

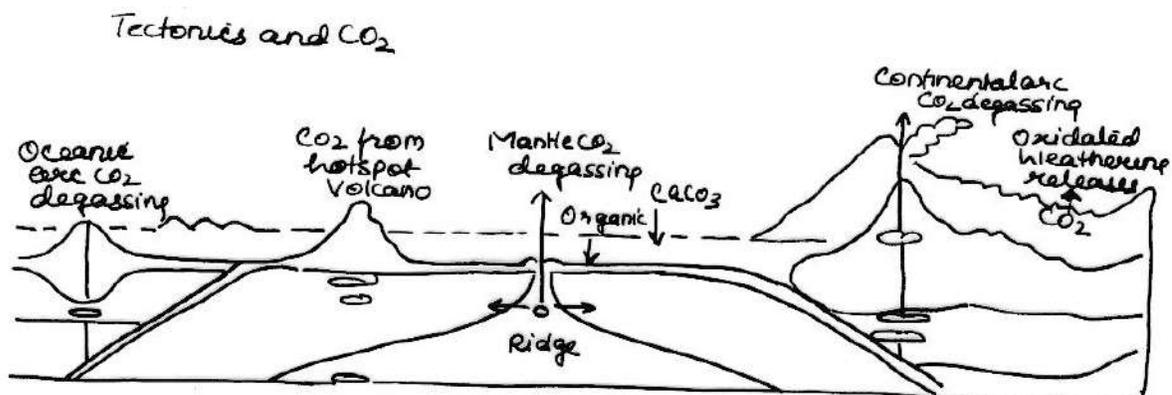
Que. “Tectonics induces dual effect on climate” explain.

Ans. Modern climate system is a product of long-term tectonic changes and that in many ways it is unique in geological history. Tectonics have two major effects on our climate:

- direct effects include uplift, which changes atmospheric circulation and the hydrological cycle, and continental movement, which affects ocean circulation
- indirect effects include subduction, volcanism, introduction of gases into the atmosphere, erosion and consumption of gases by chemical weathering.

Direct effects

Horizontal tectonics Over millions of years, continents move around due to the process of plate tectonics. This changes the shape of the ocean basins and controls where mountain ranges and plateau occur. To simplify these effects we can look at north–south changes in the position of the continents or ‘latitudinal land and ice distribution’, and then we can look at west–east changes or ‘longitudinal land distribution’.



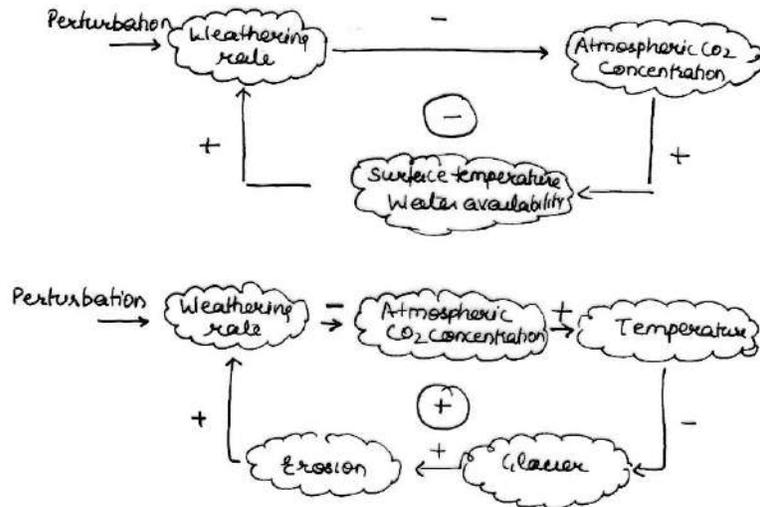
Latitudinal land and ice distribution

The best way to illustrate the huge effect of the latitudinal position of the continents is through the use of computer models . What these have demonstrated is that if all the continents are at the poles, then the equator–pole temperature gradient is extremely large, ranging from +28°C to –10°C . If ice builds up on these polar continents, the temperature gradient becomes even larger, ranging from +28°C to –30°C. This is in complete contrast to a world where the continents are centred on the tropics, as there the temperature range would much less, ranging from +30°C to +2°C. This arises as the ocean is a very good transporter of heat, so when the poles are continent-free, the ocean can mix the heat from the tropics and subtropics, and the polar regions maintain a very low thermal gradient.

Longitudinal land distribution

Surface ocean. Again, the best way to illustrate the theoretical effects of the longitudinal position of the continents is through the use of computer models. The most important elements of longitudinal continents are the gaps, or gateways, that they contain, as these allow the oceans to circulate around the globe.

- Remember that ocean circulation is driven by the surface winds, and hence they follow a very similar pattern.
- Because of the spin of the Earth, the oceans will always try to go around the planet.



Vertical tectonics During the process of plate tectonics, mountain ranges and extensive plateau are formed. These can either be destroyed by plate tectonics or slowly eroded over a longer time period. There are three main effects: rain shadow, circulation, and influence on monsoons.

Rain shadow effect

This is the effect brought about by the topography of the land, where mountain ranges can interfere with atmospheric circulation and bring about changes in the local climate between the windward and lee sides of a mountain.

Atmospheric circulation A mountain range or plateau has a major effect on atmospheric circulation, and hence where warm and cold air masses go to and where precipitation falls. In the modern day, the Tibetan plateau and the North American plateau have large effects on both summer and winter circulation; especially when you compare this circulation with a northern hemisphere without any plateau.

If you add the major ice sheets of the last glacial period over Greenland, North America and northern Europe, then the circulation becomes even more complicated. Uplift and resultant monsoonal circulation Southeast Asian monsoon. One of the most important features in the modern-day tectonically controlled climate is the monsoon system. In summer, the Tibetan plateau heats up more quickly than the surrounding lower land. This produces rising air and a low-pressure system that sucks in air from the surrounding area, which includes the Indian Ocean. However, the majority of the air is in the southern hemisphere and as it is pulled across the equator, the direction of the Coriolis force shifts, helping it towards the Tibetan plateau.

Indirect effects

The major indirect effect of tectonics on climate is through the introduction of gases and dust into the atmosphere. The key to how long the effect will last is the height at which the gases and dust are injected. If a 'normal'-sized volcano erupts, it will pump the gases and dust it releases into the troposphere. This produces a short-term cooling effect, as the dust and other aerosols block out the Sun. For example, during the summer after the 1980 Mount St Helens eruption, it was much colder than usual. This effect, however, is only short term, as rain 'cleans' the air of both the aerosols and dust. In the geological past, however, eruptions have been much larger, and much more prolonged. In these cases, they are so violent that the gases and dust are injected into the stratosphere. As this zone is above the clouds, there is no rain to clean the atmosphere so they are not removed.

Global climate and evolution

Over Earth's history, the continents have come together in a supercontinent at least twice. Each time, this has had a dramatic effect on the story of life on Earth.

This can be seen from a climatic point of view: when a supercontinent is first formed, there is a huge amount of tectonic activity: lots of clashes between continents and lots of volcanic eruptions. As a result, huge volumes of gases and dust are injected high up into the atmosphere, producing a massive greenhouse effect.

Copyright © 2021 **Direction Ultimate Learning Experience Pvt. Ltd.**

No part of this publication may be reproduced, stored in or introduced into a retrieval system, or transmitted in any forms or by any means (electronic, mechanical, photocopying recording or otherwise), without the prior written permission of the copyright owner.