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Paleowildfires in the Paleoantarctic: Understanding ~216-223 million years old fire events through PAH proxies.

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Wildfires have been a major driver in shaping the Earth's ecosystems for millions of years. Evidence of ancient fire activity is preserved in sediments throughout the geological record. Paleowildfires are identified through charcoal depositions and pyrogenic polycyclic aromatic hydrocarbons (PAHs). These records give us insights into how fire activity changed during major climate shifts, temperature fluctuations, extinction events, and other catastrophic events such as volcanic eruptions and asteroid impacts.

This study presents new PAH data from the fluvial-lacustrine deposits of the Parmeener supergroup of Tasmania, Australia. The Bicheno 3A core, used in this study, provides a continuous record of Early-Mid Norian age paleo-Antarctic conditions (~216-223 Ma). The core has repeated layers of sandstone, mudstone and siltstone beds. Prominent coal seams are also present, along with macroscopic charcoal depositions throughout the core. Significant fluctuations in PAH values and indices, TOC%, and organic carbon isotope signatures enabled us to identify key events, including the Early and Mid-Norian Environmental Turnover and the Lacian-Alaunian Boundary Event. Various PAH ratios are employed to determine pyrogenic, petrogenic and mixed source origins for PAHs and to understand how these ratios, and others, behave in samples from the geological record. For example, dimethylphenanthrene ratios from this study indicate the presence of grasses; however, since grasses had not yet evolved during this period, the signal most likely represents conifers. Similarly, Alkylated Phenanthrene Derivative Index (APDI) values below zero are generally associated with petrogenic sources or conifers and, in this study, likely represent a conifer signal as other PAH ratios suggest that PAHs are primarily pyrogenic in origin.

Understanding paleo-wildfire events helps to reconstruct Earth's climatic history, which in turn gives us a better understanding of potential future fire events. As rising temperatures and prolonged droughts result in more frequent and intense wildfires, understanding how fire events have shaped Earth's ecosystems millions of years ago can improve climate predictions and develop smarter strategies to manage and mitigate wildfires today.