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Comment on egusphere-2022-229

Anonymous Referee #2

Referee comment on "Structural characterization and K–Ar illite dating of reactivated, complex and heterogeneous fault zones: lessons from the Zuccale Fault, Northern Apennines" by Giulio Viola et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-229-RC2, 2022

Paper: Structural characterization and K-Ar illite dating of reactivated, complex and heterogeneous faut zones: Lessons from the Zuccale Fault, Northern Apennines

Authors: Viola G. et al.

General comment

In this work Viola and co-authors provide insights on a new analytical approach in studying complex fault zones with a polyphasic activity. The authors combine multiscalar structural studies and fabric analysis to identify different structural-mineralogical facies within the fault zone. Relative chronological relationships defined among the occurring facies have then been used as the base to identify suitable samples for K-Ar dating of fault gouges. Age data relative to fault activity have been then framed in the orogenic evolution of the Northern Apennines.

The paper is well written and provide an integration to an already previously described methodological approach in studying brittle fault zones (Tartaglia et al., 2020; Vignaroli et al., 2021). The designed fault is well exposed and object of study of several works since 1990 (Keller and Pialli) and has been considered has as a reference example of a low angle normal fault in recent works (e.g. Smith and Faulkner, 2010; Collettini et al., 2011) due to its flat to shallow E-ward dipping and top-to-E transport direction.

The data here provided suggest a different interpretation, following the one proposed by Musumeci et al. (2015), and consider the Zuccale Fault as a thrust fault active at different times from the Aquitanian to the Miocene-Pliocene boundary. The provided interpretation is quite well supported by presented data but I feel that it needs a more detailed description of the relationships among fault activity and the intrusion of the Porto Azzurro pluton. In figure 9, the one that summarizes the tectonic significance of the Zuccale Fault, the evolution step in which the granite intruded the already formed stack is missing and I strongly suggest the authors to consider it in the in the figure.

I feel the paper will be ready to be published after a MINOR REVISION. Minor comments on text and figures are listed below.

Line 19: Add the acronym ZF after "Zuccale Fault". In other parts of the text "fault" is written within the initial cap: please select a form and use it in the whole text, or simply use the "ZF" acronym.

Line 31: "ambient" conditions instead of "environmental conditions"

Line 190: I will move here the discussion on the normal vs. thrust kinematics of the Zuccale Fault

Line 200-203: Please express here also the thickness and its lateral variability of the foliated domain

Line 235: 40 and 39 should be formatted as superscript font.

Line 241: Is there any information related to the depth of emplacement of the Porto Azzurro pluton

Line 316: The "Triassic Verrucano quartzite and metapelite" are named in several way throughout the text (the Verrucano Formation, the Verrucano Fm., the Verrucano….), please choose a form and always use it.

Line 388: Please add a brief description of the Calanchiole Shear Zone

Line 532: in “1Md” and “2M1” d and 1, respectively, should be written as subscript. Please check the whole text for this.

Line 534-539: This section is to my opinion too much speculative. I suggest to discuss in a more detailed manner this point.

Line 635-642: I feel this paragraph may be obscure to readers not accustomed to the Apennines geology. The extensional phase that affected the Northern Apennines and its timing need to be described in brief to better support the interpretation proposed by the authors.

Tables

Table 1: In the L4 box of the central column “phylonite” should be “phyllonite”

Table 2: Substitute “Whole-rock composition” with “Mineraogical composition “ or “Rock mineralogy”. The term “whole rock composition” usually refers to the chemical composition expressed in oxides weight %.

Table 3: Please express the significance of “40Ar*” in the table caption.

Figures

Figure 1: The color used for the Porto Azzurro pluton make it poorly visible. As it represents a key geological marker I strongly suggest to change color and make the pluton more visible. In the Italy inset I would add the label “Apennines”. Font size of the

legend in figure (a) should be increased. Figure (b) lacks of topographic labels, please add some.

Figure 2: Please add a vertical scale to the Fence diagram. I suggest to include in the legend also the granitic sills within the Cretacopus flysch, or at least add them in the text near the color box.

Figure 3: I suggest to add a scale bar in figure (a) and (b)

Figure 6: Add a scale bar in figure (a) and (b) or described the width of view in the caption.

Figure 8: It would be useful I order to ameliorate the figure to use for dated samples the same color code used for the BSF's in figure 2 and table 1. Please explain I the caption the significance of the error bars.

Figure 9: As already explained in the general comment, I feel that another evolutionary step, placed between the second and the third, that show the intrusion of the Porto Azzurro pluton is mandatory. This step would serve to show which are the structures cross cut by the intrusive bodies and which tectonic units underwent thermal metamorphism close to the intrusion.