

Interactive short reply to comments provided by Reviewer1, se-2019-108-RC1-supplement.

Solid Earth Discussion Paper:

Using Seismic Attributes in seismotectonic research: an application to the Norcia's Mw=6.5 earthquake (30th October 2016) in Central Italy.

Maurizio Ercoli, Emanuele Forte, Massimiliano Porreca, Ramon Carbonell, Cristina Pauselli, Giorgio Minelli, Massimiliano R. Barchi.

Dear reviewer1,

thank you for your positive comments and very useful suggestions on our manuscript.

Obviously, we have to wait for additional comments from all the reviewers before providing a complete review of the paper. However, we here anticipate that we intend to address most of your comments and suggestions, and we add some further comments on your review, which will be very useful for improving our manuscript.

We have already addressed all the minor corrections, whilst regarding the main points of concern, here below you can find our current reply:

1) We will improve the order and structure of the text regarding the data presentation, better distinguishing the data from the interpretations. We will use univocal codes for the faults and other features in the images, as suggested.

2) We are improving the main scope of this work, that aims to demonstrate how the seismotectonic studies based on seismic interpretation can benefit of the enhancement provided by attribute analysis, even in case of *vintage and poor-quality data*. ***Such data are often the only available data for seismo-tectonic researches, and are worth to be use in the most appropriate way for constraining the subsurface geological setting.***

Moreover, we understood from the reviewer's comments that we have to reinforce and discuss in greater detail the seismotectonic implications of our work, highlighting the impact on the comprehension of the presented case-study.

We strongly agree with the reviewer on the need of using the external datasets to validate the proposed interpretations. So, we want to clarify how the fault distribution at the surface (as derived from analysis and comparison of ALL the existing maps) fits with the faults traced in the seismic interpretation. Such data includes a detailed summary of the main normal faults and surface ruptures of the area, obtained after carefully checking the most important geological maps in literature. We specifically refer to Pierantoni's map, but we have looked also at other regional geological maps at 1:10'000 and 1:100'000 scales, as well as the most recent ones published in literature. The other important external data-set consists of the seismological data, i.e. location and fault geometry as suggested by the focal mechanisms of the mainshocks and by the distribution of the aftershocks.

In addition, we'd like to remark that there is any deep borehole stratigraphy available for this zone (all details about surrounding deep wells have been already summarized in Porreca et al., 2018).

However, following your advice we are going to improve the geological details on the faults adding two different interpretations (with and without) on the same dataset, using clear and declared principles. In addition, we will surely reinforce the seismotectonic discussion, to better fit the manuscript title.

3-4) Thank you for suggesting additional articles about seismic attributes. Approaches like in Jacopini et al. are able to provide more quantitative results, specifically on 3D offshore data volumes that allow to test more

possibilities and have optimal spatial resolution; on 2D lines the computation of attributes has clearly more limitations, so we emphasise that the results are possibly limited, but we think this is definitely important when no other data are available.

So, we started our analysis by using first well-known and widely used attributes like the instantaneous amplitude, phase, frequency, and their combinations. Then, we have also tested attributes more suitable for 3D volumes (like coherency/similarity etc...) but they didn't perform so well due to limited vertical and spatial resolution of the data. Therefore, among the several attributes computed, we have selected the Energy, Energy Gradient and Shaded Relief, that provided, in our opinion, the best results.

Anyway, as suggested, we will try to improve the manuscript discussion and description of the attribute results on the Fault Zones.

Yours sincerely,

Maurizio Ercoli and co-authors.