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The Effect of Paleozoic Land Plant Evolution on Atmospheric CO_2 and O_2

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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 CO_2 to dissolved bicarbonate and ultimately to marine carbonates. Atmospheric CO_2 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 CO_2, 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 O_2. This led to a Permo-Carboniferous maximum in atmospheric O_2 at levels possibly as high as 30%. This elevated O_2 likely contributed to an increase in the size of organisms, such as insects and amphibians, which breathe via various diffusive-like 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, O_2 production declined and brought about a large drop in O_2. This drop must have been a contributing factor to the Permo-Triassic extinction.