Point-by-point Response

Reply to RC1: 'Comment on egusphere-2024-1263', Anonymous Referee #1, 30 May 2024

Comment: The manuscript by Chen and Chen examines the strike-slip faults in East China to talk about the formation of the Bohai Bay basin. Through detailed fieldwork, the authors propose a new two-stage model, namely, the superimposition of the NE extension parallel to the subduction zone on the NW extension perpendicular to the subduction zone. I think it is worth to be published and will attract the attention of the audience in the Solid Earth. Thus, I suggest some revisions before considering accepting for publication.
Meanwhile, I hope my comments and suggestions are useful for your revision.
Reply: Thanks for your review. Your constructive comments and suggestions are very useful for my revision. So, we modified some sentences and photos, and added some materials, to improve our manuscript. The changes are marked in red color.

Comment: In the first paragraph of section 2.1, the authors think of the “Jiaodong and Liaodong Peninsulas” as the key areas. What’s your reason? Please clarify it in detail.
Reply: In the first paragraph of section 2.1, we list some reasons to explain why the Jiaodong and Liaodong Peninsulas as the key areas for the formation of Bohai Bay.

Comment: The figure 3 is too large to see the details of structural features in your study area. I hardly find the faults you studied in this map. I suggest that you also provide a detailed structural map of your study area.
Reply: The figure 3 is separated into two maps, a sketched regional map (figure 3) and a detailed structural map of studied area (figure 4), in order to emphasize the structural features of studied area.

Comment: Some photos, such as Fig. 4A, Fig. 5, and Fig. 9 seem not to relate to the topic authors discussed, even presenting as a single figure. I suggest they should be removed. And I think it’s better to merge Figure 6 with Figure 7.
Reply: We agree with your comments, some of the pictures do not relate to our topic. We removed these photos, such as Fig. 4A, Fig. 5, and Fig. 9, and merged Figure 6 with Figures 7 and 8.

Comment: There is a logical gap between structure and geodynamics, and I think the bridge is the deformation timing. How do you know the ages of faults you studied, and then correlate them with the opening of the Bohai Bay basin, and even the Paleo-Pacific subduction? I know it is difficult to date the faults, but it’s better to give more interpretations and discussions about the deformation timing.
Reply: Really, it is important and difficult to understand the deformation time. We can speculate the faulting time from two aspects. First, previous studies gave us some information about the faulting time. Especially, some of them predicated fault time according to cooling ages in the Luxi area. Second, we have made some logical analysis of fault time. We distinguish fault time according to the relationship between the fault and related strata, especially the effect of the faulting on sedimentary processes. Therefore, we can correlate the normal faulting with the formation of Bohai Bay basin or Bohai Sea. In addition, we can also consider the opening of Bohai Bay basin as the

result of the back arc extension of the Paleo-Pacific subduction, despite there are some gaps between structure analyses and geodynamics, and we need more detailed further studies to reduce the inaccuracy.

Comment: Based on a lot of measurements, Paleo-stress analysis is a useful method to study the kinematics of the faults. I suggest that the authors could add related analysis.
Reply: We have included some preliminary paleo-stress analysis to study the kinematics of the faults, mostly based on previous studies. Further more detailed studies should be conducted in the future.

Comment: The distribution of the magnetic anomaly is a more direct way to discuss the extensional direction, such as the study of the South China Sea (e.g., Barckhausen et al., 2014 Marine and Petroleum Geology). If you can collect the magnetic anomaly data of the Bohai Bay, it may test your two-stage model.
Reply: We have collected data of the magnetic anomaly in the Bohai Sea area, which is modified from Xiong et al., 2015. The data is good evidence for the two-stage model of the studied area.

Reply to RC2: 'Comment on egusphere-2024-1263', Chen Wu, 30 May 2024

Comment: All looks great, accepted as suggested.
Reply: Thanks a lot for your kindly review. We have modified the manuscript, in order to improve the writing.

Reply to RC3: 'Comment on egusphere-2024-1263', Anonymous Referee #3, 03 Jul 2024
Citation: https://doi.org/10.5194/egusphere-2024-1263-RC3

Comment: This paper deals with the mechanisms of opening of the Bohai sea in NE China. On the formal point of view, the English must be seriously improved, some points are mentioned in the annotated pdf manuscript.
Reply: Thanks a lot for the comments. We have seriously improved our English writing in this time, especially based on the suggestion that the referee mentioned in the annotated pdf manuscript. The modified text has been marked in red.

Comment: From the scientific point of view, there are many flaws in this manuscript.
Reply: Indeed, our manuscript contains some flaws. We have carefully checked the manuscript and earnestly corrected some flaws. Most of the corrections are based on the two referees' suggestion, including another referee.

Comment: (1) In the introduction, the scientific questions must be addressed more clearly as they are. The conclusion must not be presented in the Introduction.
Reply: We have reanalyzed the scientific questions involved in the manuscript, and addressed them more clearly. Also, we have deleted the statements that look like conclusion in the Introduction.

Comment: (2) The Geological Overview section is partial and to some extend incorrect. Many works dealing with the Cretaceous extension, and the MCC in Liaodong and Shandong peninsulas are missing, for instance Lin et al., 2007 GSSP, 2008 J. of Geology, Lin and Wei, IGR; Charles et al., 2012 GR; Qiu et al, 2023 ESR, and many others.
Reply: We have checked the *Regional geological background* section, and prudently present it in current level of understanding, to avoid any incorrect and false statement we can find. However, some geological problems are still not solved in current level, and different views are still needed for the future researches. In this section, we added several references related to MCC in Liaodong and Jiaodong peninsulas, such as Lin et al., 2007 GSSP, 2008 J. of Geology, Lin and Wei, IGR; Charles et al., 2012 GR; Qiu et al, 2023 ESR, and others.

Comment: The term “Indosinian” is improperly used. Collision between N and S China blocks, if any exist east of the Tan-Lu fault, occurred in Early Paleozoic like in the Qinling-Dabie belt. Moreover, "Indosinian" is not a suitable term. This word must be reserved for the S. China-N Vietnam orogen, other orogens of the same age are nor relevant to the same plate convergence system.
Reply: We agree with the referee’s suggestion that the term “Indosinian” should be reserved for the S. China-N Vietnam orogen. To eliminate misconception, we have modified the using of term “Indosinian”, instead as “Triassic”. We added some references on the collision between N and S China blocks, also Faure et al., 2014 on the S China block-Indochina collision. Many geologists from China and other countries may have different views than the referee on the formation time of Qinling-Dabie-Sulu orogenic belt, which is also named as the Central China Orogenic Belt. They thought that the Qinling-Dabie-Sulu belt was formed in the Triassic, resulting from the collision between N and S China blocks in that time. They believe that there is still the existence of the Qinling Ocean between the N and S China blocks in the Late Permian and Early Triassic. Many researchers considered the Tan-Lu fault as a transform fault which offset the Qinling-Dabie and Sulu belts.

Comment: (1) Fig. 3 is too complex and thus not understandable. The geological map of this area must be redrawn in order to highlight the important features.
Reply: We have simplified and redrawn Fig. 3, to emphasis some important tectonic features in this area. At the meantime, we added Fig. 4 to focus the studied area around the Bohai Sea. We have rearranged the figure numbers.

Comment: (2) Often the structural field evidence for normal and strike-slip faults are not convincingly provided. Figure 4 presents complex structures that are hardly believable. The differences between the red and pink lines are not mentioned. Fig 4A is useless.
Reply: We accepted the referee’s suggestion, deleted the previous Fig 4A, and rearranged the other figures. The structural relationship drawn in the figures is the result of what we observed on the outcrop. Their geometry and kinematics are believable. To avoid confusion, we added some original photos as comparisons with explained structural results. Also, we added some legends and explanations for different colored faults in the figure and caption.

Comment: In section 3.2, there is a mess between the brittle joints, the faults, and the magmatic

structures observed in the Cretaceous granites. As a whole, the kinematics of the strike slip faults is not convincingly presented too.
Reply: Thanks for the referee's remind. However, we don't think there is a mess. The brittle joints, faults, and magmatic structures are developed during different stages and different strain fields, which represent different stress statues with different kinematic implication. They reflected the complexity of fault activities and structural developing. In the revised manuscript, we have given further explanations of fault kinematics, although some branch faults have very little displacement. We believe that the arrangement of extensional brittle joints could be adopted as kinematic indicator of related strike-slip faulting.

Comment: Section 4 is hard to understand. The authors seem to argue that due to their geological similarities the Jiaodong, Liaodong and Korea peninsula experienced strike-slip and normal faulting. Even if the 3 areas have obviously common geological features since Archean to Cretaceous at least, these similarities do not prove at all strike slip or normal offset.
Reply: In the revised manuscript, we added evidence from aeromagnetic anomaly, to explain the rationality of the block comparison surrounding the Bohai Sea. We know that, for most professional researchers, our model is hard to understand. This is because, most researchers have already had pre-existing or solidified traditional understanding of regional geology and tectonics. They may start off from the aspect of the Tan-Lu fault, believed that the north extending of Tan-Lu fault may have no problem, and the fault activity is not too complex. However, if we stand from the perspective of Bohai Sea, we will find that, it is hard to track the footprints of Tan-Lu fault within the Bohai Sea area, although there is only 20-meter depth of the sea water. The aeromagnetic anomaly of Bohai Sea area shows that the Archean basement of Liaodong Peninsula can be connected with the basement in the Laizhou Bay, rather than the Archean basement of Jiaodong Peninsula. We conceive that different faults had their different activities in different periods, with different natures. Although some faults may have almost the same location in the surface, they cannot be considered as the same fault, since they have different natures in different periods and different extending in the depth. Therefore, we suggested a tectonic model which is different from previous studies, to solve the complicated superimposed tectonics in the Bohai Sea area.

Although there may still exist some questions and flaws in our model, however, we think that it has made some significant improvements compared to previous studies, especially on the Tan-Lu fault. About the normal faulting, our understanding is basically derived from a series of regional geological surveys, marine geological surveys, and oil and gas geological surveys made by many geological researchers in China. Their achievements on normal faults are mainly reflected in the Geological Map of Asia (Ren et al., 2013) and Geological Map of China (China Geological Survey, 2004), as well as a series papers on regional oil and gas exploration in the Bohai Sea area. In the process of oil and gas exploration, some understanding of strike-slip faults has also been proposed, mainly concentrated in the Liaodong Bay area. In our manuscript, we propose a new perspective on the understanding of JLF, the Jiao-Liao fault, as a right-lateral strike-slip fault, offsetting the Jiaodong and Liaodong Peninsulas. The current understanding of Tan-Lu and Jiao-Liao faults is still relatively superficial and simple. We look forward to more work that can validate, improve, or even overthrow our model.

Comment: Fig 11 is not understandable. The genetic model of the Bohai Sea requires additional explanations.
Reply: Based on the referee's suggestion, we made further modification of the previous Fig. 11 (now Fig. 9), and added more words explanation for this figure in the text.

Comment: In conclusion, I cannot recommend the publication of this manuscript in its present form. More work is necessary to present convincing data on the fault kinematics. The text and figure must be also improved in order to built up an understandable geodynamic model.
Reply: We appreciate all the constructive suggestions from the referee, which allowed us to do more carefully check of the work in the manuscript. We think that our current work can basically support our current tectonic model for the formation of Bohai Sea. We expect that more work should be done in the future and more researchers should be involved in the discussion. In this time, we have made serious modifications of the text and figures, to improve the manuscript. Thanks again for the referee's review and constructive suggestions.