

Interactive comment on “Active faulting, 3-D basin architecture and Plio-Quaternary structural evolution of extensional basins: a 4-D perspective on the central Apennine chain evolution, Italy” by Stefano Gori et al.

Anonymous Referee #2

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The authors show a nice example of a multidisciplinary study that combines field geological data and ambient seismic noise to reconstruct the Quaternary evolution of a fault bounded extensional basin in the Central Apennine chain. Despite the limited dimension of the basin, its location among the major active faults is favorable to provide new constraints on the tectonic setting of the Central Apennine and to define the seismogenic role of the minor faults. Structural field data are interesting and welcome, but the article is at the present of rather local focus. With modifications and better emphasis on how this work is of enough interest for a publication with a broad readership such as Solid Earth, this manuscript should be acceptable for publication. At first sight,

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the research seems focused on a too local geological problem, in term of topographic extent (the Subequana Valley seems one of the smallest basin in the Apennine) and in term of geodynamic problem (the basin is touched only by minor faults). To add appeal of this manuscript, I think that authors should improve the abstract and introduction to show the main tectonic problems in the Central Apennine and how, also a small intra-montane basin may provide crucial constraints on the chain evolution and seismogenic potential of the not well known faults. I found interesting the study of the relationship between the tectonic structures with NW-SE orientation and structures with NE-SW orientation. In the other hand, for a reader not expert in Apennine geology, this tectonic pattern needs a better description. In particular about the timing, the style, and the possible interpretation. Moreover, in central Apennine several structures show a change in the orientation, and they are not always parallel. The timing of basin evolution is not completely convincing. In particular I am not convinced of the two stages of Subequana valley evolution led by an early NW depocenter and by a younger southern depocenter. I think that early NW depocenter is not completely proved by solid constraints: asymmetry of the basin could be also a consequence of a not symmetric slip along the strike of the Subequana Valley fault. Did the authors consider this hypothesis? The knowledge of the authors on the specific context is surely profound and acquired through the years; a less expert reader would find that a detailed reconstruction such as that shown in figure 9 is not entirely sustained by the data shown and discussed in the article. I think that the style of the language could be improved, to make the manuscript easy to read. I am not qualified to judge the English, but I found the language sometimes too forced toward a poetic style. The use of foreign terms (German, French and Latin) is nice, but a little abused. I discourage also the frequent use of the double quotes: one has the feeling that the authors are not capable to find the right geological terminology. In general, I found that the manuscript is a little poor in references that should be added, especially in the introduction; this would improve the quality of the manuscript.

Detailed comments

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Abstract: line 10; why innermost? The basin is located closer to Adriatic coast (front of the chain) than Tyrrhenian coast. line12; what is the polarity of a depression? I find the term polarity not completely clear. line 12; use of capitalization to sub-divide Cenozoic Epochs (e.g. Miocene, Pliocene) and Ages (e.g. Burdigalian) should be corrected. I think that only formally recognized divisions should be capitalized (see www.stratigraphy.org) (e.g. Upper Cretaceous) whereas subdivisions of Epochs use small letters (e.g. late Miocene, early Burdigalian). This should be corrected throughout text. lines 18-22. I agree with this sentence that, on the other hand, sounds a little trivial. I found also a little contradiction. The authors propose that a scientifically wider approach is needed to face the Apennine chain, but in turn, they never discuss the long wavelength topographic evolution, or the role of the deep processes, etc.

Introduction The "basins and ranges" term is used here to describe the topographic aspect of the Apennine chain. Also if the use is not completely exact from a geodynamic point of view, I approved this use, limited to the topographic description. I disagree the use of the "basin and range" when it is coupled with terms such as structure, model, etc. I think that a general map of the Central Apennine could help the readers to localize the studied area.

Methods I am not a specialist of this technique, but I find that the ambient seismic noise is perfectly appropriate to the aims of this research. I am not totally convinced to place the methods paragraph just after the introduction. The risk is to break into the line of the reading between the introduction and the geological setting.

Geological background Since the Pliocene the two tectonic phases are active together. The evolution through time and space of the two phases needs a better description. line 30 Saw? change, please.

Morpho-stratigraphic investigation I do not find necessary to specify that the data presented here has been collected during a PhD work. It sounds a little not professional. It is better to write it in the acknowledgements. Eventually, one time in the manuscript

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is enough. About paleomagnetic data and U-series dating. These data are already published? Why data are not presented here in detail? line 8 Phd work is better than project. 19 to 24 lines. Rephrase the sentences, please. Change: this, this, these. line 25. River incision produces (or other synonym) rather than defines. line 27, "borehole for water" sounds awkward. better "for water extraction" or synonym.

Evidence for the long term (Quaternary) activity of the SVF about the title: I suggest to change the title to leave Quaternary only. I am not convinced of the fault timing. I agree that you constrained that western splay is post lake basin infill. But, about eastern fault, the timing is uncertain, if you do not show evidence of clear relationship between faulting and sedimentation. If eastern splay bring evidence of synsedimentary activity, I agree that eastern is older than western plays. Otherwise, the timing is not clear: for example, the eastern splay could have cut the surface eastward beyond the lake sediments, and could be younger.

New data from the Avezzano-Bussi faults The paragraph needs to be a little revised. The authors should try to report more details on the fault geometry and kinematics. Adding the plots of the structural data would greatly improved the quality of the manuscript. In this form, it seems that the authors describe some structures already analyzed in previous published works (Giaccio et al. 2009, Gori et al. 2014, Falcucci et al.2015, etc.).

lines 13. delete here line 18 where is Popoli on the map?

Discussion The deep structure of the Sulmona basin and the relationship between ABF and sediments are not clear. The asymmetry discussed in the manuscript, is not evident in figure 8. In figure 8 the fault trace is quite far from the sediments, therefore it is difficult to be convinced that ABF could control sedimentation of the Sulmona basin. On the other hand, in figure 9 the sediments of the Sulmona basin are drawn in contact to the fault trace like if sedimentation is controlled by the fault movement. The figure 8 and figure 9 show some discrepancies. About the comparison with Fossa-

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San Demetrio basin, I am not convinced on the similarity of the deep shape of the two basins. The Fossa-San Demetrio basin looks clearly NE-SW oriented, conversely to Subequana basin.

line 3. change which with that line 4. perspective? the term do not look appropriate
Lines 5 to 7. No evidence of Quaternary activity between Subequana valley and Fucini basin could be due to lacking of suitable deposits? May it could be better to chage the order: number 2 seems the main shared characteristic between Subequana ad Fucino basins.
line 13. To be fair, I do not see the asymmetry from figure 8.
line 18. change route.
lines 25 to 26. The last sentence does not seem necessary
line 35. Remove formation of

Concluding remarks Rather than conclusion, this paragraphs shows important discussions about seismogenic implications and tectonics model. The Tre Monti fault it is not shown in the map. I find interesting the comparison of the data obtained with different interpretation with models proposed in literature (see for example works from G. Roberts and A. Michetti). I think that improving this part of the discussion would attract interest of international audience. The discussion of the comparison with Benedetti et al., seems too limited and should be improved. Moreover, in Benedetti et al., 2013 the authors specify that Tre Monti fault is a minor fault and the slowest fault of the Fucino fault system. It would be nice for the reader to show a comparison of the Apennine example with other tectonic setting in the word: I am wondering to know if interaction between two orthogonal faults systems is described in the other extension domain and mountain chain.

line 1 pag 13 It is not only an assumption, but an interpretation based on the analytical data from all the fault planes analyzed at regional scale
line 27. the second one is not a result.
line 29, Benedetti et al., 2013 is not in the references list.

Figure Figure 1. I think that a general map of the Central Apennine could help the readers on the location of the structures and studied area. I suggest to the authors to

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change the 3D view of the figure 1 with a simple topographic map. The 3D view makes difficult to detect the fault orientation and the trace on the topography.

Figure The label "young Stefano Gori for scale!!" could be nice, but personally I find it too familiar, and I suggest to remove it.

Figure 9 See the general comments. I think that model of figure 9 should be modified to make it consistent with the figure 8 and the data.

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