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Reactivity and Fate of Dissolved Organic Matter in Anoxic Waters

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When oxygen consumption exceeds renewal, anoxic conditions can develop rapidly. The delivery of terrestrial organic matter to inland waters often promotes anoxia by fueling microbial O_2 consumption and increasing the resistance towards convective mixing, as observed in wetland ponds and small lakes. There, and further along its passage through the aquatic network, such dissolved organic matter (DOM) is subject to microbial processing, and the water retention time is known to be a key determinant of its ambient concentration and reactivity. However, in the absence of oxygen, the prevalent biogeochemical conditions markedly shift and so do the processes that modulate and consume organic carbon. Since anoxic waters are ubiquitous components of the land-ocean continuum, we aim to reconcile DOM modifications during its transient residence in anoxic waters with its reactive fate during downstream transport.

Here, we present results of a study explicitly assessing the various reaction pathways of DOM in the anoxic water layers of two small north-temperate lakes. We found that increasing residence time in anoxic waters gradually alters the chemical, optical and redox properties of DOM. By monitoring additional metabolism indicators including C mineralization, bacterial production and electron acceptor consumption we were able to gain an improved understanding of the factors that govern the rate of carbon processing in this environment. Our results suggest that contrary to the general perception, anoxia constitutes an environment of continuous carbon turnover that possibly harbors unique DOM processing routes. Specific landscape features that control the exposure of DOM to anoxia during the land-to-ocean transit will be discussed.