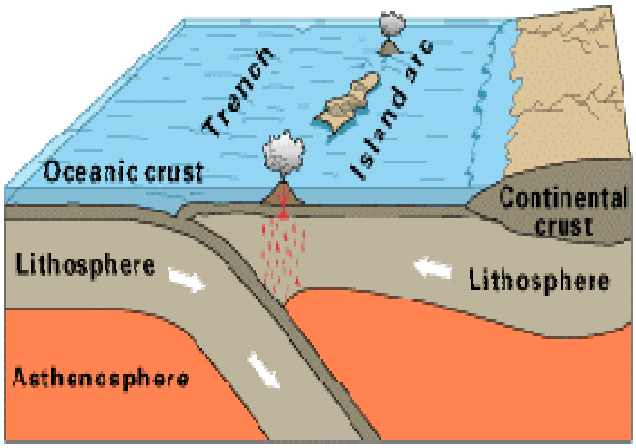
B. OCEANIC TO OCEANIC PLATE BOUNDARY

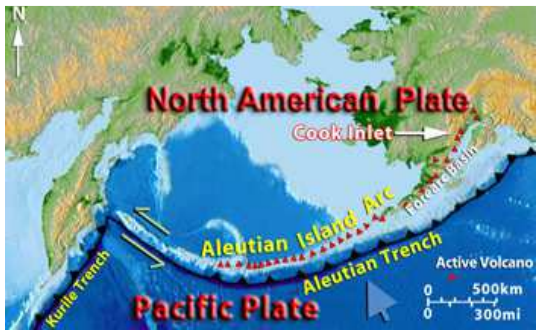


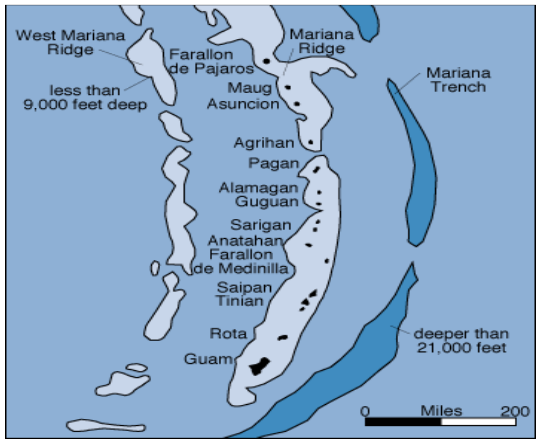
Oceanic-oceanic convergence

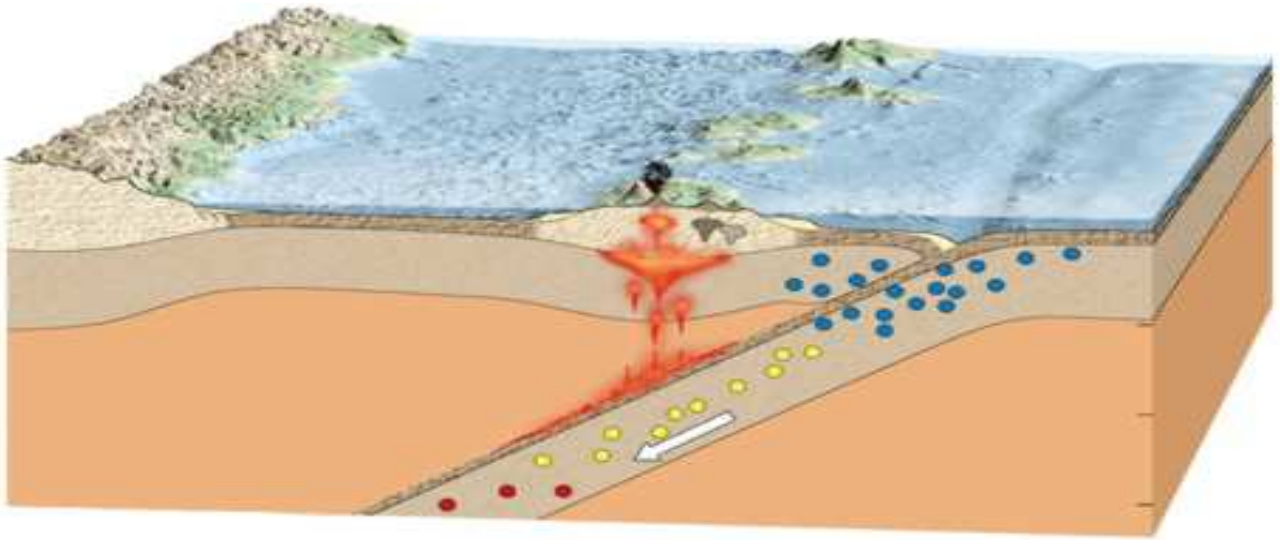
The main features found at a destructive oceanic to oceanic plate boundary are:-

1. A deep narrow ocean trench parallel to the zone of suduction where the oceanic crust is buckled down by the process of subduction
2. The Benioff zone, a zone of shallow, intermediate and deep earthquakes caused by the movement of the subducting plate
3. A line of volcanic islands called an island arc caused by rising bubbles of magma called diapirs
4. Examples are the Aleutian Islands in north west Alaska and the Japanese islands

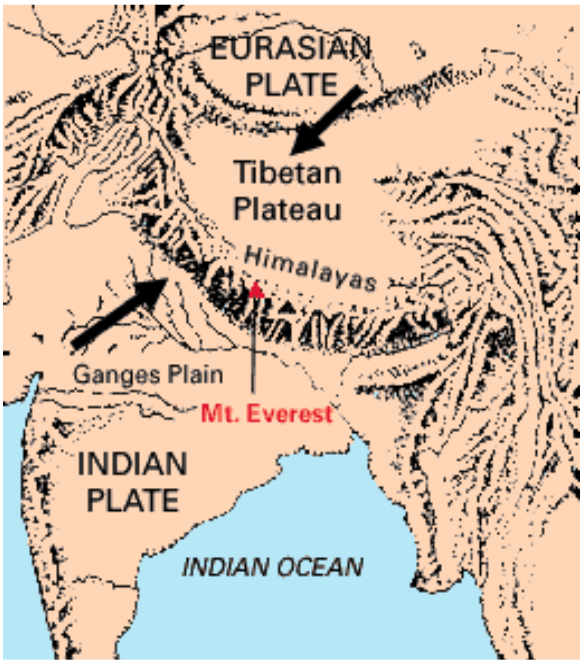
- As with oceanic-continental convergence, when two oceanic plates converge, one is usually subducted under the other, and in the process a trench is formed. The Marianas Trench (paralleling the Mariana Islands), for example, marks where the fast-moving Pacific Plate converges against the slower moving Philippine Plate. The Challenger Deep, at the southern end of the Marianas Trench, plunges deeper into the Earth's interior (nearly 11,000 m) than Mount Everest, the world's tallest mountain, rises above sea level (about 8,854 m).
- Subduction processes in oceanic-oceanic plate convergence also result in the formation of volcanoes. Over millions of years, the erupted lava and volcanic debris pile up on the ocean floor until a submarine volcano rises above sea level to form an island volcano. Such volcanoes are typically strung out in chains called *island arcs.* As the name implies, volcanic island arcs, which closely parallel the trenches, are generally curved. The trenches are the key to understanding how island arcs such as the Marianas Islands have formed and why they experience numerous strong earthquakes. Magmas that form island arcs are produced by the partial melting of the descending plate and/or the overlying oceanic lithosphere. The descending plate also provides a source of stress as the two plates interact, leading to frequent moderate to strong earthquakes.



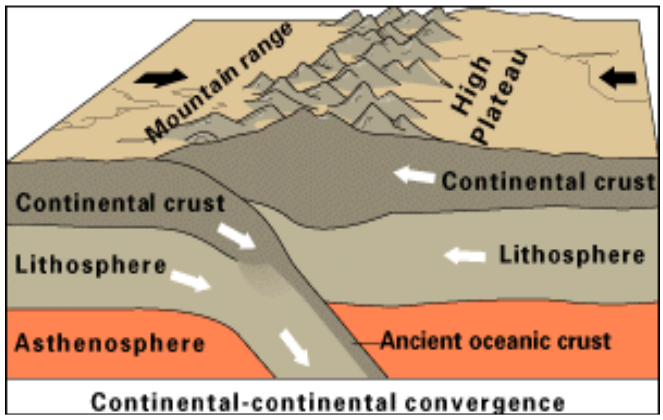




C. CONTINENTAL TO CONTINENTAL PLATE BOUNDARY



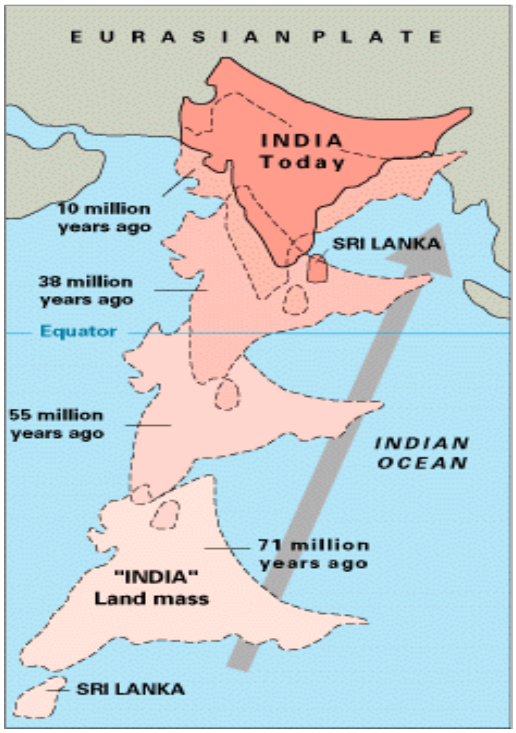
The convergence of two continental plates causes the formation of a range of young fold mountains as the rocks and sediments between the two continents are squeezed, compressed and raised. The initial subduction causes volcanic activity and intrusions, but over time subduction ceases and igneous activity dies away

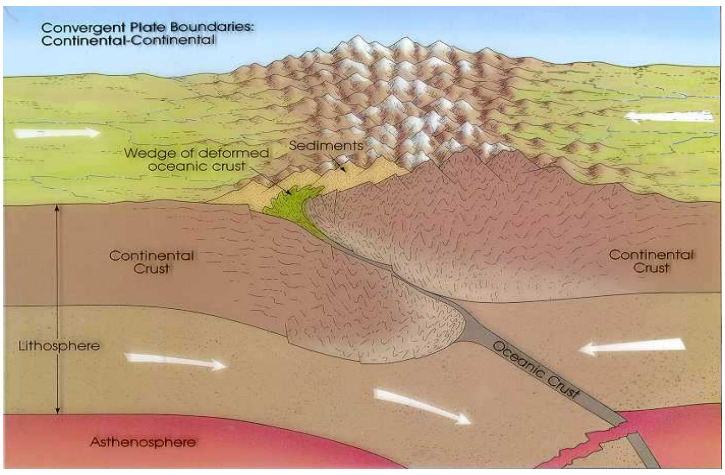


The Himalayan mountain range dramatically demonstrates one of the most visible and spectacular consequences of plate tectonics. When two continents meet head-on, neither is subducted because the continental rocks are relatively light and, like two colliding icebergs, resist downward motion. Instead, the crust tends to buckle and be pushed upward or sideways.

The collision of India into Asia 50 million years ago caused the Eurasian Plate to crumple up and override the Indian Plate. After the collision, the slow continuous convergence of the two plates over millions of years pushed up the Himalayas and the Tibetan Plateau to their present heights. Most of this growth occurred during the past 10 million years.

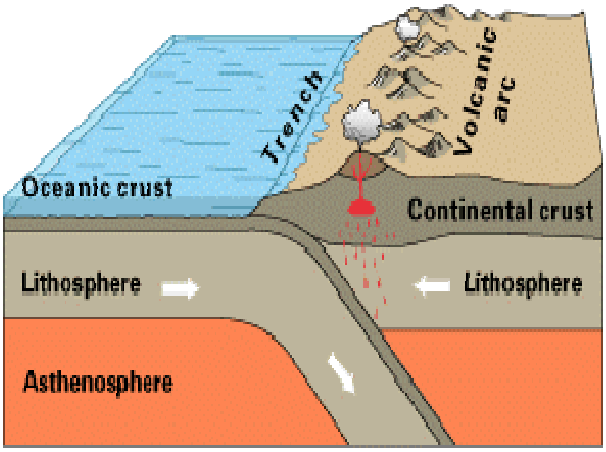
The Himalayas, towering as high as 8,854 m above sea level, form the highest continental mountains in the world. Moreover, the neighbouring Tibetan Plateau, at an average elevation of about 4,600 m, is higher than all the peaks in the Alps except for Mont Blanc and Monte Rosa, and is well above the summits of most mountains in the United States.





Although the phase of major upheaval of the Himalayas has passed, the Himalayas are still rising, albeit at a much slower rate. The Indian plate is continuously moving north at the rate of about 2 cm every year. Because of this reason the Himalayas are rising at the rate of about 5 mm per year. This means that the Himalayas are still geologically active and structurally unstable. For this reason, earthquakes are a frequent occurrence in the entire Himalayan region.

A. OCEANIC TO CONTINENTAL PLATE BOUNDARY

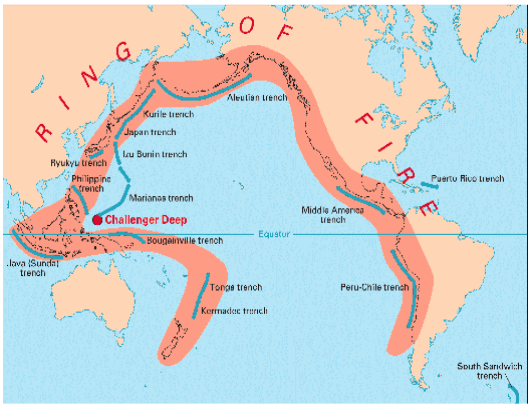


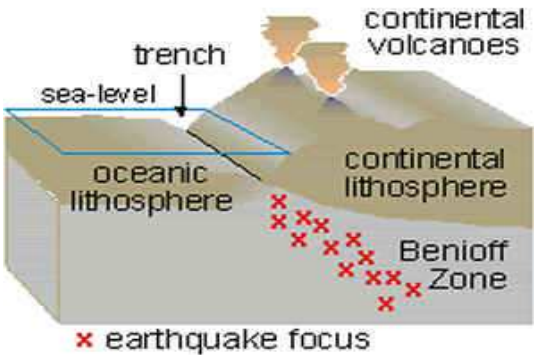
Oceanic-continental convergence

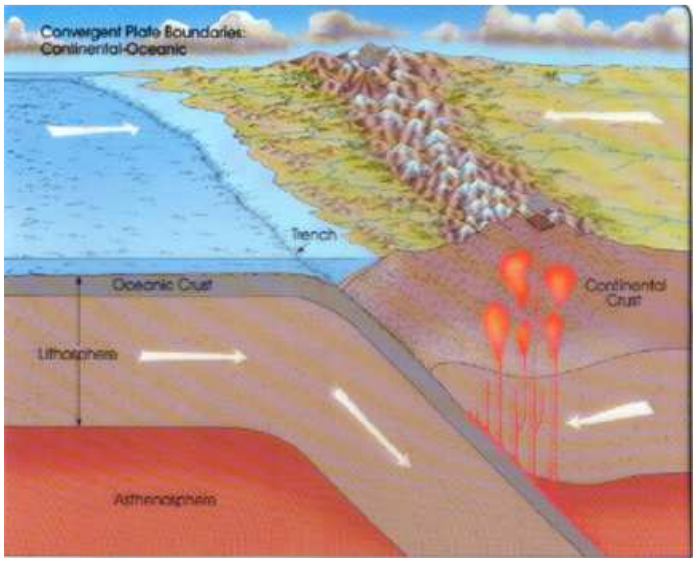
The main features found at a destructive oceanic to continental plate boundary are:-

1. A deep narrow ocean trench parallel to the continental margin where the oceanic crust is buckled down by the process of subduction
2. The Benioff zone, a zone of shallow, intermediate and deep earthquakes caused by the movement of the subducting plate
3. A line of volcanic activity and volcanoes caused by rising bubbles of magma called diapirs
4. A linear zone of old mountains caused by the convergence of the two plates and the compression of sediments and rocks

- If by magic we could pull a plug and drain the Pacific Ocean, we would see a most amazing sight -- a number of long narrow, curving *trenches* thousands of kilometres long and 8 to 10 km deep cutting into the ocean floor. Trenches are the deepest parts of the ocean floor and are created by subduction.
- Off the coast of South America along the Peru-Chile trench, the oceanic Nazca Plate is pushing into and being subducted under the continental part of the South American Plate. In turn, the overriding South American Plate is being lifted up, creating the towering Andes mountains, the backbone of the continent. Strong, earthquakes and the rapid uplift of mountain ranges are common in this region. Even though the Nazca Plate as a whole is sinking smoothly and continuously into the trench, the deepest part of the subducting plate breaks into smaller pieces that become locked in place for long periods of time before suddenly moving to generate large earthquakes. Such earthquakes are often accompanied by uplift of the land by as much as a few meters.
- On 9 June 1994, a magnitude-8.3 earthquake struck about 320 km northeast of La Paz, Bolivia, at a depth of 636 km. This earthquake, within the subduction zone between the Nazca Plate and the South American Plate, was one of deepest and largest subduction earthquakes recorded in South America. Fortunately, even though this powerful earthquake was felt as far away as Minnesota and Toronto, Canada, it caused no major damage because of its great depth.







*The subducting plate causes friction with the base of the continental plate to produce heat

*Water taken down by the subducting oceanic plate lowers the melting point of rocks

*Magma diapirs form which are less dense than the surrounding rock and therefore rise up through the continental plate

*Some of the magma is intruded deep into the base of the fold mountains on the continental plate, slowly cooling to form granite batholiths

*Some of the magma reaches the surface to form explosive volcanoes such as Mt St Helens

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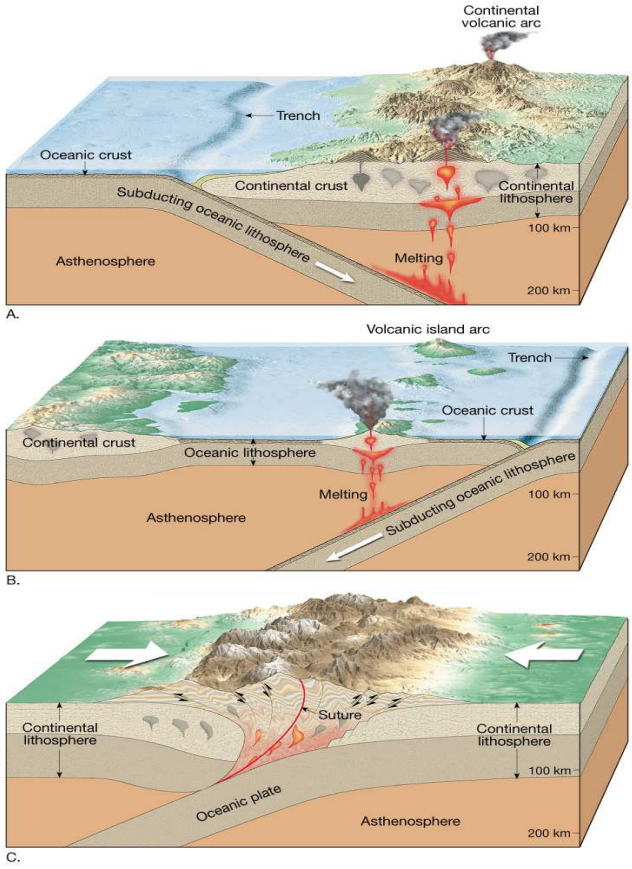
GEOGRAPHY/GEOLOGY

CASE STUDY REVISION BOOKLET

PLATE TECTONICS DESTRUCTIVE / CONVERGING BOUNDARIES - SUBDUCTION

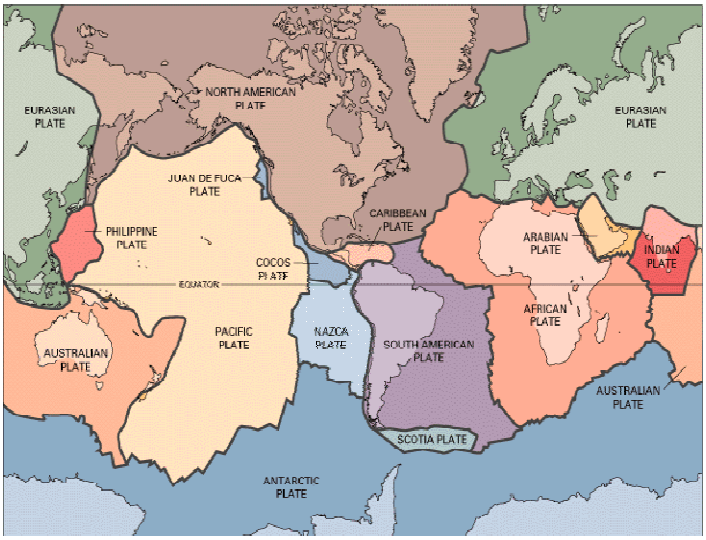


FACTFILE :-

Destructive plate boundaries are found where sections of lithospheric crust are converging. One of the plates is usually driven or subducted beneath the other

There are 3 types of destructive / converging plate boundaries

A. Where an oceanic plate and a continental plate are converging the denser oceanic plate made of basalt is subducted beneath the lighter, granitic continental plate
B. Where two basaltic oceanic plate converge, one is slightly denser and is subducted to form an ISLAND ARC of volcanic islands
C. Where two continental plates are converging a COLLISION ZONE is formed, one plate is initially subducted, but the subduction usually decreases as fold mountains are made



Destructive plate boundaries usually have certain features in common :-

1. Subduction causes magma to rise, so a line of active volcanoes occurs
2. Subduction depresses the plates to form a linear ocean trench
3. Convergence causes rocks and sediments to be compressed into fold mountains
4. Movements of the plates causes the boundaries to be seismically active (earthquake zone)