Solid Earth Discuss.,
https://doi.org/10.5194/se-2019-162-AC1, 2020

Solid Earth
Discussions
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Interactive comment on "Cenozoic deformation in the Tauern Window (Eastern Alps, Austria) constrained by in-situ Th-Pb dating of fissure monazite" *by* Emmanuelle Ricchi et al.

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Received and published: 14 February 2020

Answers to the comments in this letter are bracketed by two dashes.

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General comments The manuscript of Ricchi et al. provides a substantial number of new SIMS monazite spot ages from fault zone-relate hydrothermal fissure monazites from the Tauern Window in the Eastern Alps substantially complementing available thermochronological data sets from the same region. Three major periods of monazite

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growth are recorded between 22 – 19 Ma, 19 – 15 Ma and 13 – 8 Ma. The ages are interpreted to be related to N-S shortening in association with E-W extension, the beginning of strike-slip movements, and reactivation of strike slip faulting in the Tauern Window. These findings very nicely support the interpretation of former 40Ar-39Ar mica and zircon, apatite fission track ages.

I find a slight weakness in the formulation of the interpretation of the monazite SIMS dates: The monazite dates do not date tectonic activity in the sense of tectonic movements, as stated in the manuscript. They merely date fluid activity which may be indirectly related to tectonic movements. This is a slight but important difference and should be correctly stressed in the text. - -We agree that the formulation of the interpretation of monazite ages needs to be stressed. The following sentence was added to the manuscript: “Fissure monazites date crystallization following chemical disequilibrium within a fissure. This causes a dissolution-precipitation cycle that may include dissolution or partial dissolution of existing fissure monazite. This has the consequence that late dissolution/precipitation steps may be well recorded, whereas earlier growth domains may be completely destroyed. Thus, monazite crystallization due to chemical disequilibrium is interpreted as being related to tectonic activity (e.g. volume change, fissure propagation, exposure of fresh host-rock, delamination of fissure wall, seismic activity, fluid loss or gain).”- -

Specific comments There are a number of issues concerning BSE imaging, SIMS data reduction and interpretation which have to be addressed. Most importantly the authors use two different common Pb correction schemes which are not necessarily comparable. Therefore I have some doubts whether or not the two data sets are directly comparable, inasmuch as very small age differences (1-2 Ma) are interpreted to be significant. I would very much like to see both raw data sets reduced with the same common Pb correction scheme. - -We agree and for sake of consistency we decided to reduce all the data using the CIPS software. Th-U-Pb analyses of all the grains are now presented in the new Table 3 where both 204- and 207-corrected ratios and ages

are provided. In every case 204- and 207-corrected ages agree within uncertainty. The weighted mean ages summarized in the new Table 4 and described in the SI file and in the reviewed manuscript were calculated using the 207-corrected ages because these ages are more robust and consistent (better statistics and less scatter in the data).- -

The authors interpret the BSE signal intensity, aka zonation, as representing growth domains/zones. This is not quite correct. What one sees in the BSE images is the chemical zonation and/or chemically ± homogeneous domains. That such domains are characteristic for growth domains is an (over-)interpretation. I therefore suggest to be more objective in interpreting the monazite BSE images. - -Chemical domains (A, B, etc.; displayed in Figs.3 and 4 and listed in Tables 3-4) were defined combining Th and U concentration with textural information (chemical zoning visible on BSE images). We interpret chemical domains as representing growth domains caused by chemical disequilibrium in the fissure. Most of these domains have regular zoning typical of growth. Quartz domains are visible in cathodoluminescence images and fluid inclusions in the different domains indicate different temperatures of crystallization. For these reasons we believe that the same applies to monazite (in most cases too small for fluid inclusions studies). Our experience shows that in fissure monazite, the chemical domains generally are growth domains of distinct age, in some cases overlapping within uncertainty.- -

There are a number of rather vaguely formulated statements which I find should be stated more precise and stringent. For instance line 239: '... bring the MSWD within acceptable values...'. What such acceptable values should be remains for the reader to find out by himself. I suggest that all such formulations are avoided. - -We agree and this was corrected as follows: "[...] MSWD within acceptable values (MSWD < 3; Spencer et al., 2016)."- -

Technical comments I find the English to be very fine and have only found a few typos. So from this point of view the manuscript is easily acceptable.

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I suggest to move some statements concerning tectonism from the 'Results' section to the 'Geologic settings' section. - -We prefer to keep the statements regarding the field observations in the "Results" section because we develop here a description of the fissures we observed of the field.- -

Some of the figures show too small labelling. Probably this ought to be changed. - -Small labels have been marked in bold and figures provided in vector graphics.- -

The SIMS data tables are not complete. They do not provide all necessary data for the reader. This has to be corrected. - -The missing information is now provided.- -

I have given a number of specific comments directly in the manuscript. Please also note the supplement to this comment: https://www.solid-earth-discuss.net/se-2019-162/se-2019-162-RC1-supplement.pdf - -Please see all points addressed in the annotated manuscript.- -

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