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Extreme peat combustion tips some boreal peatlands to a degrading carbon stock through a collapse of resilience-enhancing ecohydrological feedbacks

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Deep peat burning at the margins of sub-humid Boreal Plains peatlands in some hydrogeological settings has brought into question the long-term stability of these peatlands under current and future predicted climate. Small peatlands located at mid-topographic positions on coarse sediments have been identified as hotspots for severe burning, as these peatland margins are not regularly connected to regional groundwater flow. The ability of these peatland systems to recover carbon lost from both the interior and margin within the fire return interval is examined by assessing peatland soil carbon accumulation along a chronosequence of time since fire for 26 Boreal Plains ombrotrophic bogs located across a range of hydrogeological settings. Soil organic carbon accumulation following wildfire does not appear to be influenced by hydrogeological setting; however, the ability of a peatland to recover the quantity of carbon lost within the fire return interval is dependent on the amount of carbon which was released through smouldering, which is influenced by hydrogeological setting for peatland margins. It is very likely that peatlands which experience severe smouldering at the margins, such as ephemerally perched systems on glaciofluvial outwash sediments, are likely undergoing permanent loss of legacy carbon stores. The implications of this for an ecosystem regime shift, the degradation of the peatland carbon stock, and the collapse of autogenic negative feedbacks will be discussed.