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Rapid Transformation of Glacially Derived Dissolved Organic Matter from Marine-Terminating Glaciers in the West Antarctic Peninsula and Eastern Canadian Arctic

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Marine-terminating glaciers are increasingly recognized as dynamic sources of dissolved organic matter (DOM) to polar coastal oceans, yet the fate and biogeochemical influence of this material remain poorly constrained. Here we present comparative chemical analyses of DOM exported from tidewater glacier systems in the West Antarctic Peninsula (Canadian Antarctic Research expedition 2025-2026) and the eastern Canadian Arctic (Amundsen 2025 cruise), regions undergoing rapid climatic and oceanographic change. Using a combination of fluorescence spectroscopy and high-resolution mass spectrometry, we evaluate the molecular composition, lability, and transformation pathways of DOM as it transits from subglacial discharge to the coastal ocean. Across both polar regions, glacier-derived DOM initially exhibited signatures characteristic of young, protein-like, and microbially influenced DOM. However, evidence from gradients along fjord transects revealed that this DOM is rapidly and substantially transformed. Microbial processing led to marked decreases in labile compounds alongside the production of more oxidized, humic-like molecular formulae, indicating efficient turnover and reworking. Despite strong regional and polar contrasts in oceanographic setting, the rapid pace of DOM alteration was a consistent feature, suggesting a fundamental biogeochemical constraint on the persistence of glacier-derived DOM. Our results highlight that the contribution of the glacial carbon to longer-term marine carbon pools is likely limited by its rapid microbial transformation. Understanding these processes is increasingly urgent as accelerating glacier melt reshapes carbon fluxes across the high-latitude cryosphere–ocean interface.