

Evidence for the Late Cretaceous Asteroussia event in the Gondwanan Ios basement terranes

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Authors' responses to the reviewer's comment.

Authors' responses are identified as blue text

General comments

- (1) EMPA data is missing in the manuscript in addition to BSE images to distinct complex microfabrics dated.
The EMPA analysis and BSE images will be included in the supplementary materials of the resubmitted manuscript.
- (2) Reviewer suggests considering analysis on garnets for P-T calculation.
We acknowledge that there is potential of extracting further information on fabric within the garnets for P-T calculation. But this cannot be done for this paper.
- (3) P-T conditions for the Late Cretaceous Asteroussia event is generalized, detailed information on how this is derived is needed.
We will include pressure and temperature information that can be extracted from phengite silica content in the resubmitted manuscript.
- (4) Distinction of the various white mica generations needs to be more detail, with information on how to identify them in the argon data.
We will revisit how this procedure is presented in the text and add details on the figure to show how different white mica generations can be recognised using the Arrhenius plot.
- (5) Reviewer suggests checking the validity of the apparent Late Cretaceous Ar/Ar ages by the isotope inversion.
Analysis based on the York plot will be included in the resubmitted manuscript.
- (6) Mineralogy of each sample should be added in table 1
Table 1 will be revised in the resubmitted manuscript.
- (7) Shear senses of various stages of deformation needed to be shown in figure 3b.
Showing shear senses of various stages in the lower detailed map is difficult as the entire field area is affected by the broad, large scale shear zone. We will consider achieving this by including a field analysis with tectonic sequence diagrams (TSDs).

Specific and editorial remarks:

Reformulate the statement "southwards of the surface outcrop of the sub-duction megathrust" in line 16.

This sentence is reformulated in the revised manuscript.

The introduction does not explain clearly why rocks mentioned in line 20 are considered the (pre-Alpine) Ios basement.

We will revise this sentence with special note to this comment. This is a widely accepted understanding in previously published papers, but we will make it clearer in the resubmitted manuscript.

No explanation on why changes mentioned in line 36 is a significant modification.

We will reformulate this sentence with respect to this aspect.

Some detailed structural aspect is not clear in figure 2a, b, hence causes confusion.

The Aegean terrane stack has been accreted above the lower plate in figure 2a. We will enlarge the figure and potentially separate it into two so the details are clear in the resubmitted manuscript.

Sentence in line 91-92 needs to show reference to figure 3

This sentence is reformulated as suggested.

Tectonic unit "the Port Beach tectonic slice" mentioned in line 105 is not shown explicitly in figure 3.

The Port Beach tectonic slice include augengneiss (the main lithology) and other lithologies such as garnet-mica schist, graphitic quartzite and other smaller units. This 'tectonic slice' is used so as not to oversimplify the nature of this tectonic unit. We will reformulate the sentence to present the idea explicitly in the revised manuscript. A revised map will be provided.

Show location of the South Cyclades Shear Zone in figure 3 as mentioned in the text.

The South Cyclades Shear Zone overprints the entire field area with some places affected by the overprinting, narrow north-directed shear zone. This observation is added to the figure caption to ensure clear understanding.

"metemorphosed" is spell incorrectly in figure 3b map legend.

Map legend corrected in revised manuscript.

Field evidence of the multiple alternating deformation events mentioned in line 111-112 is missing.

We agree with the reviewer, a new figure will be added.

Sample number and labelling is unclear in figure 4a.

Corrections and modifications have been made to be clear and concise.

Figure 5 requires more information on the microstructures identified and analysed.

Corrections and modifications have been made which include further information, both in text and in the supplementary material in the revised manuscript.

The statement "The prominent structural contact between the garnet-mica schist and the augengneiss is defined by a late-developed intense north-sense shear zone" in line 128-129 is unclear.

We will reformulate this particular sentence.

Calculations and deduction to the P-T conditions reported in line 143-144 is unclear.

The resubmitted manuscript will include these details in the main text, with reference to literature documenting the method used in our calculation.

No explanation as to why the garnet rim is black in line 158.

The resubmitted manuscript will add further detail to this observation. Analytical data will be included in the supplementary material.

No compositional data on white mica inclusions within garnet is provided in line 159-160.

The grains are too small for this type of probe analysis. The garnet crystals are small in size (1-2 mm diameter), hence the inclusion will be even finer and compositional analysis unreasonable.

No explanation why "non-end member garnets" is used in line 171.

This particular sentence is restructured with additional information.

No composition data of the white mica inclusions in garnet in line 175.

Please see response to line 159-160

Presence tense is needed in line 181-182

This is corrected in the revised manuscript.

Method of the P-T conditions estimate is unclear and missing in line 179-181.

The resubmitted manuscript will include these details with reference to previous literature.

Correct a typo in figure 7(a).

This is corrected in the revised manuscript.

The reviewer suggests referring line 209-210 to the supplement with Analytical details for $^{40}\text{Ar}/^{39}\text{Ar}$ dating.

We agree with the reviewer.

Description of argon geochronology result in line 223- 224 needs to be similar to what described in the microstructure analysis.

We agree with the reviewer.

The reviewer suggests referring line 227-229 to the corresponding figure.

We agree with the reviewer.

No explanation on "N.A" in Table 2.

This is corrected in the revised manuscript.

A word is missing in line 234-235.

This is corrected in the revised manuscript.

The reviewer suggests mention that the spectra in figure 9 are from a previous paper (Forster and Lister, 2009).

This is corrected in the revised manuscript.

Correct "ourtcrops" in line 253.

This is corrected in the revised manuscript.

The reviewer suggests reformulating "potassium feldspar was replaced by metamorphic and/or metasomatic events at those times" in line 274-275.

We agree with the reviewer, the sentence is modified in the revised manuscript.

The reviewer suggests replacing "K-feldspar concentrate" in line 283 with "K- feldspar grain sample"

This is corrected in the revised manuscript.

A reference for the Gondwanan affinity is missing in line 300-301.

We agree with the reviewer and have revised this sentence.

The reviewer commented that: Most data are rather low-pressure, meaning T-dominated metamorphism' to lines 301-307.

Outcrops of the Asteroussia terrane in other Cycladic islands do overall demonstrate a high temperature – low pressure metamorphic condition. But the rocks in los suggests medium temperature – high pressure conditions. We will reformulate lines 301-307 to ensure clear presentation.

Title of table 2 is misleading.

The resubmitted manuscript will revise the table title with respect to this comment.

Reference is missing in line 326-328

This is corrected in the revised manuscript

Change “Tripoliz” to “Tripolitza” in line 362.

This is corrected in the revised manuscript

The reviewer suggests revising line 364 as there is no formal Middle Oligocene in the International Stratigraphic Chart.

This is corrected in the revised manuscript.

The reviewer thinks the relation to eastern Alps as presented in line 365 is unlikely.

We will fix this sentence. Note that this statement is listed as unresolved issues in this paper. We think it is worth noting such correlation when one is looking at the tectonic setting of this region (e.g., the extent of the Asteroussia terrane as reconstructed by Van Hinsbergen et al., 2020). The nature of the late Cretaceous event in the Eastern Alps is not discussed in that Greater Adria reconstruction paper. Yet, the idea has been presented and we therefore include it in the “unresolved issues” section.

Incomplete referencing in line 488-489, line 535

This is corrected in the revised manuscript.

Omit “IF” in line 547

This is corrected in the revised manuscript.

Reference to the Flux monitor GA1550 (Spell & Mc- Dougall, 2003) is missing in the supplementary material.

This is corrected in the revised manuscript.

The reviewer cannot open data tables in the Supplementary Material.

We will make sure these are included and accessible.