

# Catastrophic Asteroid Impacts and the Prevalence of Non-Photosynthetic Underground Plants

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As many as thirty lineages of plants have independently evolved an extreme lifecycle with a subterranean phase that is completely dependent on arbuscular mycorrhizal (AM) fungal symbionts for fixed carbon. This subterranean phase can live entirely underground for as many as 10 years while being sustained through its AM symbionts that are translocating carbon from neighboring photosynthetic plants. We are the first to molecularly characterize the fungal symbionts in ancient lineages of plants that have this type of underground life cycle. We show that AM fungi are shared between the underground life cycle phases and neighboring photosynthetic plants. We propose that AM networks are widespread and translocate carbon between connected plants. Given the number of known catastrophic asteroid impacts that have occurred during the period when plants evolved and diversified on land (last 475 million years) we propose that plants with long-lived underground life cycle phases capable of receiving carbon through AM fungal networks may have had enhanced survival. This hypothesis may account for the widespread (although thoroughly understudied) occurrence of subterranean plants.