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Behavior of dissolved black carbon in the northwestern Pacific marginal seas

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Dissolved black carbon (DBC) constitutes the largest molecularly identifiable slow-cycling organic carbon pool in the ocean. However, its behavior remains debated because radiocarbon ages of DBC are much older than residence times estimated from oceanic mass balance, implying substantial removal during transport from source regions. To examine the sources and behavior of DBC, we measured DBC concentrations and molecular markers across the northwestern Pacific marginal seas, including the East China Sea, the Yellow Sea, and the East Sea (Japan Sea), which are characterized by intense biogeochemical processing and long water residence times (~100 years). DBC concentrations in surface waters exhibited a strong negative correlation with salinity across the study region, indicating that DBC is predominantly derived from riverine sources and behaves conservatively across the marginal seas. A uniform B6CA/B5CA marker ratio together with consistent mass balance estimates further support this interpretation. Despite the conservative behavior of DBC in surface waters across the marginal seas, DBC concentrations in the deep East Sea (200–3000 m) were ~10% lower than those in surface waters, suggesting that the vertical gradient likely reflects enhanced modern inputs rather than removal processes. Taken together, these results suggest that the discrepancy between DBC radiocarbon ages and residence times is more likely explained by enhanced contemporary DBC production rather than substantial removal processes.