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Solid Earth Discussions

Interactive comment on "Extensional reactivation of the Penninic Frontal Thrust 3 Ma ago as evidenced by U-Pb dating on calcite in fault zone cataclasite" *by* Antonin Bilau et al.

Anonymous Referee #2

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REVIEW of the paper SE-202-119

Extensional reactivation of the Penninic Frontal Thrust 3 Ma ago as evidenced by U-Pb dating on calcite in fault zone cataclasite by A. Bilau et al.

This paper presents the first attempt to date the extensional reactivation of the so-called Penninic Frontal Thrust PFT in the Southwestern alpine arc. The paper is concise, well organized and well written. It brings new important quantitative data for the understanding of the late-alpine tectonics in the Southwestern Alps as a whole. A weakness of the paper concerns the relevant bibliography, that must be improved, mainly in the introduction and discussion parts.

Indeed, I do recommend the acceptation of the ms. in Solid Earth, after minor revision.

I detail hereafter step-by-step recommendations.

abstract - line 29-31: the discussion on the coeval extension in the internal zones and compression propagation in the external zone is not well constrained/dated and is not properly address in the discussion part of the ms. a specific paragraph could be added in the discussion. However, it is not a key point of the paper, and could be discarded.

1. introduction - line 46: does the PFT really acted as a "plate boundary"? eventually discuss and/or present the structural relations between the Briançonnais and the external zone. - line 48: also refer to Sue and Tricart (1999, Eclogae Geol. helv. ; 2003, Tectonics) for the reactivation of the PFT in extension and the description of the regional fault system. - line 51 also refer to Sternai et al. (2019, ESR) for the isostatic/buoyancy forces discussion.

2. Geological setting - line 64 67: the concept of "plate boundary" implies to consider the briançonnais zone as a single (micro)plate. I do think that this point deserves a longer analyze, specifically in terms of paoleogeography. Quote also Tricart, (1984, Am. J. Sci) for the PFT top-to-the-west thrusting history. - line 68: Zhao et al (2016) is an important reference in the frame of this ms. but not on the nappe-related structure. Write a specific sentence for the lithospheric structure seen by Zhao et al. - line 80-82: also quote Agard (2002 J. Metam. Geol). - line 94-95: also quote the synthesis of Bertrand and Sue (2017, Swiss J. Geosci.) - line 97-101: the overall seismotectonic local framework in the study area, including geodesy, should be better exposed. See for instance the recent paper by Mathey et al., (2020, GJI). the same matter arises in the discussion part. - line 96: Note that the very first reports of the brianconnais' seismicity has been published by Rothè (1941). The seismotectonic regional frame is first described by Sue et al. (1999, JGR); these references could be added. - line 101: the Jenatton et al (2007) and Leclère et al. (2012)'s works focused on the Ubaye swarm, to the South of the study area, which actually occurred West of the PFT, in

relation with fluid circulation. This thematic could be discussed in the ms., but in a specific paragraph, as these works are not directly connected to the PFT reactivation. - line 120: the same Oreac section has been described by Sue and Tricart (1999, Eclogae Geol. Helv.) in term of brittle deformation and related paleostress.

3. Sampling strategy and analytical method - this part is well organized, precise and informative.

4. Results fig4a: could you provide the corresponding photography? give also a close-up location map of the samples (smaller scale than fig.2). - line 243 and following: better explain the stable isotope results, for a non-specialist. - line 262-263: the comparison with the Mont-Blanc ECM is very interesting. It must be better developed in the discussion part. In the present form, the last sentence of the paragraph is unuseful. Either discard it, or (better) develop a bit more. - line 275-276: better explain this sentence (re-write). - line 277-283: these ages are very good regarding the questions still under debate on the overall late extension thematic. Moreover, they represent the core of the paper. I would advise to better underline the quality and novelty of these pretty young ages. - Fig7 could be enlarged. The figures and words embedded in the panels are not legible.

5. Discussion the overall discussion is written with a pretty affirmative tone. I suggest the authors to use more careful words in their interpretations. - line 319320: precise and rewrite the 3 points (i) (ii) and (iii) in a more logical way. - line 332-333: this sentence is unclear. rewrite and develop a bit the concept you wanna describe. - line 340-345: the comparison with the Mont-Blanc ECM deserves to be better developed. I would suggest to writte a complete paragraph on this comparison, eventually supported by a new specific figure, including a map view of the related MB vs. Briançonnais contexts. Concerning the MB's exhumation processes, quote at least Seward and Mancktelow (1994, Geology). - Line 347, together with Zhao et al (2016), the references to the ECORS profile and related interpretations regarding the PFT at depth must be quoted (e.g. Mugnier et al., BSGF 1993). I also suggest to quote the ECORS

cross-section re-assessed by Schmid and Kissling (2000, Tectonics). - line 380: the fault dated in the ms. "may" represent a paleo-HD fault. It is still an interpretation. - line 389-400: this very small paragraph on "evolution through time" (indeed from c.a. 3 Ma up to now and the active deformation) must be better developed and improved. A map of the active deformation at the local scale could be interesting. The paragraph should integrate discussion on the uplift, which is not restricted to the ECM, but also affect the inner area (Nocquet et al. 2016; Sternai et al., 2019), together with the extension seen both in geodesy (e.g. Walpersdorf et al., 2015, J. Geodyn) and looking at the focal mechanisms of earthquakes (Sue et al. 1999 JGR ; 2007 IJES). Indeed, such a discussion should bring the gap between the current activity of the Briançonnais area, which is well constrained, and the "late alpine" faulting, which is now well dated by the present paper.

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