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Interactive comment on "Organomineral nanocomposite carbon burial during Oceanic Anoxic Event 2" *by* S. C. Löhr and M. J. Kennedy

Anonymous Referee #1

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In their manuscript "Organomineral nanocomposite carbon burial during Oceanic Anoxic Event 2" Stefan Löhr and Martin Kennedy show that organic matter content (TOC) in sediments during OAEII correlates and co-varies closely with clay mineral surfaces area (MSA) but not with redox indicators. They conclude that organic matter preservation in this interval is primarily controlled by smectite influx ultimately derived from intense volcanic activity, and that anoxic conditions and primary productivity only played secondary roles in influencing organic loading of clay minerals.

This paper was a great pleasure to review and an eye opener in several respects.

The methods and very broad range of sophisticated experiments are at the cutting edge and appear to be thoroughly performed and are well presented. The correlation between TOC and MSA is very strong and convincing, amazingly good, in fact, for

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such a complex system. Thus, I was initially worried that the MSA/TOC correlations might partially be an artifact of the methodology, i.e. that the EGME method for MSA determination essentially measures organic matter surfaces, not mineral surfaces (thus creating an autocorrelation). However, this concern is dispelled by the correlation in Fig 3 between MSA before and after organic matter removal. For this correlation, it would be useful to add evidence about the efficiency of OM removal using hydrogen peroxide (i.e., was OM entirely eliminated?).

Also convincingly demonstrated is the association of organic matter with smectite minerals by FTIR microspectroscopy at the micrometer scale and cyclotron STXM mapping at the nm-scale. This is major discovery #1: the required high resolution finally explains why it is often impossible to see any organic matter using optical microscopy!

The data implies that high TOC during OAEII is ultimately caused by volcanic clay mineral emissions (and not primarily by redox conditions or primary productivity). This has two major implications: #2 A paradigm shift about what caused OM deposition during this interval and maybe in other OAEs and other black shale events as well. This observation is a breakthrough in OAE research. #3 And of even wider significance, especially for Earth systems and climate scientists working at all time scales: there is a new negative feedback mechanism between volcanic CO2 emissions and removal of CO2 through volcanic clay production.

In summary, this paper presents exceptionally powerful data, is well argued, presented and written (including the figures and supplementary material), and presents three conclusions of major significance.

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