

Interactive comment on “Evidence for the Late Cretaceous Asteroussia event in the Gondwanan los basement terranes” by Sonia Yeung et al.

Franz Neubauer (Referee)

franz.neubauer@sbg.ac.at

Received and published: 9 January 2021

General remarks:

This potentially an interesting manuscript showing some evidence on a Late Cretaceous Asteroussian metamorphic event on los basement and correlate this with a megathrust of an Asteroussia nappe extending to Crete. Basically, this would be an interesting story for the international readership. On the way to be convincing with the data on which the story is based several additions should be added to the revised version. These include: (1) The microfibrils of dated samples are complex, and the history is based mostly on white mica generations. No EPMA data are given for the white mica and other critical minerals like the two-stage zoned garnet. Add this sort

C1

of data as well as BSE images to show the distinction of fabrics. Garnet would be a prime goal to extract further detailed information on fabric and, in conjunction with other minerals, for P-T calculation. (2) Add detailed information on the generalized P-T conditions for the Late Cretaceous Asteroussia event, on which the HP event is based except simply the phengite composition. (3) White mica wm2 and wm3 have similar grain sizes in Fig. 4b. Consequently, how did to distinguish these? It is also unclear, whether wm1 (muscovite porphyroclasts) could have been in dated aggregate. Show and discuss also the Ar release pattern of sample IO18-01, for which also Late Jurassic ages are listed in Table 1. (4) I recommend check the validity of of the apparent Late Cretaceous Ar-Ar ages by the isotope inversion. At least for samples AG3-03 and AG-3-5, there are potentially sufficient steps for such a task.

Some further issues: In Table 1, add mineralogy to each sample, this is a critical information. Show shear senses of various stages in the lower detailed map.

Specific and editorial remarks: L. 16: “southwards of the surface outcrop of the subduction megathrust: I find this an unlucky expression. Please reformulate. Not the surface outcrop was displaced, but the rock unit of the Asteroussia nappe. L. 20: For the informed reader, explain in the Introduction, why these rocks on los are (pre-Alpine) basement. This seems nowhere said with sufficient clarity. L. 36: For clarity, please, add for what this is a significant modification. Figure 2a, b: To accrete the Aegean terrane stack, this must have been accreted above the lower plate. L. 91-92: Refer to Fig. 3: “focusing on the north-west corner of the basement terranes in an attempt to determine the meaning of the previously reported 70-80 Ma ages.” L. 105: “the Port Beach tectonic slice”: not explicitly on Fig. 3 = Port Beach augengneiss? Fig. 3: Show location of lower graph on the los map above. Which fault is the the South Cyclades Shear Zone mentioned in the text? los fault? Correct in lower map legend “metamorphosed”. L. 111-112: Show the field evidence of these multiple alternating deformation events mentioned here. Fig. 4a: Show the shear sense in figure: “(a) δ -type garnet porphyroblasts in Port Beach garnet-mica schist.” (c) What do you mean

C2

with "not shown" in caption? "Large (1-2 mm muscovite fishnot shown". Mention also which sample. Fig. 5: "two types small, second generation garnets with different chemical compositions are identified": The photomicrograph is convincing but show also the chemical composition of garnet core and rim. The second generation of garnet in (b) and (c) is greenish and dark and somehow untypical for usual garnet. Please provide more information. However, it is clear that the first and second generations are sharply separated and show two-stage growth. Mention also which sample. L. 128-129: "The prominent structural contact between the garnet-mica schist and the augengneiss is defined by a late-developed intense north-sense shear zone": Does this mean, that the augengneiss-garnet micaschist is another shear zone not shown on Fig. 3? L. 143-144: "suggesting P-T conditions of 100-140 MPa and 500-600°C": Specify the P-T conditions in a clear way how you reached these P-T conditions. L. 158: Mention why the garnet rim is black. L. 159-160: Are there compositional data on white mica inclusions within garnet? L. 171: Explain why not these are no "end member garnets". L. 175: "white mica-rutile inclusion": Composition of the white mica inclusions in garnet? L. 181-182: Use presence: "tectonic slice also records a complex history" L. 179-181: "The Si-content of white micas in sample IO17-03 and IO18-05 (both as mixture of muscovite and phengite) suggests that the phengite grew under P-T condition up to 500-1000 MPa and 400-500°C (Fig. 6c)": How did you calculate the P-T conditions? It remains also unclear at which metamorphic stage. Fig. 7: (a) There is a hornblende porphyroblast correctly labelled, but no white mica porphyroblast. "(a) an older generation white mica preserved as large porphyroclasts wrapped by younger, recrystallized white mica. In caption correct "whist".

L. 209-210: Refer to Supplement with Analytical details for $^{40}\text{Ar}/^{39}\text{Ar}$ dating. L. 223-224: "The argon geochronology analyses yielded age clusters in Early-Middle Jurassic, Late Cretaceous, Eocene-Oligocene and Oligocene-Miocene time (Table 1)": In fabrics, you distinguish between three white mica populations. L. 227-229: "The phengitic components produce significantly high activation energy estimates": Show and refer to the corresponding additional figure: This interpretation seems critical for the whole

C3

story. Table 2: Explain N.A. L. 234-235: A word seems missing in this sentence. Figure 7: Mention that these spectra are from a previous paper (Forster and Lister, 2009). L. 253: Correct "ourtcrops" L. 274-275: Reformulate: "potassium feldspar was replaced by metamorphic and/or metasomatic events at those times": Supposedly K-feldspar is still K-feldspar but recrystallized. L. 283: Better "K-feldspar concentrate" than "K-feldspar grain sample" L. 300-301: "The $^{40}\text{Ar}/^{39}\text{Ar}$ data is the first report of Asteroussia ages in a terrane of unmistakably Gondwanan affinity": Add a reference for the Gondwanan affinity. L. 301-307: Most data are rather low-pressure, meaning T-dominated metamorphism.

Table 2: The headline "TABLE 2 – PUBLISHED PEAK METAMORPHIC CONDITION ESTIMATES IN THE CYCLADES" is clearly misleading. I suppose that you mean the P-T condition of the Asteroussia event. I recommend also to give ages if available. Then: "with error on temperatures in the range of ± 50 °C": Add the error to the corresponding T estimates.

L. 326-328: Add references to this statement: "Dispute arises because of the focus on the exhumation of the Cycladic eclogite-blueschist terranes" L. 362: "Tripoliz": You mean Tripolitza? L. 364: Change slightly to: "This must have occurred sometime between "mid" Oligocene and early Miocene" There is no formal Middle Oligocene in the International Stratigraphic Chart. L. 365: Relation to eastern Alps seems unlikely: In eastern Alps, the late Cretaceous event is related to extension and exhumation of HP/UHP units.

References: Complete referencing: L. 488-489, L. 535, omit IF in L. 547

Supplementary material: Add the reference to the Flux monitor GA1550 (Spell & McDougall, 2003). I could not open the data tables. These must be included in the Supplementary Material.

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2020-186>, 2020.

C4