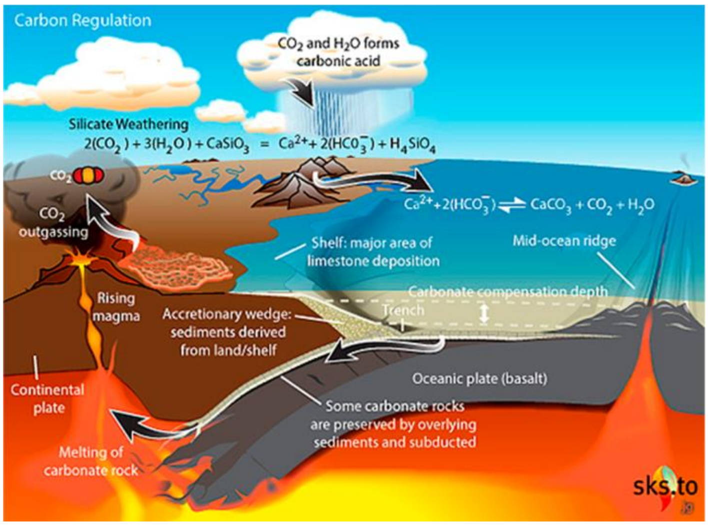
Supercontinents and Climate Reading

Supercycle and slow change

The plate tectonic supercycle takes 500 – 700 million years to complete. Thus, its influence on climate occurs over very large timescales. The position of a supercontinent determines the magnitude of its influence on climate. However, there is a general alternation of icehouse and greenhouse conditions that can be attributed to the supercontinent cycle.

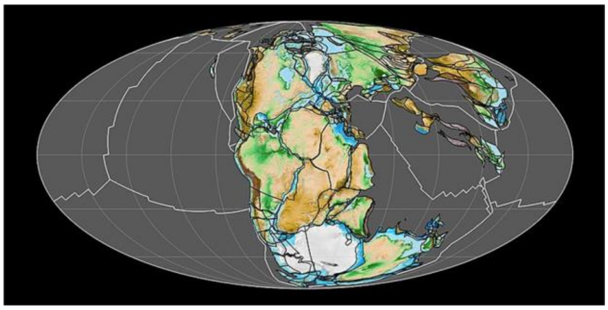


Weathering releases calcium that washes into the oceans and forms carbonate rock, decreasing carbon dioxide. Volcanic outgassing releases carbon dioxide. The balance of these processes changes during the supercontinent cycle, influencing global climate. (J Garrett 2013, Wikimedia Creative Commons)

Icehouse in supercontinent times

The formation of a supercontinent results in tall, young mountains from continental collisions. These are rapidly weathered and eroded. The rocks are broken physically by ice wedging, landslides and rivers. The mineral fragments are chemically weathered through oxidation and acid rain. Weathering products are transported down rivers to the oceans.

The calcium from the weathered minerals combines with carbonate in the oceans to form limestone, locking up carbon. Atmospheric carbon dioxide is dissolved and replenishes the oceanic carbonate. This process gradually decreases the amount of carbon dioxide in the atmosphere, reducing the greenhouse effect. There is little or no volcanic activity to replenish carbon dioxide. If enough carbon dioxide is removed, global temperature drops and ice sheets form.



Pangea blocked equatorial ocean currents, hampering the global distribution of heat. The interior became very dry, whilst the polar regions were glaciated. (F Clamosa 2019, Wikimedia Creative Commons)

The position of the supercontinents also influences icehouse conditions. If the landmass is in polar regions, larger ice caps are formed. Glaciers and ice caps also form on the tall mountains created by continental convergence. Ice has a high albedo – it reflects light and heat. The area becomes colder and more ice forms. This positive feedback loop leads to icy conditions and increased glaciation.

Greenhouse in dispersed times

Mantle heat builds up under the insulating supercontinent, eventually triggering rifting. Renewed volcanic activity releases vast quantities of carbon dioxide into the atmosphere. This increases heat retention and the global climate begins to warm. Warming melts ice caps and decreases albedo, further increasing warming. As continents disperse, ocean currents flow between the new continents, aiding global heat distribution.

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