Clim. Past Discuss.,
https://doi.org/10.5194/cp-2020-48-RC1, 2020

Climate of the Past Discussions

Interactive comment on "Exploring a link between the Middle Eocene Climatic Optimum and Neotethys continental arc flare-up" *by* Annique van der Boon et al.

Anonymous Referee #1

Received and published: 27 April 2020

This is an interesting test between the possible link of arc volcanism and climate change. It fits the scope of the journal. After the carefully read, I found that the ms has many logical and method flaws, which needs significant revision.

The successful link between the arc volcanism and climate change depends on how much carbon dioxide has been outputted through the ∼40 million years old volcanos. Firstly, the authors claimed there is an intensive eruption pulse at 40 million years based on their own and published data. However, the crucial point is how much 40 Ma volcanism has erupted. The assumption of the authors is improper and geologically impossible. 1-The authors assumed the total area of the 40 Ma is 40,000 km2, and

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the thickness is 3-9km, so the volume of the middle Eocene volcano is 100,000-350 000 km3. 9 km is almost the whole thickness of the upper crust, so how could one volcanic eruption make 1/3 of the crust. After I checked the reference Verdel et al., 2011, they claimed the whole Paleogene (66-23 Ma) strata, including the volcanism and sedimentary rocks in the UDMA is 3-9 km. Clearly, the authors have much overestimated the thickness of 40 Ma volcanic rocks. According to figure 2, we see volcanic events throughout the whole Eocene. Although there is an intense event at 40 Ma, still, the 40 Ma volcanic rocks are only a part of the Paleogene volcanic strata (3-9 km). You must be precise how thick is the $\sim$40 Ma rock.

2-The second point is that the authors probably underestimated CO2 output based on their calculation.

The authors compared the size of the arc volcanism with the large igneous province in Deccan and directly used the CO2 output data from LIPs. However, the compositions of arc volcanism are fundamentally different from those of LIP. The arc volcanism is more felsic that is compared to the dominated basalt of LIPs. Then the arc volcanism is much enriched with volatile like carbon (0.6-1.3 wt%, Wallace et al.,2005), water (4 wt%, Plank et al.,2013.). Therefore, if the authors used the arc data, I think the output of carbon maybe more. Because of the compositional difference, the felsic arc volcanism is more like to interact with the carbonate to form skarn that further releases more CO2. The LIP basalts are more likely to assimilate with carbonate and related to fewer CO2 (Carter et al., 2016). On the contrary, the basalts are much easier to weathering, which consumes many CO2, which may cause cooling.

3-Current data do not support their conclusion. The authors must recalculate the budget. MECO is a global effect. I suggest the authors also add some discussion on the possible Eocene arc volcanism at other places like along the Tethyan region and the Cordillera region in the eastern Pacific. As far as I know, the post-Laramide volcanism is also very strong.

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