

Comments on the manuscript:

## **“Three-dimensional structural model of the Qaidam basin: Implications for crustal shortening and growth of the northeast Tibet”**

By J. Guo et al.

Submitted to *Solid Earth* (se-2016-74)

This manuscript deals with the structural evolution of the Qaidam basin (northeast Tibet) by using geological and geophysical datasets. The main geological surfaces (both stratigraphic and tectonic) are reconstructed in 3D structural modelling, providing a sequential restoration of the whole basin through time. The results are used to infer the tectonic role of the Qaidam basin within the Tibet plateau development.

Taking into account the aims and the implications, this work is of interest for an international audience and it is appropriate for being published in *Solid Earth*. Anyway, the present version of the manuscript suffers of an inadequate organisation of the text and insufficient data presentation. I recommend major revisions and my comments/suggestions follow here.

### **Major comments**

Abstract. Some information are not clearly stated. For a reader that has not familiarity with the geology of Tibet, the relationships between the Tibet plateau, the Qaidam basin and the Altyn Tagh fault are obscure. Briefly, you should explain, starting from the Abstract, how the Qaidam basin, and its relationships with the Altyn Tagh fault, are crucial for understanding the tectonic evolution of the Tibet region.

Introduction. The last part of this paragraph (e.g., page 6, lines 8-12) should be rewritten. In particular, here it should be clearly stated which are: (i) the main objectives of the work, (ii) the main obtained results, and (iii) which are the tectonic implications derived. I invite you to clearly state which is the novelty of your work with respect to that already published by other researchers (I suggest stressing on the 3D reconstruction derived from integration of geological and geophysical datasets).

Regional tectonic context (NEW PARAGRAPH). I propose to include this new paragraph in order to clarify (i) the geological context, (ii) the models proposed for Cenozoic deformation in the Qaidam basin, (iii) the processes advocated as responsible for the present-day structural architecture of the Qaidam basin, and (iv) the structural/tectonic relationships between the Qaidam basin and the surrounding domains (i.e., the Altyn Tagh fault, the Kunlun Mountains, the Qilian Mountains). I think this is important for providing a clear background of your study area. You can use some parts of the main text that are presently dispersed within the Introduction paragraph (page 2, lines 22-25), the Results paragraph (page 5, line 20 to page 6, line 5), the Discussion paragraph (page 6, lines 22-25; page 7, lines 5-11).

By providing such a background, it will be more clear which is your innovative contribution in defining the tectonic evolution of the Qaidam basin with respect to already published works (for example, in comparison to Yin et al., 2008, *GSA Bulletin*).

Results. This paragraph should include and detail your dataset. Indeed, it does not provide enough information on the dataset used and how these data have been integrated for producing the 3D restoration.

I suggest to re-organise this paragraph by adding few specific sub-paragraphs. For example:

- Structural dataset: here you could focus the attention on the structural elements characterising the Qaidam basin (such as folds, faults and lineaments) and describe their properties (distribution, persistence, attitude, crosscut relationships, etc...). This may include your text in page 4 (lines 24-29) and page 5 (lines 1-11). Here, I would like to see a more detailed characterisation of the Altyn Tagh fault in terms of fault architecture (thickness and length of damage zone and fault core) and structural data. For the latter, I suggest to provide more evidence of fault kinematics by using field pictures, line drawings, stereographic projections and statistical analysis of the structural elements (e.g., fault strike, pitch values);
- Wells dataset: a detailed description of the well stratigraphies completely lacks in this work (or did I miss something in downloading the manuscript?) I think you can not exclude this dataset that you used for constraining the seismic profiles and, then, the 3D restoration.
- Geophysical dataset: here you could present the seismic profile you used by describing geometries and thicknesses of layers, as well as geometries and offsets of the main faults.

Discussion. I think this paragraph could be improved in the light of text re-organisation within the previous paragraphs. In particular, I propose to better explain why and how your restoration is different from that already published (e.g., Yin et al., 2008; Zhou et al., 2006).

Conclusions (NEW PARAGRAPH). I encourage you to introduce a conclusive paragraph in which you can stress on your main results and implications (at the scale of the Qaidam basin and at the scale of the Tibet plateau).

### **Minor Comments**

- Page 2, lines 1-4: too long phrase. Please, split it into two concise phrases.
- Page 2, line 3: add “(*northeast Tibet*)” after Qaidam basin.
- Page 3, lines 8-10. I don't understand the relations between this statement and the previous one. I suggest to delete it (or remove and to use it within the Discussion).
- Page 3, lines 11-12: Qilian and Kunlun mountains have been never mentioned before. Not easy to understand their relationships with the Qaidam basin.
- Pages 4-5, lines 22-29 and 1-7: all the information should be better supported by a more detailed geological-structural map in Figure 1 (see below) and by field pictures in Figure 2.
- Page 5, line 2: delete “*to*” and change the comma in full stop.
- Page 5, lines 12-19: this is no part of the Results paragraph. It should be moved within Methodology and re-arranged.
- Page 5, line 22: “(*Fig. 4*)” not appropriate to cite there. Remove.
- Page 5, lines 22-25: this phrase is very confusing. I suggest to rewrite it. Anyway, as you are declaring that thrusts are related to the Altyn Tagh fault, I would like to understand if you consider them either (i) fault termination in a horsetail arrangement, or (ii) contractional

- duplex in restraining bend of the Altyn Tagh fault, or (iii) resulting from restraining stepover between two parallel faults (i.e., the Altyn Tagh fault and the Kunlun fault).
- Page 5, line 20 to page 6, line 5: it seems to me that the information derives from previous works. If so, I strongly suggest to delete it from here and to merge it within the paragraph concerning the Regional Tectonic Context.
  - Page 6, line 8: why do you introduce Fig. 6 before Fig. 5?
  - Page 6, lines 22-25: delete this information and merge it within the Regional Tectonic Context.
  - Page 6, line 27: “Means” with lowercase letter.
  - Page 7, line 3: change “indicating” with “suggesting”.
  - Page 7, lines 5-10: this is part of the Regional Tectonic Context.
  - Figure 1. I suggest these captions:
    - (A): Structural map of the Tibet Plateau within the Eurasia/India continental collision. Black arrow indicates present-day displacement of India continental block.
    - (B): Shaded relief map.....
  - Figure 1: provide latitude degrees in the shaded relief map. Provide a legend for explaining the meaning of A-B, C-D, line with triangles (thrust).
  - Figure 2:
    - indicate orientation and an approximate scale for all pictures.
    - provide location of these structures in Figure 1.
    - Improve legibility by introducing some labels and symbols indicating bedding (strike and dip), trace of possible fault segments, offsets along fault segments, ....
    - Within the caption: change “filed” with “field”.
  - Figure 3:
    - Add scale for all figures.
    - In printed page, labels and symbols are not legible. Improve them by changing colour and/or increasing the size.
    - No caption is provided for (A).
    - In (B): which is the meaning of the big red arrow and the black one? Please, indicate the river you are considering.
    - In (E): the stereographic projection is not visible. As suggested above, please provide more accurate structural dataset.
    - Within the caption: change “filed” with “field”.
    - The caption of this figure should be re-organised by following the figure sequence from (A) to (F).
    - Statement in lines 5-6 makes no sense if you don’t provide an accurate structural dataset and statistical analysis of the pitch values.
  - Figure 3:
    - This figure is not explained within the main text. Geometries, depths and offsets of the main seismic reflectors should be described.

- All red lines are thrusts? Please provide a legend.
  - Indicate the Altyn Tagh fault in seismic profile C-D
- Figure 5:
- Which is the meaning of T0, T21, T4, and TR as reported in caption? Are these time steps? Depths? Please, indicate within the figures.
  - What does the green arrow? North? India displacement?
- Figure 6: following you model, uplift attained only after N<sub>2</sub><sup>3</sup> layer deposition. Indeed, starting from the Abstract, you stated that deformation and uplift were synchronous in Tibet (thus in the Qaidam basin). Please, explain.
- Figure 7: what does the green symbol? Does arrow point the north?

I hope my comments and suggestions can improve the manuscript.

My name may be communicated to the authors.

Sincerely,

Gianluca Vignaroli

*Istituto di Geologia Ambientale e Geoingegneria (IGAG)  
Consiglio Nazionale delle Ricerche (CNR)  
Area della Ricerca di Roma 1, Via Salaria Km 29, 300-00015  
Monterotondo Stazione, Rome, Italy  
[gianluca.vignaroli@igag.cnr.it](mailto:gianluca.vignaroli@igag.cnr.it)*