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Millennial- to Milankovitch-scale physiognomic and ecological floral changes associated with the end-Triassic extinction, carbon isotopic anomaly, and eruption of the Central Atlantic Magmatic Province (CAMP)

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The end-Triassic mass extinction event (201.4 Ma) profoundly affected plant communities. Here we describe trends in cheirolepidaceous conifer leaf physiognomy and changes in fern abundance from the Pangean tropics (present eastern North America) that parallel the pronounced initial negative isotopic δ^{13}C excursion recorded in the same continental strata as well as globally in marine strata. The conifer physiognomic changes appear abruptly within a few thousand years of a previously described palynological extinction level, fern spike, and one of several Ir anomalies. These macrofloral assemblages involve the development of microphyllous leaves with thickened cuticle and sunken papillate stomata. At the same time, the dipteridaceous fern *Clathropteris* and in some places the fern *Cladophlebis* become unusually abundant, as do their spores. The unusually microphyllous cheirolepidaceous conifers persist through the first set of CAMP eruptions, remaining common through the following positive excursion to the Triassic-Jurassic boundary for ~100 ka. This interval corresponds to the first pulse of elevated CO_2 reported by (1). Ferns remain unusually abundant upward to the next major set of CAMP eruptions and associated CO_2 spike for an additional ~150 ka, but subsequently decline markedly to background levels above that. For the next ~340 ka longer-leaved cheirolepidaceous conifers become more abundant but still remain low in numbers and ferns are rare. Longer-leaved cheirolepidaceous conifers do not become dominant until at least 400 ka after the third major set of CAMP eruptions and CO_2 anomaly. This pattern is consistent with the thermal damage hypothesis of McElwain (2) and provides a high resolution temporal pattern for understanding the floral response to extremely elevated CO_2 related to eruptions of what may be the Earth's most aerially extensive continental flood basalt province.

(1) Schaller, M.F., Wright, J.D., Kent, D.V., 2010, Eos Transactions, AGU 91:B51F-0411. (2) McElwain, J.C., Beerling, D.J., Woodward, F.I., 1999. Science 285:1386.