EGU21-10132, updated on 12 Jun 2021
https://doi.org/10.5194/egusphere-egu21-10132
EGU General Assembly 2021

Enhanced paleo-wildfire occurrences caused by marine organic carbon burial during the Late Devonian Frasnian–Famennian mass extinction

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The Frasnian–Famennian (F–F) boundary is characterized by worldwide depositions of organic-rich strata, a series of marine anoxia events and one of the biggest five mass extinction events of the Phanerozoic. Due to the enhanced burial of organic matter, a coeval positive carbon isotope ($\delta^{13}C$) excursion occurred around the F–F boundary, raising questions about carbon cycle feedbacks during the mass extinction. In this study, we test the hypothesis that enhanced burial organic carbon during the F–F mass extinction led to the rise of paleo-wildfire occurrences. Here, we reconstructed paleo-wildfire changes across the F–F boundary via analyzing fossil charcoal (inertinites) and pyrogenic polycyclic aromatic hydrocarbons (PAHs) from an Upper Devonian Chattanooga Shale in the southern Appalachian Basin. Our data show low abundances of inertinites and pyrogenic PAHs before the F–F transition and an increasing trend during the F–F transition, followed by a sustained enhancement through the entire Famennian interval. The changes in paleo-wildfire proxies suggest a rise of wildfires starting from the F–F transition. Furthermore, we quantified the amount of organic carbon burial required to drive the observed $\delta^{13}C$ excursion using a forward box model. The modeling results show an increased carbon burial rate after the onset of the F–F transition and peaking during its termination. The comparison of the carbon burial rate and wildfire proxies indicates that widespread organic carbon burial during the F–F transition might cause elevated atmospheric oxygen levels and hence increased occurrences of wildfires. In addition, chemical index alteration index and plant biomarkers suggest a drying climate initiated during the F–F transition, implying that the enhanced carbon burial probably result in the climate change and amplify the wildfire occurrences.