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CUET · GEOGRAPHY · CLASS XI · CODE 313

Distribution of Oceans and Continents

CUET unit: Distribution of Oceans and Continents (Fundamentals of Physical Geography)

By **UniDrill** · NCERT-grounded study material

📌 Snapshot

- The positions of oceans and continents have changed through geological time — the idea runs from **Abraham Ortelius (1596)** and **Antonio Pellegrini**, through **Wegener's Continental Drift Theory (1912)**, to **Holmes (1930s)**, **Hess's Sea Floor Spreading (1961)** and the **Plate Tectonics framework of McKenzie, Parker and Morgan (1967)**.
- The evidential foundation — **jig-saw fit, rocks of the same age, tillite, placer deposits, distribution of fossils, palaeomagnetic data** — underpins every subsequent physical geography topic including climate, ocean circulation and landform genesis.
- This topic links global-scale tectonics to the physical setting of India (Himalayas, Deccan Traps, Indian plate movement), prerequisite knowledge for India's climate, drainage and relief.
- There are **three plate boundaries** (divergent, convergent, transform), the **mechanism of sea floor spreading**, and **seven major and several minor plates** — all high-frequency CUET topics.
- India's own journey from **~50° S to its present position** is highly relevant to questions on the origin of the Himalayas, the Tethys Sea and the Deccan Traps.

📖 Detailed Notes

2.1 Core concepts

- Continents cover **29%** of the surface of the earth and the remainder is under oceanic waters. Positions of the continents and ocean bodies have not been the same in the past and will not remain so in the future (NCERT §Introduction, p. 27).
- **Abraham Ortelius**, a Dutch map maker, was the first to suggest the possibility that Europe, Africa and America were once joined — as early as **1596**. **Antonio Pellegrini** drew a map showing the three continents together. However, it was **Alfred Wegener — a German meteorologist — who put forth a comprehensive argument in the form of the "Continental Drift Theory" in 1912** regarding the distribution of oceans and continents (NCERT §Continental Drift, p. 27).
- According to Wegener, all continents once formed a single continental mass called **PANGAEA** ("all earth"), surrounded by a mega-ocean called **PANTHALASSA** ("all water"). Around **200 million years ago** Pangaea began to split — first into two

large continental masses: **Laurasia** in the north and **Gondwanaland** in the south. Subsequently they continued to break into the various smaller continents that exist today (NCERT §Continental Drift, p. 27).

- **Evidence in support of Continental Drift**:
- **The Matching of Continents (Jig-Saw-Fit)** — the shorelines of Africa and South America facing each other have a remarkable and unmistakable match. A computer-generated **best fit by Bullard (1964) at the 1,000-fathom line** (instead of the present shoreline) proved quite perfect (NCERT §Matching, p. 27).
- **Rocks of Same Age Across the Oceans** — radiometric dating shows that the **belt of ancient rocks of 2,000 million years from the Brazil coast matches with those from western Africa**. The earliest marine deposits along the coastlines of South America and Africa are of the **Jurassic age**, suggesting the ocean did not exist before that time (NCERT §Rocks of Same Age, p. 28).
- **Tillite** is the sedimentary rock formed out of deposits of glaciers. The **Gondwana system of sediments from India** has its counterparts in **six different landmasses of the Southern Hemisphere — Africa, Falkland Island, Madagascar, Antarctica and Australia**. At the base, the system has thick tillite indicating extensive and prolonged glaciation. Glacial tillite provides unambiguous evidence of **palaeoclimates and also of drifting of continents** (NCERT §Tillite, p. 28).
- **Placer Deposits** — rich placer deposits of gold occur on the **Ghana coast**, with the absolute absence of source rock locally; the **gold-bearing veins are in Brazil**. The Ghana gold deposits are obviously derived from the Brazil plateau when the two continents lay side by side (NCERT §Placer Deposits, p. 28).
- **Distribution of Fossils** — when identical species adapted to living on land or in fresh water are found on either side of marine barriers, a problem arises in accounting for the distribution. The observation that **Lemurs occur in India, Madagascar and Africa** led some to consider a contiguous landmass called **"Lemuria"** linking the three. **Mesosaurus**, a small reptile adapted to shallow brackish water, is found only in the **Southern Cape Province of South Africa** and the **Iraver formations of Brazil** — the two localities now **4,800 km apart** with an ocean in between (NCERT §Distribution of Fossils, p. 28).
- **Force for Drifting**: Wegener suggested two forces — (i) **pole-fleeing force** related to the **rotation of the earth** (the earth is not a perfect sphere; it has an equatorial bulge due to rotation); and (ii) **tidal force** due to the attraction of the **moon and the sun** that develops tides in oceanic waters. Wegener believed these forces would become effective when applied over many million years. **Most scholars considered these forces totally inadequate** to move continents (NCERT §Force for Drifting, p. 28).
- **Post-drift studies** — for continental drift, most evidence had been collected from continental areas (flora, fauna, tillite). After WWII, mapping of the ocean floor added

new information to geological literature, providing new dimensions to the study of distribution of oceans and continents (NCERT §Post-drift Studies, p. 28).

- **Convectional Current Theory — Arthur Holmes, in the 1930s**, discussed the possibility of convection currents operating in the mantle portion. These currents are generated by **radioactive elements causing thermal differences in the mantle**. Holmes argued that such a system exists in the entire mantle portion, providing an explanation for the **force problem** that had discredited contemporary continental-drift theory (NCERT §Convectional Current Theory, p. 28).
- **Mapping of the Ocean Floor** revealed that the ocean floor is **not a vast plain** but full of relief — **submerged mountain ranges as well as deep trenches**, mostly closer to the continental margins. **Mid-oceanic ridges** were found to be most active in volcanic eruptions. Dating of rocks revealed that ocean-crust rocks are much **younger** than continental ones, and rocks equidistant on either side of the ridge crest have remarkable similarities both in age and constituents (NCERT §Mapping of the Ocean Floor, p. 28).
- **Ocean Floor Configuration** — the ocean floor is segmented into three major divisions based on depth and relief:
- **Continental Margins** — transition between continental shores and deep-sea basins; include **continental shelf, continental slope, continental rise and deep-oceanic trenches**. The **deep-oceanic trenches** are of particular interest for distribution of oceans and continents.
- **Abyssal Plains** — extensive plains lying between continental margins and mid-oceanic ridges, where continental sediments that move beyond the margins get deposited.
- **Mid-Oceanic Ridges** — interconnected chain of mountain system within the ocean — the **longest mountain chain on the surface of the earth, though submerged**. Characterised by a **central rift system at the crest**, a fractionated plateau and flank zones all along its length; the rift is the zone of intense **mid-oceanic volcanic activity** (NCERT §Ocean Floor Configuration, p. 29).
- **Distribution of Earthquakes and Volcanoes** — the line of dots representing seismic activity coincides with the **mid-oceanic ridges** (shallow-focus earthquakes). The shaded belt of deep-seated earthquakes coincides with the **Alpine-Himalayan belt and the rim of the Pacific Ocean**. The volcano map shows a similar pattern; the rim of the Pacific is called the **Ring of Fire** because of its concentration of active volcanoes. **Hot spots** are also visible — Hawaii, Yellowstone, Galapagos (NCERT §Distribution of Earthquakes and Volcanoes, p. 29; Fig. 4.2).
- **Concept of Sea Floor Spreading** — palaeomagnetic studies of oceanic rocks revealed: (i) **Volcanic eruptions** are common all along the **mid-oceanic ridges** and bring huge amounts of lava to the surface. (ii) Rocks equidistant on either side of the crest of mid-oceanic ridges show remarkable similarities in **period of formation, chemical compositions and magnetic properties**. Rocks closer to the ridges

have **normal polarity** and are the **youngest**; rock age increases as one moves away from the crest. (iii) **The age of rocks in the oceanic crust is nowhere more than 200 million years old, whereas some continental rock formations are as old as 3,200 million years**. (iv) Sediments on the ocean floor are unexpectedly **very thin**; nowhere was the sediment column found to be older than 200 million years. (v) The **deep trenches have deep-seated earthquakes**, while in mid-oceanic ridge areas the foci are shallow.

- These facts and a detailed analysis of magnetic properties led **Hess (1961) to propose his hypothesis "sea floor spreading"** — constant eruptions at the crest of oceanic ridges cause rupture of the oceanic crust; new lava wedges into it, pushing the oceanic crust on either side. The ocean floor thus spreads. The younger age of the oceanic crust and the fact that spreading of one ocean does not cause shrinking of the other made Hess think about consumption of the oceanic crust — **the ocean floor that gets pushed by volcanic eruptions at the crest sinks down at the oceanic trenches and gets consumed** (NCERT §Sea Floor Spreading, pp. 30–31).
- **Plate Tectonics** — interest in the problem of distribution of oceans and continents was revived after the advent of sea floor spreading. In **1967, McKenzie and Parker and also Morgan, independently** collected the available ideas and came out with the concept termed **Plate Tectonics**. A **tectonic plate (also called lithospheric plate)** is a massive, irregularly-shaped slab of solid rock, generally composed of both **continental and oceanic lithosphere**. Plates move horizontally over the **asthenosphere** as rigid units. The lithosphere thickness ranges between **5–100 km in oceanic parts and about 200 km in continental areas**. A plate may be **continental or oceanic** depending on which portion is larger — the Pacific plate is largely oceanic; the Eurasian plate is largely continental. The theory proposes that the lithosphere is divided into **seven major plates and some minor plates**, surrounded by young fold-mountain ridges, trenches and/or faults (NCERT §Plate Tectonics, pp. 31–32).
- **Seven major plates** (NCERT p. 32): I. Antarctica and the surrounding oceanic plate. II. North American plate (with western Atlantic floor separated from the South American plate along the Caribbean islands). III. South American plate (with western Atlantic floor separated from the North American plate along the Caribbean islands). IV. Pacific plate. V. India–Australia–New Zealand plate. VI. Africa with the eastern Atlantic floor plate. VII. Eurasia and the adjacent oceanic plate.
- **Important minor plates** (NCERT pp. 32–33): **Cocos** (between Central America and Pacific), **Nazca** (between South America and Pacific), **Arabian** (mostly the Saudi Arabian landmass), **Philippine** (between Asiatic and Pacific), **Caroline** (between Philippine and Indian plate, north of New Guinea), Scotia, Juan de Fuca (visible on Fig. 4.5).
- Plates have constantly moved over the globe throughout the history of the earth. It is the **plate that moves**, not the continent per se. All plates have moved in the

geological past and will continue to move. Palaeomagnetic data have determined positions held by each landmass in different geological periods. Position of the Indian subcontinent (mostly Peninsular India) is traced with the help of rocks analysed from the **Nagpur area** (NCERT p. 33).

- **Three types of plate boundaries** (NCERT p. 33):
- **Divergent Boundaries** — where new crust is generated as the plates pull away from each other; sites are called **spreading sites**. Best-known example: the **Mid-Atlantic Ridge**, where the American Plate(s) is separated from the Eurasian and African Plates.
- **Convergent Boundaries** — where crust is destroyed as one plate dives under another; the location is called a **subduction zone**. Three modes of convergence: (i) ocean–continent; (ii) ocean–ocean; (iii) continent–continent.
- **Transform Boundaries** — where crust is neither produced nor destroyed as plates slide horizontally past each other. **Transform faults are planes of separation generally perpendicular to the mid-oceanic ridges**. Since eruptions don't take place all along the entire crest at the same time, there is differential movement; the earth's rotation also affects the separated blocks.
- **Rates of Plate Movement** — strips of normal and reverse magnetic field paralleling mid-oceanic ridges help scientists determine plate movement rates. The **Arctic Ridge has the slowest rate (less than 2.5 cm/yr)**, and the **East Pacific Rise near Easter Island, in the South Pacific about 3,400 km west of Chile, has the fastest rate (more than 15 cm/yr)** (NCERT §Rates of Plate Movement, p. 33).
- **Force for Plate Movement** — both the surface and interior of the earth are dynamic. The mobile rock beneath the rigid plates is believed to be moving in a circular manner: heated material **rises, spreads, cools and sinks back** — a **convection cell** (convective flow). Heat within the earth comes from **radioactive decay and residual heat**. **Arthur Holmes first considered this idea in the 1930s**, later influencing Harry Hess's thinking about seafloor spreading (NCERT §Force for the Plate Movement, pp. 33–34).
- **Movement of the Indian Plate** — the Indian plate includes **Peninsular India and the Australian continental portions**. The **subduction zone along the Himalayas forms the northern plate boundary in the form of continent–continent convergence**. In the east, it extends through the **Rakinyoma Mountains of Myanmar** towards the island arc along the **Java Trench**. The eastern margin is a spreading site east of Australia (oceanic ridge in SW Pacific). The western margin follows the **Kirthar Mountain of Pakistan**, extends along the **Makrana coast** and joins the spreading site from the **Red Sea rift** southeastward along the **Chagos Archipelago**. The boundary with the Antarctic plate is also a divergent boundary running roughly W–E and merging into the spreading site south of New Zealand (NCERT §Movement of the Indian Plate, p. 34).

- India was a large island situated off the **Australian coast** in a vast ocean. The **Tethys Sea separated India from the Asian continent till about 225 million years ago**. India started its **northward journey about 200 million years ago** at the time when Pangaea broke. **India collided with Asia about 40–50 million years ago causing rapid uplift of the Himalayas**. About **140 million years before present** the subcontinent was at about **50° S latitude**. The two major plates were separated by the Tethys, and the Tibetan block was closer to the Asiatic landmass. During the northward movement, a major event was the **outpouring of lava and formation of the Deccan Traps**, starting around **60 million years ago** and continuing for a long period. At that time the subcontinent was still close to the equator. **From 40 million years ago and thereafter, the event of formation of the Himalayas took place**; the process is still continuing and the height of the Himalayas is rising today (NCERT pp. 34; Fig. 4.6).

2.2 Definitions to memorise

Term	Definition	Page
Pangaea	The single super-continent postulated by Wegener consisting of all present-day landmasses; means "all earth"	27
Panthalassa	The mega-ocean that surrounded Pangaea; means "all water"	27
Laurasia / Gondwanaland	Northern and southern halves into which Pangaea first split ~200 million years ago	27
Jig-Saw-Fit (Bullard 1964)	Computer-generated best fit of Atlantic margins at the 1,000-fathom line	27
Tillite	Sedimentary rock formed from deposits of glaciers; key evidence for continental drift and palaeoclimates	28
Placer deposit	Concentration of valuable minerals (e.g. gold on Ghana coast) deposited by sediment transport from a distant source rock	28
Lemuria	Postulated contiguous landmass once linking India, Madagascar and Africa, suggested from lemur distribution	28
Mesosaurus	Small reptile of shallow brackish water; fossils found only in Southern Cape (South Africa) and Iraver formations (Brazil) — 4,800 km apart	28
Pole-fleeing force	Force suggested by Wegener related to rotation of the earth and equatorial bulge	28
Tidal force	Wegener's second force, due to attraction of the moon and the sun	28
Convectional Current (Holmes 1930s)	System of currents in the mantle generated by radioactive heat, providing the force for plate movement	28
Abyssal Plains		29

Term	Definition	Page
	Extensive flat areas of the ocean floor between continental margins and mid-oceanic ridges	
Mid-Oceanic Ridge	Longest interconnected submerged mountain chain on earth, with a central rift of intense volcanic activity	29
Ring of Fire	Rim of the Pacific Ocean characterised by active volcanoes and frequent earthquakes	29
Sea Floor Spreading (Hess 1961)	Hypothesis that volcanic eruptions at ridge crests push oceanic crust sideways and the displaced crust sinks at trenches	30–31
Tectonic (Lithospheric) Plate	Massive, irregularly-shaped slab of solid rock (continental and/or oceanic lithosphere) moving over the asthenosphere	32
Asthenosphere	Mobile zone below the lithosphere over which plates move	32
Subduction Zone	Location at a convergent boundary where one plate dives under another and crust is destroyed	33
Spreading site	Divergent boundary where new crust is generated (e.g. Mid-Atlantic Ridge)	33
Transform Boundary	Plate boundary where plates slide horizontally past each other; crust neither created nor destroyed; faults perpendicular to ridges	33
Convection Cell	Circular pattern in the mantle where hot material rises, spreads, cools and sinks — driving plate movement	33–34
Tethys Sea	Ancient ocean separating Indian subcontinent from Asia until ~225 million years ago	34
Deccan Traps	Vast outpouring of lava on the Indian plate around 60 million years ago during its northward journey	34

2.3 Diagrams / processes to remember

- **Figure 4.1 (Ocean Floor cross-section, p. 29)** — shows the hypsographic curve and the major divisions: **continental shelf, continental slope, ocean basin floor and deepest ocean trench**, with sea level and average heights/depths.
- **Figure 4.2 (Distribution of Earthquakes and Volcanoes, p. 30)** — world map with shallow earthquake centres along mid-oceanic ridges, **deep earthquake zones** along the Alpine-Himalayan belt and Pacific Rim, volcanic eruption sites, and **hot spots (Hawaii, Yellowstone, Galapagos)**. The **Ring of Fire** is clearly delineated.
- **Figure 4.3 (Sea Floor Spreading, p. 31)** — illustrates **convergent, divergent and transform plate boundaries**; shows oceanic ridge, trench, subducting plate, hotspot, shield volcano and strato-volcano in one cross-section. Central concept for CUET.

- **Figure 4.4 (Position of Continents through Geological Past, p. 31)** — six globe diagrams showing continent positions at **540, 420, 300, 120 million years ago and the present**; India's migration from southern latitudes is the key takeaway.
- **Figure 4.5 (Major and Minor Plates of the World, p. 32)** — world map labelling all seven major plates plus **Cocos, Nazca, Arabian, Philippine, Caroline, Scotia, Juan de Fuca**. Must-memorise for CUET plate identification.
- **Figure 4.6 (Movement of the Indian Plate, p. 34)** — timeline diagram showing India's position at **71, 55, 38, 10 million years ago and today** relative to the Eurasian plate; shows the northward drift across the equator and collision.
- **Process — Sea floor spreading**: lava eruptions at mid-oceanic ridge → new crust pushes older crust outward → older crust subducts at deep trench → consumption balances creation → ocean floor "spreads" without net expansion of Earth.
- **Process — Indian plate journey**: India near Australia → Tethys separates India from Asia (~225 mya) → northward drift begins (~200 mya) → at 140 mya, India at ~50°S → Deccan Traps (~60 mya, near equator) → collision with Asia (~40–50 mya) → Himalayas rise.

2.5 Key data table (NCERT figures from this chapter)

#	Item	NCERT figure	Page
1	Continents' share of earth's surface	29%	27
2	First scientist to suggest joined continents	Abraham Ortelius (1596)	27
3	Continental Drift Theory year & author	1912; Alfred Wegener (German meteorologist)	27
4	Pangaea split year	About 200 million years ago	27
5	Bullard's computer best fit	1964 at 1,000-fathom line	27
6	Brazil–West Africa rock match age	~2,000 million years	28
7	Mesosaurus localities apart	4,800 km	28
8	Holmes Convectional Current Theory	1930s	28
9	Hess's Sea Floor Spreading	1961	30
10	Oceanic crust maximum age	200 million years	30
11	Oldest continental rocks	3,200 million years	30
12	Plate Tectonics formalised	1967 (McKenzie, Parker, Morgan)	32
13	Oceanic / Continental lithosphere thickness	5–100 km / ~200 km	32
14	Major / Minor plates	7 major + several minor	32
15	Slowest ridge rate	< 2.5 cm/yr (Arctic Ridge)	33

#	Item	NCERT figure	Page
16	Fastest ridge rate	> 15 cm/yr (East Pacific Rise)	33
17	Tethys Sea separated India until	About 225 million years ago	34
18	India started northward journey	About 200 million years ago	34
19	India's latitude 140 mya	About 50°S	34
20	India–Asia collision	40–50 million years ago	34
21	Deccan Traps formation	About 60 million years ago	34

2.4 Common confusions / NTA trap points

- **Wegener vs Hess vs Plate Tectonics** — Wegener = continental drift (1912); Holmes = convection currents (1930s); Hess = sea floor spreading (1961); McKenzie/Parker/Morgan = plate tectonics (1967). NTA often asks who proposed which concept.
- **Pole-fleeing force vs Tidal force** — both were Wegener's suggested forces, but the **pole-fleeing force is due to Earth's rotation** (not revolution), and tidal force is due to the **Moon and Sun** — not just the Moon. NCERT exercise Q1(ii) tests this directly.
- **Antarctica is a MAJOR plate, NOT a minor plate** — a very common trick question; Nazca, Arabia, Philippines and Caroline are minor; Antarctica is major (NCERT Exercise Q1(iii)).
- **Oceanic crust age cap = 200 million years**, while some continental rocks are **3,200 million years old**. NTA may give "3,200 million years" as an option for oceanic crust — wrong.
- **Indian plate boundary along Himalayas = continent–continent convergence**, NOT ocean–continent convergence (NCERT Exercise Q1(v)). India's oceanic leading edge had already subducted before collision.
- **Sea-floor-spreading evidence does NOT include "distribution of fossils in different continents"** — NCERT exercise Q1(iv) frames this as an option that was **not** considered. The four real points are volcanic activity at ridges, magnetic stripes, age of oceanic rocks, and thin sediments.
- **Lemuria** linked India, Madagascar and Africa — based on **lemur** distribution. **Mesosaurus** is South Africa + Brazil only — don't confuse the two fossil-distribution arguments.
- **Tethys closed ~225 mya** (India became free of Asia by separation), and India **collided with Asia 40–50 mya**, not at the start of its drift.
- **Deccan Traps formed ~60 mya during India's northward journey, while it was still close to the equator** — NCERT exercise Q2(iv) tests this.
- **Mid-oceanic ridges = shallow-focus earthquakes; Alpine-Himalayan belt & Pacific Rim = deep-seated earthquakes** — sometimes inverted.

- **Best fit of Atlantic margins** is at the **1,000-fathom line** (Bullard 1964), not the present shoreline — a detail trap.

🎯 Practice MCQs

📊 PYQ Alignment

This chapter appears with moderate-to-high frequency in CUET Geography papers. Questions typically focus on **identifying the proposer of continental drift or sea floor spreading**, distinguishing **types of plate boundaries**, identifying **major vs minor plates** (especially the Antarctica trap), and the nature of the **Indian plate boundary along the Himalayas** (continent–continent convergence) — directly given as an NCERT exercise question. The Deccan Traps timing, the Tethys closure date, and Wegener's pole-fleeing/tidal forces also appear regularly. For drill sets and previous-year analyses see /pyq/geography.