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# The timelessness of pyrogenic carbon, a 172 MA story of the recalcitrance and reactivity of wildfire-derived pyrogenic carbon as a mechanism of elemental transport

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For hundreds of millions of years, wildfires have been a dominant global process, generating an immense amount of pyrogenic carbon (PyC). The modern is no exception, with wildfire activity annually producing an average of 116 – 385 Tg PyC, with 8 – 28% of this amount being transported fluvially [1]. PyC is known to be highly reactive towards elements in aqueous and soil environments. However, how this reactivity translates to influence global elemental cycling is poorly constrained. Further, the relative contribution of PyC in elemental transport compared to other reactive materials transported by rivers, such as planktonic microorganisms, iron oxides, and clays, has yet to be determined. In this study, we begin to bridge this gap in knowledge by quantifying the proton and metal adsorption potential, of wildfire-derived pyrogenic carbon (F-PyC) from both the modern and the Jurassic Period. Our objective was to determine the contributions of F-PyC to elemental transport from terrestrial to marine environments, both presently and in the geological past. Results reveal that both the modern and Jurassic-aged F-PyC exhibit significant cation (e.g. $Cd^{2+}$) reactivity in freshwater settings across a range of pH conditions. To assess the relative importance of F-PyC for elemental transport within fluvial environments, we conducted a competitive sorption model with F-PyC and other common fluvially transported reactive materials. Our findings highlight a previously unrecognized mechanism of elemental transport that likely influenced nutrient cycles since the emergence of land plants on Earth, dating back around 430 million years ago [2].

**References**

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