# Particulate organic matter in northern peatlands as a terminal electron acceptor

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Wetland ecosystems, including northern peatlands, store between 15 and 30% of terrestrial soil carbon. If canonical anaerobic microbial respiration is the dominant carbon mineralization process in anoxic parts of peatlands, equal (1:1) molar quantities of carbon dioxide ($CO_2$) and methane ($CH_4$) are expected to be generated. However, in both field and lab studies, northern peatlands are routinely found to produce more $CO_2$ than $CH_4$. As $CH_4$ has up to a 72-fold greater global warming potential than $CO_2$, understanding the processes that control this dynamic is of great importance.

Among the hypotheses proposed for the over-production of $CO_2$ over $CH_4$ in peatlands is the use of natural organic matter (NOM) as an alternative terminal electron acceptor (TEA) in anaerobic respiration. This hypothesis is built on the assumption that NOM in peatlands, present as both larger sized particulate organic matter (POM) and smaller dissolved organic matter (DOM), contain electron accepting moieties onto which microorganisms can respire in the absence of more traditional TEAs ($O_2$, $NO_3^-$, $SO_4^{2-}$, etc.). While both POM and DOM from non-peat sources have been previously shown to contain electron accepting quinone moieties, the electron accepting properties of peat NOM are less thoroughly characterized. Such characterizations have, in the past, been impaired due to analytical limitations in quantifying electron transfer to DOM at low concentrations and POM in general.

Here, we use mediated electrochemical analysis, a novel analytical approach, to quantified the electron accepting and electron donating capacities (EAC & EDC) of POM and DOM isolated from depth profiles of three ombrothropic peat bogs in central Sweden. We show that >80% of the EAC and EDC of peat NOM is found in the POM fraction, while the DOM fraction has a smaller contribution to the overall capacities. The EDC of both DOM and POM generally increased with depth, suggesting an increase in phenolic content with depth. In comparison, there was less variations in the EAC values with increasing depth, suggesting comparable concentrations of reducible moieties with depth. We will discuss possible implications of the POM-associated EAC on the $CO_2/CH_4$ dynamics in peatlands.