Review for Biogeosciences

Title of manuscript: Ideas and perspectives: Emerging contours of a dynamic exogenous kerogen cycle

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MS Type: Ideas and perspectives

Author: Thomas Blattman

Recommendation: Reject

The manuscript entitled "Ideas and perspectives: Emerging contours of a dynamic exogenous kerogen cycle" by Blattman summarises the role that kerogen oxidation versus kerogen burial plays in balancing atmospheric CO_2 versus O_2. Some factors governing the transfer of organic carbon locked in kerogen from lithospheric storage to the atmosphere or offshore to be reburied are reported. Although the content is interesting it only offers a brief review of the literature. As it stands, I consider the manuscript to be of insufficient detail for a review article. Furthermore, because it contains no new data or analysis it is unlikely to be of great value to the biogeosciences community. It does not really add much in terms of 'ideas and perspectives' to what is already known.

The abstract does not explain the purpose of this article or its novelty. It is also misleading, as the weathering of kerogen is not only modulated by the activity of glaciers (consider erosion, temperature, precipitation and so on, which have previously been discussed in the literature). It is also not clear to me why the author focuses on glacial-interglacial atmospheric CO_2 budgets when previous work (e.g. Petch, 2014; Bolton C cycle papers) outline the million year (rather than kyr) timeframe over which the kerogen cycle is relevant. Petch (2014) is an important review paper on organic carbon weathering that has not been cited

In the main text, the author postulates the role of kerogen reburial efficiency as a major contributing factor to atmospheric C budgets, referencing river basin data from Galy et al. (2015). In section 2, it would be worth pointing out that we do not have good constraint on how geochemical carbon fluxes change over time in large river basins globally. Furthermore, some consideration of weathering efficiency would be appropriate here. Although kerogen reburial efficiency may change over time, how too do weathering efficiency and weathering flux change. For example, high weathering intensity (low reburial of kerogen) may associated with low weathering fluxes, while lower weathering intensity (high kerogen reburial) is probably associated with high weathering fluxes. To what extent does weathering efficiency and weathering flux vary across the inorganic versus organic carbon cycles? Together, these ideas are relevant for achieving an integrated perspective of C cycling at Earth's surface through time. Although kerogen reburial efficiency may be an important driver of atmospheric CO_2 budgets, and may make sense in the context of data published in Reimer et al., 2013 and Roth and Joos, 2013, in glacial episodes there is also a large shift in the biospheric C distribution and activity that would be critical to consider.

The idea of looking into kerogen reburial efficiency in the context of major climatic events (e.g. PETM) using trace elements is an interesting idea that could perhaps form the basis of a future research proposal. This article may therefore be more suitable as the basis of a proposal introduction. Alternatively, it could potentially be rewritten as a more in-depth and comprehensive review article.

I find figure 2 misleading with the terms 'open' and 'closed'. Presumably, the author is just trying to represent reduced kerogen reburial in periods of warming relative to cooler episodes?