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# Particulate organic matter as electron acceptor for microbial respiration in peatlands

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Northern peatlands store approximately 500 Pg carbon in the form of peat particulate organic matter (POM). Ombrotrophic bogs are peatlands that only receive water and nutrients through precipitation, creating anoxic, water-logged soils deprived of inorganic terminal electron acceptors (TEAs). In the absence of suitable TEAs for anaerobic respiration, methanogenesis prevails as final step in the degradation of organic matter and is expected to result in equimolar $CO_2$:$CH_4$ production ratios. However, field and laboratory studies revealed higher $CO_2$:$CH_4$ production ratios than expected based on low concentrations of canonical inorganic TEAs, suggesting the presence of a previously unrecognized TEA used in anaerobic microbial respiration. It has been hypothesized that oxidized particulate organic matter ($POM_{ox}$) functions as TEA, explaining elevated $CO_2$:$CH_4$ production ratios. Through seasonal water table fluctuations, POM gets re-oxidized abiotically, creating a microbial hotspot at the oxic-anoxic interface. To investigate these processes, incubation studies linking $CO_2$ and $CH_4$production to the reduction of $POM_{ox}$ are indispensable. Here, we present data strongly indicating that POM collected from ombrotrophic bogs in Sweden functions as TEA in anaerobic respiration, suppressing methanogenesis. We ran anoxic incubations with various initial ratios of oxidized and reduced POM and hence a range of starting electron accepting capacities, which we quantified using a novel spectrophotometric assay. Increasing contributions of $POM_{ox}$resulted in higher $CO_2$:$CH_4$ production ratios and prolonged transition times from anaerobic respiration to methanogenesis. These findings strongly support the use of POM as TEA, suppressing methanogenesis until $POM_{ox}$ was depleted through respiration. Additionally, we developed an incubation system that allowed amending incubations with $^{13}C$-labeled substrates to selectively track their conversion to $^{13}CO_2$ and $^{13}CH_4$. Using $^{13}C$-glucose we successfully linked $^{13}CO_2$ and $^{13}CH_4$ formation ratios to POM redox state. Our results advance our understanding of microbial carbon turnover in peatlands in the present and future climate.