Evidence for increased forest fires in response to organic carbon burial during OAE2 as a positive feedback on marine productivity

F. GARRETT BOUDINOT*[1] , JULIO SEPÚLVEDA [2]

[1]Department of Geological Sciences and Institute of Arctic and Alpine Research, University of Colorado Boulder, 4001 Discovery Dr., Boulder, CO 80303 (*correspondence: frank.boudinot@colorado.edu)

[2] Department of Geological Sciences and Institute of Arctic and Alpine Research, University of Colorado Boulder, 4001 Discovery Dr., Boulder, CO 80303 (jsepulveda@colorado.edu)

Oceanic Anoxic Event 2 (OAE2; ~94Ma) is characterized by a ^{13}C enrichment in global carbon pools as a result of globally significant carbon burial. Carbon burial on this scale likely contributed to an increase in atmospheric pO_2. A negative $\delta^{13}C$ punctuation during the otherwise ^{13}C enriched OAE2, known as the Plenus Cold Event, exhibits unique geochemical trends previously interpreted as signals of climate cooling in response to carbon burial. Using pyrogenic polycyclic aromatic hydrocarbons, we provide the first organic geochemical evidence of increased forest fires during the Plenus event from a marginal location of the Western Interior Seaway. Enhanced forest fire activity (burn persistence and area) may have resulted from a combination of increased pO_2 from global-scale carbon burial, and a higher incidence of lightning strikes due to elevated temperatures during the mid-Cretaceous. Using a simple mixing model, we estimate that ~25-45% of terrestrial biomass must have burned to produce the negative $\delta^{13}C$ excursion during the Plenus. The impacts of such global-scale fires on nutrient delivery to the oceans may have been an important feedback on continued marine productivity, contributing to ^{13}C enrichment for the remainder of OAE2. The effect of forest fires on global oxygen isotope reservoirs, terrestrial weathering, and marine productivty may have had downstream effects on other geochemical proxies during the Plenus, including weathering-indicative trace metals and palaeothermometers such as $\delta^{18}O$ and TEX_{86}. This study suggests that the Plenus event was a culmination of multiple feedbacks in the Earth-climate system, rather than a singular response of temperature to carbon burial.