The Effect of Paleozoic Land Plant Evolution on Atmospheric CO2 and O2

Modeling, field and experimental studies, and proxy measurements support the idea that the rise and evolution of large vascular land plants, especially trees, during the mid-to-late Paleozoic had a profound effect on the biogeochemical carbon cycle. The development of extensive root systems brought about increased Ca and Mg silicate weathering and increased transfer of atmospheric CO2 to dissolved bicarbonate and ultimately to marine carbonates. Atmospheric CO2 was also removed as a result of increased burial of plant-derived organic remains, especially in the form of microbially resistant lignin. Increased weathering and organic burial led to a large drop in CO2, helping, via the atmospheric greenhouse effect, to set the stage for the vast Permo-Carboniferous glaciation.

Increased organic burial also resulted in the increased production of O2. This led to a Permo-Carboniferous maximum in atmospheric O2 at levels possibly as high as 30%. This elevated O2 likely contributed to an increase in the size of organisms, such as insects and amphibians, which breathe via various diffusive processes. During an approximately 20 million year period across the Permian-Triassic boundary, due to a decline in large land plant production that resulted in decreased terrestrially-derived organic burial, O2 production declined and brought about a large drop in O2. This drop must have been a contributing factor to the Permo-Triassic extinction.