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Distribution of BPCA-derived black carbon in oceanic sediments at global scale

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Black carbon (BC) plays a significant role in the global carbon cycle as a sink of long-lived organic carbon accumulated in oceanic and continental sedimentary reservoirs. However, the magnitude of the inventory and burial flux of BC in marine sediments remains poorly constrained due to methodological limitations and the low spatial coverage of oceanic sediments. Despite its widespread application in investigating BC in continental and aquatic environments, the potential of the Benzene Polycarboxylic Acids (BPCA) method to characterize pyrogenic carbon (PyC) distribution in global oceanic sediments remains unexplored. This study presents the first dataset on BPCA, exploring the distribution, composition, and sources of BPCA-derived BC (BC_{BPCA}) across 54 marine surface sediments from all major ocean basins. Integrating BPCA data with isotopic carbon signatures ($\delta^{13}C$ of BC_{BPCA}), we address potential overestimations of BC content caused by contributions from non-pyrogenic BC_{BPCA} sources. The results revealed the ubiquitous presence of BC_{BPCA} in pelagic sediments, with higher concentrations in high-productivity coastal upwelling systems. In addition, the wide range of B5CA/B6CA ratios (0.04 to 1.24) indicated significant variations in BC_{BPCA} chemical composition across the world oceanic sediments. One of the key findings of this study was the minimal carbon isotopic ($\delta^{13}C$) distance found between BC_{BPCA} and total organic carbon (TOC) in many oceanic regions, pointing to a dominant marine/diagenetic origin for sedimentary BC_{BPCA}. However, large oceanic regions between 30°S–30°N contained BC with an isotopic signature consistent with pyrogenic materials from C_4-dominated biomes. This finding aligns with evidence that tropical savannas are the primary emitters of pyrogenic materials to the global atmosphere.