

Biogeosciences Discuss., referee comment RC3  
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## **Comment on bg-2021-4**

Anonymous Referee #3

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Referee comment on "Ideas and perspectives: Emerging contours of a dynamic exogenous kerogen cycle" by Thomas M. Blattmann, Biogeosciences Discuss.,  
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This work hypothesizes that de-glaciation and weathering of kerogen-rich lithologies in western Canada made a major contribution to CO<sub>2</sub> rise at glacial terminations by compiling and re-interpreting empirical evidence. I have several comments regarding the interpretation and methods of the manuscript, which I hope to help to improve the manuscript. I'd recommend revisions before acceptance for publication.

Major comments:

Comment 1: 'kerogen' should be clearly defined: how does this term compare to the other terms used in the relevant studies, for example, rock-derived organic carbon, and petrogenic carbon. Do those concepts overlap/differ or are they the same? Would organic carbon in metamorphic rocks also be termed 'kerogen'?

Comment 2: it needs to acknowledge existing understandings/studies about carbon fluxes during glacial-interglacial time periods. What did previous work find/conclude about glacial terminations and CO<sub>2</sub> rise? How does the kerogen weathering hypothesis in this manuscript differ from the previous studies? What were the magnitudes of other carbon fluxes during deglaciation (e.g. the carbon exchange between the atmosphere and ocean reservoirs) and how do those compare to the kerogen weathering flux?

Comment 3: there's no detailed lithology/kerogen amount/kerogen weathering kinetics/kerogen  $^{13}\text{C}$  signal/topography information (e.g. maps or data compilation) about western Canada – all those variables are important and relevant to the total oxidation flux of kerogen, and need to be discussed.

Comment 4: over glacial-interglacial timescales, would weathering of aged soil organic carbon (with residence time of thousands to tens of thousands of years) play an important role for  $\text{CO}_2$ ? Was aged soil organic carbon considered a part of kerogen in this work? How did the aged soil carbon flux/pool compare to those of kerogen organic carbon?

Comment 5: it sounds like the exhumed kerogen was all delivered to the oceans and got buried in marine sediments during the interested timescale of deglaciation (e.g. Figure 1) – was this true? Sediment residence time in floodplains and sedimentary basins could reach tens of thousands of years – meaning some of the kerogen might not be delivered to the oceans during the deglaciation. Then, would the conditions in floodplains and sedimentary basins also influence kerogen carbon reburial efficiency? can add relevant discussions.

Title: can be more focused and straightforward – sth like 'oxidation of kerogen contributed to  $\text{CO}_2$  rise at glacial terminations'

L25: please clarify how the 150 PgC/kyr was determined? uncertainties?

L30-35: should also introduce major thoughts of the causes of glacial terminations

L40-45: this carbon cycle framework is very incomplete – at least should put in silicate weathering, see more in Berner et al. (1983)

L100: Equation 2 is unclear...explain what Zeng (2003), Simmons et al. (2006), and Horan et al. (2017) have done? Where were those studies conducted? What did they find?

L125-130: how much did the  $^{14}\text{C}$  composition of the then atmosphere-ocean carbon reservoir change? Any comment on  $^{13}\text{C}$ ?

L230-235: could expand a bit and discuss some existing mechanisms – their pros and cons?

L500 – Table 1: how did the laboratory experiment-based results translate to a flux of unit area? for example, bituminous coal and oil sands – how to convert the reaction kinetics results of several samples to fluxes over certain areas of landscapes?

L525: Figure 4 can be improved by displaying topography and lithology maps