Planning India's first five Plans

Purpose and period

The first five Five Year Plans ran from 1951 to 1978, with three Annual Plans between 1966 and 1969. Their common goals were growth, modernisation, self-reliance and equity. Growth means rising output; development also includes qualitative change.







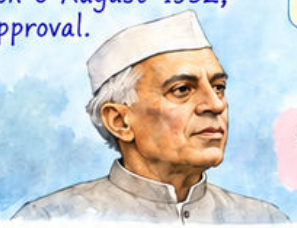


The planning machinery

The Planning Commission was established by a Government resolution on 15 March 1950, with the Prime Minister as Chairperson. Jawaharlal Nehru was its first Chairman. The Commission drafted Plans; the National Development Council, established on 6 August 1952, gave final approval.



Planning Commission (15 March 1950) → National Development Council (6 August 1952) → Plans (drafted by Commission; final approval by NDC)



Jawaharlal Nehru (first Chairman)

Gadgil's role

D.R. Gadgil was Deputy Chairman during the early Fourth Plan and left the post on 2 May 1971. The Gadgil formula of 1969 guided distribution of Central assistance among States during the Fourth and Fifth Plans. It was not a model for economic growth.



D.R. Gadgil (Deputy Chairman during the early Fourth Plan)

Gadgil formula (1969)
Distribution of Central assistance among States

- State
- State
- State

Not a model for economic growth.

The later contrast

The State-led industrial approach of these Plans differs from the Industrial Policy of 1991. NITI Aayog replaced the Planning Commission on 1 January 2015. Keep those later institutional changes separate from the machinery that framed the first five Plans.

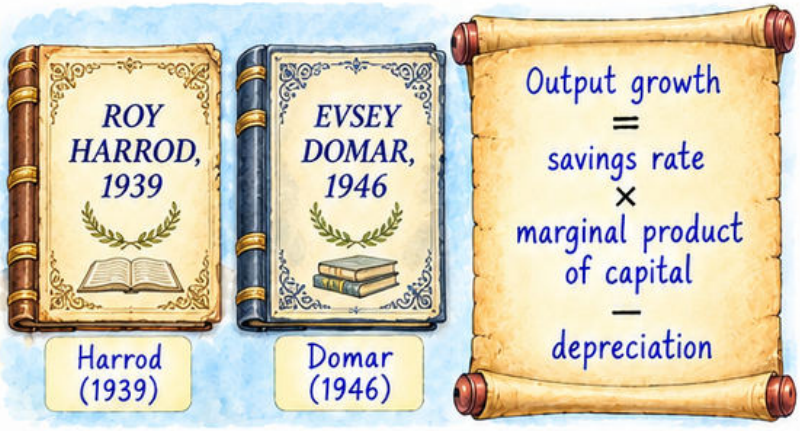


Sources: Day 29 Source Index | Topic 285

Two models answer different questions

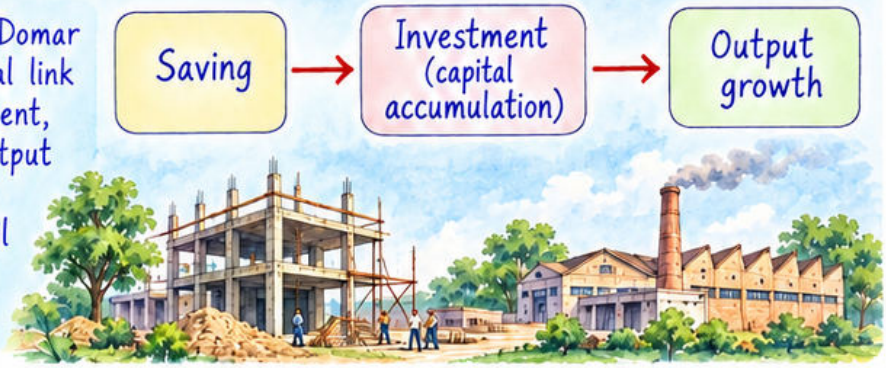
Harrod and Domar

Roy Harrod's contribution dates to 1939 and Evsey Domar's to 1946. In this model, output depends on capital stock alone and the marginal product of capital is constant. Output growth equals the savings rate multiplied by the marginal product of capital, minus depreciation.



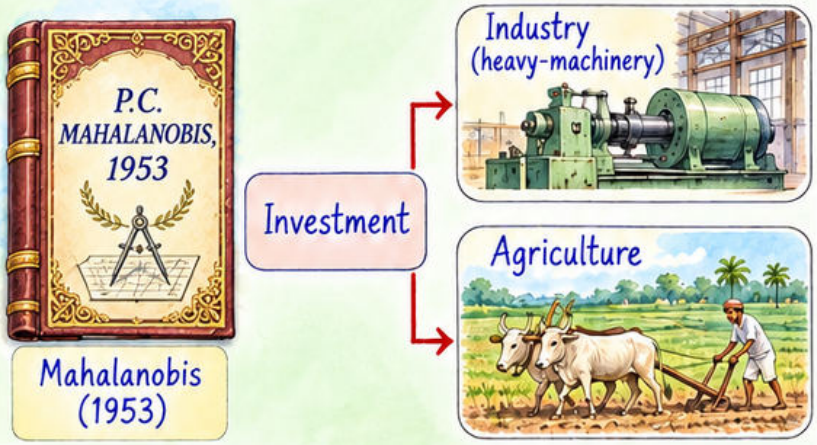
Saving and investment

The First Plan used Harrod-Domar with modifications. Its central link runs from saving to investment, capital accumulation and output growth. This is a growth framework, unlike the Gadgil formula for distributing assistance.



Mahalanobis, 1953

P.C. Mahalanobis's model sought the best allocation of investment among producing sectors. It assumed a closed, inward-looking economy, with imports mainly of capital goods. The Second Plan used it to divide resources between sectors such as agriculture and industry.



Not an exclusive pairing

The Second Plan also used Harrod-Domar for overall projections. Mahalanobis supported rapid industrialisation and an active public sector and is called the architect of Indian planning and of the Second Plan. Planning in its fuller structural sense is associated with that Second Plan.



Sources: Day 29 Source Index | Topic 285

First Plan agriculture and irrigation

1951-56: the agrarian priority

The First Plan sought to move the economy out of a cycle of poverty. Agriculture, dams and irrigation received central attention under a modified Harrod-Domar approach.



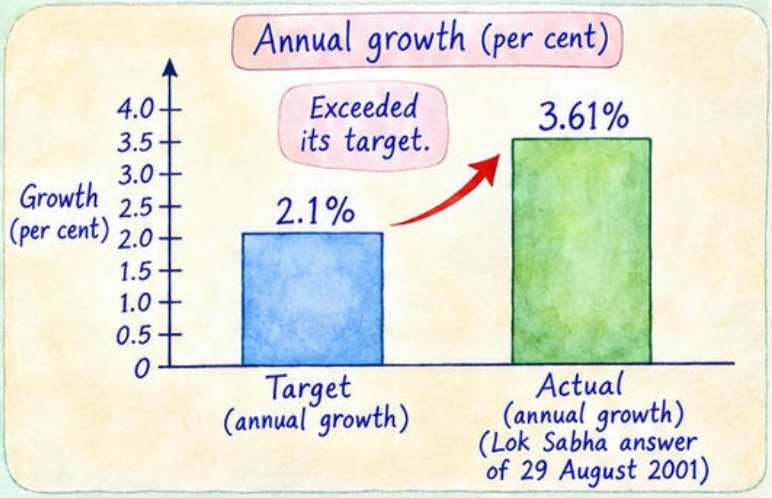
Major works

Huge allocations supported projects such as Bhakra Nangal. Hirakud and Damodar Valley dams also belong to the Plan's key project associations. Large irrigation and power works were expected to support agricultural recovery and wider development.



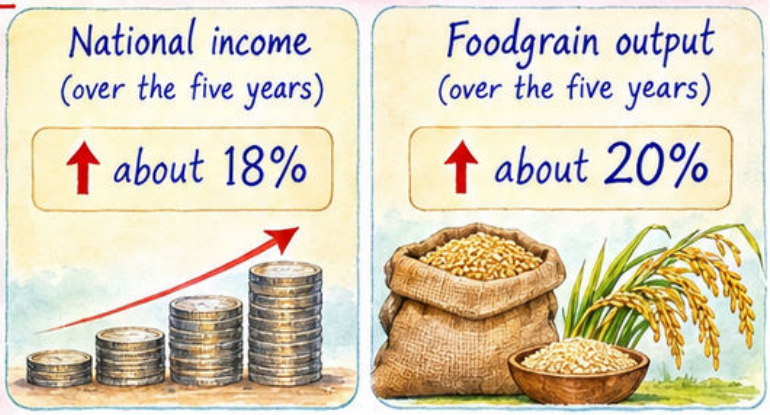
Target and outcome

The annual growth target was 2.1 per cent. The Ministry of Planning's Lok Sabha answer of 29 August 2001 gives actual growth as 3.61 per cent. On that series, the Plan exceeded its target.



Other measures of progress

The Second Plan document says national income rose by about 18 per cent over the five years and foodgrain output by 20 per cent. These cumulative increases should not be confused with annual growth rates. Other official series report annual First Plan growth as 3.6 or 3.5 per cent, reflecting different calculations and bases.



Sources: Day 29 Source Index | Topic 285

Second Plan builds heavy industry

1956-61: structural transformation

The Second Plan shifted emphasis towards industrialisation and heavy industry. It sought quicker structural change than the First Plan's more patient agrarian approach. Planned investment was Rs 6,200 crore.

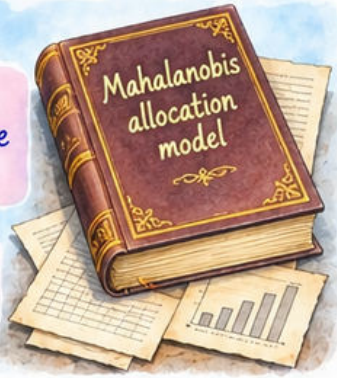


The public sector

The State was to control the commanding heights of the economy. Mahalanobis's allocation framework favoured building productive capacity, while Harrod-Domar still informed overall projections.

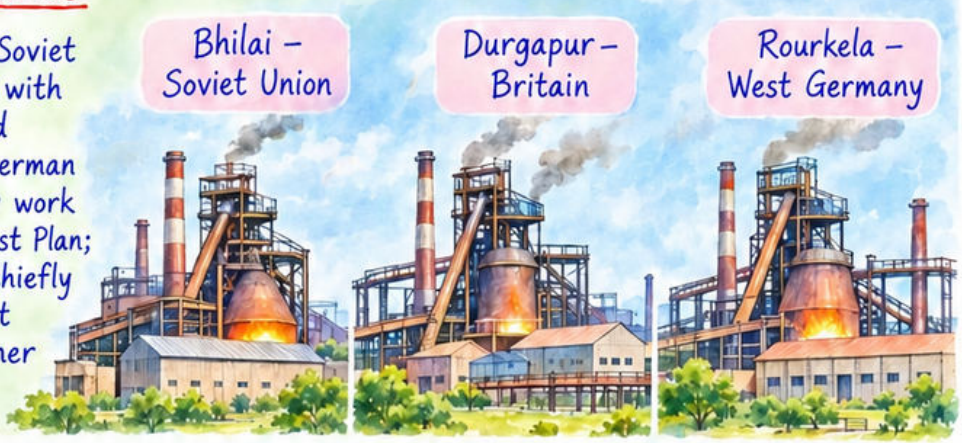
Mahalanobis's allocation framework → building productive capacity

Harrod-Domar → overall projections



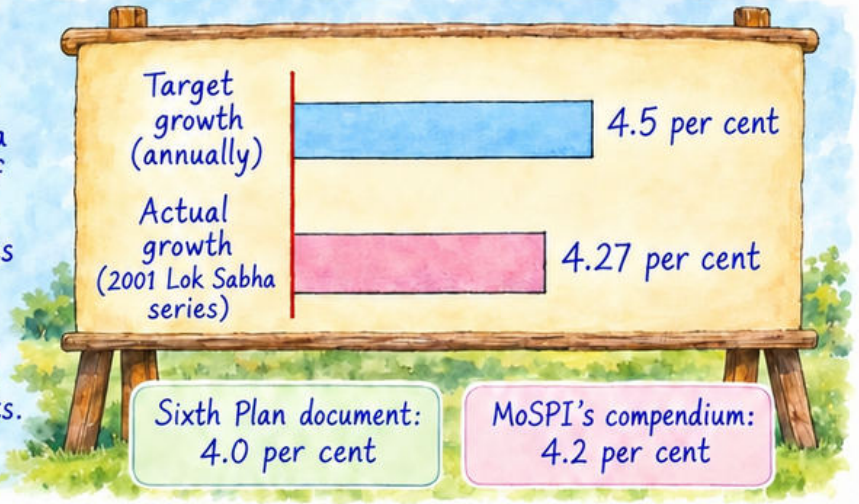
Three steel plants

Bhilai was built with Soviet assistance, Durgapur with British assistance and Rourkela with West German assistance. Preliminary work occurred during the First Plan; construction belongs chiefly to the Second. Do not interchange the partner countries.



Growth record

The target was 4.5 per cent annually. The 2001 Lok Sabha series gives actual growth of 4.27 per cent, below target. The Sixth Plan document gives 4.0 per cent and MoSPI's compendium 4.2 per cent. Those are alternative official series, not extra growth targets.



Sources: Day 29 Source Index | Topic 285

Third Plan meets war and poor harvests

1961–66: continuity

The Third Plan was not significantly different from the Second in its broad approach. It continued that line of development rather than inaugurating an entirely unrelated model.



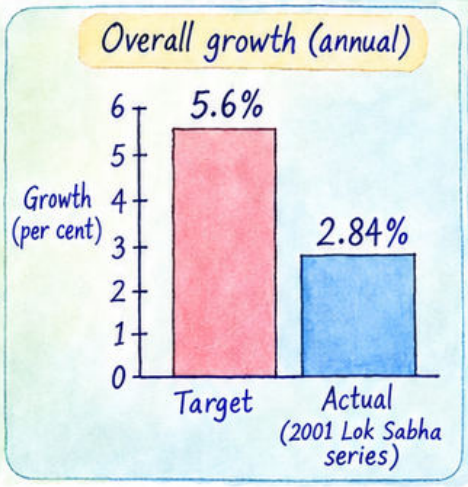
Major shocks

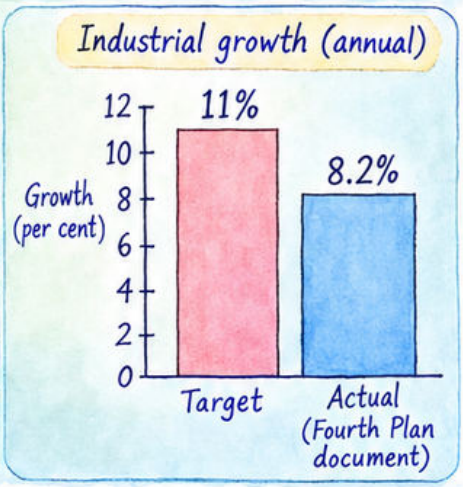
The war with China in 1962 and hostilities with Pakistan in 1965 were followed by two bad harvests. The drought of 1965–66 forms part of the background to the later agricultural strategy.



Growth and industry

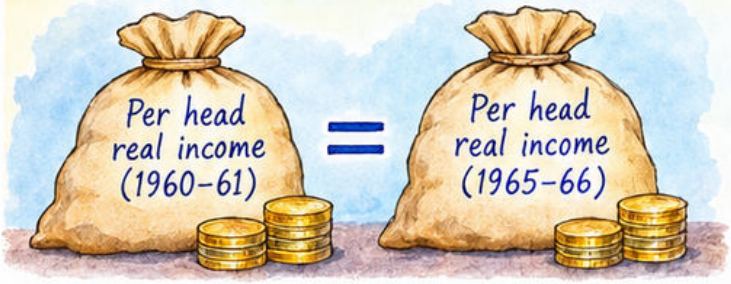
The annual target was 5.6 per cent. Actual growth in the 2001 Lok Sabha series was 2.84 per cent, the weakest result among these five Plans. The Fourth Plan document says industrial growth reached 8.2 per cent annually against an 11 per cent target.





Living standards and measurement

Real income per head in 1965–66 was about the same as in 1960–61.



Other sources put the overall annual growth figure at:

- 2.2 per cent in the Sixth Plan document,
- 2.8 in MoSPI and
- 2.4 in Wikipedia.

These figures must retain their source labels rather than being combined into a single exact value.

Sources: Day 29 Source Index | Topic 285

The plan holiday lasted three years

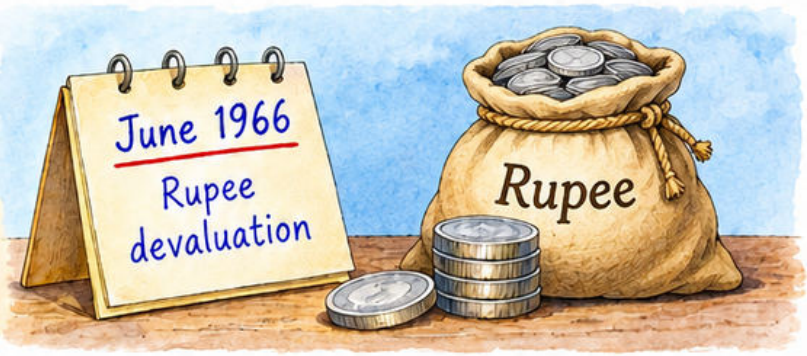
The Fourth Plan was delayed

The Fourth Plan was due to begin in 1966, but the Government chose a plan holiday. Three one-year Annual Plans covered 1966–69, concentrating on agriculture and industry. A plan holiday did not mean the absence of all planning.



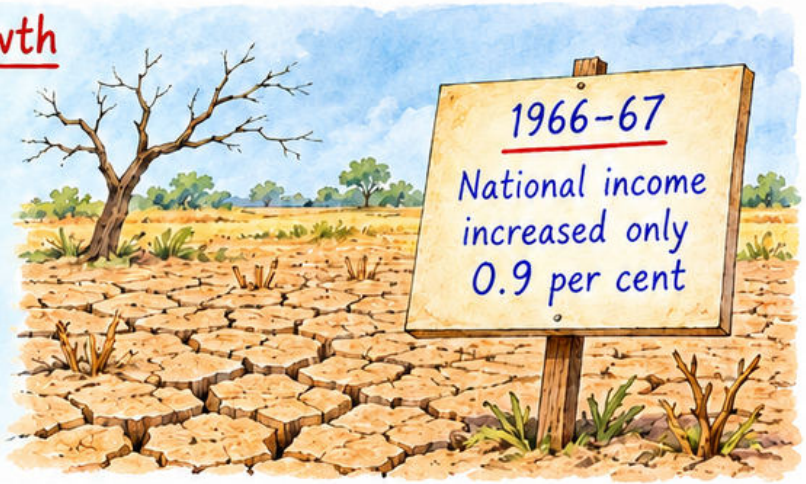
Rupee devaluation

The rupee was devalued in June 1966, after the Third Plan had ended. Place the event in the Annual Plan period rather than automatically inside the Third Plan.



Drought and weak growth

A severe drought affected 1966–67. National income increased only 0.9 per cent that year. The summary series used for the five Plans supplies no overall growth target or actual figure for the Annual Plans; absence from that table is not a zero growth rate.



The sequence to remember

Third Plan: 1961–66. Three Annual Plans: 1966–69. Fourth Plan: 1969–74.



The three-year break is essential when matching events to Plan periods, and explains why the first five Plans do not form an uninterrupted twenty-five-year sequence.

Sources: Day 29 Source Index | Topic 285

Fourth Plan growth with stability

1969-74: the approach

The Fourth Plan sought growth with stability and progressive self-reliance. Its document applies growth with stability to both the Fourth Plan and the longer Perspective Plan.



Agriculture and banks

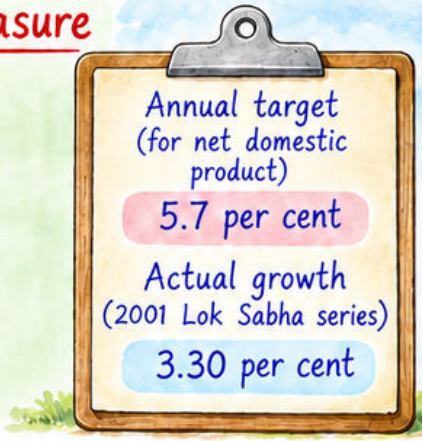
The new agricultural strategy and Green Revolution were central associations, though agricultural growth remained moderate in the textbook assessment. The 14 largest commercial banks were nationalised by Ordinance from midnight of 19 July 1969.





Targets need their measure

The standard tables give an annual target of 5.7 per cent for net domestic product. The Plan's own wording calls for about 5.5 per cent average annual increase in total production. Those measures should not be silently treated as identical.

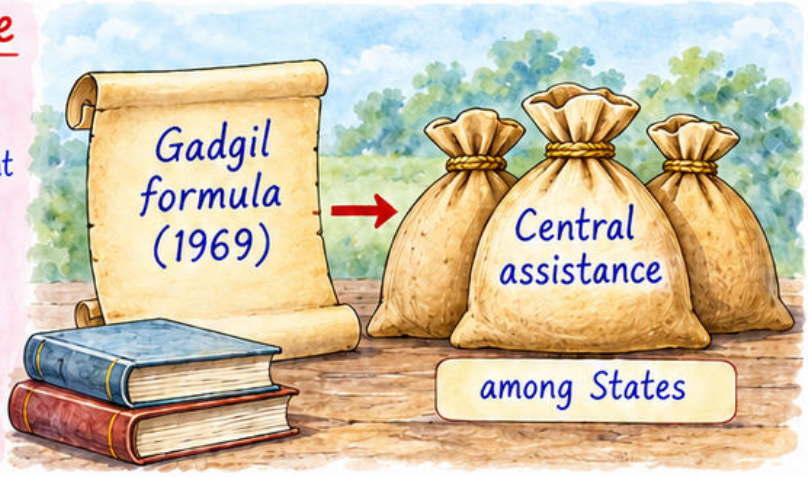


Different measure

Target: about 5.5 per cent average annual increase in total production

Growth and assistance

The 2001 Lok Sabha series reports actual growth of 3.30 per cent; the Sixth Plan document gives 3.3 and MoSPI 3.2. The Gadgil formula of 1969 allocated Central assistance among States; it did not explain the economy's growth rate. Gadgil left the Deputy Chairmanship on 2 May 1971.

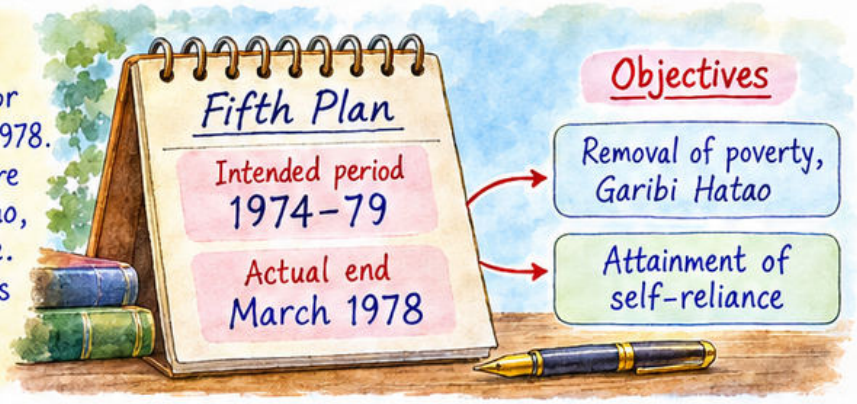


Sources: Day 29 Source Index | Topic 285

Fifth Plan poverty and minimum needs

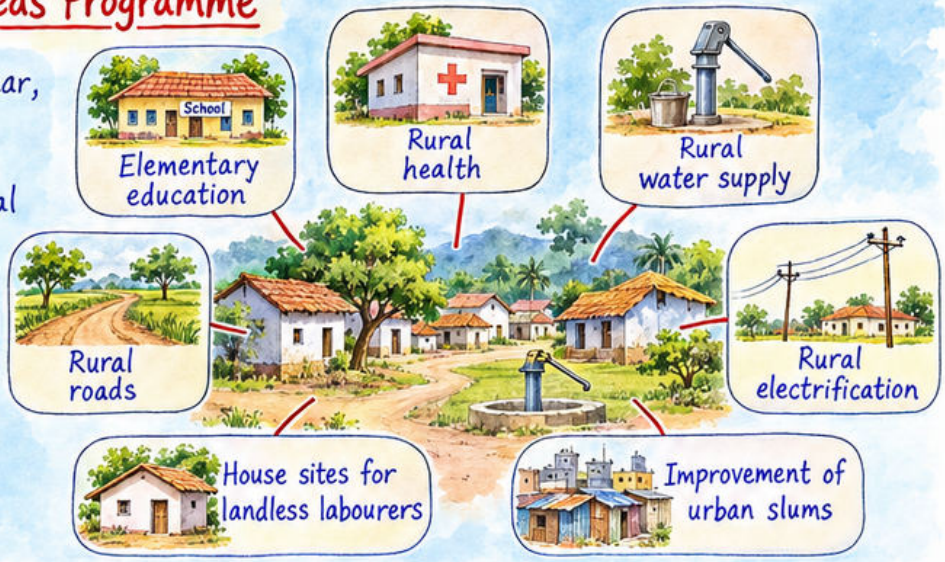
The original period

The Fifth Plan was intended for 1974–79 but ended in March 1978. Its two principal objectives were removal of poverty, Garibi Hatao, and attainment of self-reliance. Employment and minimum needs were priorities.



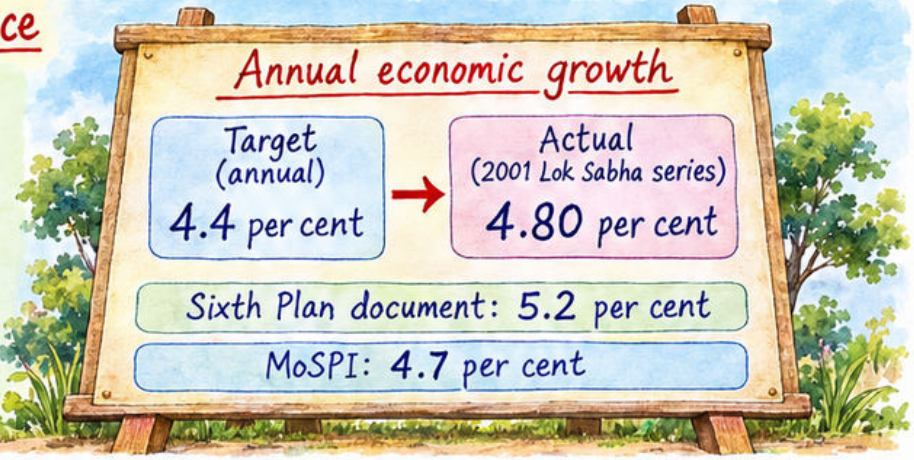
The Minimum Needs Programme

Introduced in the first year, it covered elementary education, rural health, rural water supply, rural roads and rural electrification. It also included house sites for landless labourers and improvement of urban slums.



Growth performance

The annual target was 4.4 per cent. The 2001 Lok Sabha series gives actual growth of 4.80 per cent, above target. The Sixth Plan document reports 5.2 per cent and MoSPI 4.7 per cent.



Why the end date matters

The Janata Government cut the Plan short. When matching a scheme or event, distinguish the intended 1974–79 span from the actual end in March 1978. The First and Fifth Plans exceeded their targets across the compared series, while the Second, Third and Fourth fell short.

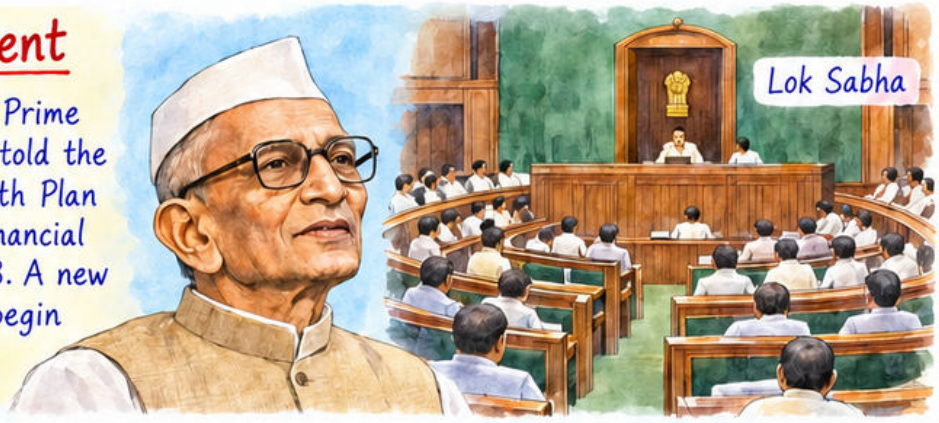
Plan	Performance (across the compared series)
First Plan	✓ Exceeded target
Second Plan	✗ Fell short
Third Plan	✗ Fell short
Fourth Plan	✗ Fell short
Fifth Plan	✓ Exceeded target

Sources: Day 29 Source Index | Topic 285

The rolling plan and slow trend growth

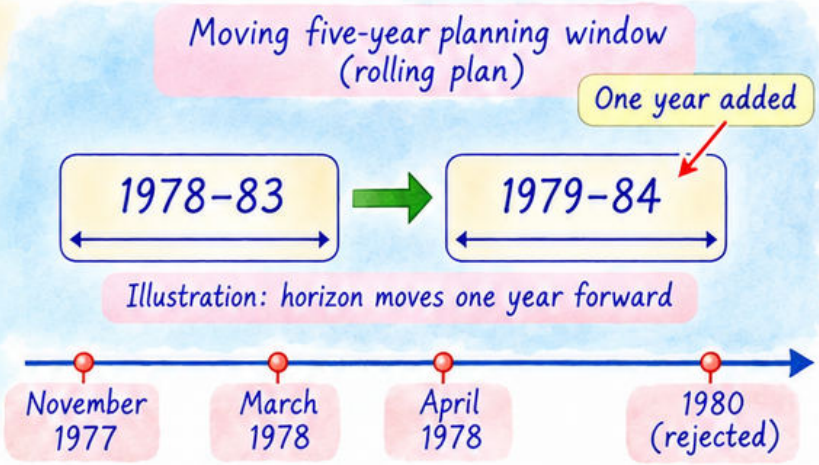
The announcement

On 16 November 1977, Prime Minister Morarji Desai told the Lok Sabha that the Fifth Plan should end with the financial year ending March 1978. A new 1978–83 Plan was to begin in April 1978.



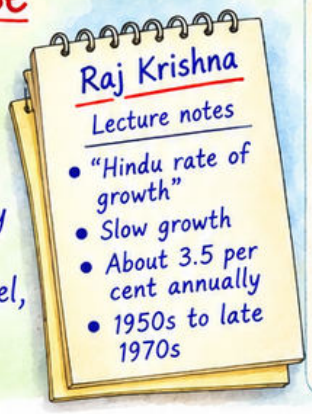
What rolling means

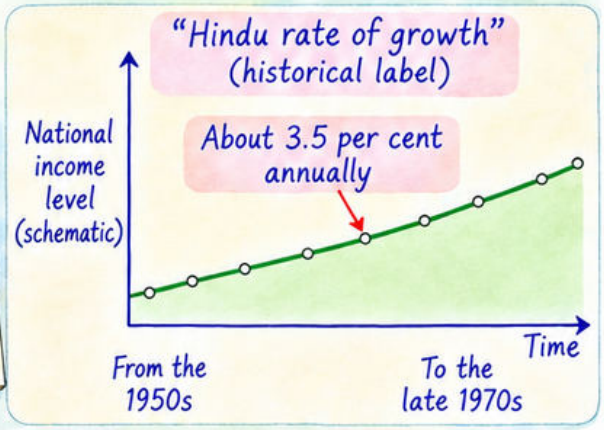
At the end of each year, a rolling plan adds one further year. The horizon moves forward rather than remaining fixed to the original terminal year. The next Government rejected the 1978 Plan in 1980.



The growth phrase

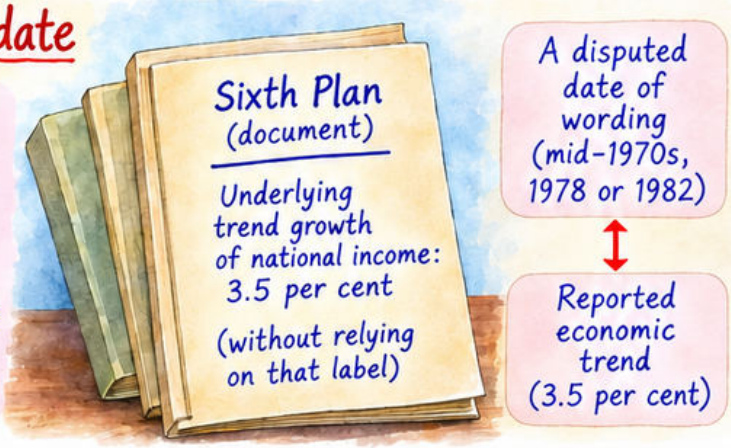
Economist Raj Krishna is credited with the phrase "Hindu rate of growth", describing slow growth of about 3.5 per cent annually from the 1950s to the late 1970s. It is a historical label, not an explanation based on religion.





Do not force one coinage date

Accounts place his first use in the mid-1970s, 1978 or 1982. The Sixth Plan document states the underlying trend growth of national income as 3.5 per cent without relying on that label. Keep a disputed date of wording separate from the reported economic trend.



Sources: Day 29 Source Index | Topic 285

Read growth figures with their source

The 2001 Lok Sabha series

Annual targets for Plans One to Five are 2.1, 4.5, 5.6, 5.7 and 4.4 per cent. Their reported actuals are 3.61, 4.27, 2.84, 3.30 and 4.80 per cent respectively.



Two other official series

The Sixth Plan document's Table 1.1 reports 3.6, 4.0, 2.2, 3.3 and 5.2 per cent.

MoSPI's Table 15.1 reports 3.5, 4.2, 2.8, 3.2 and 4.7 per cent.

Source / Series	Plan I	Plan II	Plan III	Plan IV	Plan V
Target (Plans I–V)	2.1	4.5	5.6	5.7	4.4
Lok Sabha (2001) (actuals)	3.61	4.27	2.84	3.30	4.80
Sixth Plan (Table 1.1)	3.6	4.0	2.2	3.3	5.2
MoSPI (Table 15.1)	3.5	4.2	2.8	3.2	4.7

Wikipedia series (alternate): actuals 3.6, 4.27, 2.4, 3.3 and 4.8; Fourth Plan target 5.6.

Bases differ

Targets for the first three Plans concerned national income; the Fourth used net domestic product and later Plans GDP. MoSPI's actuals are GDP growth at factor cost. Figures compiled at different times and on different bases can therefore differ.

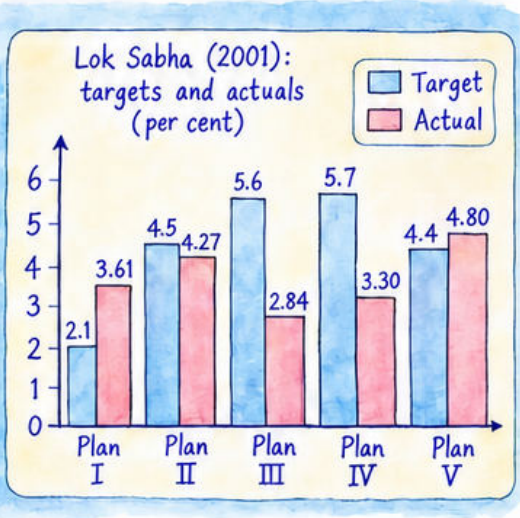


The exam check

Wikipedia's corresponding actuals are 3.6, 4.27, 2.4, 3.3 and 4.8, with a Fourth Plan target of 5.6. Use the series named in the question; the 2001 Lok Sabha figures are the preferred set here. The stable conclusion is First and Fifth above target, Second to Fourth below, with the Third weakest.

Lok Sabha (2001): actual vs target

- ✓ First: above target (3.61 > 2.1).
- ✗ Second: below target (4.27 < 4.5).
- ✗ Third: below target (2.84 < 5.6) — weakest.
- ✗ Fourth: below target (3.30 < 5.7).
- ✓ Fifth: above target (4.80 > 4.4).

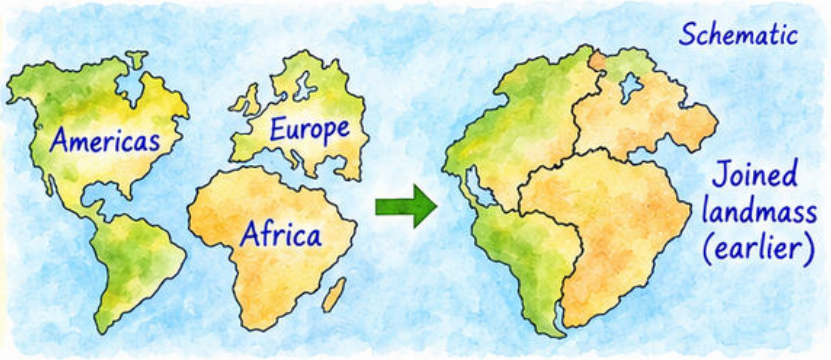


Sources: Day 29 Source Index | Topic 285

From drifting continents to moving plates

Early recognition

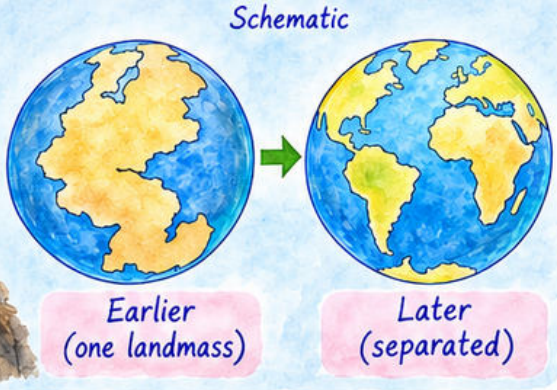
Abraham Ortelius suggested in 1596 that the Americas, Europe and Africa had once been joined. The matching Atlantic shapes prompted questions long before a mechanism was established.



Wegener's theory

German meteorologist Alfred Wegener presented continental drift in 1912 and published the full account in *The Origin of Continents and Oceans* in 1915. He proposed that continents had formerly belonged to one landmass and later separated.





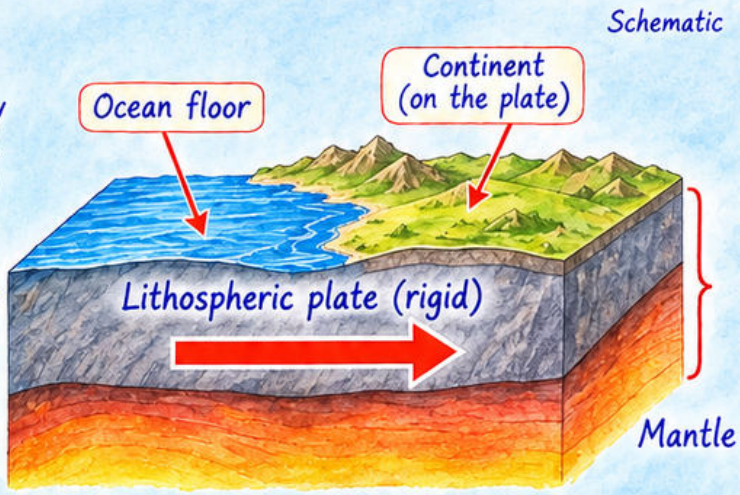
Steps towards a mechanism

Arthur Holmes discussed mantle convection in the 1930s. Harry Hess proposed sea-floor spreading in 1961. Bullard's computer fit of Atlantic margins followed in 1964. These developments strengthened the case for large-scale surface movement.



Plate tectonics, 1967

McKenzie and Parker, and independently Morgan, put forward the plate-tectonic concept. The crucial distinction is what moves: Wegener moved continents themselves; plate tectonics moves rigid lithospheric plates containing continents and ocean floor. Continental drift supplied an important idea, but lacked the later theory's adequate mechanism.

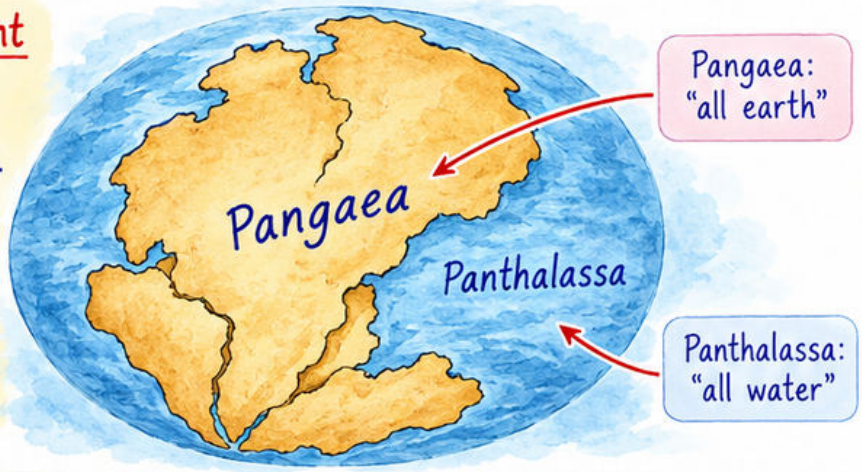


Sources: Day 29 Source Index | Topic 286

Pangaea was land Panthalassa was ocean

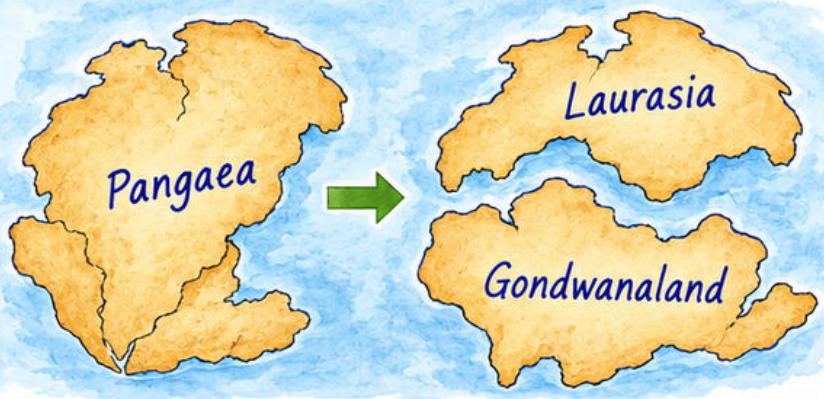
The original arrangement

Wegener's reconstruction joined the continents into Pangaea, meaning "all earth". A single surrounding mega-ocean was called Panthalassa, meaning "all water". These names refer to different parts of the reconstruction.



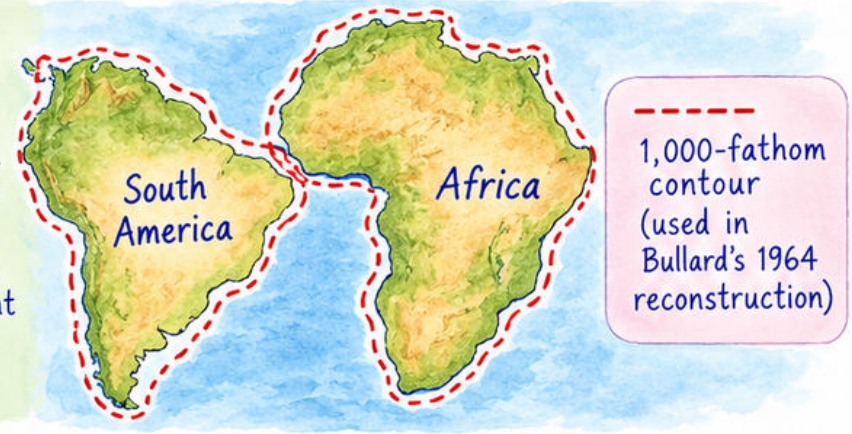
The breakup

Around 200 million years ago, Pangaea began separating into northern Laurasia and southern Gondwanaland. Later fragmentation and drift produced the separated landmasses. The Peninsular Plateau is associated with the breakup and movement of Gondwana land.



The Atlantic fit

The opposite sides of the Atlantic show a jigsaw correspondence. Bullard's 1964 computer reconstruction used the 1,000-fathom contour rather than today's shorelines. A margin-based fit is different from forcing every modern beach to match.



Why reconstruction needs evidence

A visual fit alone does not establish the entire history. Corresponding rocks, fossils and glacial deposits provide independent checks. The scientific argument combines several kinds of evidence rather than relying only on the familiar shape of South America and Africa.

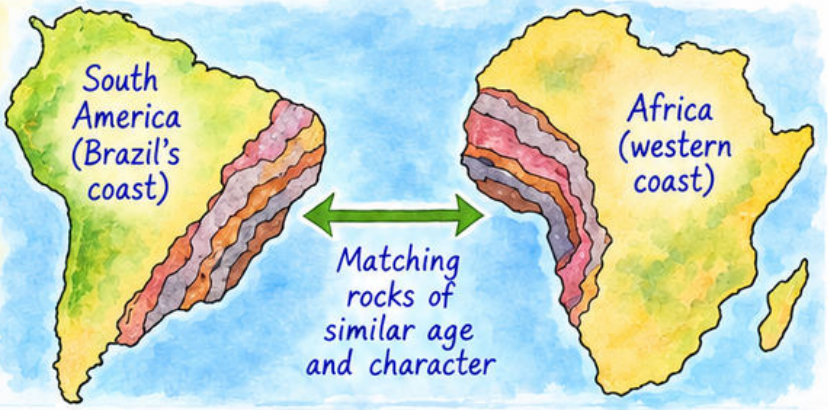


Sources: Day 29 Source Index | Topic 286

Rocks climate and gold connect continents

Matching ancient rocks

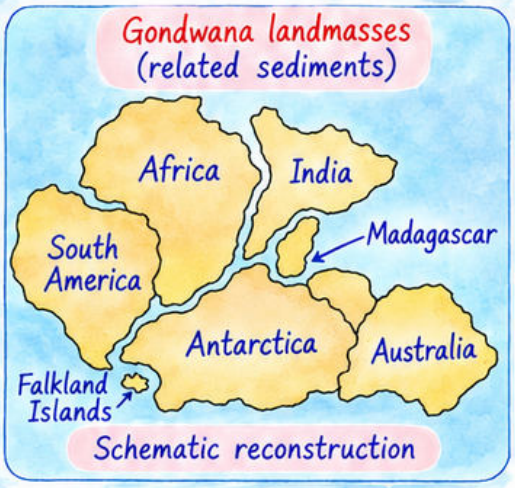
A belt of approximately 2,000-million-year-old rocks on Brazil's coast matches rocks in western Africa. Similar age and geological character across an ocean support reconstruction of formerly connected land.



Tillite as climate evidence

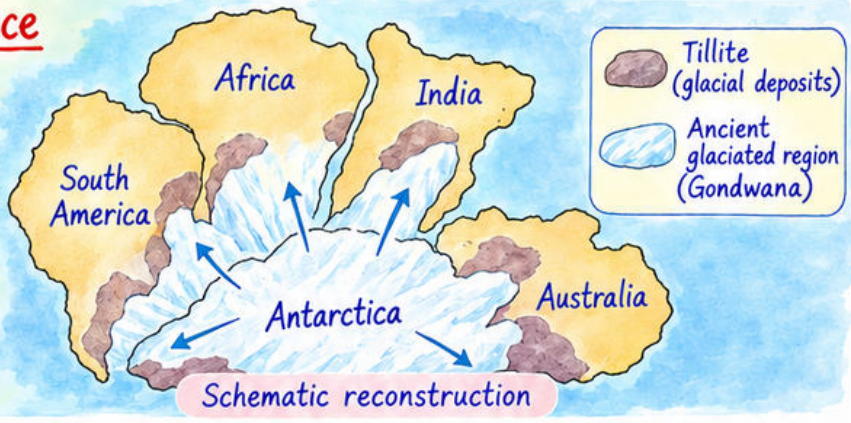
Tillite is a rock formed from glacial deposits and records past climates. Related Gondwana sediments link India with other Southern Hemisphere landmasses, including Africa, the Falkland Islands, Madagascar, Antarctica and Australia.





Reading glacial evidence

When glacial deposits on separated continents are reassembled with Gondwana, their distribution can be understood as parts of a connected ancient glaciated region. Tillite therefore adds climatic evidence to the correspondence of rocks and continental margins.



Placer deposits

The traditional drift argument links rich gold placer deposits on Ghana's coast with the Brazil plateau as their proposed source. This is an evidentiary interpretation within the continental-drift account. A placer is a concentration of valuable heavy material, and the key classroom connection is Ghana on one Atlantic side and Brazil on the other.

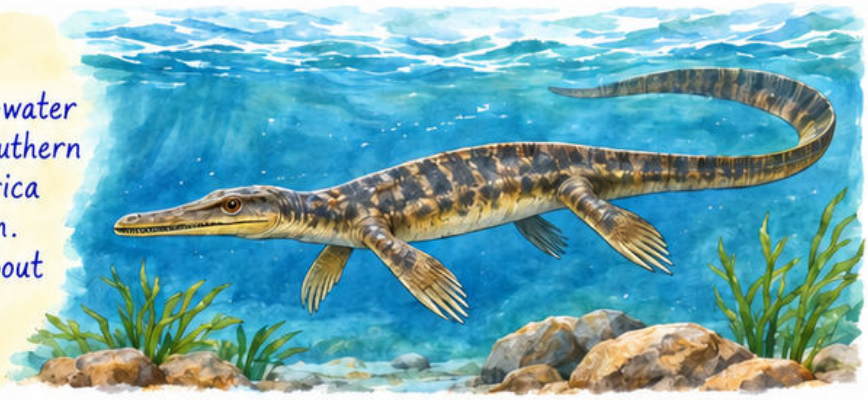


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Fossils preserve a former connection

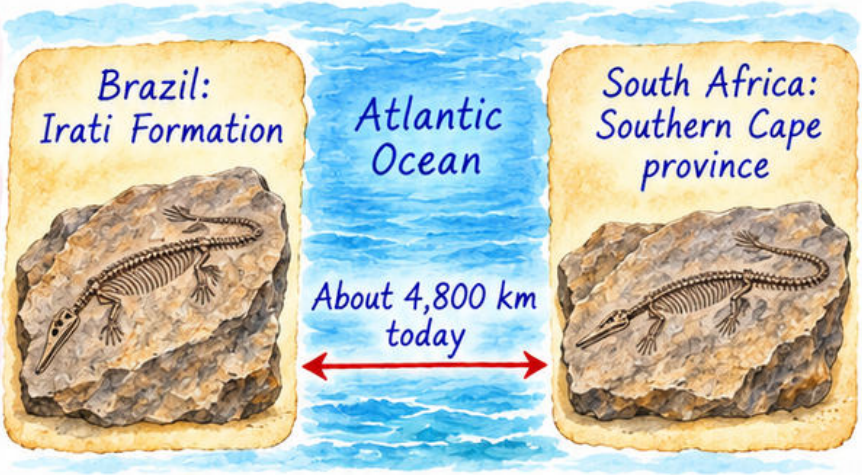
Mesosaurus

This small shallow-brackish-water reptile is recorded in the Southern Cape province of South Africa and Brazil's Irati Formation. The fossil areas are now about 4,800 km apart with the Atlantic between them.



Why this matters

A limited distribution in separated rock sequences raises a biogeographical question: how did related remains occur on opposite sides of an ocean? Former connection offers an explanation that can be tested alongside rock and climate evidence.



Lemurs and Lemuria

Nineteenth-century attempts to explain the distribution of lemurs and related forms led to the proposed connecting land called Lemuria. It was a historical biogeographical hypothesis, not a demonstrated continent or the modern explanation of plate movement.



Glossopteris

Glossopteris is a fossil seed fern used in reconstructing Gondwana. Its remains occur across now-separated southern landmasses, including Antarctica. Fossil distribution and changing palaeoclimate complement a coastline fit, but none by itself supplied Wegener with a satisfactory driving force.

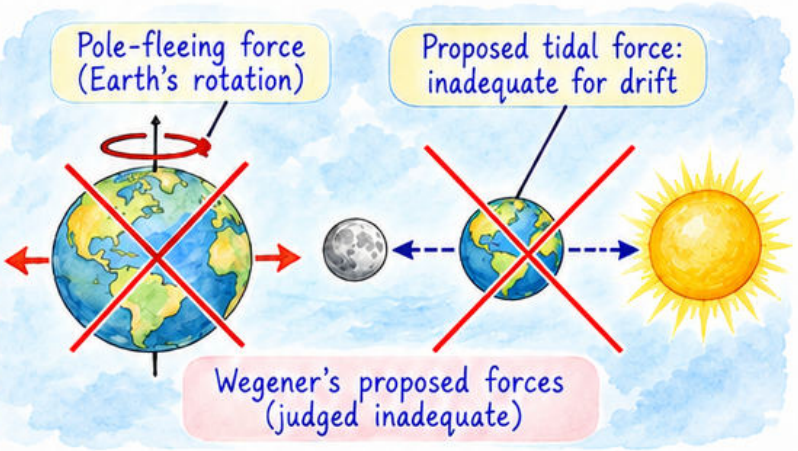


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Why Wegener's mechanism failed

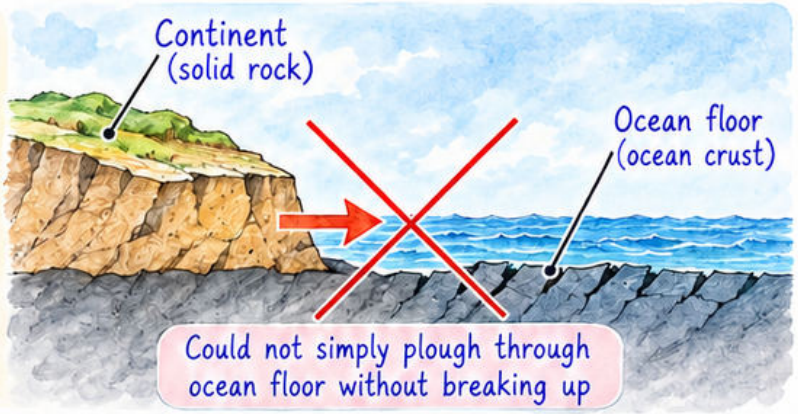
Two proposed forces

Wegener invoked pole-fleeing force associated with Earth's rotation, and tidal force associated with the attraction of the Moon and Sun. These were proposed causes, not the accepted modern mechanism.



The central objection

Most scholars judged those forces inadequate to move such large rock masses over great distances. Harold Jeffreys argued that solid continents could not simply plough through ocean floor without breaking up.



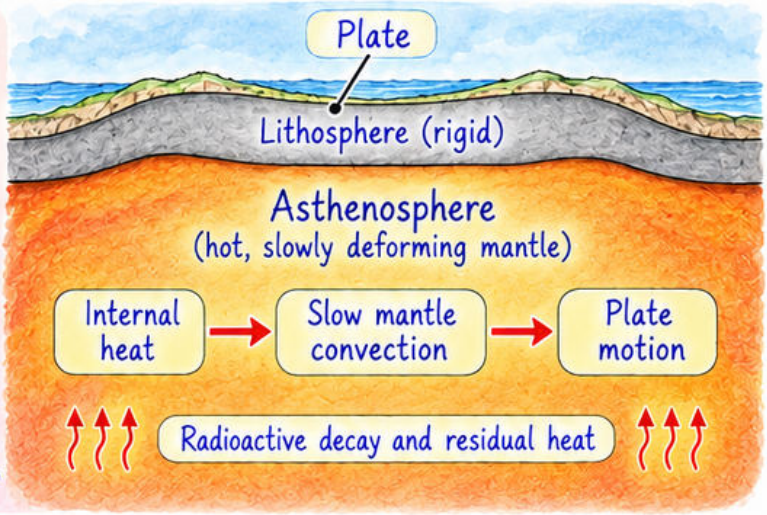
Rejection and revival

By about 1930, most geologists had dismissed the theory's driving explanation. The drift idea was revived within plate tectonics in the 1960s after new evidence and mechanisms emerged. Weakness of a proposed mechanism did not erase the matching geological evidence.



Holmes and convection

In the 1930s, Arthur Holmes discussed mantle convection driven by thermal differences associated with radioactive elements. Modern plate motion is linked to slow movement of hot, softened mantle in convection cells, with radioactive decay and residual heat as energy sources. Plates move over the asthenosphere rather than continents cutting independently through ocean crust.

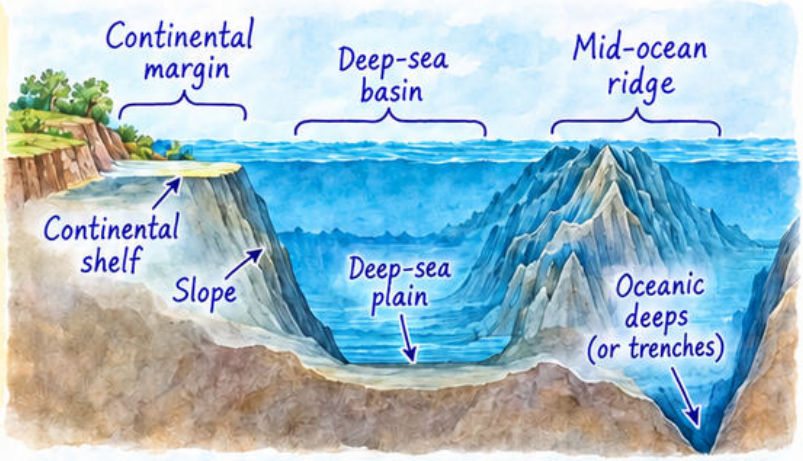


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New crust forms at ocean ridges

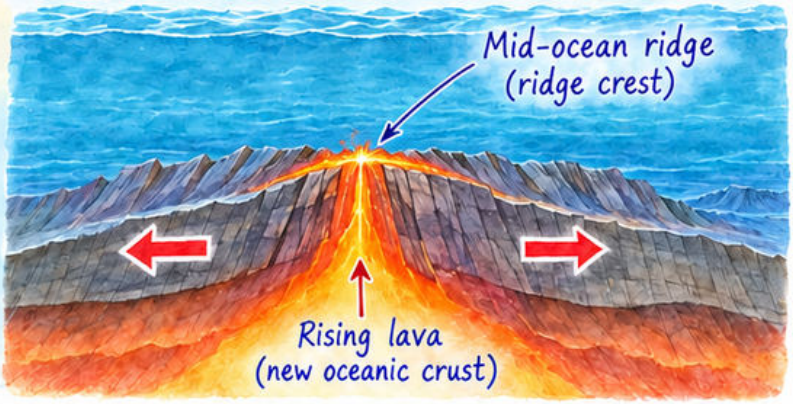
The ocean-floor framework

The plate-tectonics account groups the ocean floor into continental margins, deep-sea basins and mid-ocean ridges. A fuller relief description distinguishes continental shelf, slope, deep-sea plain and oceanic deeps or trenches, with ridges as another feature.



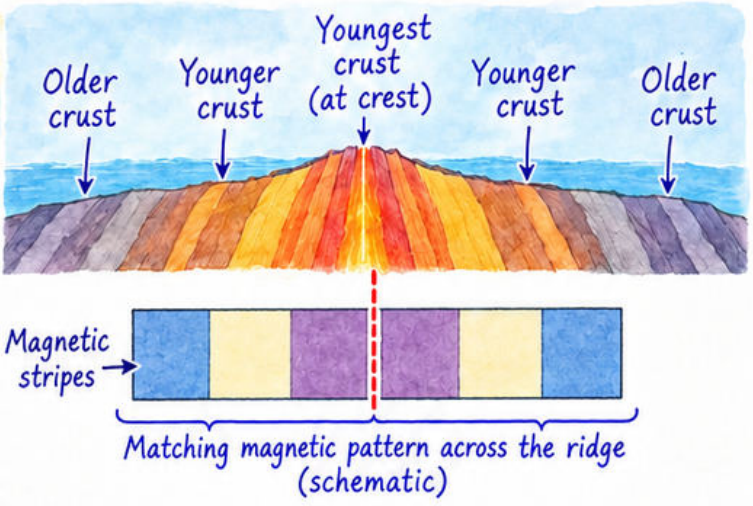
Hess's explanation, 1961

Repeated eruptions at ridge crests bring up lava and create new oceanic crust. The new material pushes the crust on either side apart. Mid-ocean ridges are major active volcanic zones.



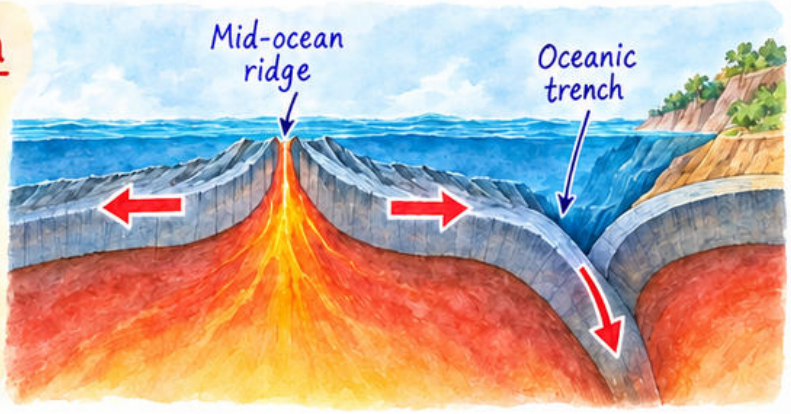
Symmetry across the ridge

Rocks equally distant from a ridge crest on opposite sides are similar in age and composition. The youngest crust lies near the crest; progressively older crust occurs outward on both sides. Magnetic stripes record repeated reversals of Earth's magnetic field.



Creation and consumption

Ocean floor moving away from ridges is consumed where it sinks at oceanic trenches. Spreading does not require an ever-growing Earth: its size is thought to have changed little, if at all, since formation.

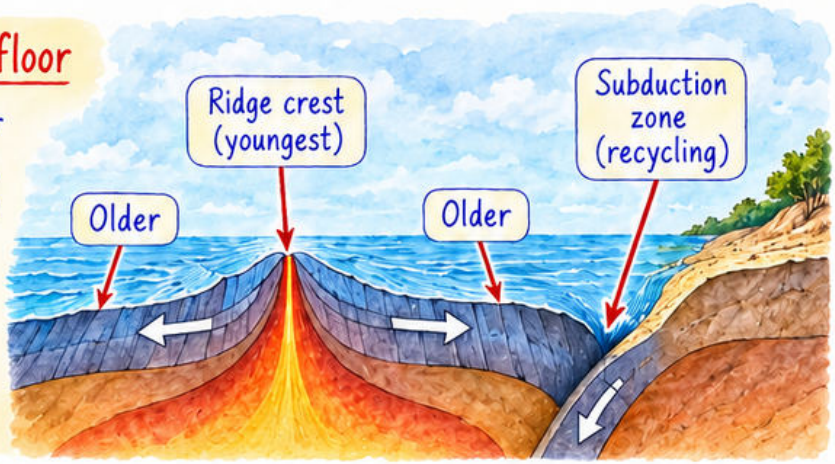


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Oceanic and continental rock ages

A young, recycled ocean floor

Most oceanic crust is younger than about 200 million years. New crust forms at mid-ocean ridges and older oceanic lithosphere is recycled at subduction zones. The ridge crest is youngest; crust becomes older away from it.



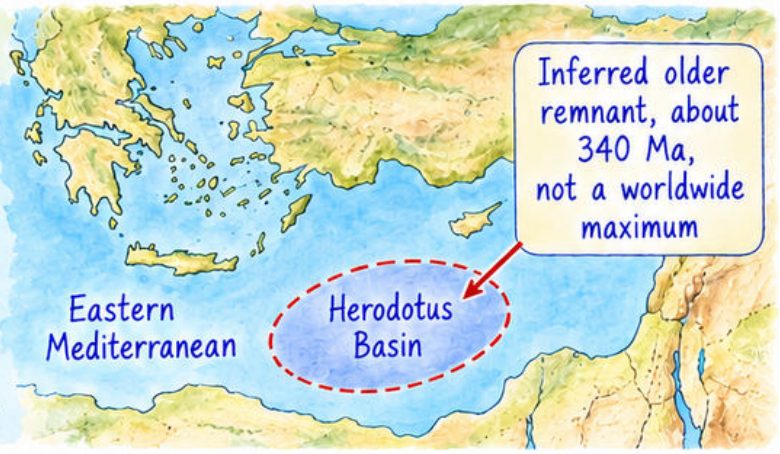
Very ancient continental rocks

Continents preserve rocks billions of years old. Some formations are at least 3,200 million years old, and the oldest surviving continental rocks approach four billion years. Continental and oceanic crust therefore preserve very different age records.



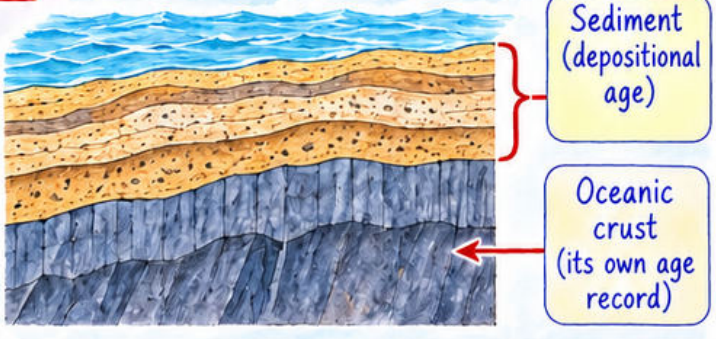
Older oceanic remnants

Older oceanic remnants can survive. Magnetic evidence from the Herodotus Basin in the eastern Mediterranean has been interpreted as crust formed about 340 million years ago. This is a regional inferred age, not a new worldwide upper limit.



Sediments are a separate record

Sediment accumulates above the crust. The age of a sediment layer and the age of the underlying crust are different measurements. No single universal 200-million-year ceiling should be applied to every marine sediment record.

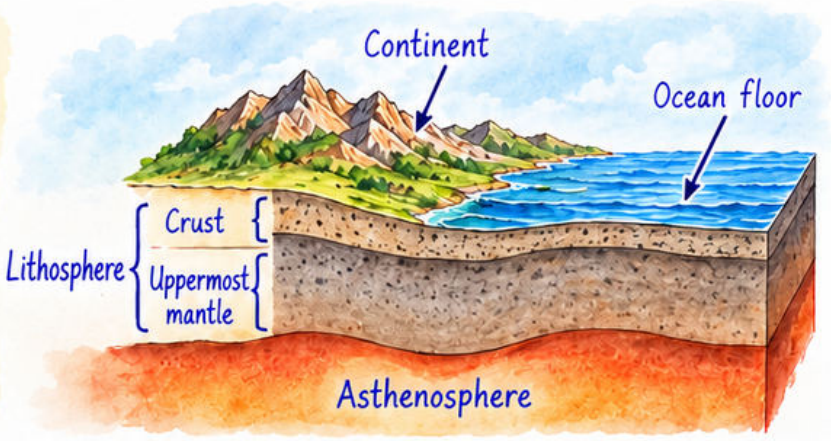


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Lithospheric plates move as rigid units

What a plate contains

A plate is a massive, irregular slab of solid rock. The lithosphere comprises the crust and uppermost mantle, not the crust alone. It is divided into plates that move horizontally as rigid units over the asthenosphere.



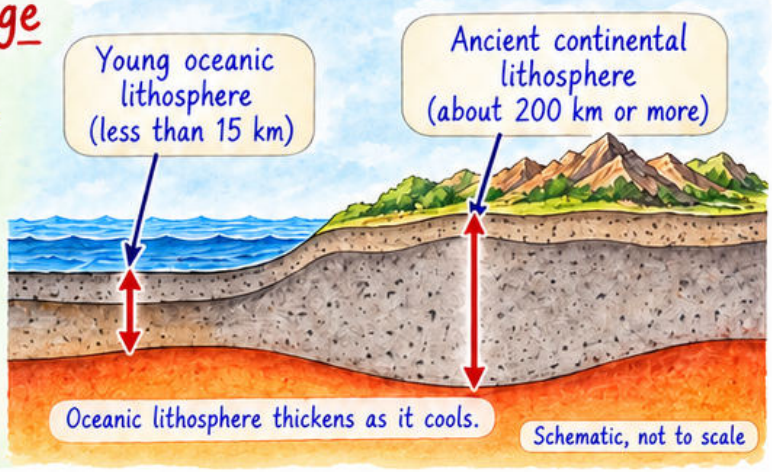
Continental or oceanic

The label depends on which type occupies most of the plate. A continental plate may include substantial ocean floor. A plate boundary therefore need not coincide with a coastline or national border.



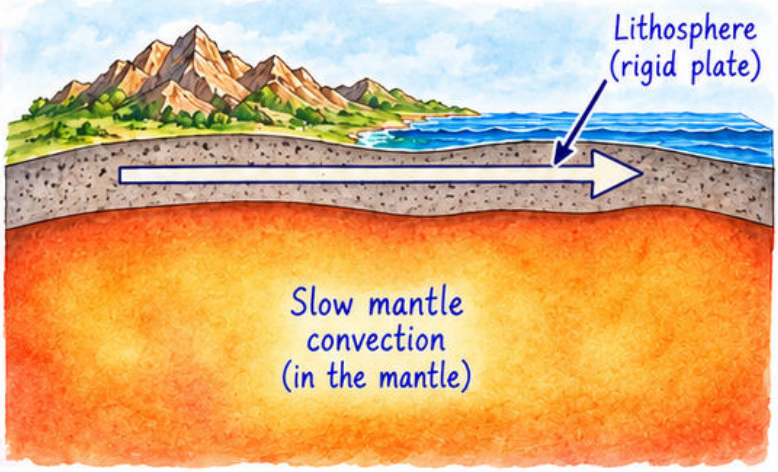
Thickness changes with age

Lithospheric thickness varies greatly: young oceanic lithosphere can be less than 15 km thick, while ancient continental lithosphere can reach about 200 km or more. Oceanic lithosphere thickens as it cools. These are plate thicknesses, including crust and uppermost mantle, not crustal thickness alone.



The moving unit

Continents form parts of plates, so the whole plate moves. Heat from radioactive decay and residual internal heat supports slow mantle convection beneath the rigid surface. This distinction replaces the idea of continents independently forcing their way through a stationary ocean floor.

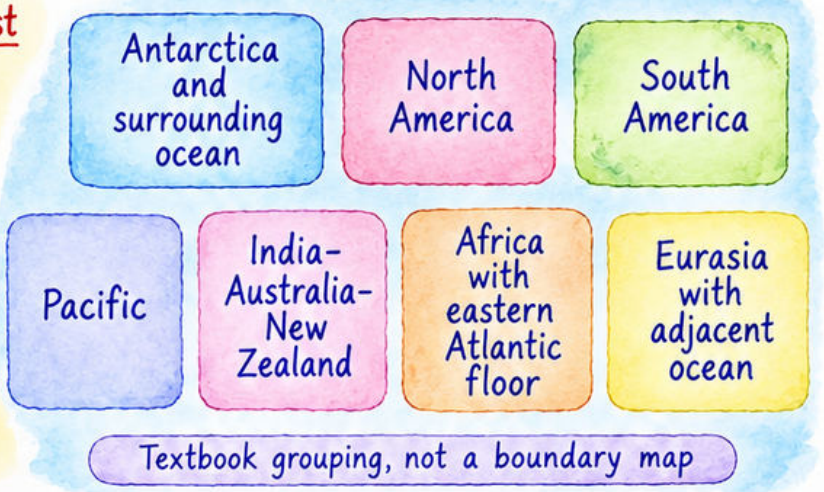


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Seven major plates and smaller neighbours

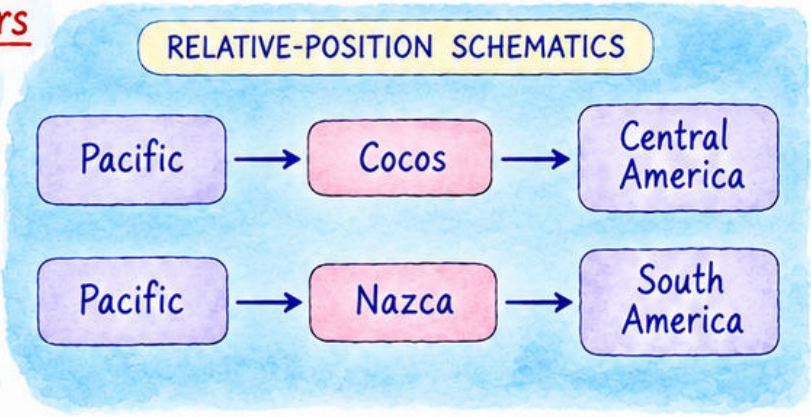
The seven in the textbook list

The list comprises Antarctica and surrounding ocean; North America; South America; Pacific; India-Australia-New Zealand; Africa with the eastern Atlantic floor; and Eurasia with adjacent ocean. This is the textbook's grouping, not a claim that every scientific plate model uses identical divisions.



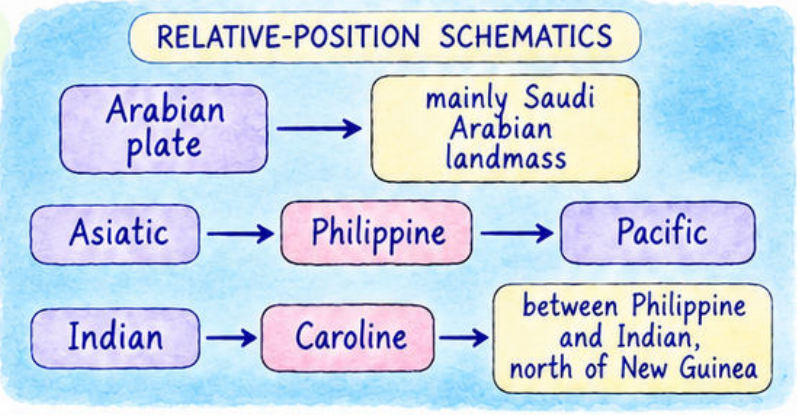
Eastern Pacific neighbours

The Cocos plate lies between Central America and the Pacific plate. Nazca lies between South America and the Pacific plate. Their positions matter when interpreting subduction and mountain-building examples.



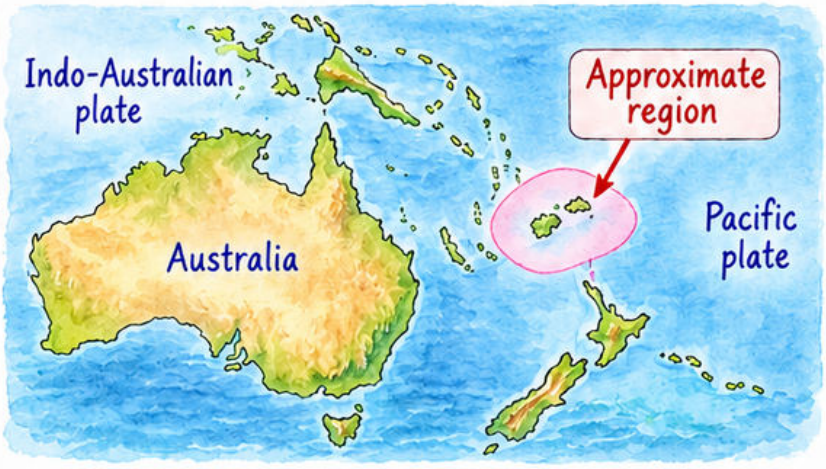
Asian-Pacific neighbours

The Arabian plate consists mainly of the Saudi Arabian landmass. The Philippine plate lies between the Asiatic and Pacific plates. Caroline lies between the Philippine and Indian plates, north of New Guinea.



The Fiji microplate

Fiji lies in the complex southwestern Pacific boundary region between the Pacific and Indo-Australian plates, northeast of Australia. Geological accounts identify a Fiji microplate. The wider region contains several smaller plates, so their exact boundaries depend on the model used.

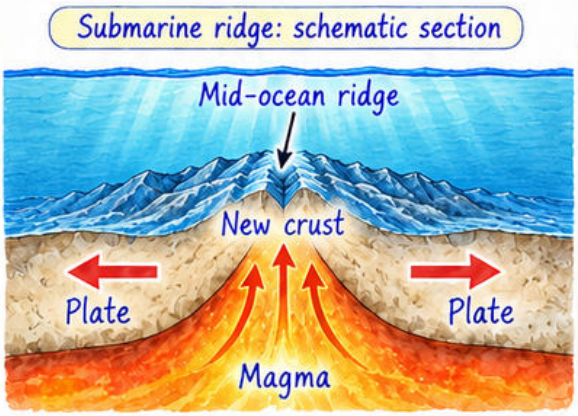


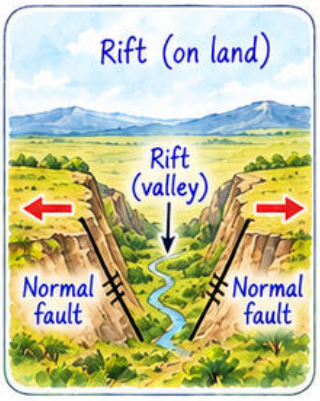
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Divergent plates create new crust

The motion

At divergent boundaries, plates pull away from each other and new crust forms. These are spreading sites. A mid-ocean ridge is the characteristic oceanic feature; on land, a rift may open.

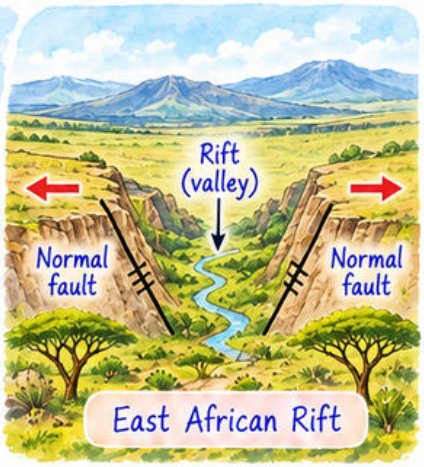




Examples

The Mid-Atlantic Ridge is the standard example. Iceland straddles the spreading centre between the North American and Eurasian plates. The East African Rift illustrates a region where a new spreading centre may be developing.





Slow and fast spreading

The textbook gives the Arctic Ridge as the slowest, below 2.5 cm per year, and the East Pacific Rise near Easter Island as the fastest, above 15 cm per year. Easter Island lies in the South Pacific about 3,400 km west of Chile.

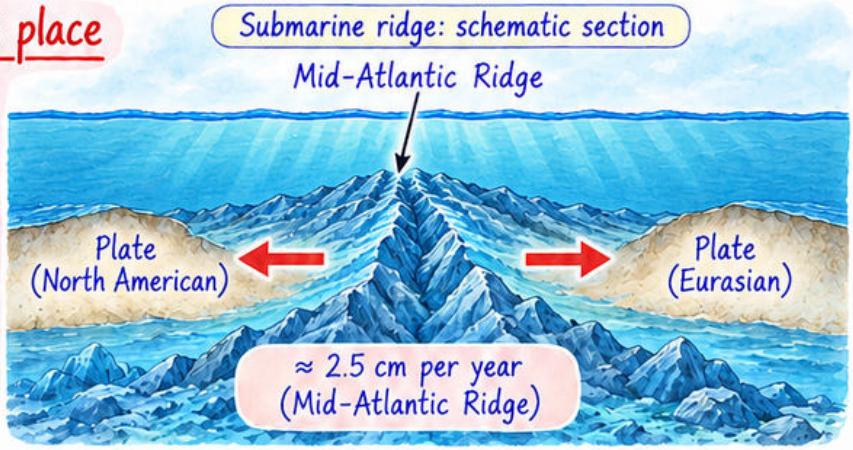
Arctic Ridge	< 2.5 cm per year
Mid-Atlantic Ridge	≈ 2.5 cm per year
East Pacific Rise	> 15 cm per year



Easter Island lies in the South Pacific about 3,400 km west of Chile.

Read each rate with its place

USGS gives the Mid-Atlantic Ridge's average spreading as about 2.5 cm per year. A rate belongs to a specified ridge or segment and a stated measure; it should not be used as the speed of every plate. Centimetres per year accumulate into major continental movement over geological time.

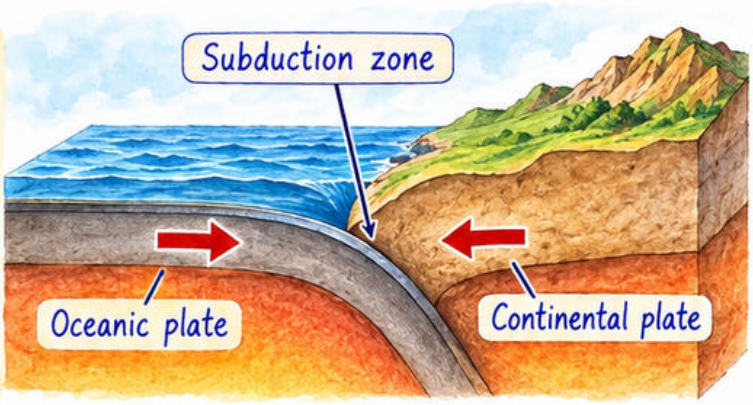


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Convergent boundaries build trenches and mountains

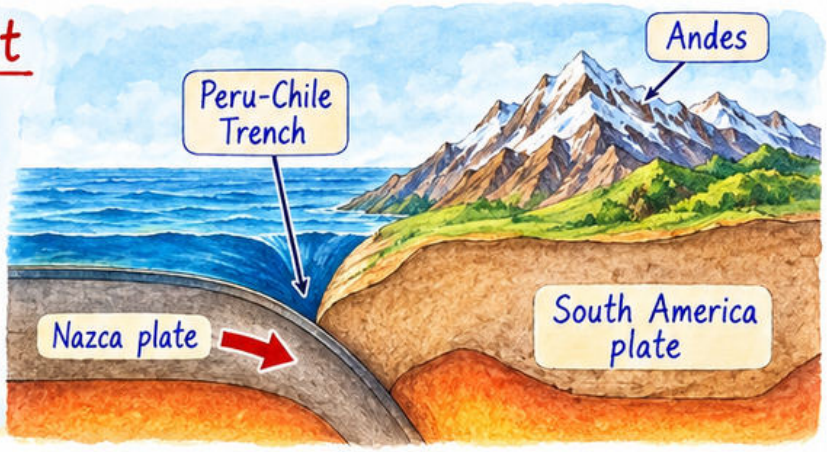
Plates approach

At convergent boundaries, plates move towards each other. Where one plate descends beneath another, the sinking region is a subduction zone. The textbook distinguishes ocean-continent, ocean-ocean and continent-continent convergence.



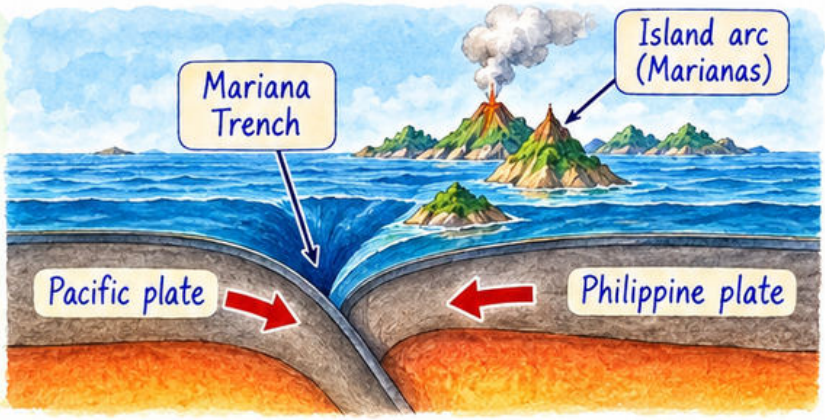
Ocean meets continent

The Nazca plate subducts beneath South America. This is associated with the Andes and the offshore Peru-Chile Trench. Match the oceanic plate, mountain chain and trench as one example.



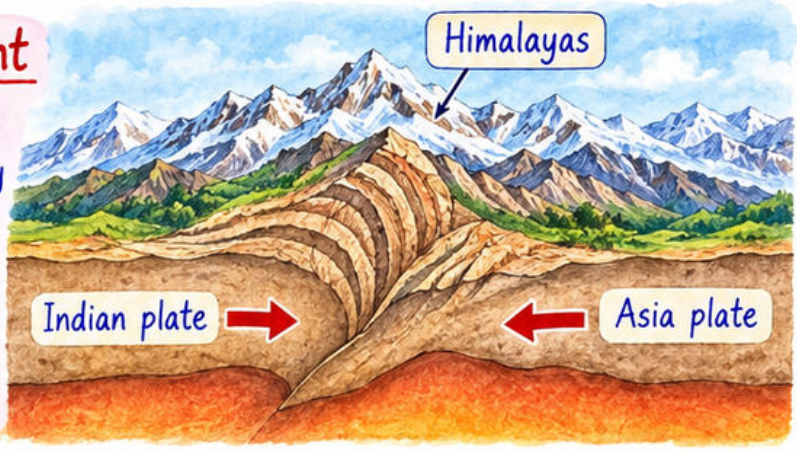
Ocean meets ocean

The Pacific plate converges against the Philippine plate at the Mariana Trench. Oceanic convergence produces trench and island-arc systems; the Marianas and Aleutians are examples of island arcs.



Continent meets continent

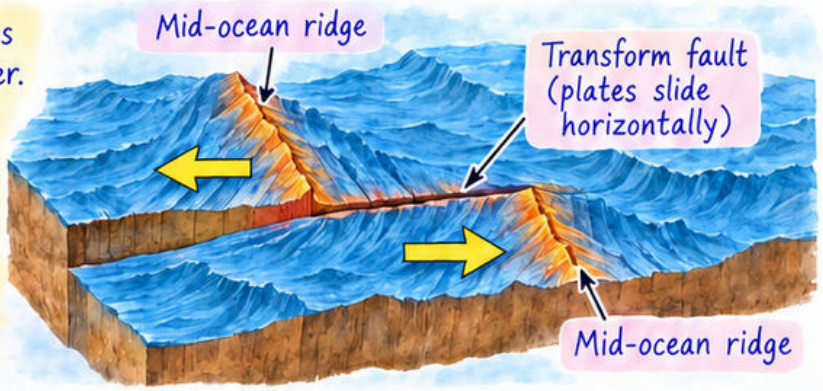
The Himalayas formed at the Indian plate's northern boundary through collision with Asia. Mountain-building here is a continent-continent convergence example.



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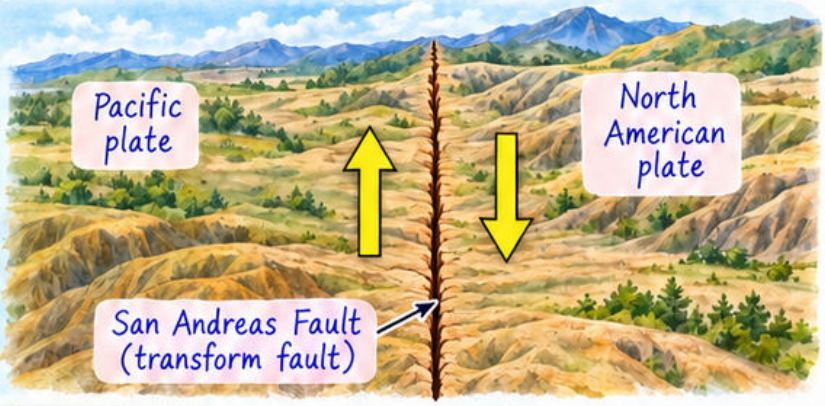
Transform faults and broad boundary zones

At a transform boundary, plates slide horizontally past each other. Crust is neither created nor destroyed by that boundary motion. Transform faults are planes of separation, commonly perpendicular to mid-ocean ridges.



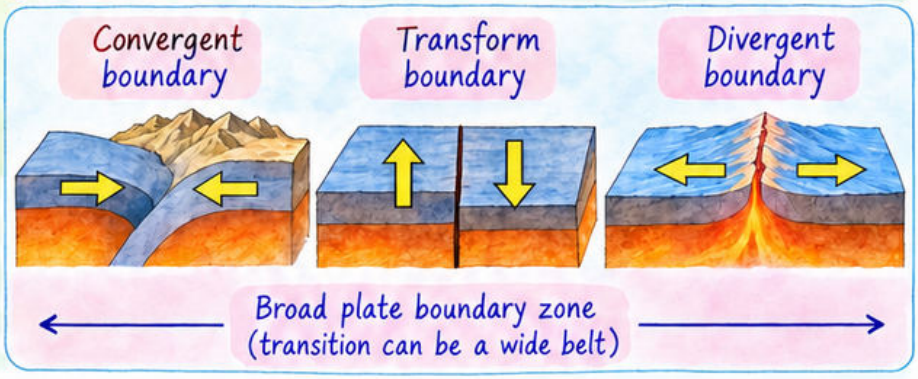
San Andreas

The San Andreas Fault separates the Pacific and North American plates. USGS describes the Pacific plate as grinding past North America there for about 10 million years. The example belongs to transform motion, not to a spreading ridge.



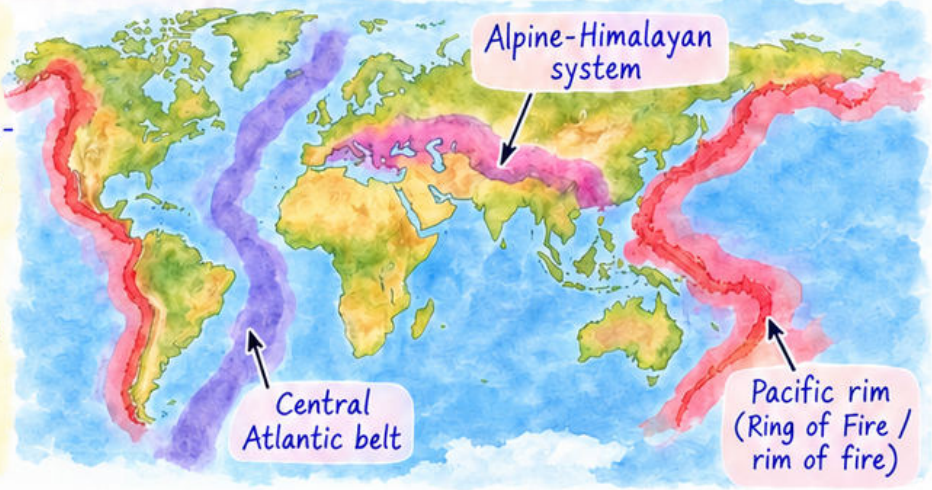
Some boundaries are broad

USGS also recognises plate boundary zones where limits are not sharply defined. A simple three-type diagram is useful, but the real transition can be a broad belt rather than a single clean line.



Earthquake and volcano belts

Activity follows a central Atlantic belt and the Alpine-Himalayan system and Pacific rim. The circum-Pacific belt is the Ring of Fire, also called the rim of fire. The concentration of earthquakes and volcanoes supports the association between active deformation and plate margins, though the two phenomena should not be drawn as identical at every boundary.

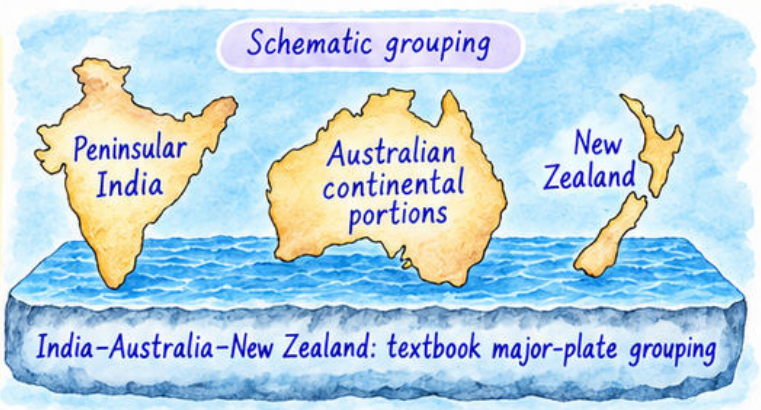


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The Indian plate and its boundaries

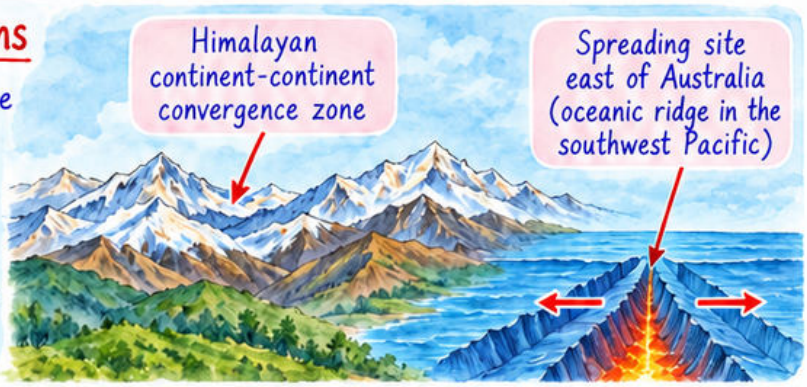
More than Peninsular India

In the textbook classification, the Indian plate includes Peninsular India and the Australian continental portions, within the India-Australia-New Zealand major plate. Political outlines do not define lithospheric plates.



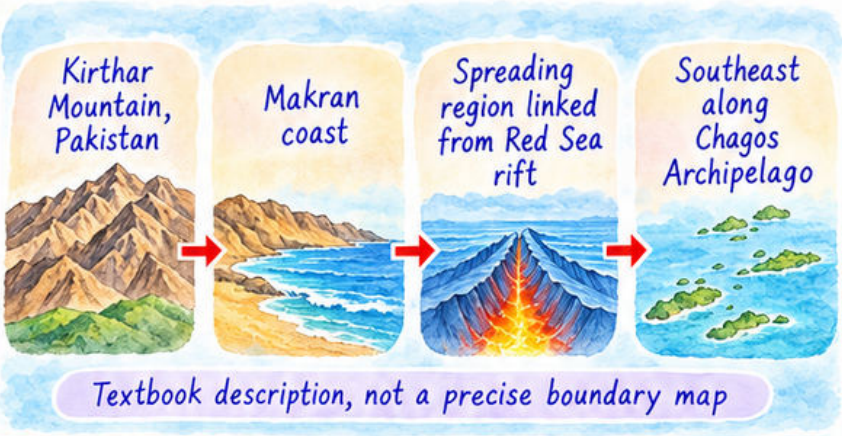
Northern and eastern margins

The northern boundary follows the Himalayan continent-continent convergence zone. The eastern boundary is described as a spreading site east of Australia, an oceanic ridge in the southwest Pacific.



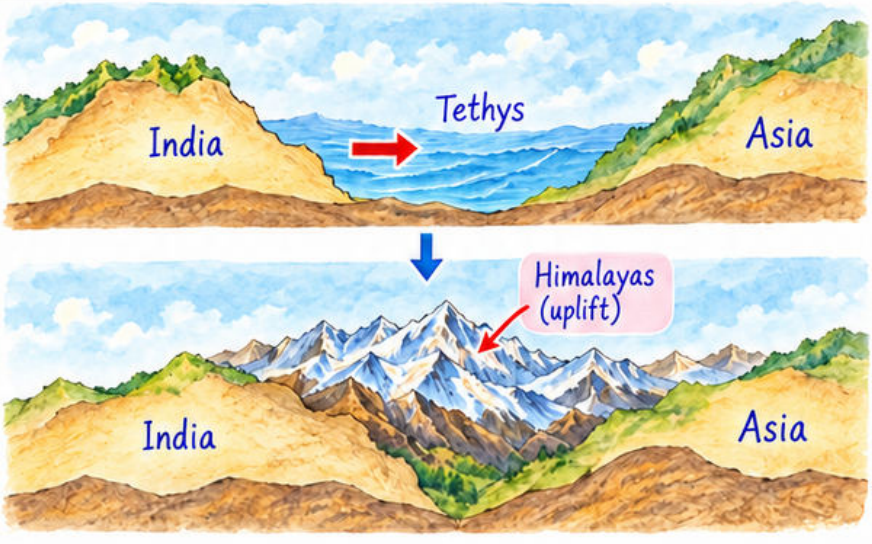
The western margin

The textbook traces it along Pakistan's Kirthar Mountain and the Makran coast, written "Makrana" in that account, then towards the spreading site linked from the Red Sea rift southeast along the Chagos Archipelago.



The broad journey

India moved north across the Tethys towards Asia. Collision around 40–50 million years ago caused rapid Himalayan uplift; USGS uses about 50 million years or 40–50 million years in its accounts. Himalayan development from about 40 million years ago to the present continues.



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India moves from Gondwana towards Asia

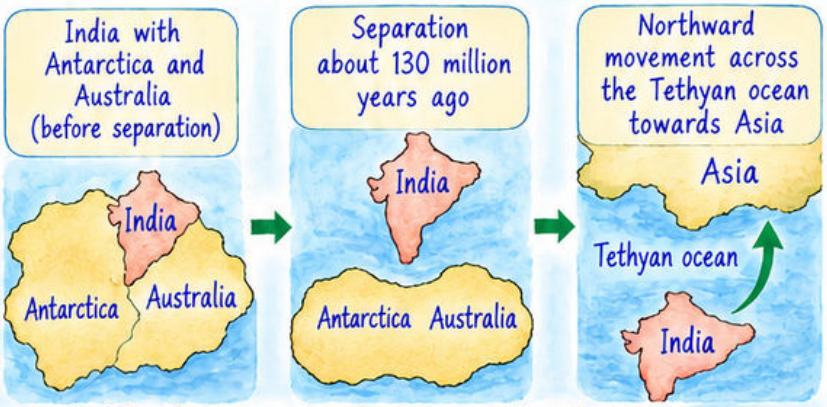
Part of Gondwana

India was part of Gondwana within Pangaea, not a freely isolated island at 225 million years ago. Pangaea began to break apart about 200 million years ago, while India remained within eastern Gondwana alongside Antarctica and Australia.



Separation and northward movement

Gondwana broke up in stages. Seafloor spreading separated India from Antarctica and Australia about 130 million years ago. India then travelled north across the Tethyan ocean towards Asia. The journey took tens of millions of years.



Schematic stages, not exact palaeogeographic outlines

The Deccan flood basalts

The main phase of Deccan Traps eruptions occurred around 66 million years ago, while India lay near the equatorial belt. The voluminous main sequence erupted over roughly one million years. Some peripheral volcanic activity was earlier or later; 60 million years ago is not the start of the main Deccan phase.



Collision and the Himalayas

India collided with Asia around 50 million years ago, commonly summarised as about 40–50 million years. Continental collision thickened and uplifted the crust to build the Himalayas. Convergence and mountain-building continue today.

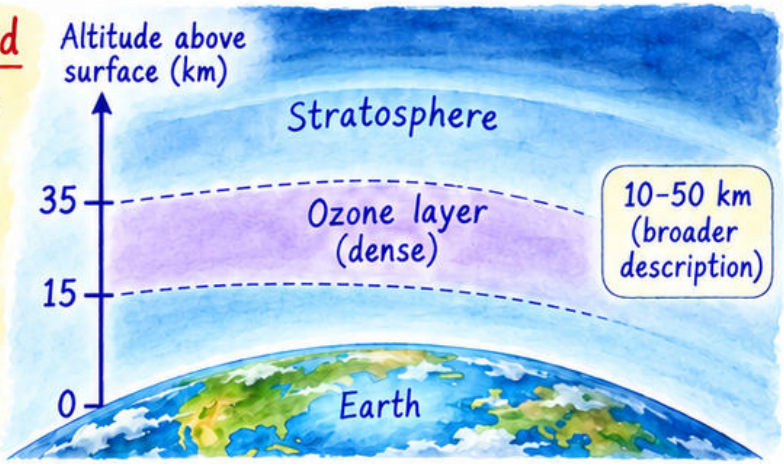


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A thin shield high above Earth

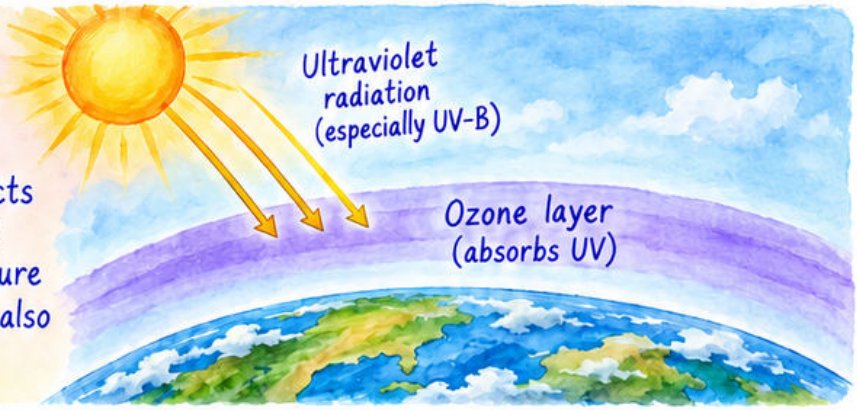
Where ozone is concentrated

About 90 per cent of atmospheric ozone lies in the stratosphere. The dense ozone layer is roughly 15–35 km high. Broader descriptions use 10–50 km or about 15–50 km because they include different portions of the ozone distribution.



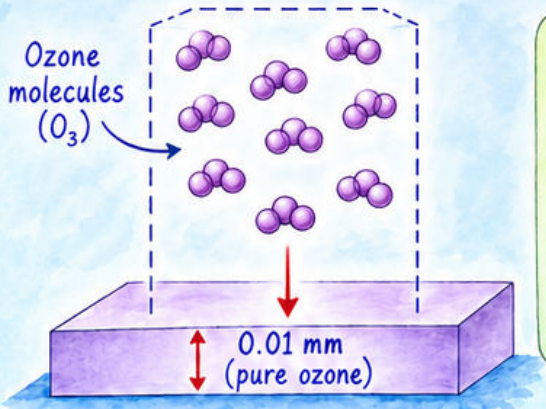
What it does

Ozone absorbs much of the Sun's ultraviolet radiation, especially UV-B. This protects life below and helps explain why stratospheric temperature rises with height. Ozone is also a greenhouse gas.



The Dobson unit

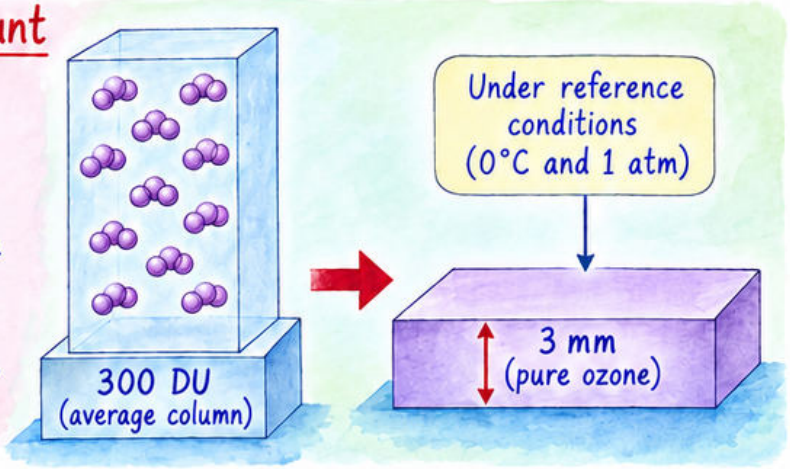
One Dobson unit, DU, is the number of ozone molecules needed to form a pure-ozone layer 0.01 mm thick at 0°C and one atmosphere pressure. This is a compressed-column measure, not the physical thickness of the stratospheric region.



One Dobson unit (DU) = number of ozone molecules needed to form 0.01 mm of pure ozone at 0°C and 1 atmosphere pressure.

A surprisingly small amount

An average column of about 300 DU would form only about 3 mm of pure ozone under those reference conditions. Keep kilometres of atmospheric altitude separate from millimetres of compressed ozone. Both describe the same shield in different ways, not contradictory estimates of its height.

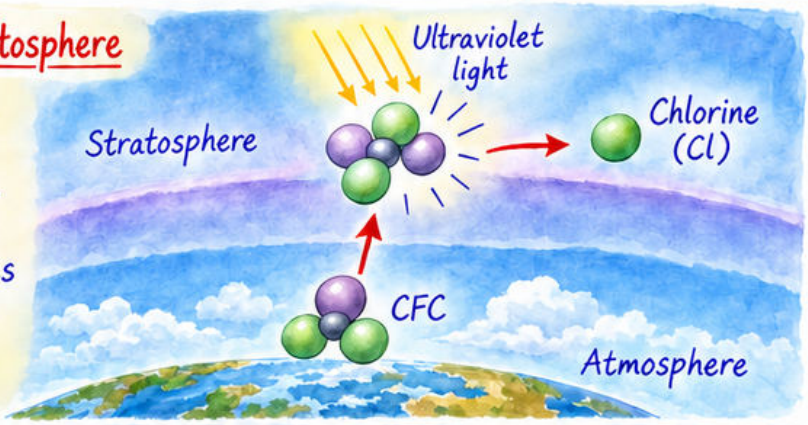


Sources: Day 29 Source Index | Topic 287

How chlorine and bromine destroy ozone

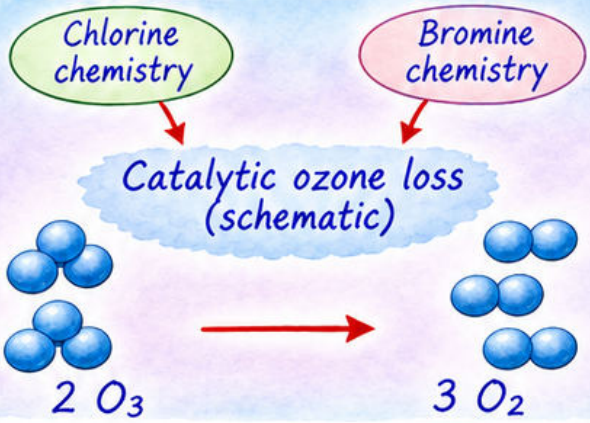
Chemicals that reach the stratosphere

CFCs are stable in the lower atmosphere and survive long enough to reach higher layers. Stratospheric ultraviolet light breaks them apart and releases chlorine, which participates in ozone-destroying reactions.



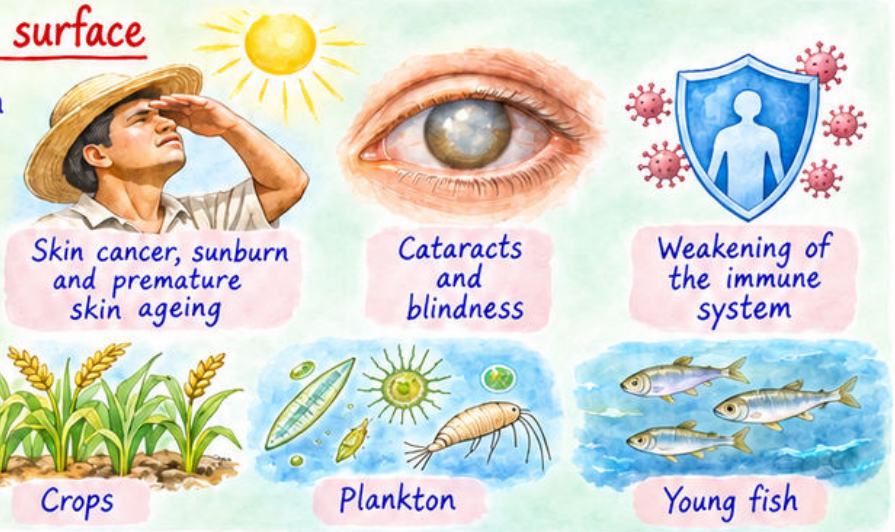
The controlled substances

Ozone-depleting substances include CFCs, halons, carbon tetrachloride, methyl chloroform, methyl bromide, HCFCs, HBFCs and bromochloromethane. Chlorine and bromine chemistry together account for a large share of ozone loss.



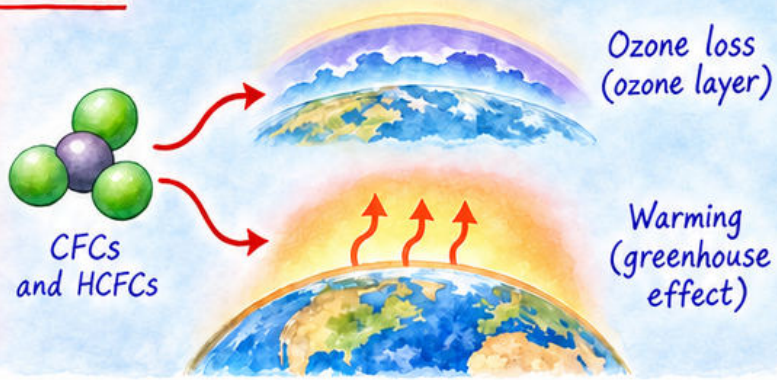
Consequences at the surface

More UV-B can cause skin cancer, sunburn and premature skin ageing; cataracts and blindness; and weakening of the immune system. Crops, plankton and young fish are also vulnerable.



Ozone and climate are connected

CFCs and HCFCs are greenhouse gases as well as ozone-depleting substances. That does not mean every greenhouse gas destroys ozone. The chemical action causing ozone loss and the warming influence of a gas are separate properties that may coexist in the same substance.

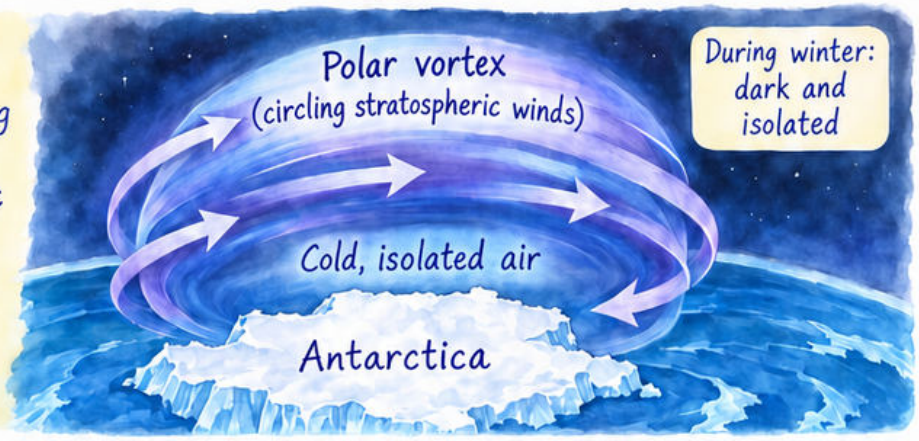


Sources: Day 29 Source Index | Topic 287

Why Antarctica develops an ozone hole

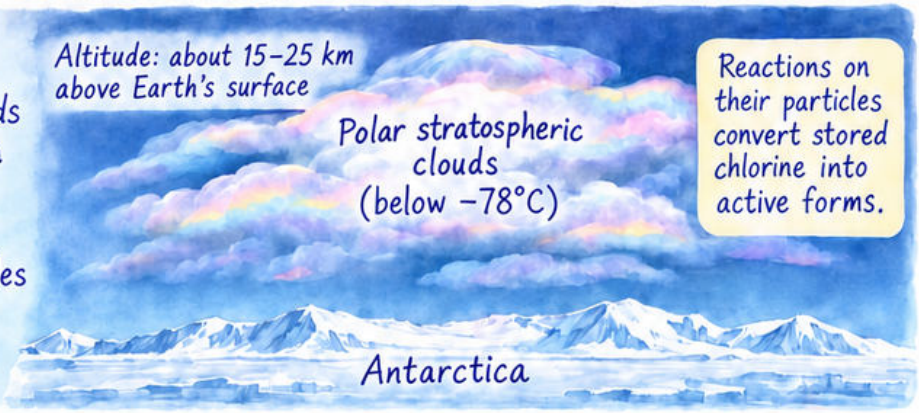
Winter isolation

A polar vortex, a circling system of stratospheric winds, isolates Antarctic air during winter. Darkness allows the trapped air to become extremely cold.



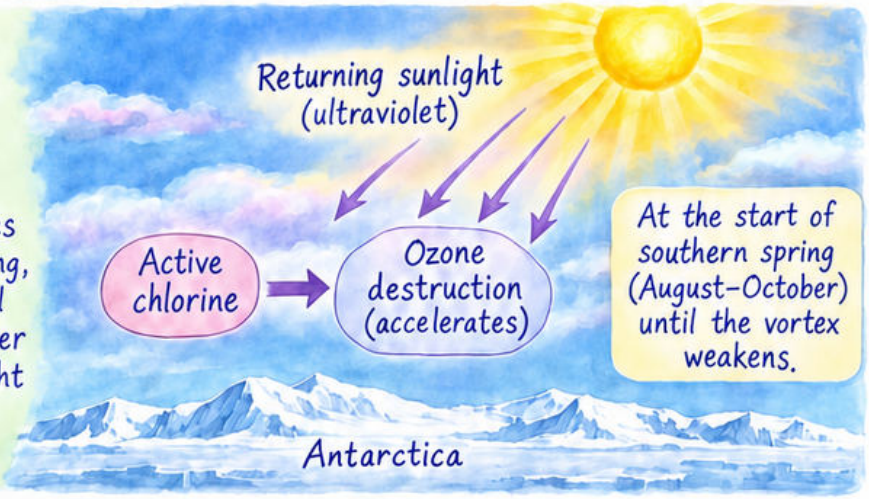
Cloud chemistry

Polar stratospheric clouds form at about 15–25 km when temperatures fall below minus 78°C. Reactions on their particles convert stored chlorine into active forms.



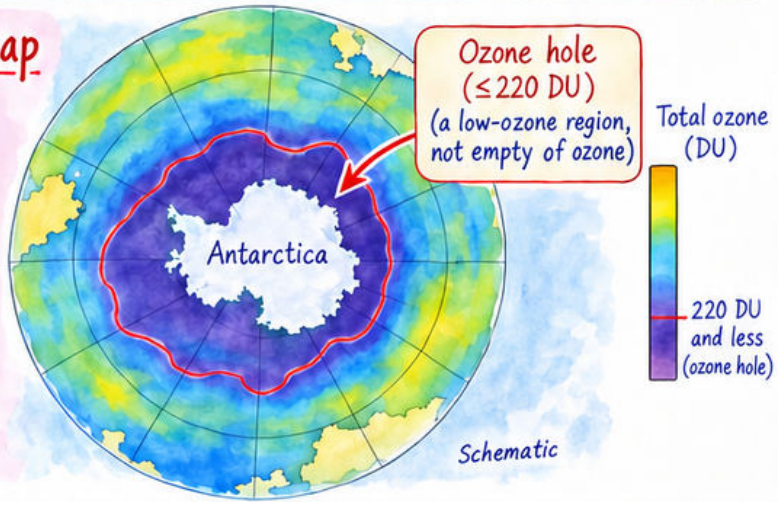
Spring destruction

Returning sunlight releases reactive chlorine through ultraviolet-driven chemistry. Ozone destruction accelerates at the start of southern spring, during August–October, until the vortex weakens. The winter preparation and spring sunlight are both necessary parts of the explanation.



A low-ozone region, not a gap

NASA Ozone Watch defines the Antarctic ozone hole as the area with total ozone of 220 DU or less. Values below 220 DU were not observed before 1979. "Hole" therefore describes severe thinning, not a region entirely empty of ozone. Its size and depth vary with stratospheric conditions.



Sources: Day 29 Source Index | Topic 287

Ground measurements revealed the loss

Halley Bay's record

The British Antarctic Survey measured ozone at Halley Bay from 1957 using a Dobson spectrophotometer. A long ground-based record made the seasonal change detectable.



The discovery paper

J.C. Farman, B.G. Gardiner and J.D. Shanklin published the first paper on Antarctic springtime ozone losses in Nature in 1985. The initial published discovery did not come from satellites.



The satellite contribution

In 1986, NASA scientists used satellite data to establish that the hole was a regional-scale Antarctic phenomenon. Ground measurements identified the loss; satellites showed its broad extent.



Satellite data (1986, NASA)

↓

Established that the hole was a regional-scale Antarctic phenomenon.

World Ozone Day

16 September commemorates the Montreal Protocol agreed in 1987. The UN General Assembly proclaimed the International Day for the Preservation of the Ozone Layer on 19 December 1994. The 2026 theme is "Global action for a cooler planet", marking ten years of the Kigali Amendment. The commemoration links ozone protection with the continuing climate benefits of action.



Sources: Day 29 Source Index | Topic 287

Vienna provides a framework Montreal adds controls

Vienna Convention

Adopted on 22 March 1985 and in force from 22 September 1988, the Convention for the Protection of the Ozone Layer promotes systematic observation, research and information exchange. It did not itself require control actions.



Montreal Protocol

Agreed on 16 September 1987 and in force from 1 January 1989, the Protocol on Substances that Deplete the Ozone Layer establishes binding controls on production and consumption of ozone-depleting substances.

Vienna: framework for observation, research and information exchange



Adoption
Vienna: 22 March 1985

Adoption
Montreal: 16 September 1987

In force
Vienna: 22 September 1988

In force
Montreal: 1 January 1989

Montreal: binding controls on production and consumption of ozone-depleting substances



Universal participation

On 16 September 2009, Vienna and Montreal became the first treaties in UN history ratified by every country. Vienna is also described as the first convention of any kind to achieve universal ratification.



Ratified by every country (16 September 2009)

Amendments and adjustments

Five amendments expanded the regime. Adjustments can accelerate agreed reductions and apply automatically to all Parties. Keep the mechanisms distinct. Also separate adoption from commencement: Vienna and Montreal were adopted two years apart, in 1985 and 1987, but entered into force one year apart, in 1988 and 1989.

Amendments (five) expand the regime

Adjustments can accelerate agreed reductions and apply automatically to all Parties

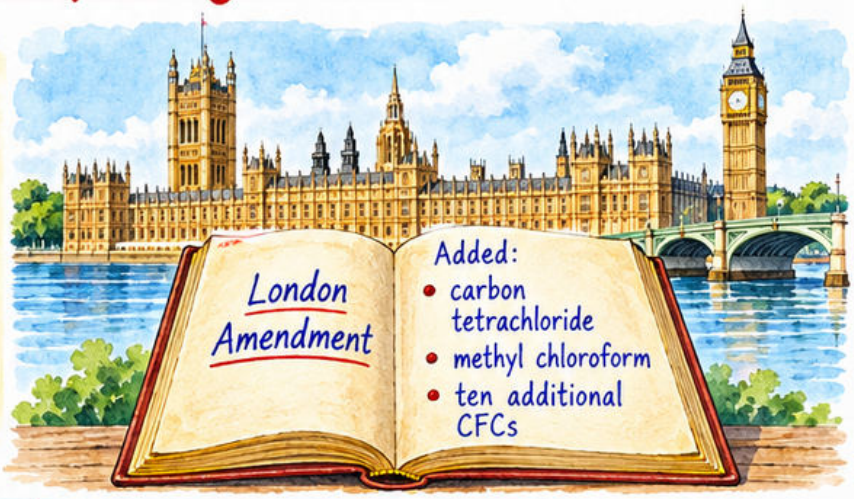


Sources: Day 29 Source Index | Topic 287

London and Copenhagen widen the controls

London, 1990

The Second Meeting of the Parties, held in London from 27–29 June 1990, agreed the London Amendment. It added carbon tetrachloride, methyl chloroform and ten additional CFCs.



Paying incremental costs

The same meeting established the Multilateral Fund. It covers the extra costs developing countries incur in complying with the controls. These countries are called Article 5 Parties, after the Protocol provision allowing them more time.



Copenhagen, 1992

The Fourth Meeting, held from 23–25 November 1992, agreed the Copenhagen Amendment. It brought methyl bromide, HBFCs and HCFCs under control.



Implementation matters

Copenhagen also agreed the non-compliance procedure and established the Implementation Committee. Adding substances, financing compliance and checking implementation are different functions of the treaty system. The years 1990 and 1992 identify the meetings that adopted these amendments; they should not be presented as unverified entry-into-force dates.



Functions of the treaty system

- Adding substances
- Financing compliance
- Checking implementation

Sources: Day 29 Source Index | Topic 287

Licences further controls and Kigali

Montreal Amendment, 1997

The Ninth Meeting of the Parties, 15–17 September 1997 in Montreal, introduced licensing for the import and export of ozone-depleting substances. It strengthened the control of trade, rather than creating the original Protocol anew.



Beijing Amendment, 1999

The Eleventh Meeting, held from 29 November to 3 December 1999, brought bromochloromethane under control and added further controls on HCFCs.



Kigali Amendment, 2016

The Twenty-Eighth Meeting was held in Kigali, Rwanda, from 10–15 October 2016. The Amendment was agreed on 15 October to phase down HFC production and consumption.



When Kigali began

Kigali entered into force on 1 January 2019. The condition of twenty ratifications had been met on 17 November 2017. The regime's five amendment names are London, Copenhagen, Montreal, Beijing and Kigali. A treaty amendment's adoption, ratification threshold and entry into force are different milestones, each with its own date.

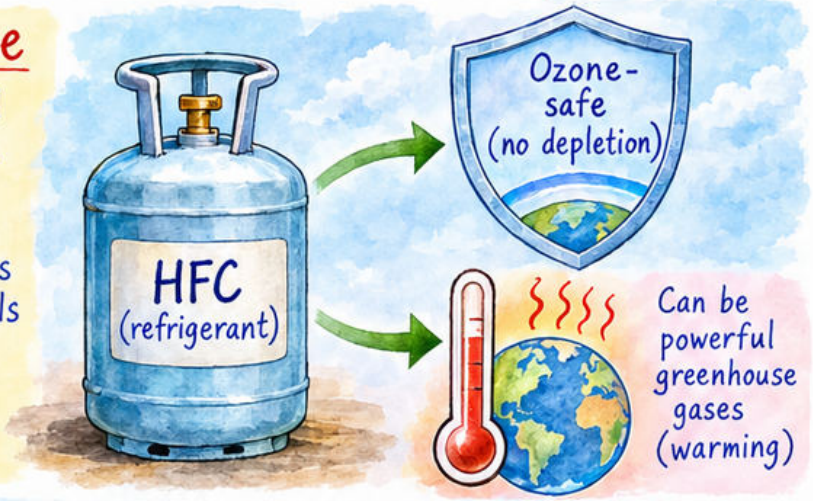


Sources: Day 29 Source Index | Topic 287

HFCs spare ozone but warm the planet

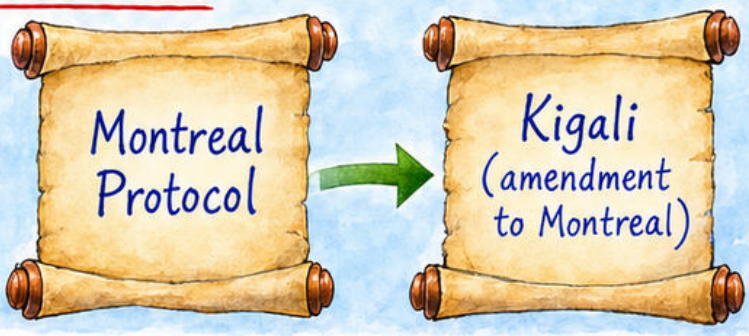
Why HFCs entered use

Hydrofluorocarbons replaced ozone-depleting substances. They do not deplete ozone, but they can be powerful greenhouse gases. UNEP gives HFC global-warming potentials ranging from about 121 to about 14,800.



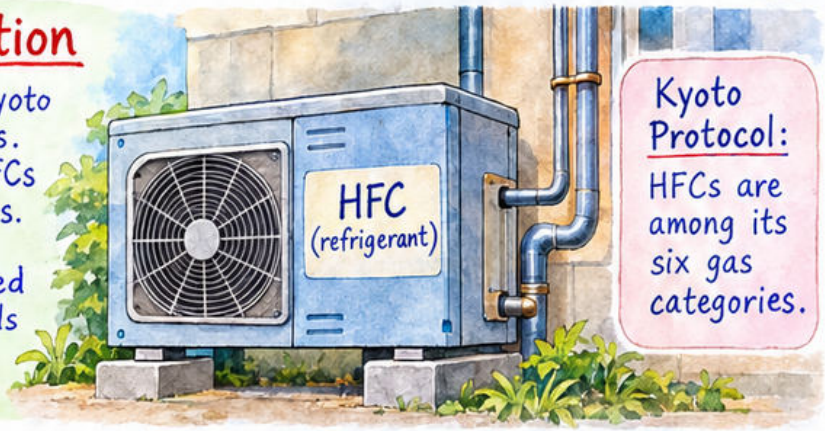
Why Montreal now controls them

Kigali brings HFC production and consumption under the Montreal Protocol. It is an amendment to Montreal, not to the Kyoto Protocol or the UN Framework Convention on Climate Change.



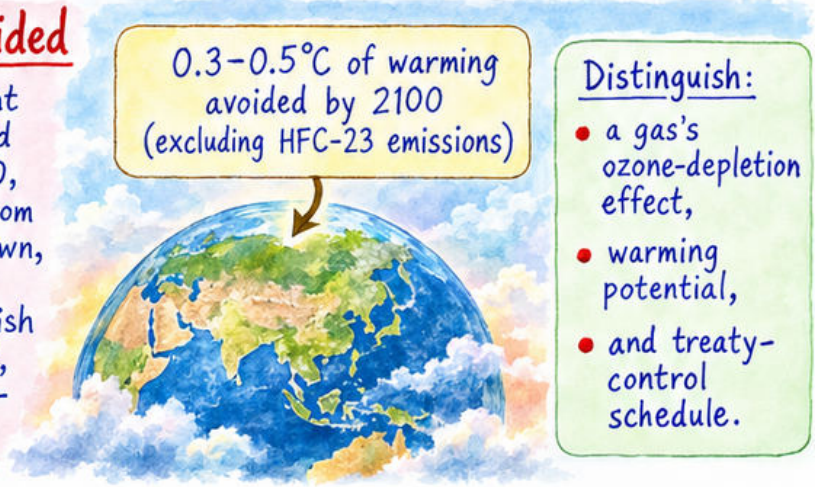
The climate connection

HFCs are also among the Kyoto Protocol's six gas categories. The overlap does not turn HFCs into ozone-depleting chemicals. Kyoto's framework concerns greenhouse gases not controlled by Montreal, while Kigali adds a specific HFC phase-down within the ozone regime.



Expected warming avoided

The 2022 scientific assessment estimates that Kigali can avoid 0.3–0.5°C of warming by 2100, excluding HFC-23 emissions from that estimate. It is a phase-down, not an assertion that HFCs immediately disappear. Distinguish a gas's ozone-depletion effect, warming potential and treaty-control schedule.



Sources: Day 29 Source Index | Topic 287

Kigali schedules differ by group

Most developed countries

For most non-Article 5 Parties, baseline years are 2011–13, with no separate freeze. Cuts below baseline are 10 per cent in 2019, 40 in 2024, 70 in 2029, 80 in 2034 and 85 in 2036.

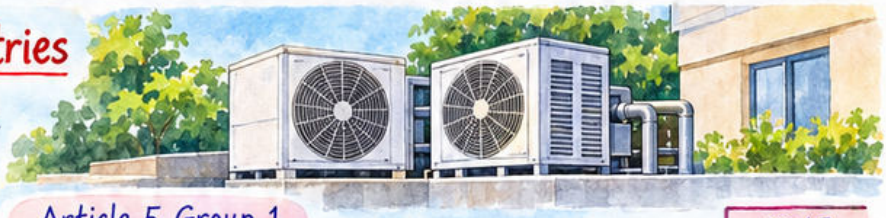


Non-Article 5 Parties (most developed)

- Baseline: 2011–13
- 2019: 10% reduction
- 2024: 40% reduction
- 2029: 70% reduction
- 2034: 80% reduction
- 2036: 85% reduction

Most developing countries

Article 5 Group 1 uses a 2020–22 baseline and a 2024 freeze. Cuts are 10 per cent in 2029, 30 in 2035, 50 in 2040 and 80 in 2045.

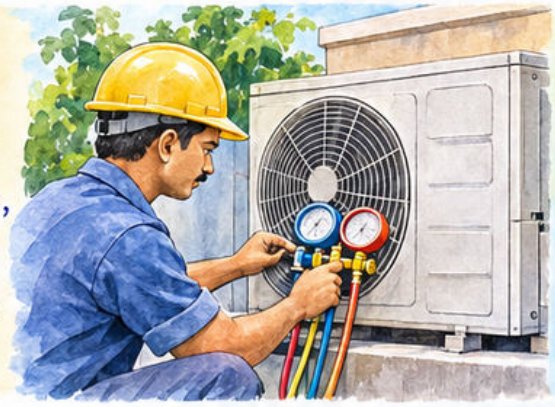


Article 5 Group 1 (most developing)

- Baseline: 2020–22
- Freeze: 2024
- 2029: 10% reduction
- 2035: 30% reduction
- 2040: 50% reduction
- 2045: 80% reduction

India's group

Article 5 Group 2 comprises India, Bahrain, Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia and the United Arab Emirates. Its baseline is 2024–26 and freeze year 2028.



Article 5 Group 2 members: India, Bahrain, Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia and the United Arab Emirates.

Baseline: 2024–26 | Freeze: 2028

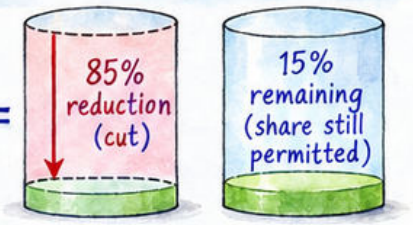
Group 2 reductions

Cuts are 10 per cent in 2032, 20 in 2037, 30 in 2042 and 85 in 2047. The treaty expresses the final limit as 15 per cent of baseline remaining, which equals an 85 per cent cut. Always label whether a number is the reduction or the share still permitted.

Article 5 Group 2 (India's group)

- Baseline: 2024–26
- Freeze: 2028
- 2032: 10% reduction
- 2037: 20% reduction
- 2042: 30% reduction
- 2047: 85% reduction

85% cut (reduction) = 15% remaining (share still permitted) =

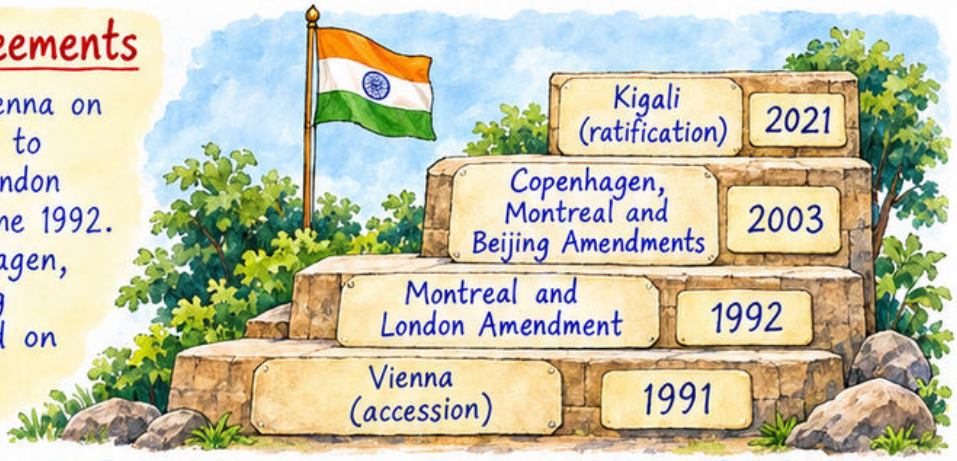


Sources: Day 29 Source Index | Topic 287

India's ratifications and domestic rules

Joining the agreements

India acceded to Vienna on 18 March 1991, and to Montreal and the London Amendment on 19 June 1992. Accession to Copenhagen, Montreal and Beijing Amendments followed on 3 March 2003.



Kigali ratification

The Cabinet approved ratification on 18 August 2021; India ratified on 27 September 2021. The 2021 Cabinet release listed an 80 per cent final cut in 2047, whereas the treaty, UNEP schedule and 30 November 2016 Cabinet release give 85 per cent. Use 85 per cent for the treaty schedule.

Treaty clarification

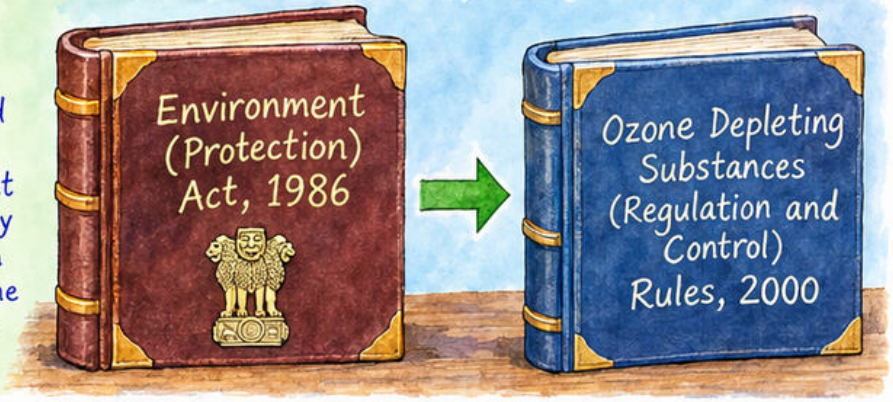
Treaty, UNEP schedule and 30 November 2016 Cabinet release: 85 per cent ✓

2021 Cabinet release: 80 per cent



Domestic controls

The Ozone Depleting Substances (Regulation and Control) Rules, 2000 were made under the Environment (Protection) Act, 1986. They banned CFCs and halons in new equipment by 2003. The 2014 and 2019 amendment rules used the same Act.



Implementation

MoEFCC's Ozone Cell handles control schedules, the HCFC Phase-out Management Plan and the India Cooling Action Plan. India phased out CFCs, carbon tetrachloride and halons for controlled uses by 2010. CFC production and consumption stopped on 1 August 2008, seventeen months ahead of schedule.





Treaty schedule (final cut): 85 per cent ✓

Sources: Day 29 Source Index | Topic 287

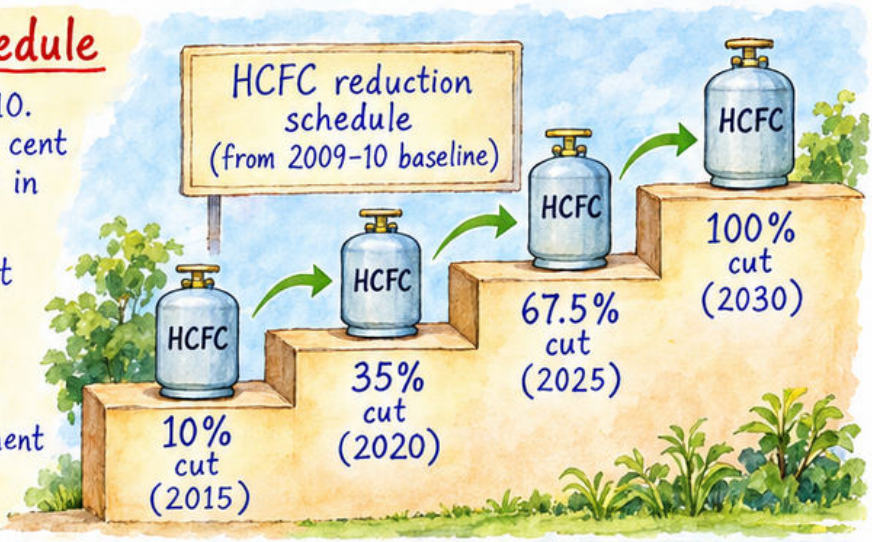
India's HCFC phase-out and cooling plan

HCFC reduction schedule

India's baseline is 2009-10. Scheduled cuts are 10 per cent in 2015, 35 in 2020, 67.5 in 2025 and 100 in 2030.

HCFC-141b was phased out in foam production from 1 January 2020.

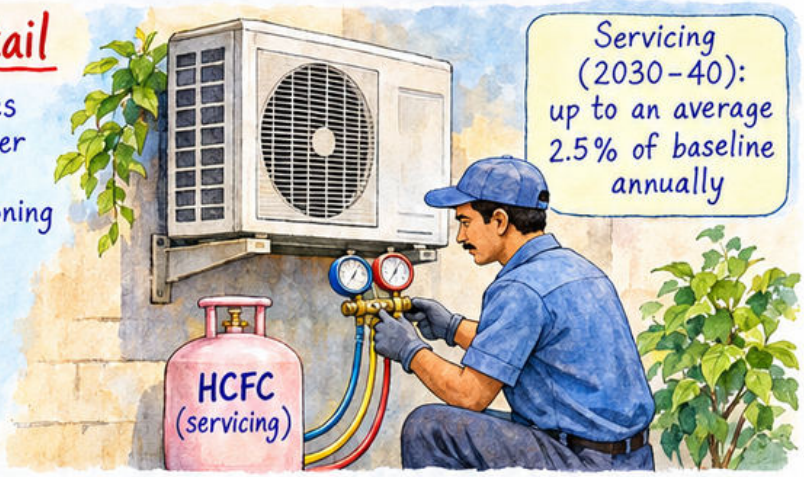
HCFCs cannot be used to manufacture any new equipment from 1 January 2025.



The narrow servicing tail

From 2030-40, Article 5 Parties may use up to an average 2.5 per cent of baseline annually for servicing refrigeration, air-conditioning and fire-protection equipment existing on 1 January 2030, plus two other narrow uses.

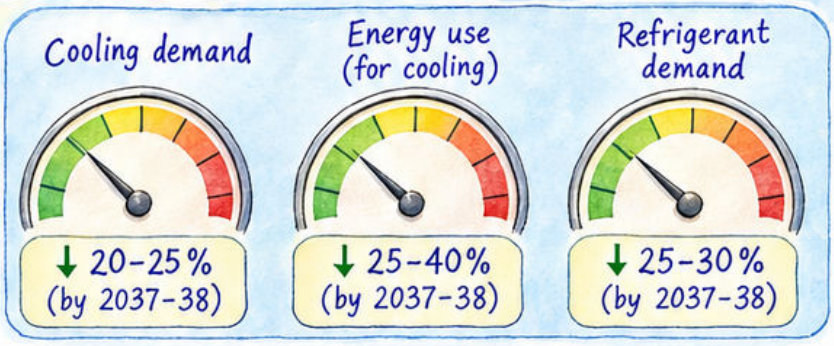
A 100 per cent scheduled cut therefore has specified limited exceptions.



India Cooling Action Plan, 2019

By 2037-38, ICAP aims to reduce cooling demand by 20-25 per cent, energy use for cooling by 25-40 per cent and refrigerant demand by 25-30 per cent.

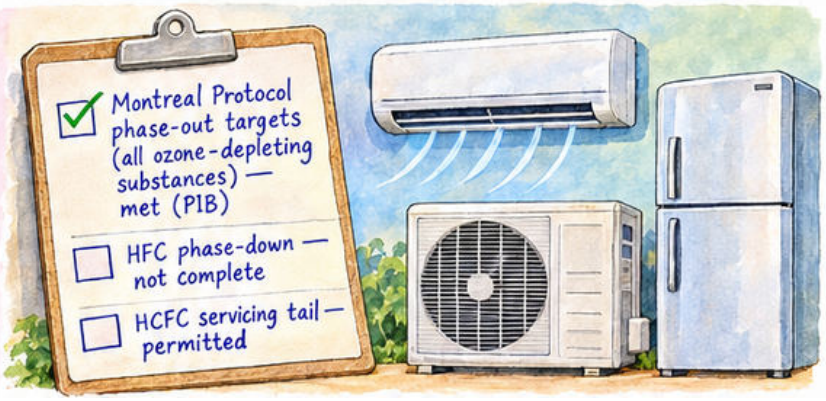
These are three different quantities and target ranges.



Progress and scope

PIB reports India has met its Montreal Protocol phase-out targets for all ozone-depleting substances.

That does not mean the later HFC phase-down is already complete, nor does it erase the permitted HCFC servicing tail.

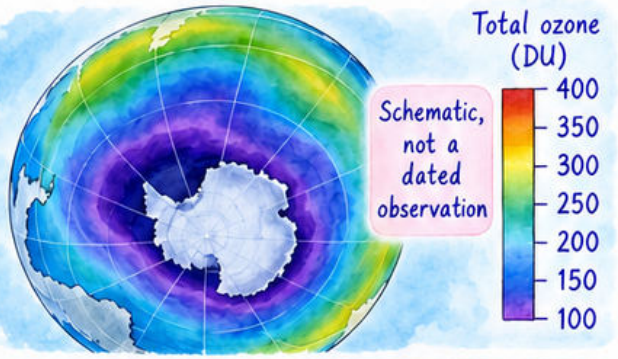


Sources: Day 29 Source Index | Topic 287

Recovery takes decades not one season

The scientific assessment

WMO/UNEP's Scientific Assessment of Ozone Depletion: 2022 was released on 9 January 2023. The Montreal Protocol's Scientific Assessment Panel prepares an assessment every four years.



Expected return to 1980 values

If current policies continue, recovery is projected around 2066 over Antarctica, 2045 over the Arctic and 2040 elsewhere. Nearly 99 per cent of banned ozone-depleting substances have been phased out. Antarctic hole area and depth have slowly improved since 2000.



Compare the same measures

In 2006, the largest daily area was 29.6 million sq km on 24 September; the 7 September–13 October mean was 26.6 million sq km; minimum daily ozone was 84 DU on 8 October.

In 2025, corresponding figures were 22.9 million sq km on 9 September, 18.7 million sq km, and 127 DU on 25 September.

	2006	2025
Largest daily area	29.6 million sq km (24 September)	22.9 million sq km (9 September)
Seasonal mean area	26.6 million sq km (7 September–13 October mean)	18.7 million sq km
Minimum daily ozone	84 DU (8 October)	127 DU (25 September)

Weather still changes each season

The 2006 season has the largest mean area in NASA's table. As of 1 November 2026, that annual table ran through 2025. Recovery must be judged across years because stratospheric weather affects individual seasons; one smaller hole does not mean complete recovery.

Two reported seasons, not an annual series

2006
seasonal mean:
26.6 million sq km

2025
seasonal mean:
18.7 million sq km

Sources: Day 29 Source Index | Topic 287