

Dear editors,

Thanks for the reviews. We are pleased to propose you a new version of our manuscript following the review phase. We have responded point by point to the remarks/suggestions/corrections of the reviewers. We have submitted our detailed answers on the website (supplement files: "se-2021-46-RC1-detailed-response" and ""se-2021-46-RC2-detailed-response". Please also find our detailed responses following this letter). We have made the necessary changes and corrections in the text ("Kalifi_et_al_manuscript_se-2021-46-review1-correction-track" file) and the figures were updated. The main changes we have made are:

- The appendices are now all included in the Supplementary data. The calls to figures have been updated in the manuscript and the figures.
- The discussion is reorganized as follows. Two paragraphs were added, and the numeration is updated (see below – changes are underlined).

5.1 => 5.1. Genetic relationships between the stratigraphical domains and the fault zones (FZ)

5.1.1 => 5.1.1 The FZ1 activity (Phase 1)

5.1.2 => 5.1.2 Onset of the SAL, GF and FZ2 faults (beginning of Phase 2)

5.1.3. => 5.1.3 Onset of FZ3, FZ4 and FZ5

New => 5.1.4. Timing of the end of deformation

5.2 => 5.2 Sequence of shortening of the Southern Jura and Subalpine massifs

New => 5.3 Comparison of deformation phases affecting the Miocene molasse in western Alps

Thank you in advance for continuing the submission process,

Yours sincerely

Amir KALIFI

In behalf of all co-authors

Here follow our responses to the review by Thierry Dumont (RC1) of our manuscript submitted to Solid Earth.

Reviews are listed in black - italic while our answers are in blue - plain text.

49-51 N-NW directed from Eocene to earliest Oligocene, driven by Adria-Europe convergence, then W directed motion driven by extrusion of the internal W Alps, leading to the radially propagating arc.

The sentence has been modified.

59 *"..Vercors and Chartreuse.."* Done

60 *"..NNW-SSE trending Miocene thrusts.."* Done

63 *"..date from the late Burdigalian.."* Done

65 *"Further south, .."* Done

73 *"..well-logs and field sections."* The sentence has been modified.

77 *"as a response to the western propagation of the Alpine orogen during the Miocene."* Done

81 also quote De Graciansky, P.C. de, Roberts D.G., Tricart P. (2011), *The Western Alps, from rift to passive margin to orogenic belt, an intergated overview. Developments in Earth Surface Processes, 14, Elsevier, 398p., ISBN 9780444537249* Done

103 *"..the westward progressive migration..?"* Done

105 *fluvial deposits?* Done

108 *"..folds and thrusts affecting the sedimentary cover, trending NNW-SSE.."* some folds are ~NS? "last WNW-ESE shortening phase" is overinterpreted, paleostress cannot be assumed to be perpendicular to present fold trends, nor can be determined along balanced cross sections whose orientation was chosen à priori.

Here we refer to published work. Furthermore, if the exact direction of compression cannot be known precisely the apparent direction of shortening is approximately perpendicular to the fold axis.

112 please locate (from N to S of what?) The sentence has been changed to clarify that point.

120 a more recent ref. about the Moucherotte thrust is still missing (Donzeau, Gamond & Mugnier, CRAS 1993 vol 317 p. 1675) The reference was added

146 split the sentence after Gidon, 1964 Done

150 *"..the Jura fold belt is progressively widening northwards."* We Changed the sentence to "... Jura synclines widen progressively northwards. »

151 *"..anticlines that develop in the hangingwall of blind thrust.."* Done

160 also quote Lickorish et al. (2002) GSA Bulletin 114, 9, p. 1089 168 *".."* Done

168 from 35 well-log and outcrop sections.. We kept the original formulation.

171 scale resolution? Done

331 *"..in the footwall of the Penninic thrust.."* Done

347 *"..thrust over.."* Done

349 not sure that "a saddle of the folds" is correct.. We now use "fold saddle". We hope this his correct.

357 *"new field observation"* should require structural measurements, only landscape views are presented.

If the figure 6 mostly shows landscape views our study is based on observations including measurements at more than 200 stations. Also see related general comment above.

358 "suggest" incorrect We changed the sentence to "We combine new field observations with the published geological maps and other publications to produce a new structural map..."

361 does it mean that the Sassenage anticline is partly older than Miocene? to be demonstrated, fig. 6B does not show anything This is a simple description and it does not imply that the Miocene deposits are unconformable. This is what can be seen on Fig. 6B. We have added "conformably".

361 "On each side.." Done

362 how can you determine fold trends so precisely without structural data? not visible in fig. 7a. We indeed have several structural measurements that are now plotted in Fig. 7a, and other ones none plotted. All structural measurements are now given in Table S6 and stereograms used for calculation of fold trends are presented in Fig. 7.

364 a better argument than the map trace would be a view of 3D geological map. Yes, we have added Fig. B1 that shows 3D views of the geological map of Fig. 7.

365 this is already proposed by Gidon 1995, fig. 1, must be quoted Done

367 is this left-lateral displacement necessary considering the dip of the Neron-Moucherotte thrust and the topography? 3D view would be useful We now also refer to the new Fig. B1

389 what means "...at 210 stations"? where are the location/data? should be removed if it is not presented. I do not find this detailed map of the Moucherotte thrust. Would require at least 3D map view for discussion.

It means that we have performed field work at 210 stations with landscape observations (some of which are shown in Fig. 6), and / or stratification and fault measurements. Only the stratification measurements are plotted on Figure 7. That figure is intended to be the detailed map of the Moucherotte Thrust, and we have added Fig. B1 for 3D views. All structural measurements are now given in Table S6.

391 "...thrust above the Miocene on top of.." Done. This part of the text has been changed.

395 this thrust at the base of Comboire cliff is not the main Moucherotte thrust because the footwall rocks are Berriasian, whereas the footwall of the main thrust should be younger (Valanginian, see Gidon, geol-alp website, page Comboire, and quote it). The argument is difficult to understand from your text. This part of the text has been changed and the cross-section has been modified.

401 "...overlain by.." Done

402 fig. 6C? "...the lower Cretaceous strata are steeply dipping eastwards" Done

403 text description very difficult to follow This part of the text has been changed.

405 "...in the footwall of the thrust." Done

414 "extend" Done

417 "...but dips locally to the west, strongly suggests that.." This part of the text has been changed.

419 in contradiction with the trace of the "Corenc tectonic window".. Not sure to understand this comment. There is indeed a large uncertainty of the precise mapping in the Grenoble area. The precise mapping of the thrust(s) and potential window(s) and klippen(s) is hidden by the Quaternary cover. We have added a question mark in that zone to stress out that the mapping is still unclear. Furthermore, there is a large anticline (Ecoutoux Anticline) that appears to be a late fold, but that is distinct from the Conest one. Our text was ambiguous to this respect. We have changed the text and hope it is now clearer.

420 no, "External Belledonne" is basement, here this is cover The formulation has been changed.

424-425 the displacement along the "Corenc-Jalla" thrust seems much lower compared to Neron. Yes, possibly. We still have to work on that aspect. The corenc Jalla is possibly only one branch of the Neron thrust. But this would not change our general conclusion.

431 I do not understand this sentence, please clarify. The sentence has been changed to be clearer.

435 there seem to be confusion between a "thrust" and a shear zone, what is the thickness of the folded section? It is clearly indicated that this a shear zone, not a single thrust. We have added an estimate of the

thickness of the thrust zone.

438 *Bellahsen et al do not figurate a complete detachment across the Bauges massif.* Well, if it is true that it is not clear on all figures of Bellahsen et al., 2014 but its figure 9 depicts in red “Thrusts of the “Aravis-Granier” units” and the legend states:” Finally, in red, we have represented the thrusts that correspond to the detached part of the ECM cover; i.e., upper part of the Mont Joly unit for example. In other words, along the Préalpes-Mont Blanc section (NE section), the whole Mesozoic cover of the Mont Blanc is represented by the Morcles nappe, while along the Bornes section (SW Mont Blanc), the Mont Joly (French Morcles) is only made of the lower Jurassic layers. The rest of the cover is displaced and composes the “Aravis-Granier” unit ».

446 *once again structural data should be synthetised in stereograms, not as individual numeric values in the text.* A stereo diagram has been added to Fig. 8B

450 *may be this can be interpreted as southward decrease in thrust displacement as for FZ1?* Here we speak of FZ2. At this stage of the text we do not aim to discuss the amount of motion, only the map trace.

453 *veers? sentence unclear* We now use “turns” that is maybe more clear.

455 *this is the classical view from the Grenoble 1/50000 sheet and Gidon papers, see also Dumont & SPIA, 2020, Geol Soc London Spec Publ 486 doi:10.1144/SP486-2019-92.* The two references have been added.

470 *"Its interpretation suggests that.." Complicated discussion, it appears that the S-N continuity of the individual thrust zones is interpretative and debatable, even with the help of seismic profiles.* We agree and now use “suggests”.

485 *not found the OU thrust in fig. 9B, inherited from Deville 2021? check consistency:*

Outherans/Outeran, SA anticline not on fig.10, FZ1 text is 1 on fig.10. We have now located The OU thrust on Fig. 9B. The correct spelling is Outherans. No mention of the SA anticline in this sentence. We checked that the CS anticline appears both in Fig. 1 and 10.

489 *why "west-dipping GF"? seems to be E-dipping everywhere* Yes this is “east-dipping”

496 *I do not understand, the potential connection is not visible on the profiles of fig.10.* This is the point so no definite option can be reached.

504 *"..by steep west-dipping.." Done*

509 *"..offset is estimated to.." Done*

508-511 *major thrust .. (FZ3) / the main fault (3) : be consistent in the text description Done*

516 *offset along 4 + 4a on line 82... looks greater than 650m (~1,5km?)* We agree, it was a mistake, and we have calculated 1.24km

526-530 *this presentation is a bit oversimplified, both thrust traces and fold trends vary between NS and NE-SW, and even NW-SE following the interpretations about the FZ continuity in Jura.* We now say “mostly trend”.

534 *further north what? BZN1 quite impossible to locate on fig.1, too small. What is the importance of this triple occurrence of Js? ("duplicated three times" means that Js occurs 6 times?).* The sentence has been changed.

535 *"an uplifted compartment" where?* The sentence was modified as follows: “Seismic imaging suggests the presence of a thrust uplifting the Brizon basement high (Le Guellec et al., 1990).”. The Brizon basement high was added on Fig.11 A, B, C, D.

543 *quote fig. 18 or remove?* We now quote Fig. 18.

545 *"Klippe" is just a result of erosion, it does not have any implication in terms of displacement or location of "roots"* The sentence has been changed.

550 *.. or simply that Subalpine and Jura thrusts cannot be individually connected?* This is always a possibility but it is not the one envisaged in the literature.

552 also quote Lickorish et al., 2006; Deville 2021. Do you mean Lickorish et al., 2002? We now cite Deville 2021.

555 veer? We now use “turn”

566-572 this discussion lacks kinematic data, in the absence of which it is not possible to decipher the relative chronology between thrusts and transfer/strike-slip faults. Similarly, the orientation of compression cannot be constrained from maps only. Do the southern Jura thrusts imply a NE-SW compression? It is right that the direction of the folds cannot be used simply and systematically to deduce the direction of shortening. However it is also true that these folds and strike-slip faults are all compatible with an ESE-WNW compression.

580 "In the footwall of FZ1.." Done

587 "..in the footwall.." Done

588 ".. the deposition of Oligo-Aquitainian sediments" We keep the original formulation.

591 "..both Oligocene and early Miocene sediments.." Done

683 "are proposed using the.." Done

718 ".. while the regressive systems tract.." Done

723 (and elsewhere) "Therefore, the sequences S6 and S7..." Done

724 "..is either synchronous or sequences .." Done

751 and §5.1.1 there is no direct evidence of the activity of FZ1 as soon as early Oligocene, the Oligocene sedimentary sequence is compatible with a flexural foreland but, as said line 763, the eastern boundary of this basin is unknown. Moreover, Oligocene is transported in the Bauges massif, suggesting that the orogenic front was located further east. This option should be presented as an hypothesis and the phase 1 (P1) on fig. 16 put in dashed line.

As mentioned in one comment above, we modified the text as follows:

“The upper Oligocene-lower Miocene tectonic front is therefore located east of the Rumilly syncline. Since marine Miocene deposits have never been described east of FZ1, we believe that it already formed a morphostructural barrier during the first marine sequences (S1a-S1b; 21.0 to ~18 Ma, Fig. 4B, C) and was thus active at least between ~21.0 and 18 Ma, and possibly as early as 29 ± 2 Ma. However, in the early stage, the active front could as well have been located east of FZ1, for example along the Entrevernes thrust [E] (Fig. 1B) or even further east, and other arguments are still needed to decipher the ante-21.0 Ma structural history.”. The possible pre 21 Ma activity of FZ1 now appears as a dashed line with question marks on fig.16.

792 what means « concordant on the folded Urgonian », is Miocene folded with Urgonian ? Yes. We have changed the sentence to make that point clearer.

797 the wavelength of flexural subsidence is several hundred km , consistent with the lithospheric thickness, this process can hardly be involved for a depocenter in the footwall of an individual thrust.

We think that this process can be involved because in the footwall of the orogenic front, two processes are adding up: (i) long-wavelength lithospheric deflection in response to subduction process, and (ii) the topographic loads in response to the growing orogenic front. Adding these two processes, the long-

wavelength lithospheric deflection curve is accentuated near the footwall of the orogenic front, and the maximum of subsidence is recorded in the footwall of the orogenic front (DeCelles and Giles, 1996; Schlunegger and Kissling, 2015).

803 hypothesis Done

805 "*..the thrusts that are interpreted to root beneath the Belledonne massif..*" Done

806 *uncorrect sentence (and the S6 sealing...)* The sentence has been changed.

807 "*end of phase 2*" is time, "*in the subalpine massifs*" is location, unclear. The sentence has been changed.

809 "*..are overthrust by the Jura units..*" Done

810 *posterior younger than..* Done

812 *tectonically-controlled..* Done

813 "*..even perhaps coeval with the deposition of S7 continental sediments*" Done

829 "*..suggests that thrust activity stopped after the deposition of S5. There, the uppermost marine..*" Done

834 the link between the arguments presented since line 828 and "*activation of out-of-sequence thrusts in an internal position*" is unclear. Moreover, such structures should produce subsidence in their footwall, not uplift; and isostatic rebound is mentioned line 833. So please clarify your interpretation of a "*tectonic event*" involving "*lithospheric processes*", it is now clear that the recent uplift of the W Alps is not directly linked with plates convergence, and is probably not "*tectonic*".

This part of the discussion has been changed (new paragraph 5.3)

This part of the text now reads: "The following structural history however strongly differ between the north and the south: at ~13 Ma in the Aar the deformation front appears to have quickly migrated more than 50 km to the NW to form the Jura, while it ended at ~12 Ma in front of central Belledonne. However, some observations suggest that the Bas Dauphiné experienced uplift after 12Ma. In the western and southern parts of the Bas-Dauphiné basin and the Crest basin (respectively, J, K, L zones, Fig. 3) the Miocene final sea retreat is recorded during deposition of sequence S7 (~10 Ma, Fig. S13, 14, 15, 16). The absence of marine deposits during S8 (~9,5 to ~8 Ma) is unexpected, as it corresponds to an eustatic transgression corresponding to a higher sea level (+40 m) than that of sequence S7 (+5-10 m, Miller et al., 2005, Fig. 4B). This implies that the ~10 Ma Miocene sea-retreat was induced by a basin-scale event. In the north-eastern part of the Bas-Dauphiné basin (F, H zones, Fig. 5), the uppermost marine deposits (sequence S6 regressive deposits, ~11 Ma, Fig. S10, 12) outcrop today at elevation of ~350 m.a.s.l. (Fig. 14B; Fig. 15A). The sequence S6 transgression involved a +25 m sea-level rise which suggests a post-sequence S6 (12 Ma) minimum uplift of ca. 325 m. This is in agreement with Deville et al. (1994)'s observations implying a post-Langhian uplift. These authors interpreted this uplift as the result of a crustal thickening due to a crustal imbrication under the molasse basins, implying the activation of out-of-sequence thrusts in an internal position of the subalpine massifs. However, these thrusts have not been clearly indentified. Another possible interpretations are that this uplift would be link to the activation of late backthrusts such as those described along section C (bkt1 & bkt2, Fig. 11), or to a deeper process."

855 *backthrusts are compatible with thrusting, they do not need another tectonic phase?* They do not need to, but it is our interpretation. The sentence has been changed to clarify that point.

875 *the onset of phase 1 as soon as early Oligocene is not well constrained, must be given as hypothetical.* Done

875-880 *there is an overlap between phase 1 and 2? (17,8Ma+/-?? - 18,05+/-0,25Ma), better use Early Burdigalian line 875?* From our data there is possibly a slight overlap, but it is beyond our temporal resolution. So, we will not discuss this in details but keep the numeric ages for comparison.

881 the "Belledonne basal thrust fault" is actually unknown, no outcrop, no seismic, no borehole. Must be presented as an interpretation.

We now present this as an interpretation.

899 "..recorded after the deposition of S5" Done

901-903 I do not understand which tectonic structure could be involved to explain this uplift by tectonic processes in Bas Dauphiné? there is no evidence of shortening, and the situation is different from the N Alpine foreland.

See answer to comment on line 834 above

Figures

Figures are generally of good quality, and contain a lot of information, but will be hard to read on a paper copy.

Figs 4 & 5 dense but clear, this is the core of the data

Figure 6: A and B are not very clear because of backlight Modified

a 3d view of the geological map draped over DEM would perhaps give a better overview.

We now Provide Fig. B1

Picture H can be processed to get better colours Done

Fig. 7: Why are the cross-sections named both with numbers (1-6) and letters (B-G)? confusing. I do not understand the trace of the east part of FZ1 outcropping both W of Corenc and E of Grenoble, not compatible with cross sections 1 & 2. Only letters of sections are now used. The FZ1 trace east of Grenoble was removed with a (?).

Fig. 9: are the interpretation based on Deville 2021 or were the lines completely reinterpreted? must be clarified. The lines were completely reinterpreted and it is clarified in the Methods. It will be also clarified in the Fig.9 caption

Fig. 11: I remain reluctant considering the FZ1 detachment over Belledonne in section A, and I totally disagree with its trace above Belledonne in section D: the normal fault offset is Jurassic as demonstrated in the 80s (La Mure fault) as the Liassic series have very different thickness on both sides (Lemoine et al., 1986). Must be changed.

We do agree that the eastern part of our cross-sections B and C are questionable and that of section D was not accurate, as it is clearly not the focus of the manuscript. Question marks have been added to the "Accident median" (AM) and the La Mure fault now clearly appears as a Normal fault (pink) in section D.

Fig. 13: sections identified using both n° and letters (3 = A, 4 = B etc.), keep only n°? Only n° of sections are now used

Fig. 15 please refer to the location of transects on a map It is referred in Fig.3. The reference was added in the caption of Fig. 15

Fig. 17: the activation of FZ1 to the east is not consistent with the occurrence of Oligocene deposition in the future Bauges massif, that is in the hangingwall of the thrust. The activation of the Belledonne thrust as soon as ~20Ma is in contradiction with the exhumation ages which are younger.

See answer to point 2) and 4) above. FZ1 fault history was possibly complex and most probably propagating during Upper Oligocene from the Entreverne thrust to the frontal thrust called FZ1 in this paper. In this scenario, the presence of Oligocene deposits in the hangingwall of the FZ1 is possible and not contradictory with the activation of the Belledonne basal thrust. The exhumation age of Belledonne is not yet precisely constrained and some new data suggest that it could be older than previously thought, but this point is beyond the scope of this paper.

Fig. 18: (A) = cross-section B; (B) = cross-section C. confusing! "restoration" We think that there is no solution to this issue

Here follow our responses to the review by Fritz Schlunegger (RC2) of our manuscript submitted to Solid Earth.

Reviews are listed in black - italic while our answers are in blue - plain text.

Line 184: samples collected in the field (not on the field) Done

Lines 189 and 190: The terms 'comprised' sounds odd to my in this context. Done ("Comprised" not essential, has been deleted)

Line 232: outlier samples and not outliers samples Done

Line 267: The term 'allocated' sounds odd to me in this context. Done, replaced by "provided"

Line 394: The marls did not deposited.... -> The marls were not deposited. Done. The sentence has been changed (line 505).

Line 396: They rather deposited....(they deposited what?) -> They rather accumulated Done, the sentence has been changed to:

"These marls, previously mapped as Jurassic (Vif geological map; Barféty et al., 1967), are rather Early Cretaceous in age based on the occurrence of Berriasella (Gidon, 2020a)."

Line 401: a boxed anticline overlyied by -> overlain by. Done

Line 446: the faults strike N3, 40°E -> something is missing @N3 Done: N3°, 40°E

Line 566: I could not find the South Jura transfer zone on a map. The name was added in Fig. 1

Line 570: I could not find the left-lateral and right-lateral faults The left-lateral faults are in violet and the right-lateral faults are in blue, as it is mentioned in the legend of Fig.1

Lines 583 and 584: I guess that the thicknesses of 1838 m and 1716 m are taken from a seismic line, which will have their uncertainties. If correct, the precisions given here (to the meters) need to be tuned down.

These data are from well log data:

“Indeed, these deposits are ~200 m thick west of the Rumilly syncline (Fig. 9C, D) (Enay et al., 1970; Gidon, 1970b), while to the east, they reach 1838 m between the footwall of the FZ1 and the hangingwall of the SAL fault (SLV2 well data, Fig. 10A, B), and 1716 m at the footwall of the SAL fault (SV-101 well data, Fig. 10A, D).”

Line 600: Firstly -> First, then second (not secondly), and then third (not thirdly) Done

Line 629: use a different term than 'brutally' (perhaps appropriate for a movie, but not really in a scientific article) Done, replaced by “sharply”

Line 632: A thickening can also be associated with a backstepping of depocenters (in case where sediment supply is lower than formation of accommodation space). Therefore, the inference that a rapid accumulation of sediment implies a depocenter migration is only correct if the sedimentary facies is considered as well. Please adjust accordingly.

Done, modified as follows:

“This firmly demonstrates that a depocenter localized close to section 4 (Fig. 13) appeared during S2a. Subsequently, the thickest accumulation of the following sequence (S2b) lies further west, at the Forezan locality (275 m, section 5, Fig. 13). This lateral variation of the thickness is associated with significant lateral facies variation characterized by a dominance of proximal marine deposits to the east (950-1015 m, section 4, Fig. 13), while to the west, S2b is mainly represented by distal marine deposits (700-920 m, section 5, Fig. 13), thereby suggesting a westward migration of the depocenter between sequences S2a and S2b.”

Line 636: 'It was never recorded thicker' sounds a bit odd to me. Please rephrase Done, replaced by “while in the Rumilly-Chambéry synclines area (Fig. 13), the sequence S3 was probably much thinner.”

Line 691: This interpretation of a complex inherited topography warrants further specifications. Done: “On the western edge of the Bas-Dauphiné basin, the absence of S2a-S2b deposits (to the northwest of PA-1, VAF-2 and MO-3 wells, Fig. 15A, B, C) and the thickness variations of the S3 sequence to the west of the Montmiral high (Fig. 15B, C) are attributed to a complex inherited paleo-topography (Kalifi, 2020) along the Oligocene West European Rift (Debelmas 1974; Curial 1986; Bergerat 1987; Ziegler 1988, 1990, 1994; Bergerat et al. 1990; Sissingh 2003).”

Line 759: According to DeCelles and Gilles (1996; Basin Research), Schlunegger and Kissling (2015; Nat. Comm.; my apologizes for this self citation), orogenic loads can have different components such as slab loads, topographic loads (both downward directed) and buoyancy forces exerted by a crustal root. Is it possible to be more specific when you talk about 'in response to orogenic load'?

Yes, thank you for the suggestion. It was detailed as follows:

“In a foreland basin, this geometry is consistent with a foredeep depozone located between the poorly subsiding proximal flank of the forebulge and the footwall of the active (tectonic) orogenic front, where the maximum of subsidence is recorded in response to the interplay between topographic loads and long-wavelength lithospheric deflection in response to subduction process (DeCelles and Giles, 1996; Schlunegger and Kissling, 2015).”

Line 773: Why is the deposit illustrated on the photo (the details are hard to see) a seismite? This interpretation is hard to appreciate without further information.

This interval was interpreted as the Facies F25 presented in Kalifi et al. (2020). It consists of a 15-meter-thick interval of tilted/disturbed autochthonous sedimentary layers containing 'Ball and pillow' structures. This unit is laterally continuous at tens of kilometers scale (Same unit was found in the same stratigraphic level, at the Forezan section n°5, 18km to the south). The organization of the autochthonous clasts of various size is chaotic suggesting earthquake-disturbed layers (i.e. seismites) and the lateral continuity at the basin scale indicate strong disturbance events.

Details are now given in lines 605-610 (modified in order to be more accurate): “Second, a 15m-thick interval (390-405m, Fig. 12A), containing disorganized monogenic clasts of various sizes (cm to pluri-m, Fig. 12C) and ‘ball and pillow’ structures (Fig. 12D), with a pluri-km lateral continuity (also described 18 km to the south, in section 5, at ~380 m, Fig. 2) suggesting an earthquake-disturbed layer (i.e. seismites, F25 of Kalifi et al., 2020).”

Line 833: What is the evidence for a rebound, and a rebound related to which process?

According to Deville et al. 1994, the isostatic uplift is linked with crustal thickening in response to new crustal imbrication under the molasses basin involved by a late active tectonic deformation (maybe the term “rebound” we used wasn't adapted). From Deville et al. 1994 :“ (uplift from the Langhian below sea-level to the present mean altitudes ranging between 500-800m, e.g., much higher than the mean altitude of coeval sediments in the Bresse basin; Bergerta et al, 1990). This could be related to the late active tectonic deformation of the foreland. Indeed, a possible interpretation could be the present development, at depth, of a new crustal imbrication that is suggested by the ECORS deep seismic results where a thickening of the lower layered crust appears under the molasses basin (Guellec et al., 1990a). The crustal thickening could be responsible for an isostatic uplift of the foreland. Note also that an active strong uplift is currently taking place in the SE parts of the Jura (Fourniguet, 1977).”

The sentence was modified as follows: “The following structural history however strongly differ between the north and the south: at ~13 Ma in the Aar the deformation front appears to have quickly migrated more than 50 km to the NW to form the Jura, while it ended at ~12 Ma in front of central Belledonne. However, some observations suggest that the Bas Dauphiné experienced uplift after 12Ma. In the western and southern parts of the Bas-Dauphiné basin and the Crest basin (respectively, J, K, L zones, Fig. 3) the Miocene final sea retreat is recorded during deposition of sequence S7 (~10 Ma, Fig. S13, 14, 15, 16). The absence of marine deposits during S8 (~9,5 to ~8 Ma) is unexpected, as it corresponds to an eustatic transgression corresponding to a higher sea level (+40 m) than that of sequence S7 (+5-10 m, Miller et al., 2005, Fig. 4B). This implies that the ~10 Ma Miocene sea-retreat was induced by a basin-scale event. In the north-eastern part of the Bas-Dauphiné basin (F, H zones, Fig. 5), the uppermost marine deposits (sequence S6 regressive deposits, ~11 Ma, Fig. S10, 12) outcrop today at elevation of ~350 m.a.s.l. (Fig. 14B; Fig. 15A). The sequence S6 transgression involved a +25 m sea-level rise which suggests a post-sequence S6 (12 Ma) minimum uplift of ca. 325 m. This is in agreement with Deville et al. (1994)'s observations implying a post-Langhian uplift. These authors interpreted this uplift as the result of a crustal thickening due to a crustal imbrication under the molasse basins, implying the activation of out-of-sequence thrusts in an internal position of the subalpine massifs. However, these thrusts have not been clearly identified and it is unclear how such thrusts could induce uplift of the Bas Dauphiné. Other

possible interpretations are that this uplift would be linked to the activation of late backthrusts such as those described along section C (bkt1 & bkt2, Fig. 11), or to a yet unclear deeper process.”

Line 836: ECMs = external crystalline massifs (please in full) Done

Line 885: Seismite, same as above. See answer above (line 773).

Line 887: 'brutal', same as above Done, replaced by “rapid”