Solid Earth Discussions

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Comment on se-2021-96

Anonymous Referee #1

Referee comment on "Exhumation and erosion of the Northern Apennines, Italy: new insights from low-temperature thermochronometers" by Erica D. Erlanger et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-96-RC1, 2021

The manuscript aims to determine the orogeny-scale (northern Apennine) erosion pattern derived from multiple thermochronometers, and to reconstruct erosion rate variation with space and time. The authors process a large data set of already published apatite fission track and apatite (U/Th)/He data that are accompanied by new detrital AFT data from 7 catchments (modern river sand). Erosion rates have been calculated for each samples using AGE2EDOT code and by applying different values of geothermal gradients.

The method to manage the geothermal data is particularly interesting and provide a very rigorous approach, mainly in light to the relevance of geothermal gradient to calculate erosion rate from thermochronological ages.

A numerical kinetic model of an asymmetric orogenic wedge evolution is set to explain the observed erosion rates, thermochronological age and maximum burial data.

The paper is well written and in general clear to read. The new data are of high quality. The obtained erosion rates data set is particularly interesting and they worth alone to be published. The application of a kinematic model and an interesting discussion made this paper perfectly suitable to be published in Solid Earth, with a only minor corrections.

My main criticism is focused on the mechanism invoked to explain decreasing in erosion rate along the Ligurian side (the retrowedge of Apennine orogenic wedge). The change in trajectory in the retrowedge seems the first order raison to explain a decrease in erosion rate with time. I feel that the depth of this variation can have a strong impact in the change in erosion rate with time. This variation in trajectory should occur between AFT closure depth and the AHe closure depth. Therefore the closure depth for AFT and AHe

systems should deeply control the erosion rate pattern in the retrowedge. In the text it not very clear how closure depth is calculated line 237). Moreover, I am wondering to see the impact of different closure depths in modeling results.

Regional pattern of several data set (i.e. Ro, fg. 2, thermochronological ages in inset map of fig. 9) shows a clear variation along strike. In the manuscript this along strike variation is never discussed, although has been interpreted in literature as a first-order tectonic control on erosion and exhumation. I would like to know the raison and conditions to apply the same kinematic model of the entire of Apennine wedge.

Line 100 to 102. Variation of Ro is clear to follow also a NW-SE gradient.

In the erosion rate result section, I found some difficulties to read the text following figures 7 and 8. Figure 8 is described before figure 7. To be fair, I do not understand the meaning of figure 7 and what information the authors want to explain. It could be useful to add the geographic orientation, i.e NW to SE or NE to SW

Kinematic model.

In this section I suggest to add some lines to describe the code and the environment of modeling. Line 237: It is not clear how the closure depth are chosen.

At line 372: the best –fit between what data? For large audience could be useful a short description how this model works. Moreover it is not very clear why the authors show this run.

Erosion rate pattern: 459, it could be interesting to specify what kind of tectonic control could be responsible for local high exhumation rate for the Apuane Alps, and to add a reference.

Fig 11. If the figure represent an enlarged portion of figure 10 (and not figure 9), so I do not understand the 100 km of horizontal scale.

Fig 9. To make the reading easier, it could be better to move the inset map within the panel 9b.