SEA LEVEL LINKS TO MASS EX

GEOPHYSICAL EXPLORATION TECHNIQUES

There is a striking correlation between mass extinctions and (rapid) sea level change. This does not mean that one caused the other, of course, both could have been driven by another factor. The usual methods of sea level change are:

- Change in the volume of water in the oceans
- Change in the volume of the ocean basin

The interglacial melting of all the Greenland ice sheets would provide a sea-level rise of 7m. However, if the ice caps of Antarctica were to melt, sea levels could rise by 75m. In comparison, the effects of the thermal expansion of the oceans is comparably small, with a rise of 1^0C of the top 500m of surface ocean water equating to just a 10cm rise in sea level. Marine transgression will occur when the ice caps melt. Marine regression will occur during a glacial period when water becomes locked up at the caps and on land as ice sheets.

For most of Earth's history, there has not been an icehouse period nor a glacial period, so the mechanism of ice causing transgression when it melts and regression when it forms is relatively rare.

SEA LEVEL RECAP

Sea level changes recap

*The earth is currently in an **interglacial**, and the last glacial period ended about 10,000 years ago. All that remains of the continental ice sheets are the **Greenland and Antarctic ice sheets** and smaller glaciers such as on Baffin Island. We are still classed as being in an **ice-house period** because there are **ice caps present** at both poles of the Earth.*

***Long-term high sea levels** (transgression periods) correspond with times of high plate velocities when lot**s of new material** is being formed by sea-floor spreading at the Mid-ocean-ridge (**MOR**). This also involves increased rates of subduction at convergent margins causing **subsidence and flooding along continental margins**.*

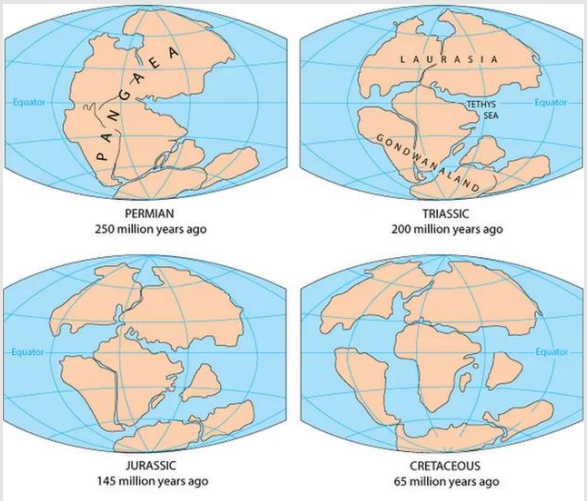
It is due to the variations in the rate of mantle convection and the consequent plate tectonic outcomes that are causes of long-term cycles in sea level.

Slightly shorter term are the effects of mountain building (orogenesis). Major orogenies cause thickening of the continental crust by folding and thrusting. Over time, the elevated mountain areas are eroded so the sediment infills ocean basins, steadily rising sea levels again.

The opposite plate tectonic action of breaking up continental plates by splitting at new mid-ocean ridges and then seafloor-spreading results in thinning of the crust (crustal extension). The continents sink isostatically and there is an increased addition of sediment to the new ocean basins, both resulting in sea level rise.

CRETACEOUS MARINE TRANSGRESSION

The breakup of Gondwanaland and then Laurasia in the Jurassic greatly increased the length of the mid-ocean ridge system. During the Cretaceous, these mid-ocean ridges were very active, with high rates of sea-floor spreading and a worldwide rise in sea level. About 40% of the continents were flooded, nearly all the British Isle s being covered by Chalk seas. Estimated sea levels were 200-250 m higher than today.

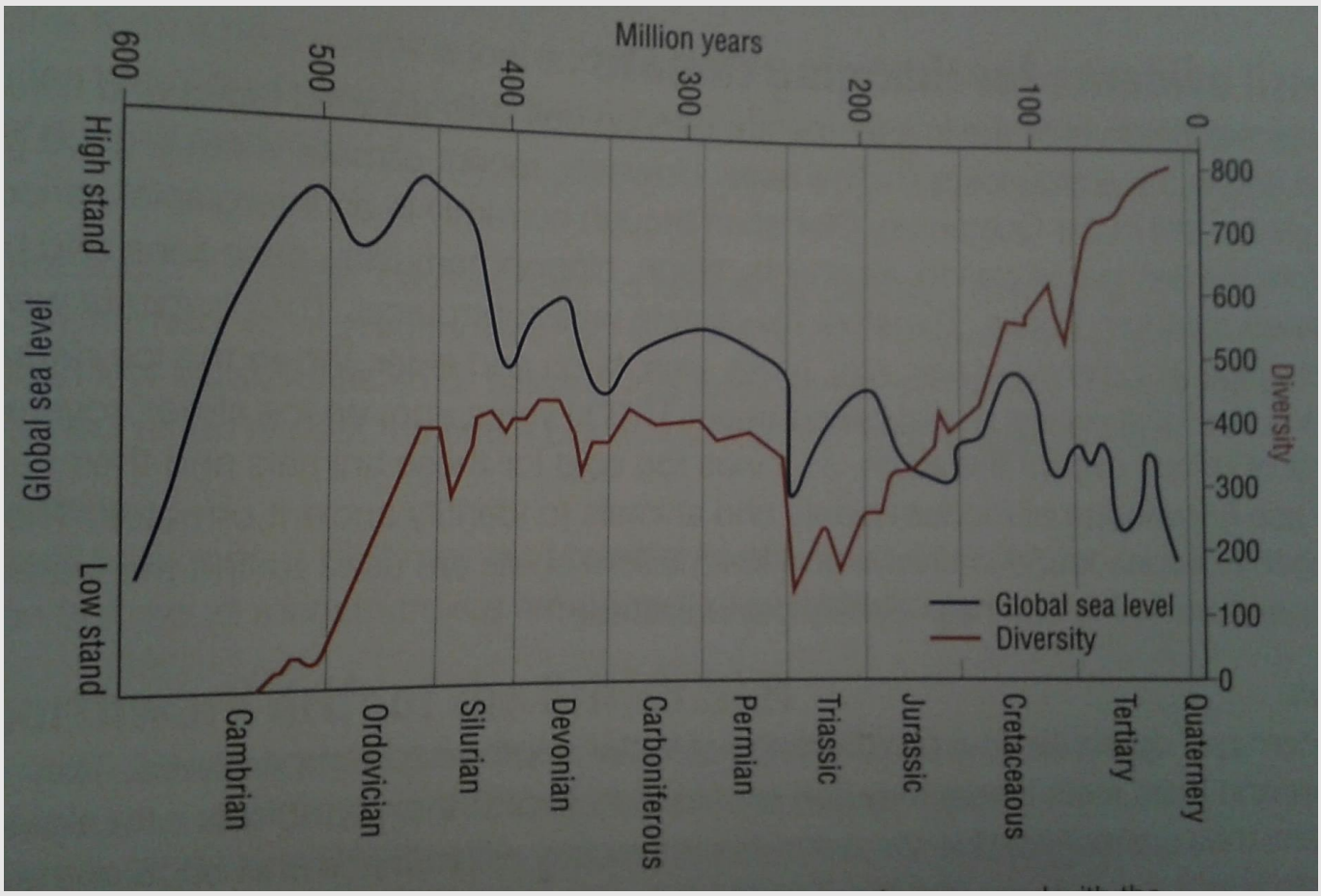


The K-T extinction event 65Ma

There was a **major fall in sea-levels** at the **end of the Chalk deposition** which was probably rapid in geological times (**100,000 years**). The climate began to **cool to an ice-house period**. Sea levels **fell by about 70-100m** and would have changed **marine habitats,** perhaps causing the extinction of **ammonites and foraminifera** in the sea.

The impact of a massive **asteroid at the Yucatan Peninsula**, Mexico combined with **extensive volcanic activity** in the **Deccan traps of India** would have added other reasons for the extinction, **especially on land**.

SEA LEVEL, CLIMATE CHANGE AND MASS EXTINCTIONS



There is a striking correlation between rising temperatures and sea levels. Just in the same way that snow/ice has a high albedo so reflects incoming solar radiation well, water is the opposite, it is very good at absorbing solar radiation (a low albedo) and so temperatures will increase if there are large areas of land covered by water.

Then again, it may be the high temperatures originally causing the high sea levels (transgression).

SEA-LEVEL DURING THE PERMIAN-TRIASSIC EXTINCTION – 251MA

There is mounting evidence that the world's oceans became anoxic in the Late Permian. This is seen at high and low latitudes and at a range of shelf depths extending into very shallow water.

This was because the deeper, more poorly oxygenated waters extended into the shallow sea areas. Suffocation could have killed many species at the time.

SEA LEVEL REGRESSION

It is thought that shallow warm seas with a high energy and so good oxygen and nutrient supply are ideal for marine life diversification. **Species diversification should, in theory, occur after marine transgressions** because sea level rises flood large areas of land to **form lots of shallow seas.**

However, sea level transgression can also have a negative effect on species and cause an extinction. While raised sea level do increase shallow sea environments, **blooms of plankton** may form. The **bacterial decomposition** of **plankton** results in a **high oxygen demand for the decay** and so **oxygen concentrations in water reduce** forming

an **anoxic environment and mass extinction**. We can recognise anoxic events by the formation of **black shales rich in organic materia**l.

Regression would cause the water previously flooding land to become locked away so remove shallow seas. The deeper waters formed from sea level regression are not ideal for most species and ought to lower diversity. Mass extinctions can correlate with the **reduction in shallow sea environments because of regression**.

The most important factor is the **rapidity** of climate changes or sea level changes. If a change in environment occurs faster than organisms can adapt/radiate then they become extinct.

It is important to note that **sea level change and mass extinctions correlate** but there is **not necessarily causation**. It may be that both sea level change and a mass extinction were caused by some other **separate factor** – an easy choice being **climate change.** One didn't necessarily cause the other.