

# ***Interactive comment on “Latest Permian carbonate-carbon isotope variability traces heterogeneous organic carbon accumulation and authigenic carbonate formation” by Martin Schobben et al.***

**Anonymous Referee #1**

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The authors explain the scatter of d13C near the P-T boundary as recrystallization and the formation of authigenic carbonates during marine diagenesis. They also use a reaction-transport model to reproduce the d13C data. While this idea is new and the discussion is great, there are some major issues with this manuscript.

The authors try to interpret the scatter in the d13C records as recrystallization with an organic carbon source during marine diagenesis. However, it is also possible that some of these variations may have been generated by meteoric diagenesis. Thus, more discussions on this point are required, and it's better to include some petrography or

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geochemical evidences. The variations may also be generated by changes of rock types, minerals and calcified fossil species. Thus, more descriptions on the samples are necessary.

The data complied from the Meishan section in South China maybe can preclude the influence of seawater chemistry. However, the Iran data do not come from the same site. The scatter in d13C may be generated by spatial heterogeneity in seawater chemistry rather than diagenesis.

The authors have talked about authigenic carbonates. A definition on authigenic carbonates is required. If the carbonates were mainly formed by recrystallization, their d13C value may have been changed due to the exchange of carbonate ions with pore-water. Can this type of carbonates be classified into authigenic carbonates? Except some shells, all ancient carbonates have suffered from recrystallization. Does this mean that all the ancient carbonates are authigenic carbonates?

Some further textual suggestions:

Page 2, line 13 methanogenesis belongs to degradation of organic matter.

Page 5, section 3.1.2. Some of the d13C data for the Meishan section are very old and are less -5‰ which may be generated by analytical error.

Page 7, equation (1), why there is no a concentration conversion factor  $(1-\varphi)/\varphi$  in the reaction term? equation (2), I guess Db(z) is biodiffusion here, should describe it and also write down the function.

Table 2. I don't know why  $\text{SO}_4/(\text{SO}_4 + \text{KSO}_4)$  is in the reaction rate law of anaerobic oxidation of methane.

Page 9, line 15. The sedimentary rate may have been changed across the P-T boundary.

Page 14, line 15. "This inverse relationship suggests that d13C<sub>carb</sub> variability is not

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controlled by the increased potential sample size". This doesn't make sense to me. If there is more sampling effort on short interval, it is possible to capture larger d13C variability. Could you show the relationship between the d13C variabilities and the numbers of data of different intervals?

Figure 5 is good. Could you also show the influence of biodiffusion? The intensity of biodiffusion could be a function of oxygen level. It is better if bioirrigation is also included.

Page 22. The discussions about the influence of seawater chemistry and meteoric diagenesis are great. It may be better to talk about the other explanations for the scatter d13C such as heterogeneity in seawater chemistry, meteoric diagenesis and the variation of mineralogy in one section. Also, all the other discussions can be putted into another section. These may make the structure of the discussion part more clear.

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