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The Devonian plant revolution and its role in multiple marine extinction crises

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The Devonian was one of the most dynamic periods in Earth history, with major changes on land and in the oceans that experienced at least two of the ten most severe biotic crises of the Phanerozoic. The Period saw the first extensive global floral record; prior to the Devonian, plant assemblages were low in diversity and abundance, and were restricted to areas close to water sources with little competition from co-existing taxa. By the end, plants were geographically widespread in diverse environments. Their colonisation of the land surface has been implicated in the Frasnian/Famennian marine crisis, but little is known of the effects of plants on the global biosphere during the rest of the Devonian. Synthesis of 389 publications reporting 294 Devonian plant genera has resulted in a database that we analyse at generic and stage level for trends in Devonian plant evolution and extinction. Our analysis reveals several key events within this dynamic phase of terrestrialisation: 1) an early Euramerican presence for all plant groups, suggesting this region may have been the site of origination for several higher taxa; 2) the origination of lycopsids in equatorial settings was followed by latitudinal migration northward and southward; 3) a major turnover in plants between the Late Givetian and Middle Frasnian, when significant diversity losses occurred in every palaeo-region in every extant plant group - this may be a hitherto unidentified terrestrial extinction event that coincided with one or both of the Taghanic and Frasnian minor marine crises; 4) several Devonian marine black shale events coincide with major steps in terrestrialisation suggestive of a causal link and supporting the notion that plant evolution played a significant role in the Frasnian/Famennian mass extinction nexus.