

Precambrian Climate - Faint Young Sun, Snowball Earth

Earth's Atmosphere

primordial gasses **outgassed** from mantle in volcanoes
early atmosphere had no free oxygen
early atmosphere rich in water vapor and carbon dioxide plus a little nitrogen
oceans formed by precipitation of water vapor that outgassed from mantle
carbon dioxide eventually was exchanged for oxygen via photosynthesis
nitrogen continued to accumulate
the early atmosphere had a strong greenhouse effect

Faint Young Sun

the early sun is estimated to have been ~73% as luminous as today
the Earth's CO₂ rich atmosphere kept Earth warm
as solar luminosity increased CO₂ decreased, Earth didn't overheat (like Venus)

Snowball Earth

extensive glacial deposits found in late Proterozoic sedimentary strata worldwide
negative (lighter) carbon isotope shift indicates drop in biological productivity
paleomagnetism indicates many glacial deposits were formed at low latitude
strange carbonate rocks cap glacial tills

Did glaciers extend from polar seas to equatorial regions?

possible causes

faint young sun
low latitude unvegetated continents - high albedo
large-scale weathering of barren continents near equator - high rainfall

cooling (freeze cycle)

cooling was sufficient to allow ice to form over polar oceans
reflection from ice further cooled Earth → more ice → more cooling →
ice-albedo effect - positive feedback
ice-covered, cold continents meant very slow weathering → CO₂ gradually rose

warming (fry cycle)

when atmospheric CO₂ levels got very high, warming began
mild warming melted ice → less reflection → more warming → more melting →
all ice melted - climate got really warm because of so much CO₂
mega-weathering (b/c hi CO₂, hot) yielded lots of ions washed into oceans
calcium and bicarbonate ions precipitated to form cap carbonates