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Climate of the Past Discussions
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Interactive comment on "Early Jurassic climate and atmospheric CO_2 concentration in the Sichuan paleobasin, Southwest China" *by* Xianghui Li et al.

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General comments

In their CP manuscript, Li and colleagues trace the evolution of Early Jurassic climate and environment in lacustrine and pedogenic carbonates from the Sichuan Basin in SW China. They use "climate-sensitive sediments" and C- and O-isotope geochemistry of pedogenic carbonates as proxies for past climate and atmospheric pCO2. The data presented are new and the pCO2 calculations based on C-isotope composition of pedogenic carbonate will be of use in any future Jurassic climate reconstructions. Data presentation is fine, eg. fig 6 is very useful. Language needs considerable improve-

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Discussion paper

ment (see below). Im not entirely happy with the structuring of this paper. I recommend, to start the study with well-defined hypotheses, questions, best based on climate models (see below). I also recommend to restructure the discussion (see below, so it will be easier to follow for the reader. Even if the new pedogenic carbon isotope data are a valid contribution for paleoclimate science, I can, recommend publication of these data only after major revision of this paper.

Detailed comments:

1)Introduction The authors start their study with a rather general sentence: “The Jurassic was a typical greenhouse period” > what is a “typical greenhouse” ? The Jurassic was an interesting time because of major plate tectonic changes affecting global climate. The fragmentation of Pangea resulted in the collapse of a Monsoonal-type climate in the earliest Jurassic and by the end of Jurassic a more zonal climate was established. Jurassic was, no surprise, a time with cooler and warmer climate, possibly even with Ice Age episodes and the new data in this study confirm that changes in Early Jurassic pCO2 were considerable. In their study, the authors compare data collected from the Sichuan Basin with data from the Colorado Plateau and from North China and northern Gondwanaland. As a reader I am, of course, interested in the paleogeography of the Early Jurassic and in the relative paleopositions of the study site and of other localities mentioned in the text. I recommend that the authors add a figure showing the plate tectonics of the Early Jurassic and showing the locations mentioned in their study. In addition to paleogeography, paleoclimate models could help to better understand climate trends in SW China and in North America, both discussed in this study. However, there are almost no models available on Early Jurassic climate. One of the few simulations providing information on precipitation pattern and aridity in the Early Jurassic can be found in Robertson et al. (Sedimentology, 2017). The authors may refer to this study. Models may help to better formulate hypotheses and questions addressed in this study. And, clear hypotheses and questions facilitate reading of the paper . » The authors may considerably improve their introductory part. Time win-

dow chosen: Your time window is defined by post-mass extinction time (Hettangian) at the base and the Toarcian OAE at the top. If you extend part of your discussion to the Mesozoic-Cenozoic (terrestrial proxies have begun to provide information. . .line 41) then you soon are moving on slippery grounds: Many, many studies on terrestrial climate exist for the Late Mesozoic and even more for the Cenozoic. Focus on your time window, even in your figures (fig 8).

2) Material and methods The methods you apply are up-to-date and they provide useful information on past climate. I recommend to add a paragraph on your selection procedure of CO2 concentration in soils. You have this discussion in your notes, that is fine. However, the S(z) value is a crucial value for your pCO2 estimates, please include your selection arguments in your main text. See also your line 162, where you may discuss the S(z) selection procedure if you did not do it in your method paragraph.

3) Discussion of your data In your discussion, you present first your sediment proxy data stage by stage, then, in a next chapter, you discuss your pCO2 data through the Early Jurassic. This structure of the text makes the reading of the discussion, at least for me, quite difficult. I prefer to see a climate discussion starting with the drivers of climate change, in this case changes in carbon cycling and in pCO2, which are both global signals (See, for example, the new and detailed C-isotope curve for the Hettangian-Pliensbachian in Storm et al.,PNAS, 2020). You can, if you take a general reference curve as a start, project your data into this curve and test, if pCO2 trends coincide, for example, with C-isotope trends, you can see if regional climate pattern (China, N-America etc) reflects some of the global trends. This may make the paper much easier to read and you can easily show the regional pattern as part of a global climate curve. You may refer in this discussion, if possible, to the few available model data. Of course, you also will use literature data you chose for your study and your figure 8 (e.g. Dera et al. 2011 and many others, as you cited correctly). A discussion starting with the global pattern also can make it easier to understand your comparison with regional data from N. America.

4) Details and corrections, including some comments on language Abstract . . .terrestrial sediments show more complicated environment and climate. . .” I assume that you want to say that climate proxies in terrestrial sediments are more complex and more difficult to interpret than many marine proxies. Please do not write “carbon-oxygen isotopes”, but carbon and oxygen isotopes. line 42 You are rather imprecise in your wording, when you write about a “negative feedback . . .. has been hypothesized to account for. . . in the carbon cycle” > what to you exactly mean? 105 . . .descriptions for sedimentary facies analysis were executed. . . 116 the description how to distinguish dolomite from a calcite the field is not really needed. It should be basic knowledge for students in geology. . . 216 . . .a distinct transfer of climate.. ??? 239 . . . a warm-humid climate followed the Late Triassic. . .. > Late Triassic climate 244-248 You compare North American climate with GSB climate throughout your study, this is ok, however, I like to know why you chose North America, what are hypotheses on climate similarities and differences between N. America and SW China. 248 » here it will be interesting to discuss climate pattern in the Early Jurassic, why is which regional climate similar/different from another regional climate? 305 Interesting is the observation that lake facies was widespread during a dry period in the Toarcian.You may further comment on this. 318 you use dolomite formation as a climate proxy, this is fine. You may refer to literature on dolomitization along the Persian Gulf (“Arabian Gulf”) , eg. by McKenzie and others. 120 chichen-wire > chicken-wire (anhydrite) 253 That is the reddish rocks developed through the whole member. . ..., but it started. . . revise 257 . . .. Calcisols were also interpreted with the description of abundant calcretes. . .. (??) revise style 282 The Ma’anshan Member is likely the Pliensbachian. . .. 302 In other hand,. . . 321 . . .can serve the determination. . . I did not mark the many additional small language inconsistencies » please revise text carefully.

Figures I like your figure 6 which serves as a very good baseline for your discussion (you may also add data from Xu et al . from the same study area in figure 6 or elsewhere?)

Fig 8 You plot changes in temperature not temperature, please correct this in the figure. The global paleosol curve is, in this case not very helpful. I also wonder, if you should start your curve after the T-J boundary (?). The high-resolution data are not really discussed in your work and you did not include any T-J boundary data.

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