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Reviewers' comments are in blue, our replies in black and quotations from the revised manuscript in maroon.

Replay to Anonymous Reviewer 1

Thank you for all your constructive and helpful corrections, comments, and suggestions. Your recommendations considerably aided revision of our manuscript and they are included in a new version of the paper. Our response to specific comments provided both in a review document and annotated manuscript are detailed below.

It is not mentioned in the Method in which laboratory fission track dating was done.

Fission track dating was done at the Institute of Geological Sciences, Polish Academy of Sciences in Kraków (Poland). This information will be included in the 'Methods' chapter.

AFT analysis, was carried out at the Institute of Geological Sciences, Polish Academy of Sciences in Kraków (Poland)…

The involvement and extent of fluid flow at the level of some of the stratigraphic levels should be treated with more caution presenting also alternative solutions which cannot be omitted at the present. Suggestions are given below and directly on the PDF text.

A possible extent of fluid flow is wider discussed in the text including alternative solutions. Concerning the latter, we already considered variation in the geothermal gradient through time while postulating the influence of advective heat transfer. Therefore, we refer to paleotemperatures in the text as a proxy of paleothermal gradient. The interpretation assuming short-lasting pulses of potassium-bearing hot fluids that effectively promote illitization in porous rocks is presented in a recent paper by Derkowski et al. (2021). We cite and use this interpretation since reporting a full set of arguments presented by Derkowski (2021) exceeds the scope of our study. We agree that the gap between the VR- and illite/smectite-derived paleotemperatures might be the effect of contamination by detrital illite. This remains an option that cannot be entirely excluded. However, in the case of detrital illite the results should be highly incoherent, whereas in the Tłuszcz IG-1 and other studied boreholes the VR-derived paleotemperatures are consistently lower than those calculated from illite/smectite data.

A similar discrepancy between the maximum palaeotemperatures evaluated from illite–smectite and biomarkers was detected for the EEP by Derkowski et al. (2021). These authors interpreted a diagenetic pattern in the Ediacaran sediments of the EEP as the result of short-lasting pulses of potassium-bearing hot fluids, effectively promoting illitization in porous rocks without altering the organic matter (Derkowski et al., 2021).

And further:

Alternatively, the gap between the VR- and illite/smectite-derived paleotemperatures might be the effect of contamination by detrital illite. However, in such a case the results should be highly incoherent, whereas in the Tłuszcz IG-1 and other studied boreholes the VR-derived paleotemperatures are consistently lower than those calculated based on illite/smectite data.

I strongly suggest to insert on the map Fig. 1 and in table 3 previously FT dating already published by Srodon et al. 2013 and Botor et al 2019 (papers given below) and discuss the differences/similarities between published FT modeling results and present ones concerning the common investigated time interval/region.

A new figure (**Figure 15**) is drafted that shows previous FT dating by Środoń et al. (2013) and some other results from the adjacent areas. Simplified results are presented jointly with the locality of sampling. The figure provides a background for the extended discussion of results. Whereas, Botor et al (2019) paper does not contain any FT dating. This paper has presented only 1-D maturity modelling results.

In order to make some plots the distribution of track lengths for each sample is necessary. Usually in studies not all track lengths are given. So it is at the level of other studies.

Figure S1 is merged with S2 and redrafted to show the radial plots and the distribution of track lengths for each sample. As Solid Earth has an appendix chapter in the template file, new name of this figure is Figure A1.

New are the Fission Track ages on apatite and the the U/He ages. The vitrinite data are from literature should be omitted from the title as other criteria are used as well for thermal modeling.

The title will be shortened as recommended.

We also implemented all suggestions directly marked on the annotated PDF text. The most important of them are listed below:

1. The position of the Teisseyre-Tornquist Zone, Caledonian Deformation Front and Variscan Deformation Front is shown in Figure 2.
2. Lettering is increased in Figures 3 and 5 (6 – revised numbering was shifted by one).
3. A reference to the map by Pożaryski and Dembowski (1983) is added to the caption of Figure 14 (15).
4. All recommended changes to the tables format are implemented.
5. Short information is supplemented to 'Geological setting' how the position of the Teisseyre-Tornquist Zone and Caledonian Deformation Front were determined.

Replay to Anonymous Reviewer 2

Thank you for your corrections, comments, and suggestions to our manuscript. They significantly helped to improve the revised version of the paper. Our response to specific comments provided are detailed below.

Since all the apatite fission-track data reported in the text are based on borehole samples, the reader might expect that the authors would at least refer to and discuss their results in the context of some known issues regarding the application of low temperature thermochronometry to the deep borehole samples. It includes i.e., defects for fission-track dating reported by Wauschkuhn et al. (2015 and references therein).

Thank you for pointing out some potential issues related to the application of low temperature thermochronometry to borehole samples as those reported by Wauschkuhn et al. (2015). However, their study was done based on several samples from a single deep borehole. In our case, we had single samples from several boreholes and two samples only from two boreholes (Gołdap-IG1, Tłuszcz-IG1). In these two boreholes, a decrease in age with depth is visible, as well as shortening of the measured confined tracks. Consequently, in our case, the number of samples per borehole was insufficient to support methodological considerations similar to those in Wauschkuhn et al. (2015). An appropriate explanation is included in the revised version of the manuscript.

Single samples were available from most of boreholes, apart from the Gołdap-IG1 and Tłuszcz-IG1, each of which was represented by two samples.

The paper by Wauschkuhn et al. (2015) is now referred to in the introduction.

Throughout the text, any information on how the length of the confined tracks have been presented (c-axis corrected or not) could hardly be found. This information must be declared in the text since the effect of bias in length distribution might be a significant component (see Ketcham et al., 2007).

For modelling, we used confined tracks non-corrected to the c-axis, taking geological constraints into account and Dpar values. Normalizing fossil track lengths to a personalized zero-length, either that of induced (Ketcham et al., 2009, 2015) or fossil (Kohn et al., 2002, 2005; Gunnell et al., 2003) tracks is a questionable procedure (e.g., Green and Duddy, 2012) for eliminating discrepancies between measured and predicted lengths as each dataset to which an annealing model has been fitted has an intrinsic zero-length that was used for its parameterization. This information we will be supplemented to the thermal modelling methodologies.

For modelling, we used confined tracks non-corrected to the c-axis as normalizing fossil track lengths to a personalized zero-length is a questionable procedure for eliminating discrepancies between measured and predicted lengths (e.g., Green and Duddy, 2012).

It is confusing to use the capital letters through the text, tables, and figures for the epochs/series names (e.g., Table 1: Triassic lower; Jurassic Middle). This needs to be clarified and homogenized throughout the manuscript following the ICS recommendations.

We followed the ICS rules in the text, i.e., writing formal chronostrtigraphic subdivisions with a capital letter and informal with a small letter. However, we made some mistakes in the tables. Thank you for pointing this out. The tables will be corrected.

In table 2, many reported Zr grains contain inclusions. Does it possibly have any influence on the reported ZHe ages?

All inclusion in Table 2 were distinguish between: (i) solid and (ii) fluid inclusions. However, chemical characteristics of inclusions were not identified. Results in Table 2 show that the inclusions did not affect the (U-Th)/He data for zircons in most cases. But in a few cases, where we were not sure about the impact of inclusions, we have just excluded uncertain zircons from calculating of average zircon (U-Th)/He ages (see Tab. 2).

Szewczyk & Gientka (2009) reported some heat flow density perturbations for the NE Poland reaching up to 2000 m depth, so in the range of many of the analysed borehole samples. In this context, please better explain which present-day temperatures (e.g., line 491) do you present in your text and use for thermal modelling.

In the analysed boreholes, where thermal modelling was carried out (Tab. 4), the contemporary temperature is much lower than the sensitivity range of the thermochronological method used. Thus, temperature fluctuations of ± 10 °C in the boreholes from the study area that are mentioned in the paper by Szewczyk & Gientka (2009) do not affect the results obtained. For example, in the Gołdap IG1 well, two samples were analysed with a temperature of 35 °C (B13) and 45 °C (B14). The fission track system in apatites is sensitive above a temperature of 60 °C and the helium system in zircons above 130 °C. An appropriate note will be added to the revised text.

A contemporary temperature in the analysed boreholes is much lower than the sensitivity range of the thermochronological method. Thus, temperature fluctuations of ± 10 °C in the boreholes from the study area that were reported in the paper by Szewczyk and Gientka (2009) do not affect the results obtained.

This figure does not contain scale and geographical coordinates; hence it should not be termed a 'map'; please adjust it accordingly. Please also add to the figure caption word 'borehole' to have 'the location of borehole samples' to avoid confusion.

Scale and geographic coordinates have been added to Figure 1. We also added 'borehole' to the figure caption.

Some abbreviations used seem not to fit its meaning, for example: Pcm – Paleoproterozoic, which fits Precambrian better; please adjust it accordingly. On the chronostratigraphic abbreviations list, Carboniferous is omitted (there is C-Cambrian instead).

Figure 2 and its caption have been corrected.

Please name the stratigraphic units by using only singular forms, not plural, neither mixed.

Figure 3 has been corrected.

On the map, the EEC acronym is used (East European Craton), but there is EEP (EE Platform) in the caption.

Caption to Figure 4 has been corrected.

Please stay uniform using only one English language standard ('Palaezoic' vs. 'paleotemperature' (ae vs. e). Please scan the whole text to verify the spelling.

We believe that spelling 'paleotemperature' is acceptable in British English (as well as Cenozoic).

There are some issues that should be explained regarding the thermal modelling performed. Does it exist any information regarding the age of detrital zircon grains? It would be helpful to use it when designing a modeling strategy.

Figure 13 (14) has been revised during manuscript revision. However, we do not have information on the age of detrital zircons. The crystalline basement as the most probable source of detritus is well dated as Paleo- to Mesoproterozoic.

This figure does not contain scale and geographical coordinates; hence it should not be termed a 'map'; please adjust it accordingly. Yellow asterisk – maybe better would be 'Wells with thermal models…' ?

Scale and geographic coordinated have been added to Figure 14 (15) and the legend modified as suggested.

Please add a number of apatite grains analyzed for each radial plot (n=XX)

Figure S1 has been revised. See also response to Reviewer #1.

Some stratigraphic units and lithologies listed in the table do not have correct English names (i.e., Proterozoik; granitoide).

Tables 1 and 4 have been corrected.

Line 30: 'These basins form an extensive platform cover resting upon the SW slope of the East European Craton, comprising Paleoproterozoic to Mesoproterozoic crystalline basement.' This sentence would benefit from a relevant literature reference.

An appropriate reference has been added: Krzemińska et al. (2017).

Lines 42-45: this sentence is a direct repetition of the paper abstract and should be discarded.

The sentence in question has been rephrased.

Line 51: 'Phanerozoic' – some of reported ZHe ages go far beyond Phanerozoic timescale. Furthermore, this section's last sentence (lines 51-53) fits much better into Abstract than Introduction.

However, our focus is on Phanerozoic tectonosedimentary evolution post-dating the break-up of Rodinia. The last sentence of 'Introduction' has been moved to 'Abstract' as recommended.

Line 58: you mention in the text a geological unit 'West European Palaeozoic Platform' and refer the reader to Fig.1, however on this figure, no such a unit exists.

Figure 1 has been modified to include the West European Palaeozoic Platform.

Lines 99-100: This sentence would benefit from a relevant literature reference.

Appropriate references have been added: Botor at al. (2019a, b).

Line 131: Please add some additional explanation about the basis of Poprawa's (2010) conclusions regarding peak temperatures.

The relevant sentence has been rephrased to provide more complete and appropriate information:

In Baltic Basin, an alternative possibility was proposed by Poprawa at al. (2010), who suggested that peak temperatures were related to burial and an associated advectional/convectional thermal event in the Late Cretaceous.

Line 141: 'thermochronology' should be replaced by 'analyses'.

Done.

Line 143: should be 'Farley (2002)' instead of '(Farley, 2002).

Done.

Lines 170-171: what about the c-axis angle correction for confined tracks measurements?

An appropriate explanation has been added to the text. See also a reply to your second comment above.

Line 196: at which depth was this temperature measured?

This temperature was measured at a depth of 5110.4m as shown in Table 1.

Lines 238-242: please add information about c-axis angle correction (see comment above).

An appropriate explanation has been supplemented to the methodological chapter (end of section 4.2). See also replies to your comments above.

Lines 253-254: It sounds like a conclusion or plausible explanation here; please be more specific by adding relevant arguments.

The relevant piece of text has been rewritten:

Thermal evolution recognised in some boreholes reveals features that are usually considered an effect of fluid flow overprinted on burial diagenesis. The possible influence of advective heat transfer is inferred based on a set of characteristic features that were documented from other sedimentary basins (Ziagos and Blackwell, 1986; Middleton et al., 1994, Lampe et al., 2001, Green and Duddy, 2012):): (1) palaeotemperatures being much higher than predicted from the burial history under conditions of vertical conductive heat transfer, (2) palaeotemperature profiles that fluctuate markedly, suggesting fluid-driven heat transfer along certain horizons and (3) discrepancies between palaeotemperatures derived from fluid inclusions, illite/smectite studies and kinetically dependent thermal maturity indicators such as vitrinite reflectance (VR) and AFTA.

Line 259: AFTA – do you explain anywhere before in the text this acronym?

This acronym has been replaced with a full term: apatite fission track analysis.

Line 261: ‘fluid flow’ explanation would benefit from i.e., relevant citation.

However, this sentence regards observations from the present study. The relevant section has been rephrased to make it clear:

In this study, such characteristics is documented and discussed in the following boreholes: Gołdap IG-1, Bartoszyce IG-1, Tłuszcz IG-1, and Siedliska IG-1. In some other wells as Opalino-2 and Lubycza Królewska-1 fluid flow influence on thermal evolution is also possible.

Line 313: should be ‘fission track lengths distribution’.

Corrected.

Line 317: should be ‘Tłuszcz IG-1’

Corrected

Line 351: basing on only 3 apatite grains might not give a meaningful result from the methodological point of view; therefore, if you’d like to use it still, please clarify this issue and explain possible shortcomings.

A low precision of the mean central age is demonstrated in this case by a large 1σ error. Therefore, an extensive explanation would be excessive. However, an extra sentence was added to make the situation fully clear.

… but second upper Silurian sample LK1/2 gives an AFT central age of 178 ± 67.5 Ma, based on 3 apatite grains (Tab. 3, Fig. 13a). A low precision of this age is demonstrated by a large 1σ error.

Line 362: which kind of thermal modeling has been used (forward, inverse?)

HeFty code consists of ‘forward’ and ‘inverse’ modelling functionalities. The ‘forward model’ allows the user to predict the expected data distribution for any given thermal history. The ‘inverse model’ finds the thermal history that best matches some input data (e.g., Vermeesch and Tian, 2014).

Line 448: does this ‘Mesozoic geothermal gradient’ has been independently confirmed.

A reference has been added: Karnowski (2003).

Lines 566-567: how does Variscan orogeny can cause erosion? In what sense?

We refer to earlier, classical papers by Żelichowski (1987) and Narkiewicz (2007) that are cited in the text. These papers postulated a simple cause and effect sequence of events: Variscan shortening → uplift → erosion. This reasoning was based on a widespread base Permian-Mesozoic unconformity. We present contemporaneous state of the art as an invocation to our interpretation.

Lines 582-588: Dniepr-Donets-Donbas Rift does not exist on any of your maps, so it might be hard for the reader to get an idea about logical (geographical) connection with your research area.

That is a very apt point. Therefore, we prepared a new, additional figure (Figure 15 – also in response to a recommendation by Reviewer #1) that shows a larger view of tectonic elements including the Dniepr-Donets-Donbas Rift.

Line 600: Pripyat Trough does not exist on any of your maps, so it might be hard for the reader to get an idea about logical (geographical) connection with your research area.

We fully agree. Please see our reply just above and Figure 15.

Lines 644-648: This conclusion remains speculative due to no solid arguments for the heat transfer change.

We rephrased the first sentence of the last conclusion to make it less categorical. Indeed, a Mesozoic decrease in heat flow is almost a common knowledge (besides papers by P. Poprawa and co-workers postulating a Late Cretaceous thermal event) and our data are supporting this view:

Our data are consistent with the decreasing heat flow during the Mesozoic.

Best regards,

Dariusz Botor