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Characterizing transformations of peatland-derived dissolved organic carbon through two-dimensional gas chromatography mass spectrometry

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Peatland ecosystems contribute one-fifth of all dissolved organic carbon (DOC) export from freshwaters globally, despite covering < 3% of the land surface. Recent studies have shown that peatland-derived DOC rapidly undergoes sunlight-driven photochemical degradation and microbial degradation once it reaches freshwaters. While these processes have implications for the downstream fate of DOC, the mechanisms involved and degradation products formed remain poorly understood. In this work, we used two-dimensional gas chromatography coupled with high-resolution mass spectrometry (GCxGC-MS) to characterize chemical transformations of peatland-derived DOC during photochemical and microbial degradation. Chemical transformations were tested for DOC collected from Indonesian peatlands – an ecosystem that contributes ~20 Pg of DOC to the ocean annually. The two-dimensional separation and high resolving power of the GCxGC-MS approach allowed for the assignment of hundreds of discrete structures within DOC, including lignin phenols produced and removed during degradation. Results from this study provide new insight into the chemical structures undergoing transformation and the products formed within DOC in peatland-draining freshwaters.