

Earth history and evolution

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In classical mythology, the cypress tree is associated with death, the underworld and eternity. Indeed, the family to which cypresses belong, is an ancient lineage of conifers, and a new study of their evolution affords a unique insight into a turbulent era in the Earth's history.

During the geological era known as the Mesozoic, the continental crust was concentrated in a single huge landmass, the supercontinent Pangea. Pangea began to break up about 150 million years ago, and the fragments drifted apart, eventually giving rise to the disposition of continents we know today. The progressive break-up of such a large landmass meant that existing groups of plant and animal species were split apart, and the descendant lineages then evolved in isolation from each other.

Dating divergence with the molecular clock

"Fossils show that the cypress family is a very ancient group of plants," says LMU biologist Professor Susanne Renner, who is also Director of the Munich [Botanic Garden](#). "We therefore suspected that it might be possible to follow their [evolutionary history](#) back to the period before the break-up of Pangea, as long as the many episodes of [climate change](#) and associated extinctions had not obscured things too much." Renner and her research group therefore set out to reconstruct the cypress family tree, based on the comparison of specific [gene sequences](#) from 122 species belonging to 32 genera reflecting the family's worldwide distribution. In order to date divergence events, they applied the concept of the [molecular clock](#).

The idea is based on a simple principle. When two lineages diverge from a [common ancestor](#), each accumulates genetic substitutions independent from the other. To a first approximation, the number of unique substitutions provides a measure of the time that has elapsed since a species diverged from its sister species. By comparing the spectra of [genetic changes](#) found in different lineages and calibrating the amount of change with fossils, one can therefore reconstruct a group's history.

Evolutionary dead ends

"Over the past 15 years, these molecular methods, in combination with new fossil finds, have revolutionized the study of biogeography, the branch of biology concerned with understanding the distribution patterns of animal and plant species," says Renner. Some groups have turned out to be surprisingly young in evolutionary terms, others much older than people had assumed.

The new study confirms that cypresses represent a very old plant family. Their origins can be traced back to Pangea, and the evolutionary divergence of the northern and southern subfamilies of cypresses actually reflects the break-up of Pangea about 153 million years ago. As fragmentation progressed and ancestral lineages were separated from each other, new lineages were established and followed separate evolutionary trajectories. The *Cupressaceae* is the first plant family whose evolutionary history gives us such a detailed picture of the break-up of a supercontinent. (PNAS online, 1 May 2012)

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