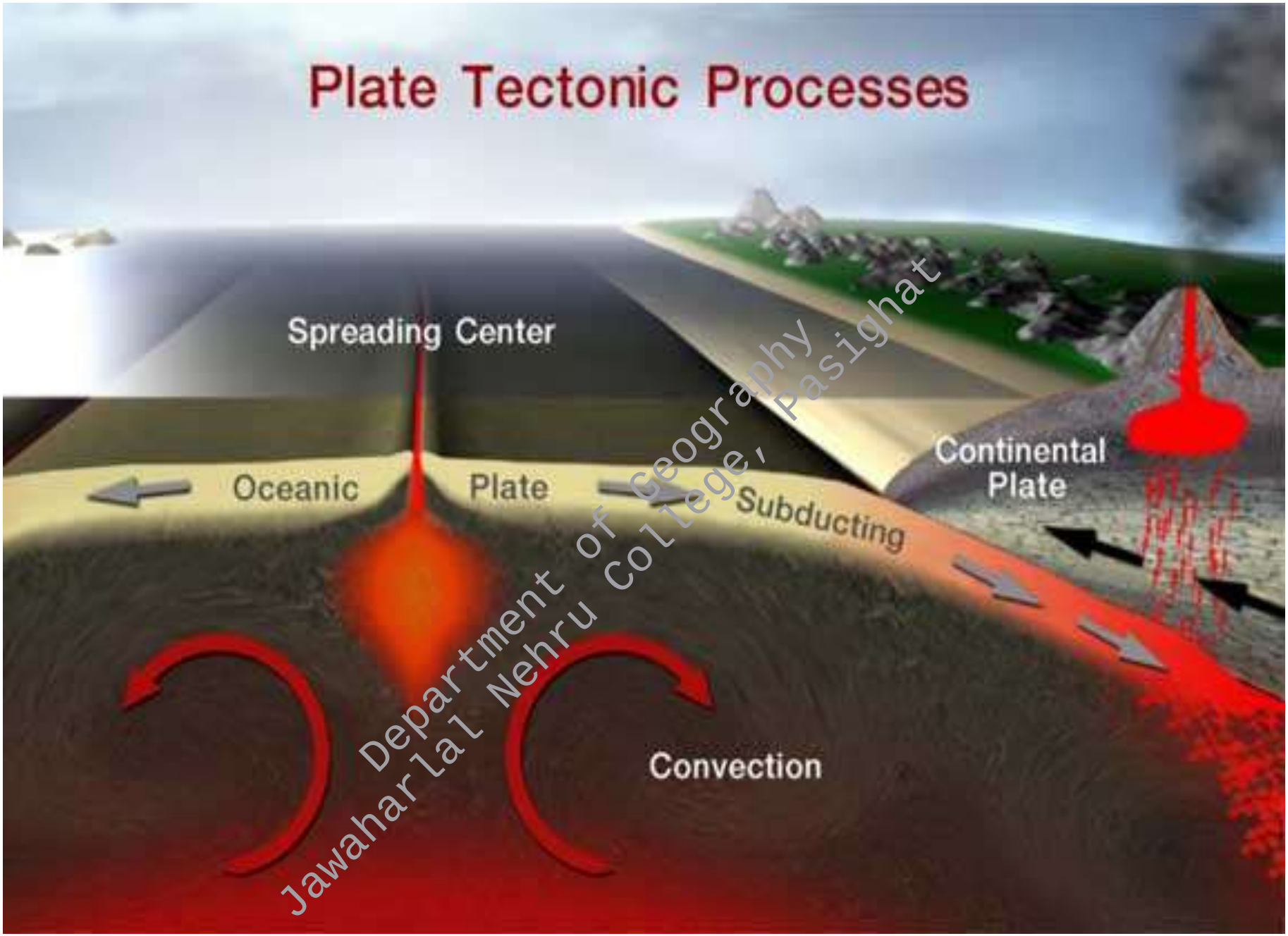
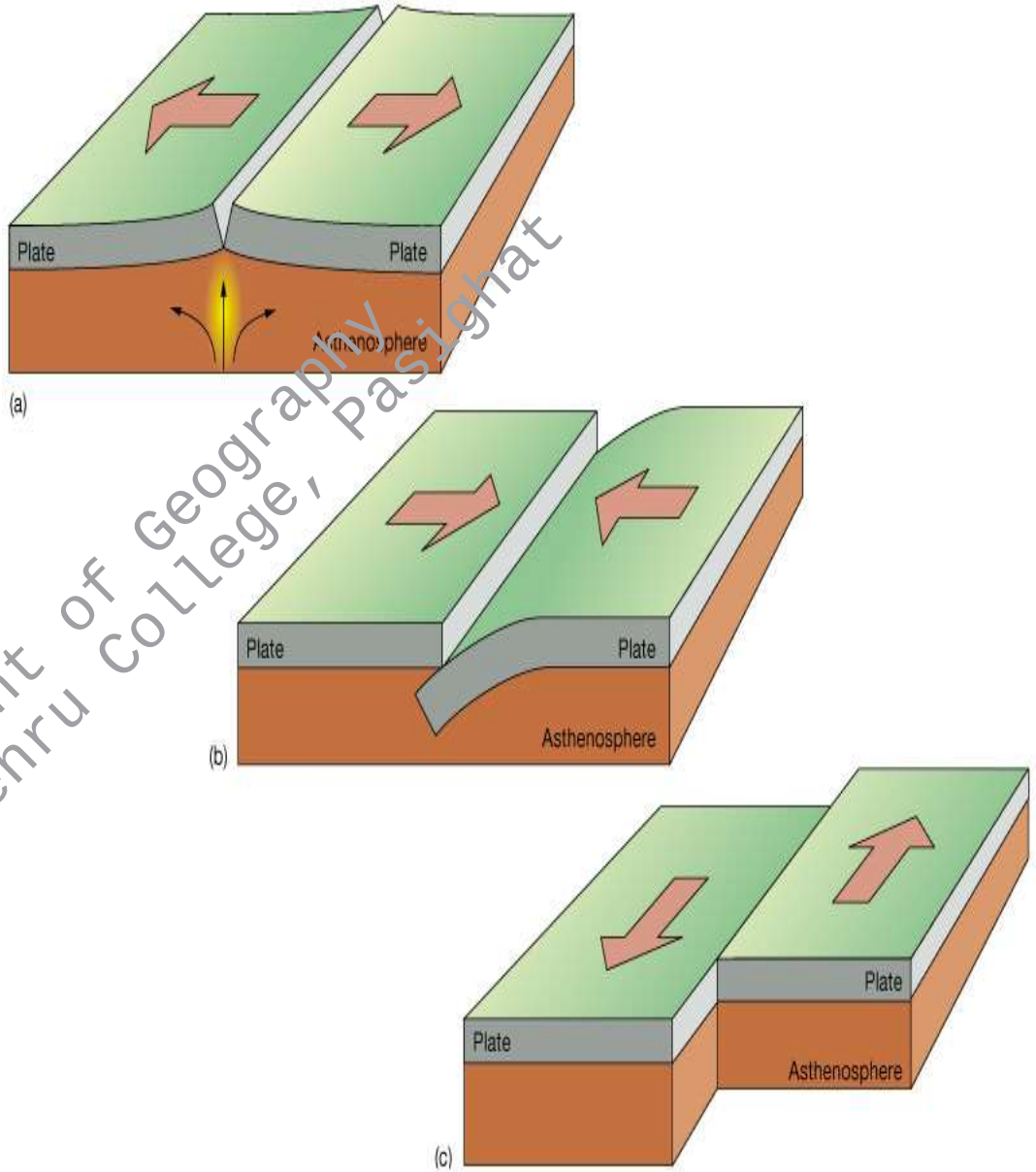


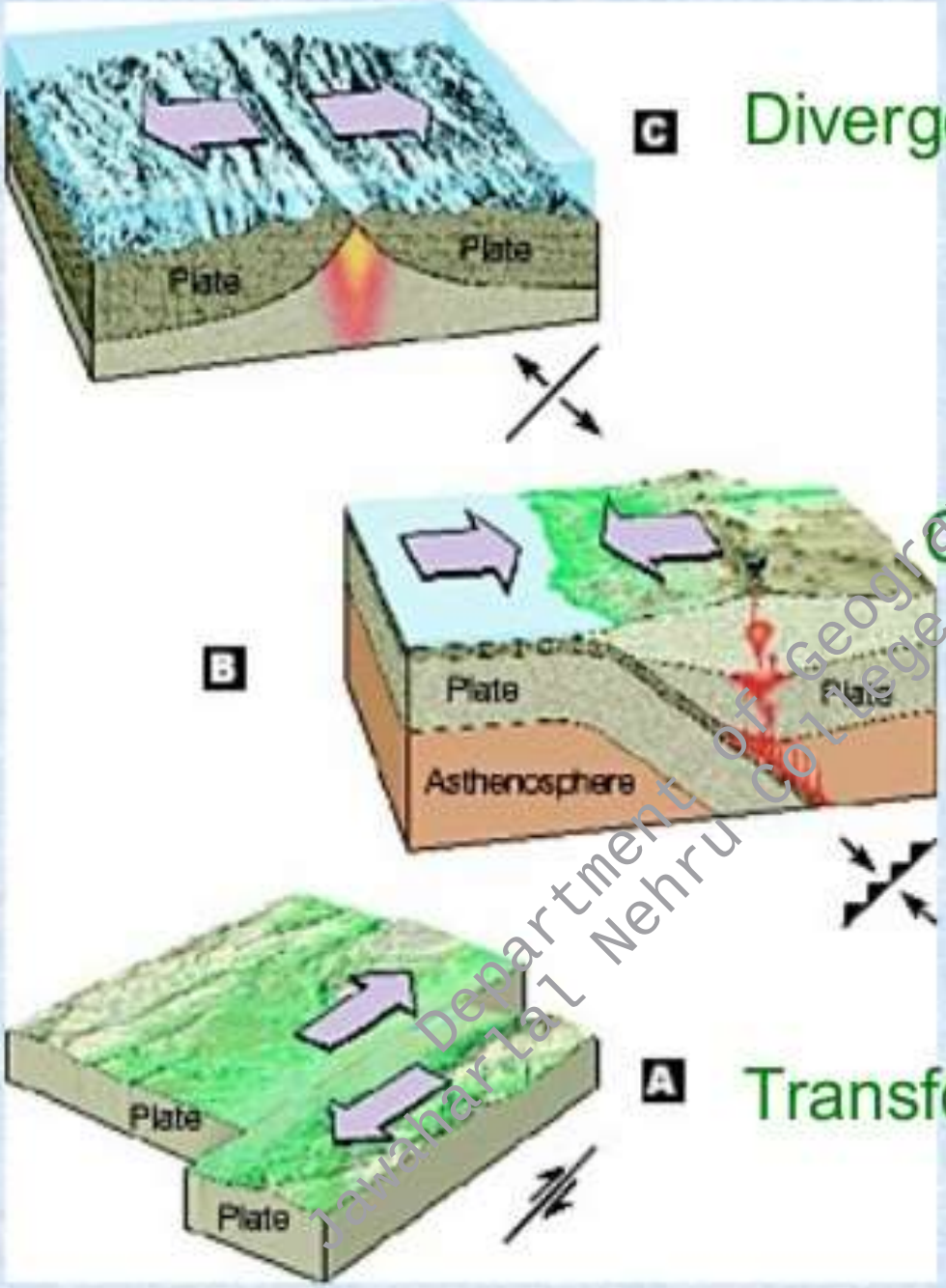
Figure 4.5 : Major and minor plates of the world



The 3 types of plate boundaries

- **1. Divergent**
- **2. Convergent**
- **3. Transform fault**

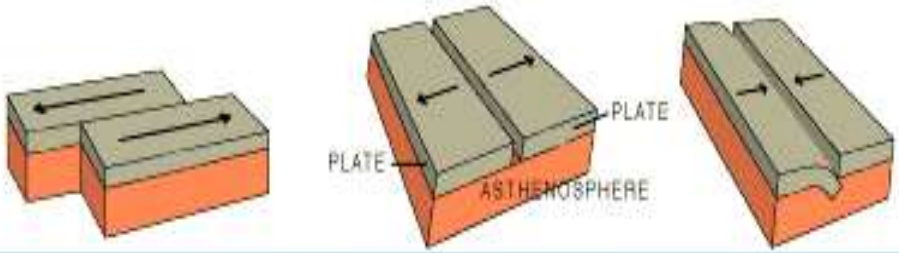


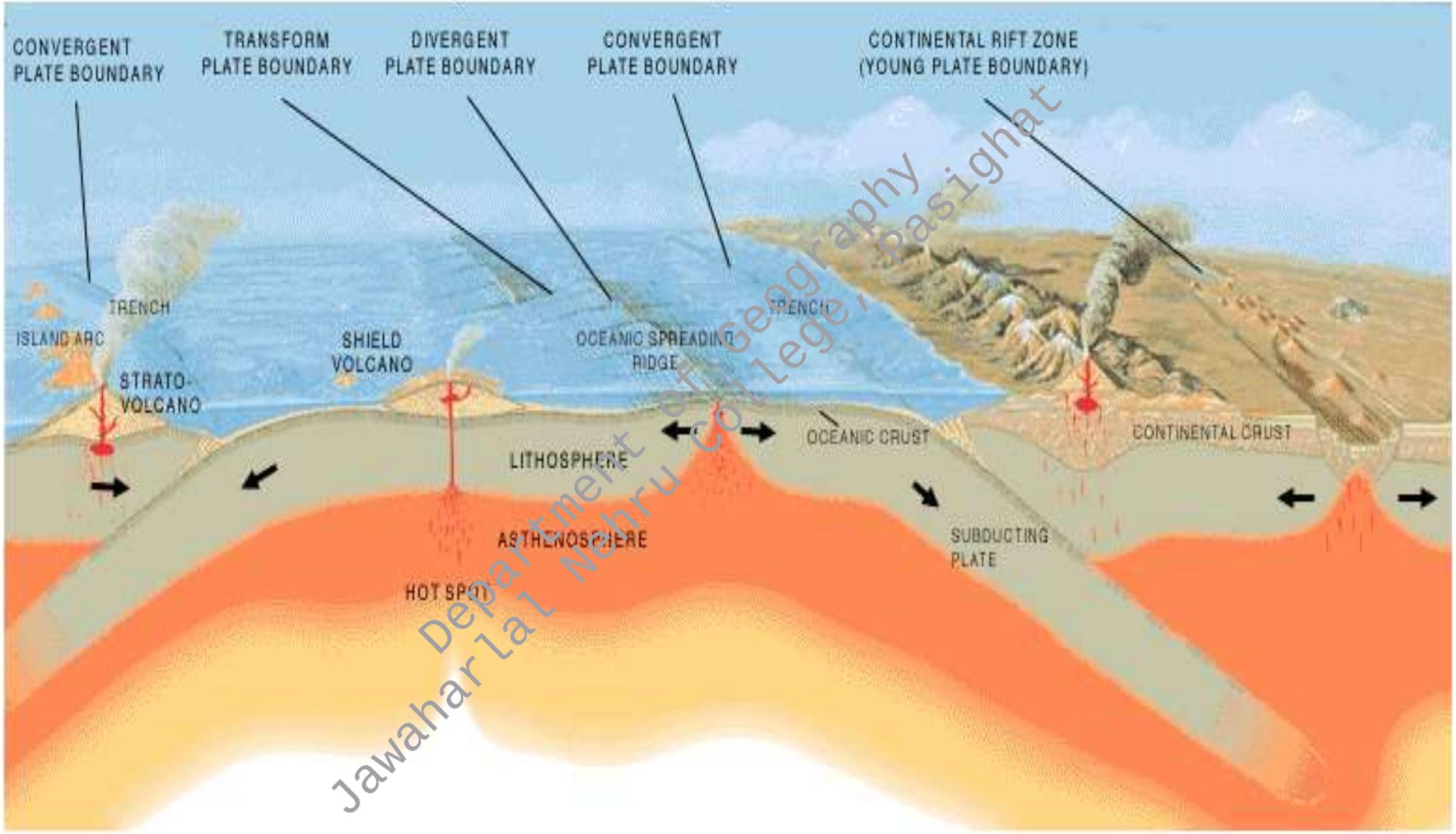


Divergent Boundary

Convergent Boundary

Transform Boundary



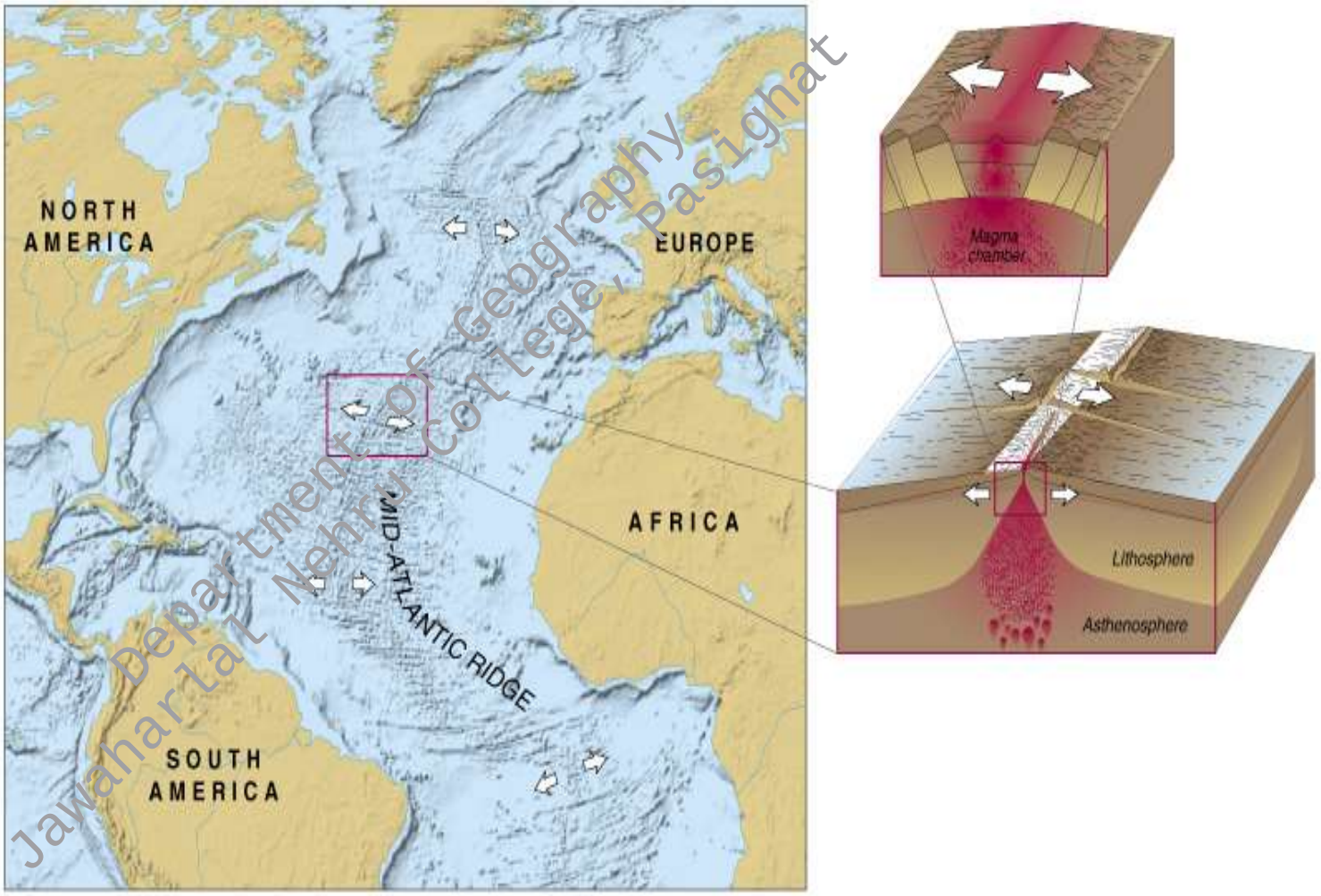


Features of Divergent Boundaries

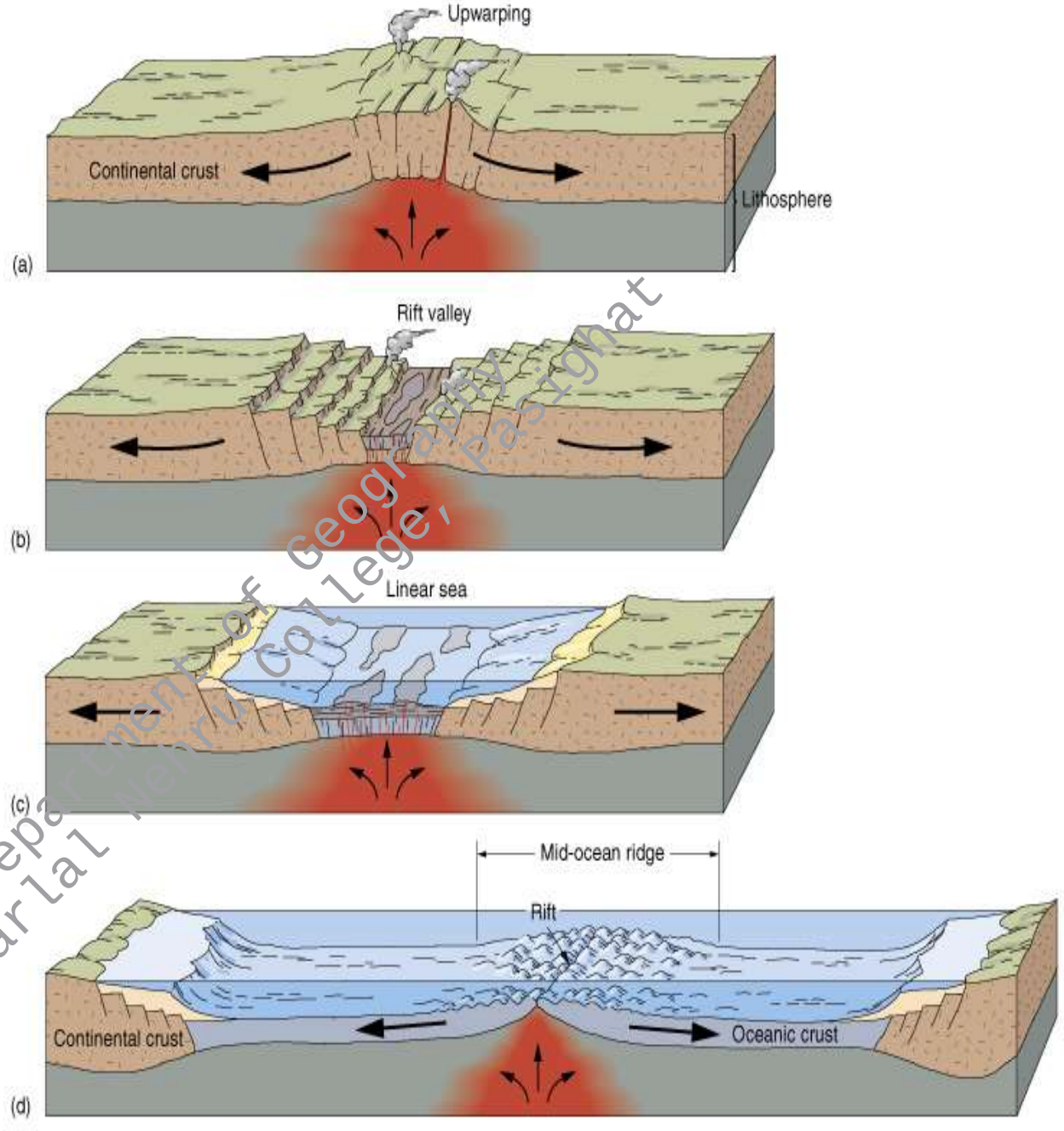
- Mid-ocean ridges
- rift valleys
- fissure volcanoes

Divergent plate boundaries

The Mid-Atlantic Ridge is a divergent plate boundary where sea floor spreading occurs



- Formation of an ocean basin by rifting and sea floor spreading



Divergent Boundary on Land

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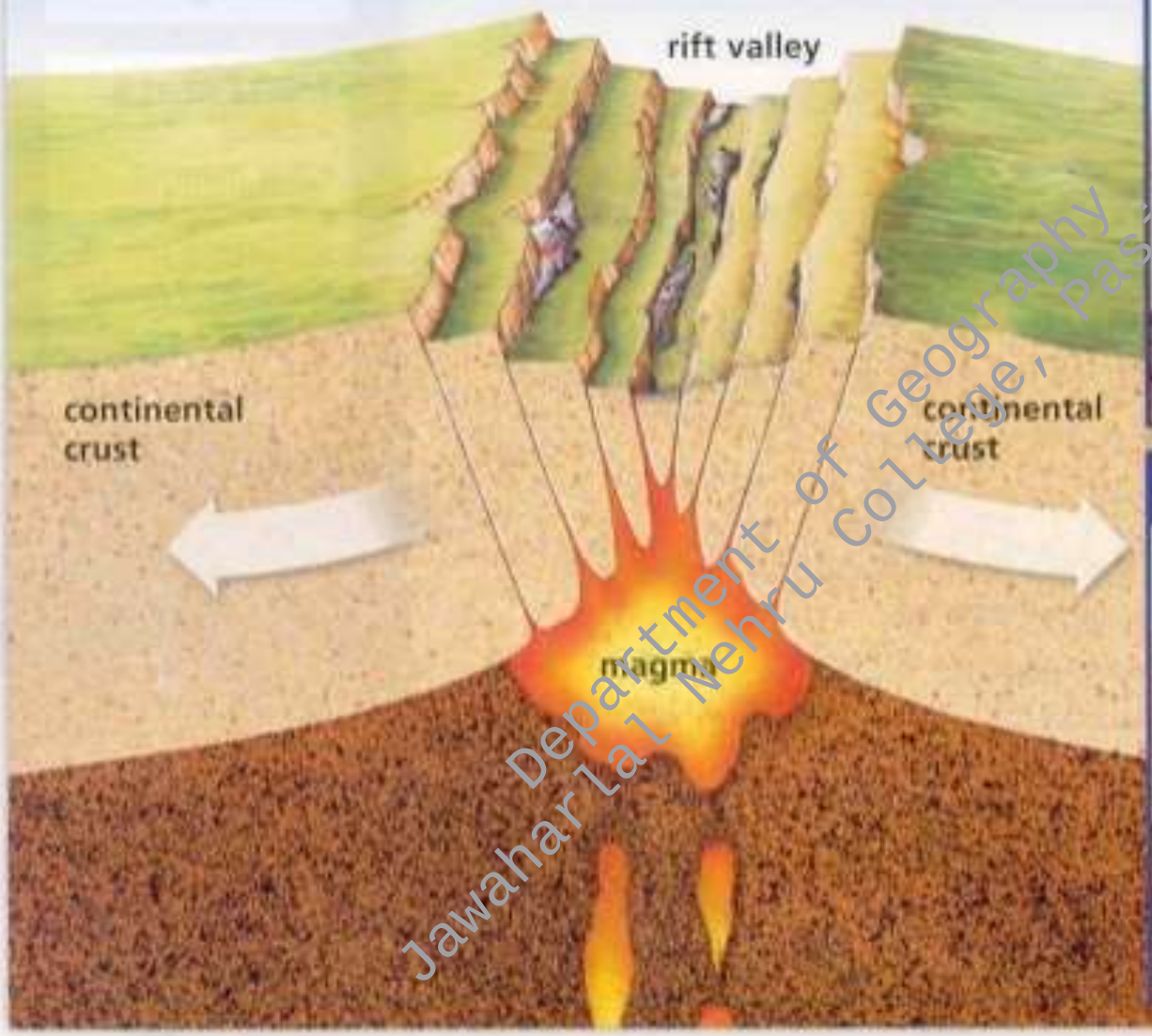
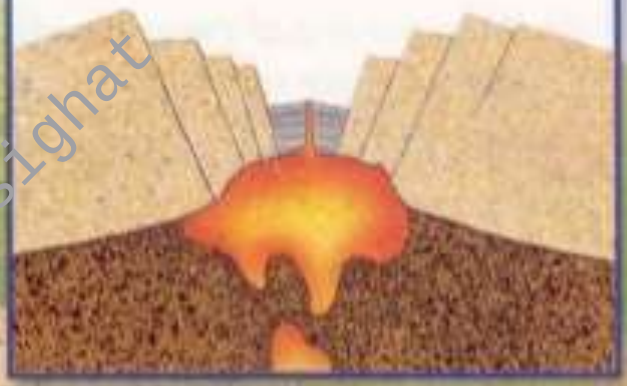
As rift valleys widen, continents begin to split apart.



Rift Valley Widens

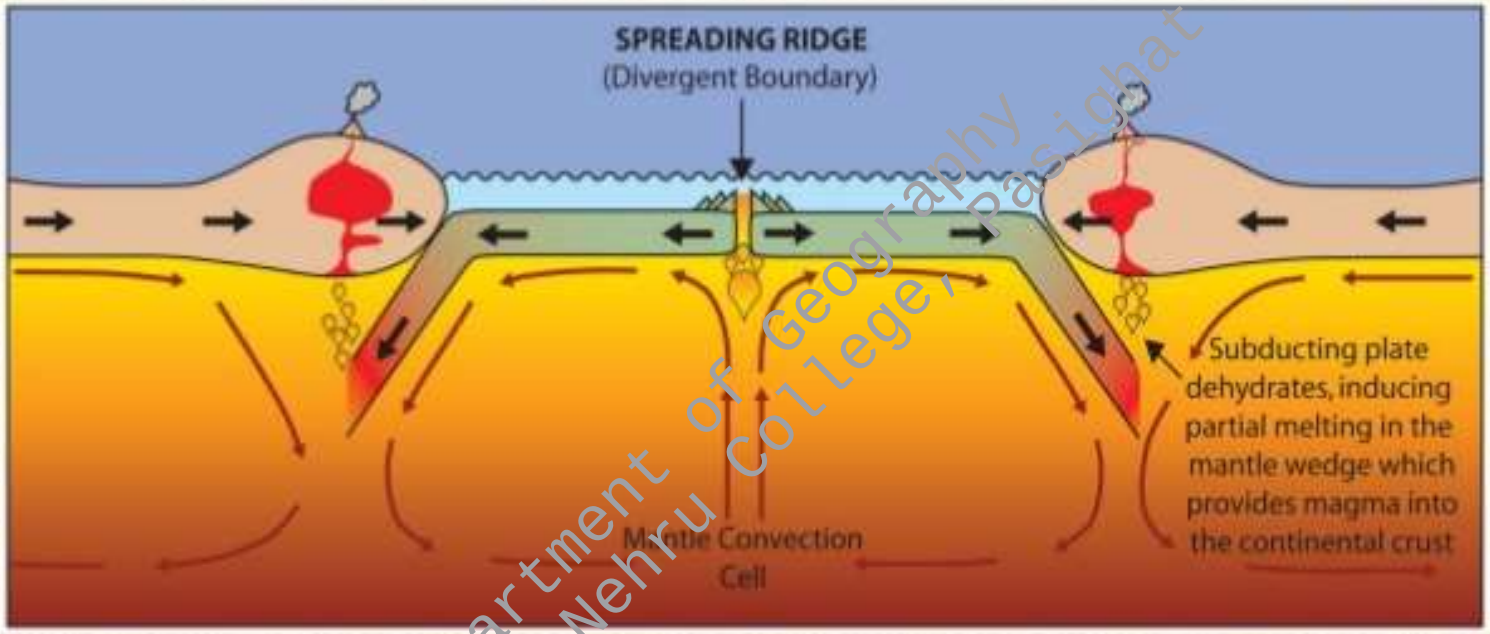
As the rift widens, the valley floor thins and sinks.



Valley Fills With Water

The valley floor falls below sea level, which allows water to enter.

Divergent Boundaries



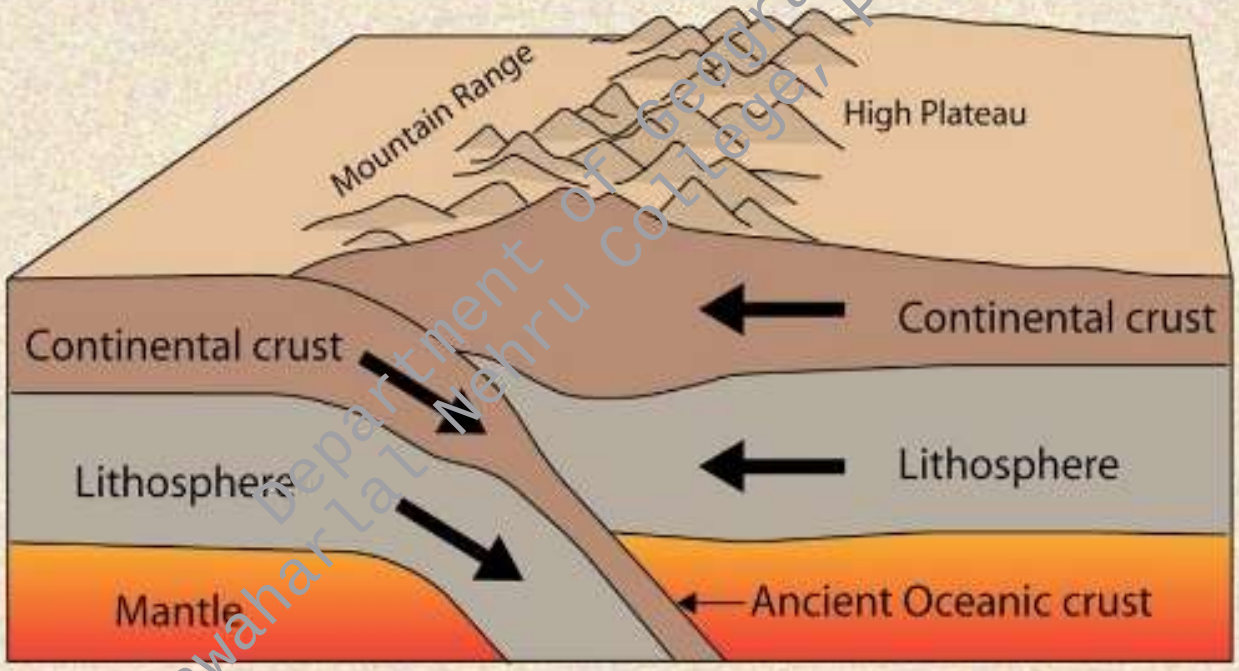
- Spreading ridges
  - As plates move apart magma fills up the gap

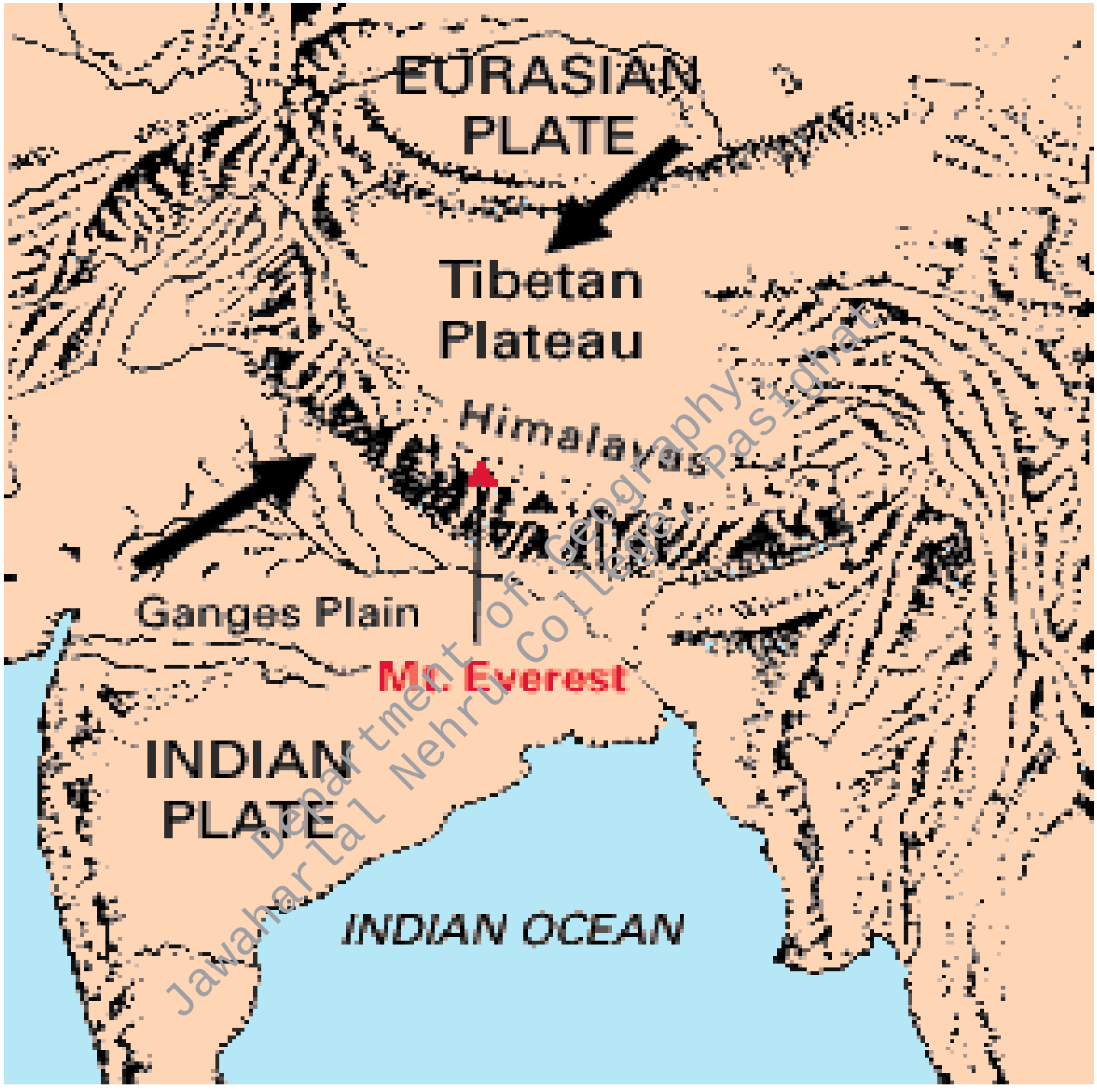
Convergent Boundaries

- There are three styles of convergent plate boundaries
  - Continent-continent collision
  - Continent-oceanic crust collision
  - Ocean-ocean collision

Continent-Continent Collision

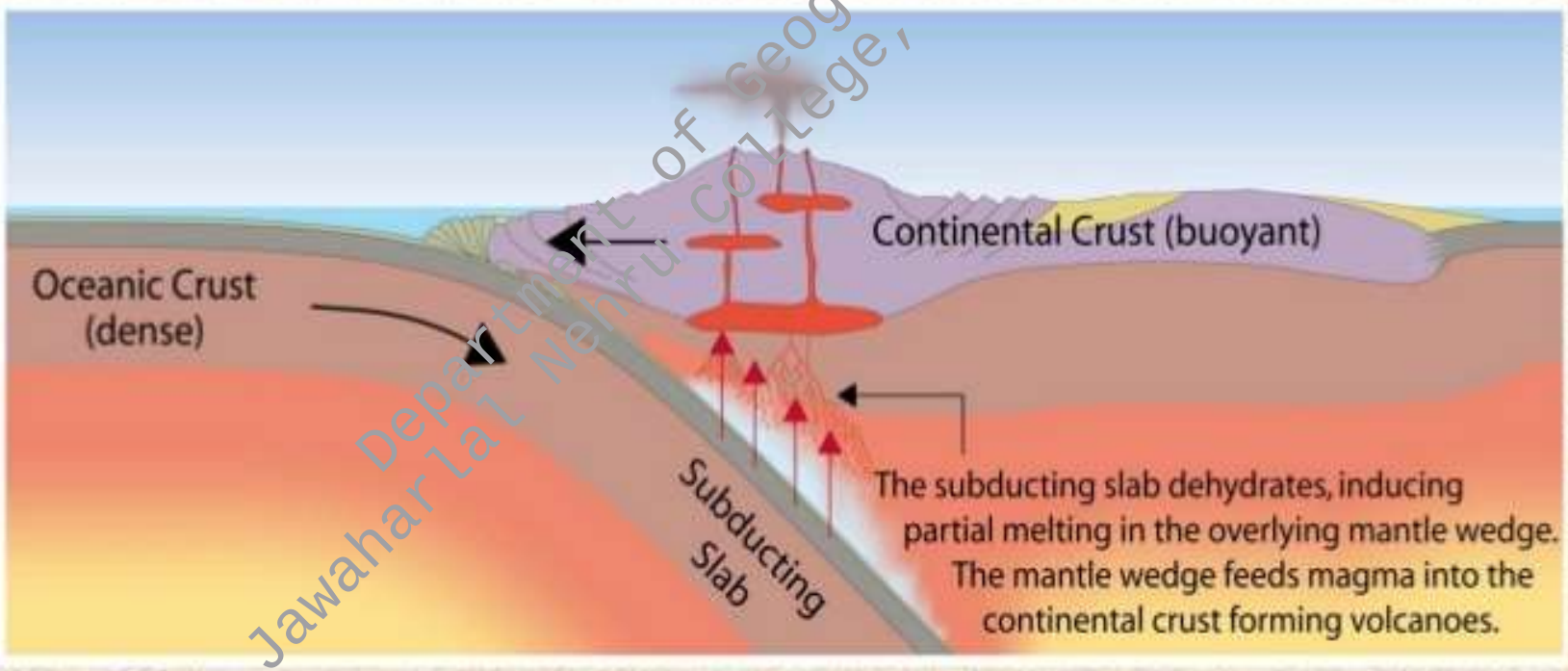
- Forms mountains, e.g. European Alps, Himalayas



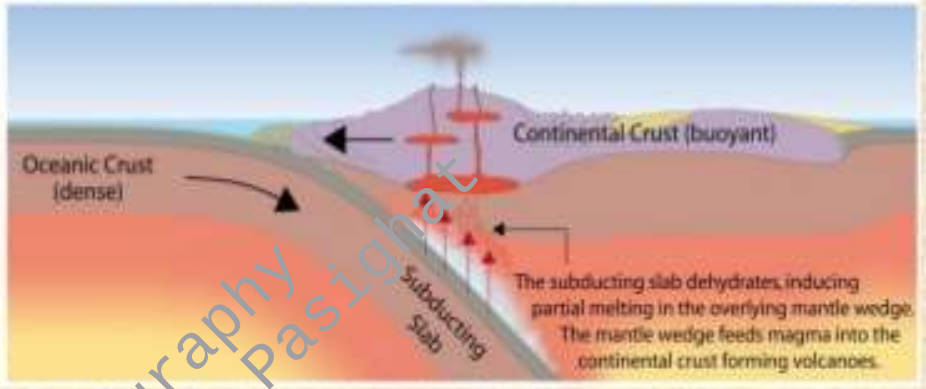


Continent-Oceanic Crust Collision

- Called SUBDUCTION



Subduction



- Oceanic plates subducts underneath the continental plate
- Oceanic plate heats and melts
- The melt rises forming volcanoes
- E.g. The Andes

Ocean-Ocean Plate Collision

- When two oceanic plates collide, one runs over the other which causes it to sink into the mantle forming a **subduction zone**.
- The subducting plate is bent downward to form a very deep depression in the ocean floor called a **trench**.
- The worlds deepest parts of the ocean are found along trenches.
  - E.g. The Mariana Trench is 11 km deep!

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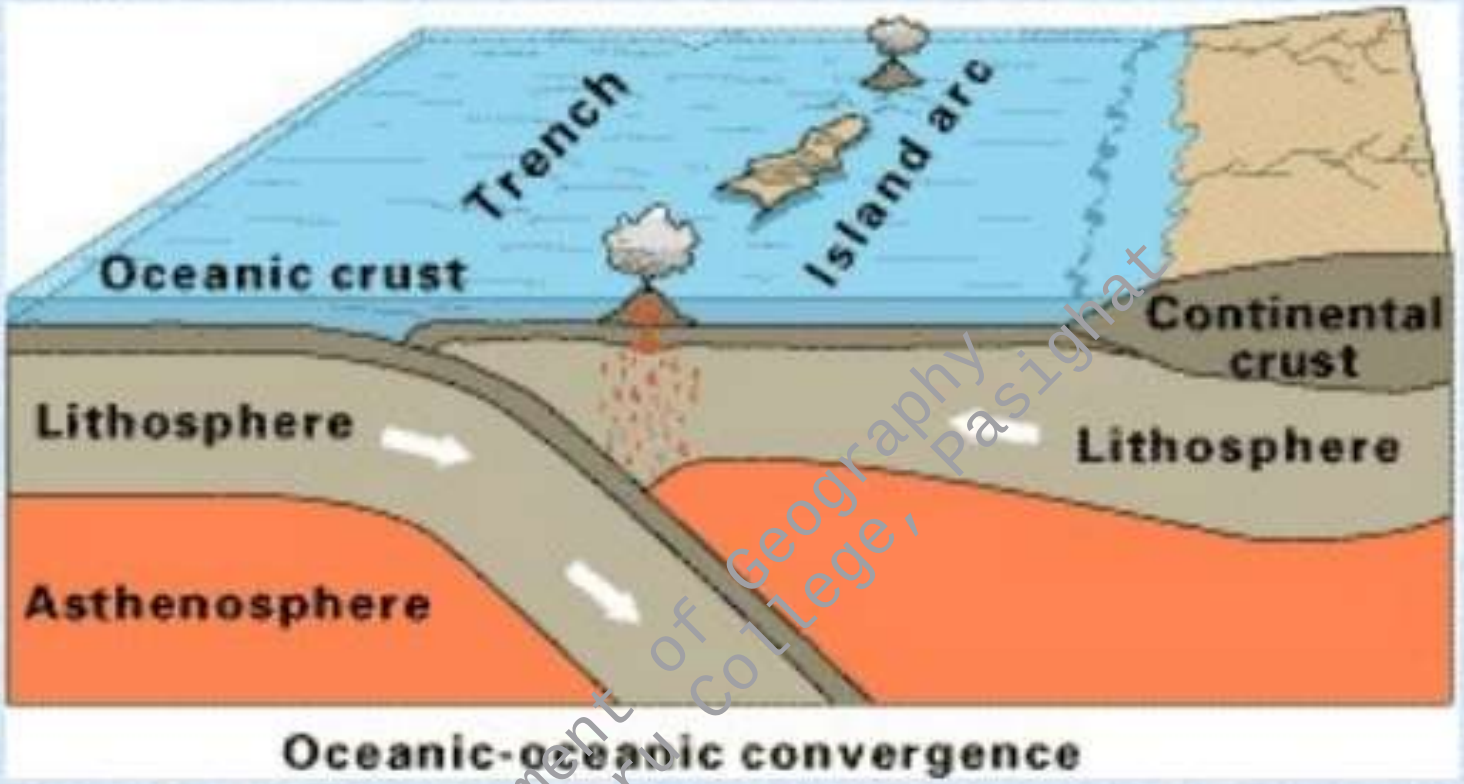
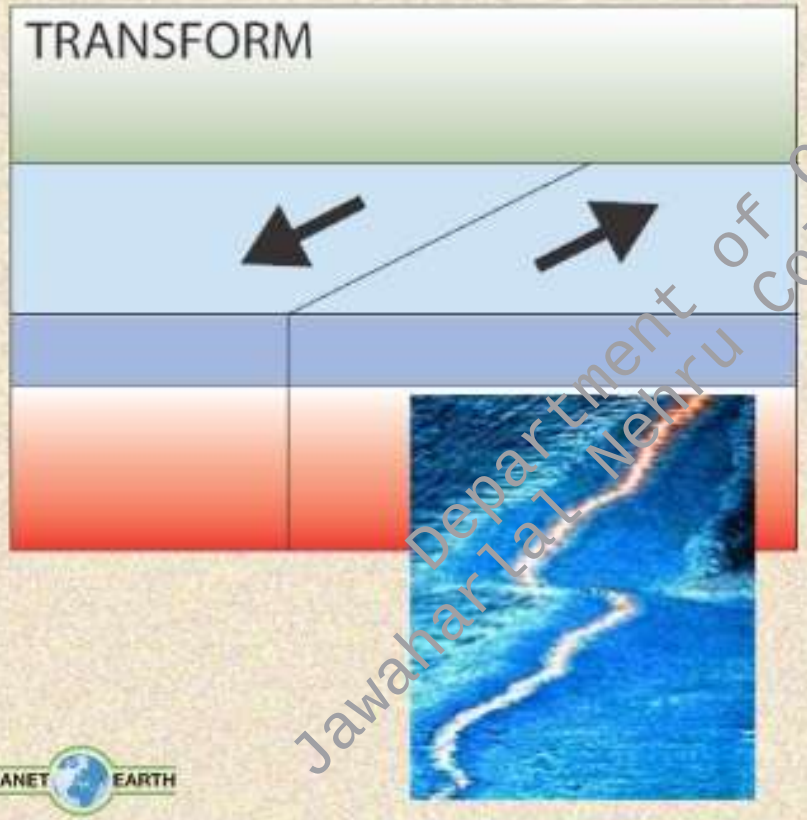
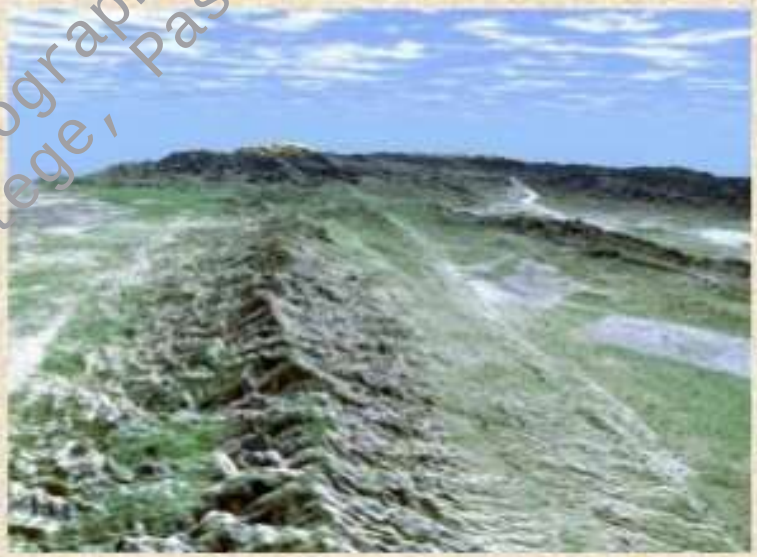


Oceanic-oceanic subductions: two oceanic plates collide and the older, denser plate sinks beneath the top plate, forming deep-ocean trenches and island arcs.

Transform Boundaries

- Where plates slide past each other





Above: View of the San Andreas transform fault

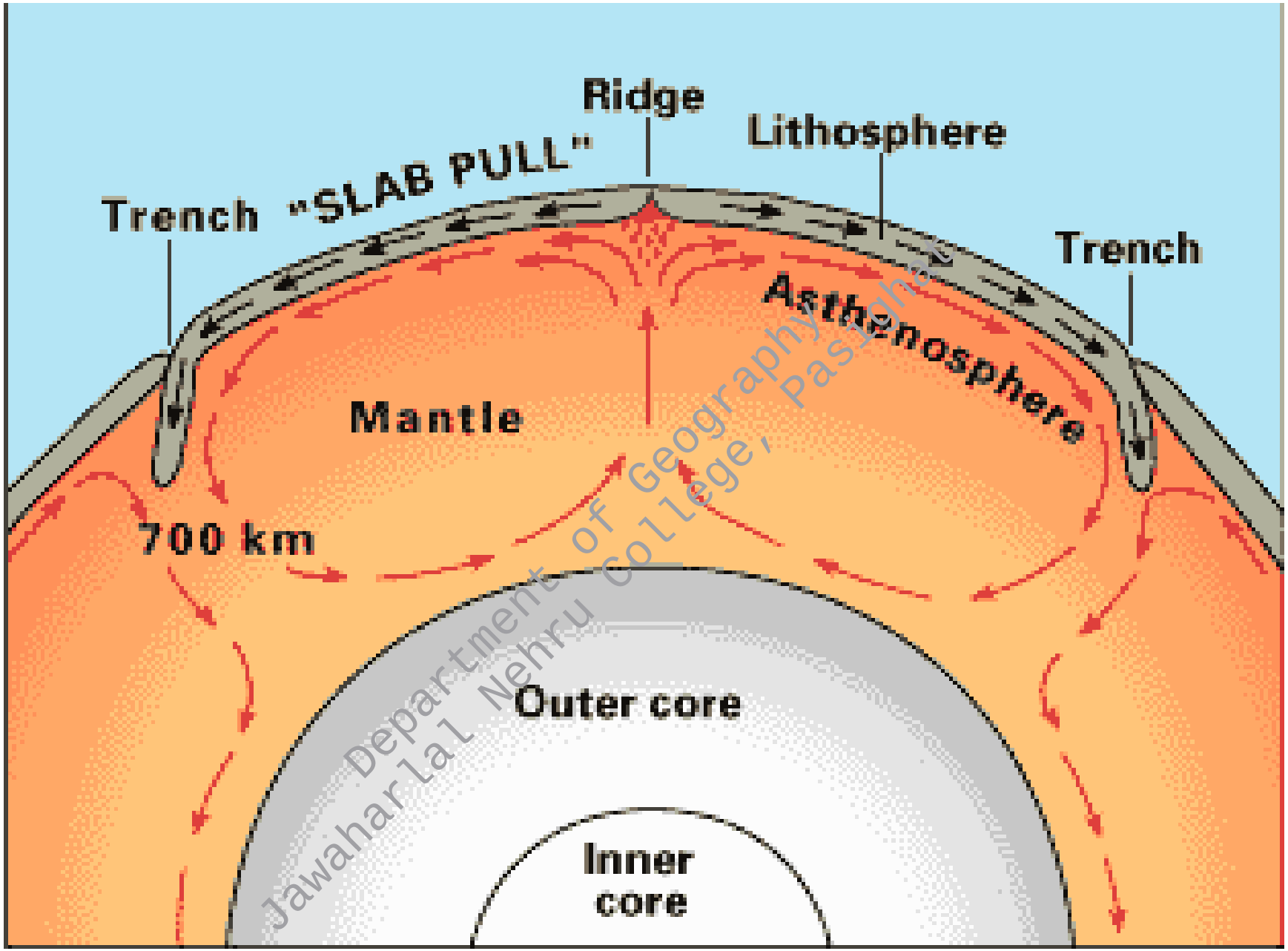
Comparing Boundaries

Divergent	*plates move apart *in ocean and on land *produce mid-ocean ridges, rift valleys, volcanoes, earthquakes
Transform	*plates move past each other in opposite directions *in ocean and on land
Convergent C-C Collision	*crumples and folds crust * produces mountains, earthquakes
Convergent O-O Subduction	*older, denser plate sinks *produce deep-ocean trenches, island arcs
Convergent O-C Subduction	*oceanic plate sinks under continental plate * forms deep-ocean trench, volcanic coastal mountains

Causes of Plate Tectonics

Convection Currents

- Hot magma in the Earth moves toward the surface, cools, then sinks again.
- Creates convection currents beneath the plates that cause the plates to move.



Comparison: Continental Drift – See Floor Spreading – Plate Tectonics

	Continental Drift	See Floor Spreading	Plate Tectonics
Explained by	**Alfred Wegener** in 1920s	**Arthur Holmes** explains Convectional Current Theory in 1930s. Based on convectional current theory, **Harry Hess** explains Sea Floor Spreading in 1940s	In 1967, McKenzie and Parker suggested the theory of plate tectonics. The theory was later outlined by Morgan in 1968
Theory	Explains Movement of Continents only	Explains Movement of Oceanic Plates only	Explains Movement of Lithospheric plates that include both continents and oceans.
Forces for movement	Buoyancy, gravity, pole fleeing force, tidal currents, tides,	Convection currents in the mantle drag crustal plates	Convection currents in the mantle drag crustal plates

Contd...

Evidences	Apparent affinity of physical features, botanical evidence, fossil evidence, Tillite deposits, placer deposits, rocks of same age across different continents etc.	Ocean bottom relief, Paleomagnetic rocks, distribution of earthquakes and volcanoes etc.	Ocean bottom relief, Paleomagnetic rocks, distribution of earthquakes and volcanoes, gravitational anomalies at trenches, etc.
Drawbacks	Too general with silly and sometimes illogical evidences.	Doesn't explain the movement of continental plates	————————
Acceptance	Totally discarded	Not complete	Most widely accepted
Usefulness	Helped in the evolution of convectional current theory and see floor spreading theory	Helped in the evolution of plate tectonics theory	Helped understand various geographical features.