Solid Earth Discuss., 7, C202–C206, 2015
www.solid-earth-discuss.net/7/C202/2015/

Interactive comment on "Three-dimensional approach to understanding the relationship between the Plio-Quaternary stress field and tectonic inversion in the Triassic Cuyo Basin, Argentina" *by* L. Giambiagi et al.

SC Corrado (Referee)

sveva.corrado@uniroma3.it

Received and published: 18 March 2015

GENERAL comments

The work presented by Giambiagi and co-authors focusses on the evolution of part of the Triassic Cuyo Basin (e.g., Cacheuta sub-basin) as a case history of tectonic positive basin inversion in the Southern Central Andes (Argentina), starting with rifting in Triassic times and evolving to selective positive inversion in Pliocene-Quaternary times. Rifting developed in the framework of the SW margin of Pangea evolution whereas in-

version pertains to the Cenozoic Andean orogeny development. The aim of this work is to define the modes and extent of inheritance of pre-orogenic extensional structures into the Andean orogen that keeps being a topic of relevance, great interest and intense debate in the literature (see Butler et al. 2006; Butler and Mazzoli 2006, for a review). In detail, most of the literature has focused on the issue of determining why extensional faults are reactivated under positive inversion unravelling the relationships between the orientation of pre-existing faults and that of the reactivating stress field starting from 2D sections. Nevertheless, there has been growing attention towards 3D kinematic reconstructions of the evolution of non-cylindrical structures in fold-and-thrust belts through both numerical and analogue modelling. In this framework the strength of the manuscript under review lies in the reconstruction of the three-dimensional geometry of structures, based on a large and robust surface and subsurface dataset on structures that are important targets for HC exploration. Furthermore the quantitative reconstruction of both geometry and kinematics of the productive structures may help in reducing the risks during further exploration. Nevertheless the reconstruction provided in the manuscript can be further detailed by providing the interpolation among sections presented in the final model of Fig. 12. The on line paper by Maffucci et al. on the 3D reconstruction of an inverted structure of the Andean retrowedge in the Salta province might be of some help in the implementation of the reconstruction by MOVE software. Furthermore it is recommended to improve both in the figure and in the text the use of the time slices derived from 3D seismic data to constrain the kinematics model reported in Fig.11 that are potentially very powerful tools to detect structure kinematics (see detailed comments).Moreover the attempt to link geometry and kinematics together with dynamics provides a tectonic key to the causes of positive inversion in this sector of the Andes. In detail the study supports the thesis that the orientation of pre-orogenic normal faults exerts a primary control on reactivation kinematics on the base of a conspicuous dataset.

The presented title might be more attractive, taking into account the general topic treated. Goals of the work as well as adopted methods are clearly described in the text. The current slip tendency analysis method has been adopted to define the potential of pre-existing normal fault to reactivate and supported the identifications of structure that were not reactivated (northern sector where sigma 1 is sub-horizontal and perpendicular to pre-existing normal faults; southern sectors where sigma 2 orientation is sub-vertical and old faults are reactivated with transpressive and strike slip kinematics). The organization of the manuscript is good and the English form is correct. Tables and figures are all of good quality and mostly informative. A few addings are needed in some of them and in the figure captions (see specific comments) Nevertheless when possible it could be helpful for the readers to reduce the use of local toponyms in the text.

In conclusion this manuscript can represent a valid contribution for Solid Earth journal after moderate/major revisions to both text and figures before it is possibly accepted for publication. Further comments are listed below. This contribution to the review process can be published and I am eventually available to contribute to a further review of the submitted manuscript. I hope that this review can be considered as a constructive contribution to the Authors to improve the manuscript and of support to the Editor to take the final decision.

SPECIFIC COMMENTS:

Page 461

Line 9: please cite properly the used software MOVE addressing the society that produces it and the adopted version.

Line 11: briefly explain how the depth of the detachment level has been derived even if you are citing two articles about this point. It is a key information for the entire reconstruction you propose and deserves more attention.

Lines 15-16 and/or discussion section: It might be useful to cite a recent contribution to the topic of tectonic positive inversion in the Adean retrowedge in NOA to the North

of the study area in the Salta province. At the base of this brand-new contribution there is field mapping and structural analysis at the outcrop scale as well as a 3D geometry econstruction of a reservoir (using MOVE software) of a positively inverted structure whose evolution can be fruitfully compared with those reconstructed in the paper under review.

Page 462

Line 12: see general comment of the detachment depth

Page 464

Line 12 Change 2700m into 2,700 m

Line 19 Cite Fig. 3 to help readers to locate oil fields.

Line Change 3000m into 3,000 m

Page 468

Lines 15-17 Delete this sentence from the results section

Line 22 Clarify the meaning of the adjective “important”

Page 470

Line 15 Change “oflocal” into “of local”

Page 473

line 28. “slip under reverse/strike-slip: : :” change into “transpressional slip”.

Page 474

Lines3-4. Add a more detailed discussion on the 3D reconstruction and its implementation (see above).

Figure 2. If possible, indicate, at least, well location.

Figure 3. Try to use the same color you used in Fig.2 for the area of HC exploration.

Figure 4 Modify the symbol for the anticline and change the term “anticline” into “trace of anticline axial surface”

Figures 5, 6, 8 and 9. Can you possibly add the restored version of the sections, at least in the section where relevant strike slip component along major faults is negligible? It helps in visualizing the amount of shortening or inversion.

Figure 11. I highly appreciated the time slices from 3D seismic data added to strengthen the kinematic model. In this light the model could benefit from a better location of time slices in the geologic map of the study area and a possible conversion of ms into depths.

Possible references to be further consulted and eventually cited:

Butler R.W.H. and Mazzoli S. 2006. Styles of continental contraction: A review and introduction Geological Society of America Special Paper 414.

Butler R.W.H., Tavarnelli E. & Grasso M. 2006. – Structural Inheritance in Mountain Belts: an Alpine-Apennine Perspective. Journal of Structural Geology, 28, 1893-1908.

Maffucci R., S Bigi, S Corrado, A Chiodi, L Di Paolo, G Giordano, C Invernizzi . 2015 Quality assessment of reservoirs by means of outcrop data and “discrete fracture network” models: The case history of Rosario de La Frontera (NW Argentina) geothermal system. Tectonophysics. doi:10.1016/j.tecto.2015.02.016 Reference: TECTO 126555.

Interactive comment on Solid Earth Discuss., 7, 459, 2015.