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Solid Earth
Discussions

Interactive comment on "Determining the Plio-Quaternary uplift of the southern French massif-Central; a new insights for intraplate orogen dynamics" *by* Oswald Malcles et al.

Anonymous Referee #1

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This article from Malcles et al., presents a nice example of how cosmogenic dating of burial sediments can be used for landscape reconstruction. The multimethodological approach is particularly interesting, coupling cosmogenic and magnetostratigraphic data with geomorphological analysis and numerical model of lithospheric scale uplift.

The article is globally well written and consistently illustrated, even if as I point out below, some of the figures can be improved to provide a better understanding of the different datasets

The paper is reasonable organized the data are produced and interpreted state-of-the art and the line of arguments is generally consistent and convincing, and supports

discussion and conclusions. However, some improvement is required with respect to a couple of problems, such as the erosion trend used as input data in the numerical model.

The paper of Malcles et al. contributes substantially to reconstruct the landscape evolution and uplift history of the French Massif Central. The paper fits excellently in the profile of Solid Earth, and I would suggest publication after moderate modifications. Some general suggestions are listed below, and are complemented by specific comments in the attached pdf text file.

My main remark is related in the interpretation of the onset of the regional uplift. I find that the data well constrain the Plio-quaternary incision rates but the onset of the uplift is not well demonstrated.

Introduction The introduction does not follow a classical organization, and introduction is merged with the tectonic setting and with the list of hypothesis to prove. I do not dislike it, but I suggest to separate in a sub paragraph the discussion of the hypothesis that the authors want to test. About the three scenarios proposed I would like address your attention on the case of old uplift. The uplift could have started early and you could record only the last <5 Ma history of incision, a probably increase in the incision rates. The attached sketch explain the two alternative scenario and a possible relationship with the flat surface.

The age and the geological meaning of the flat upper surface is relevant to reconstruct the onset of uplift. Moreover, the relationship of the cave galleries with the upper flat surface and with the geomorphological markers should be better described.

Karst model One of the main point in using the cave galleries as ancient base level is to show that cave passages were really connected to the base level and that they are not only a perched level of preferable karst dissolution. For this reason I would like to see the profiles of the cave systems and its relationship with the river and eventually some photos testifying the phreatic style of the passages. Why haven't you dated

samples from the Leicasse cave, that is placed at high elevation? Higher levels exist (between 600 and 700 m) in the same region suggesting an old history of the uplift and incision. To show the sampling sites within the caves and the location of the caves on the topographic maps could help the reader.

Geomorphological analysis I found this part interesting and useful to put quantitative data in a regional scenario. I have some doubts about the paragraph organization: the three working hypothesis shown at the beginning seem a bit extraneous in a paragraph where the authors should explain how to extract the data and show the results. I suggest to rethink this organization. Also the title of the paragraph seems a bit out of context, better "analysis" instead of "evidences", for example. I wonder to see some pictures of the analyzed and discussed markers. The limit of 2° of slope is questionable. For me the problem is the topographic gradient of the entire margin. Along a NNW-SSE directed profile from Aigoual summit to the Cevennes fault the mean gradient is about 2°, with important local variations that show topographic gradient up to 4° (few kilometers SE to the summit of the Mt Aigoual for example). I would like to see if tilted plans between 2° and 4° exist. The limit of 2° is reasonable for Plio-Quaternary marker, but it is possible that older geomorphological marker could be more tilted. How the slope of each marker have been calculated?

Numerical modeling The approach is interesting and perfectly reasonable even if I am not the right person to evaluate the details. However, I have same remarks on the input data for the modeling. The authors used a regional distribution of erosion that do not correspond exactly to the published data. In figure 11 the maximum of erosion is placed at the top the Mt Aigoual, with value of 0.08 mm/yr (or 80 m/Myr) (please, change the dimension to homogenize text and figure). But, the values on top reach the minimum values testified also by the oldest thermochronological ages (long-term erosion) of Barbarand et al., 2001 and Gautheron et al., 2009. Also the cosmogenic denudation rates of Olivetti et al. 2016 suggest that the erosion on the top of the massif close to the margin is very limited (values of about 0.04 mm/yr). The values

increase along the flank, toward the lower elevation samples, confirmed by your new data set of incision rates. Therefore, the input data of the erosion distribution that the authors used for the modeling is a bit different from the measured data. I think that an erosion trend resulting bigger at lower elevation and minor at high elevation is not consistent with a process of isostatic uplift induced by erosion, supporting event more clearly the authors conclusions. I suggest to be more rigorous in the description of the geodynamic model: for instance the flexural response to the gulf of Lion extension is complicated to invoke, for the distance between the high topography and basin. The role of the mantle upwelling has been proposed by many authors (that have to be cited) that worth to be discussed a bit more in detail (dynamic or isostatically supported, the Massif Central thin lithosphere suggests, in my opinion, a clear contribution of the mantle in the present topography).

Discussion

Lines: 376 is not clear for me. The only way that I know to re-equilibrate a river profile is a regressive erosion that move from the base level upstream. If the river is full equilibrated means that regressive erosion reached the uppermost part of the profile. Moreover the lack of knickpoint does not prove that incision rate and uplift are in equilibrium, if the landscape undergoes a long topographic degradation. It could be interesting to know why the rivers profiles from northeastern margin of the Massif (Olivetti et al.) and from Ardeche (personal data) show knickpoints and Cevennes rivers not. If the authors want to discuss about the river profiles it could be interesting to show some data. Onset of volcanism is placed about 13 Ma and even earlier if we consider the synrift volcanism (Michon and Merle 2001).

Figures: In general the figures are good, but sometimes they lack of useful information such as topographic names (summits, cities, ect). I would appreciate to see the location of the analyzed caves in a map (in the figure 9 for example) and also the profile in a vertical view of the caves to have a look of the general topographic trend, its relationship with the incised river, and to show the sampling sites. Coordinates are

lacking. Figure 3 and 4 could be merged.

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2019-99/se-2019-99-RC1-supplement.pdf

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2019-99, 2019.

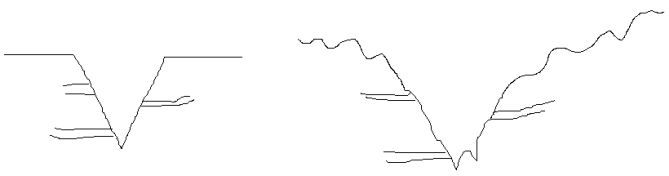

Fig. 1.