Solid Earth Discuss.,
https://doi.org/10.5194/se-2020-202-RC1, 2021

Solid Earth Discussions

Interactive comment on "How Alpine seismicity relates to lithospheric strength" *by* Cameron Spooner et al.

Anonymous Referee #1

Received and published: 29 January 2021

Dear editor,

Thank you for considering me as a reviewer for the manuscript entitled "How Alpine seismicity relates to lithospheric strength" by Spooner and co-authors. Please, find my comments below.

General comments

In this ms the authors investigate the relation between the spatial distribution of seismicity and the strength of the lithosphere in the Alps. They propose a new 3D model for the yield strength of the lithosphere, based on recent thermal and structural models, which is of great interest for better constraining the geodynamics of this complex area. The comparison of their results with the spatial distribution of earthquakes is also

relevant.

Although well written and illustrated, this ms has to be revised before being published. One concern is the lack of discussion regarding the representativeness of the seismic catalog used in the study. Although the authors have selected the events according to the location error and the magnitude, the limit of the catalog extracted from ISC and the potential bias linked to the seismic station distribution aren't discussed. This should be addressed, in order to be able to compare the modeled strength of the lithosphere with the epicenters and the depth distribution of the events. More generally, it's also essential to add a synthesis of the knowledge of the factors controlling the seismicity localization in the area, based on previous studies (e.g. Schmid and Kissling, 2000; Singer et al., 2014; Thouvenot et al., 2016) to the ms. Actually, it would help to better contextualize the study and highlight its importance.

A large part of the description of the results and the discussion refers to the spatial variability of several parameters (viscosity, integrated strength, maximum depth of seismicity, etc.). These sections are however difficult to follow because this spatial distribution isn't explicit enough with respect to the areas of interest. Using systematically the annotation in the figures (AS, vo, urg,. . ..), or naming clearly the regions would greatly help to understand the reasoning of the authors. E.g. in the sentence L314-316 (" We do however note regions where the maximum temperature of seismicity greatly exceeds 600°C, corresponding to the presenceof both actively subducting and previously subducted slabs, shown as high velocity featuresat a depth of 100km(Figure 10b) from a recent shear wave velocity model of the region (El-Sharkawy et al., 2020)"), it's unclear which regions the authors are referring to.

Schmid, S. M., and Kissling, E. (2000), The arc of the western Alps in the light of geophysical data on deep crustal structure, Tectonics, 19(1), 62– 85, doi:10.1029/1999TC900057.

Singer, J., Diehl, T., Husen, S., Kissling, E. and Duretz, T. Alpine lithosphere slab

rollback causing lower crustal seismicity in northern foreland. Earth and Planetary Science Letters, 397, pp.42-56, https://doi.org/10.1016/j.epsl.2014.04.002, 2014.

Thouvenot, F., Jenatton, L., Scafidi, D., Turino, C., Potin, B., & Ferretti, G. (2016).Encore ubaye: earthquake swarms, foreshocks, and aftershocks in the southern french alps.Bulletin of the Seismological Society of America,106(5),2244–2257.

Specific comments

Introduction L21-22 : This sentence is referring to a debate about the “seismicity distribution in the Alps”. This is vague, please explain in more detail what is the issue (see comments above).

Geological History This section should include geologic and seismotectonic details, in particular a paragraph describing the seismicity distribution and its origin according to previous studies.

Method I would suggest to split this part into “data” and “method”.

Technical corrections

L8 : Please, replace “varying seismicity distribution” by “varying spatial seismicity distribution”.

L18 : Please explicit the acronym URG.

L24 : Please, indicate the type of model you are referring to.

L26 : Please replace cross-correlation by “link” or “relation” or “correlation”

L196 : The sentence “Viscosities for the lithospheric mantle tend to be between 19 –23 log10Pa s and for the lower crust between 21 –23 log10Pa s with both largely aseismic across the region” is difficult to understand, please rephrase it.

L225 : I would suggest replacing “thereof to” by “on”.

L310 : “In thick felsic crustal regions that also lie above a weak lithospheric mantle,

such as the crustal root of the orogen, maximum depths of seismicity are significantly shallower than on the forelands and as such maximum temperatures of seismicity are also significantly lower at $\sim$350 °C”. This sentence is difficult to understand, please rephrase it.

L331 : The end of the sentence (“and”) has to be corrected.

Fig1 : Plotting the seismicity on this map would be nice.

Fig 2 and/or 3 : indicate in the caption that numbers correspond to density values.

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2020-202, 2020.