

## ***Interactive comment on “Birth and closure of the Kallipetra Basin: Late Cretaceous reworking of the Jurassic Pelagonian – Axios-Vardar contact (Northern Greece)” by Lydia R. Bailey et al.***

### **Anonymous Referee #2**

Received and published: 19 August 2020

This work deals with the paleogeographic and tectonic evolution during the Upper Cretaceous of an area of Continental Greece that belongs to the so-called Internal Hellenides. Little is known about the Cretaceous evolution of this sector of the Hellenides and many questions await answers. Apart from the number of oceanic basins, the polarity of the subduction zone, etc, there are questions about the origin, age, deposition paleoenvironment and the geodynamic significance of the Cretaceous sediments deposited unconformably on top of the obducted Vardar ophiolite complexes and the Pelagonian passive margin. Thus, this manuscript fills a significant gap in our knowledge of these issues.

C1

It is a well-written and well-structured manuscript with a wealth of data clearly presented, but in the end, it leaves the reader partially dissatisfied. And this has to do mainly with the large-scale implications of the results and their comparison with other neighboring areas of the Internal Hellenides where Upper Cretaceous sediments are also observed. As the authors report, in order to elucidate part of the controversies, they studied this small Upper Cretaceous basin, but the part of their manuscript that refers to those is poorly developed. I believe that a better analysis of this would strengthen their work even more.

Based on that I have noted the following:

a) The work that first described the Cretaceous sediments east of the Pelagonian (Almopias Zone) is not included in the reference list, although this work is about an area just north of the Kallipetra basin and gives detailed lithostratigraphic columns presenting their paleogeographic and tectonic evolution. This work is:

Mercier, J., 1968. Etude géologique des zones Hellenides en Macedoine centrale (Grèce). Ann. Geol. Pays Hell. 20 (792 pp.).

b) There is no comparison or correlation with other areas where the Cretaceous sediments are also observed. There could be a comparison apart from Mercier's work with the results of other papers, e.g. the paper of Sharp and Robertson (2006), who give an evolution model of a similar Upper Cretaceous basin north of the study area. Mercier (1968) places the beginning of the deposition of the Upper Cretaceous sediments in Aptian-Albian, while other researchers such as Sharp and Robertson and Galeos et al. (1994) describe even older aged sediments (Upper Jurassic). It could also be compared to other areas of the non-metamorphic Pelagonian, e.g. in Othrys Mt (Ferriere, 1982) and Argolida (Baumgartner, 1985). It is important to comment on the age of onset of the deposition of the Upper Cretaceous sediments, as well as the age of the emplacement of ophiolitic complexes on them, highlighting the possible differences that may exist from region to region.

C2

Ferriere J (1982) Paleogeographies et tectoniques superposees dans les Hellenides Internes au niveau de l'Othrys et du Pelion (Grèce). Soc Geol Nord Publ 8:1–970.

Galeos, A., Pomoni-Papaioannou, F., Tsaila-Monopolis, S., Turnsek, D. & Ioachim, C. 1994. Upper Jurassic–Lower Cretaceous 'molassic-type' sedimentation in the western part of the Almopia subzone, Aridhea Loutra Unit (northern Greece). 7th Congress of the Geological Society of Greece, Thessaloniki, May 1994.

c) The phrase "Upper Cretaceous basin" is used in two ways: either to describe the wider paleogeographic area where the Upper Cretaceous sediments were deposited or the small basin of Kallipetra. This dual use of the term confuses the reader. It must be made clear that the Kallipetra basin is part of a wider paleogeographic domain which, during the Upper Cretaceous, was the site of deposition of large thickness sediments.

d) An important key in the evolution of the basin is the origin of the fault that places the Vardar Oceanic Complexes (VOC) on the Upper Cretaceous sediments in the eastern part of the basin. According to the authors, the direction of tectonic transport of the VOC sealing Kallipetra Basin was from SSW to the NNE. It seems difficult that this transport can place the VOC on the sediments of the basin in a distance at least 4 km into the basin and westwards, as shown by the geological map in Figure 3 and the geological sections in Figure 8. This could happen if the VOC nappe crossed the entire basin from southwest to northeast. Also, in the map of figure 3 the fault is characterized as a reactivated thrust fault. This is not clearly described in the text except perhaps from the sentence in line 490. A much better analysis and documentation of the interpretation given is needed.

e) What is the origin of the basin and how is it associated with the growth of the Hellenides? Is it a fore-arc basin formed on top of an evolving accretionary wedge, is it a basin formed at the back of an orogenic wedge that collapsed due to underplating at its base, or is it a back-arc basin?

f) The evolution of the basin could be captured by a series of sketches, which can be

C3

either NE-SW striking cross-sections or 3D sketches, beyond the snapshot of Figure 12.

Comments on the text of the manuscript:

Line 28: There are dozens of references that could be placed here. It is better to include "e.g." at the beginning of the reference list.

Line 28: You should give the definition for the Internal Hellenides as the term is not only geographical or spatial but also has a geodynamic meaning by dividing the Hellenides into two areas with different evolution during the alpine orogenesis. Also, the first letter must be uppercase (Internal).

Line 34: What is the origin of this "Upper Cretaceous basin"? How was it created? Is it a single basin or more?

Line 36: I think that the migration is towards the SW-SSW.

Line 41: What are these controversies? I believe it needs further analysis beyond a simple reference to "controversies" and the presentation of a figure (Figure 2). You need to clarify the problem that you want to solve with this work.

Line 68: Add "e.g." at the beginning of the reference list as there are numerous works that could be cited here.

Lines 78-81: The area in which this stratigraphic gap has been described (Aptian-Albian) is very far from the study area and paleogeographically belongs to the western margin of Pelagonian and not to the eastern. Furthermore, other researchers (e.g. Sharp and Robertson 2006) argue that the onset of sedimentation occurs during the Aptian-Albian north of the study area.

Line 82: There are papers that describe older in age transgressive sediments which unconformably overlay the Pelagonian and Vardar units (e.g. Mercier 1968; Brown and Robertson 2004; Sharp and Robertson 2006; etc). See also my comment b.

C4

Line 83: You need to add more references here. There are numerous works to be cited here, with primary data except from the synthetic work of Papanikolaou (2009).

Line 92: Add "e.g." at the beginning of the reference list as there are numerous works that could be cited here.

Line 95: Leucogneisses?

Lines 95-96: Are you referring exclusively to the area west of the Kallipetra Basin or to the Pelagonian in general? If the latter is true you should add more references, as it is not only Schenker (2013) who describes the above lithologies. You could add "Schenker 2013 and references therein".

Line 111-112: The sentence "the sediments belong. . . . . as the Kallipetra basin" causes confusion (see also previous comment c). What is called as Kallipetra basin? Is it the paleogeographic domain where the large thick Upper Cretaceous sediments were deposited or only the small basin under study?

Lines 115-118: Please enter references as you seem to be referring to older works.

Line 141: What do you mean by the term "metapelitic zones"?

Lines 235-236: You argue that the fossils are deformed and reworked and are supplied by the VOC based only on the work of Schenker (2013). Apart from this study, I do not remember any other study that reports Lower Cretaceous sediments in the VOC. On the contrary, there are papers that support the start of deposition in Aptian-Albian (see also previous comment b). Even in your own work it is described that sediments of Kallipetra Formation with VOC form duplexes, so how are you convinced that the fossils belong to VOC and not to the Kallipetra formation? There are also studies that describe Upper Jurassic-Lower Cretaceous sediments unconformably on the VOC, which seal the tectonic emplacement of the VOC onto the passive margin of the Pelagonian. If you include those Upper Jurassic-Lower Cretaceous sediments in what you have named as Vardar Oceanic Complexes then you need to clarify that.

C5

Lines 311 and 312: Please correct the references. There is no Schenker (2014) in your reference list.

Line 415: Please enter reference as you seem to be referring to older work.

Line 449: The word "dramatic" has been struck through. I believe you need to delete that word.

Lines 488-489: See my comment d. As in the following lines (490-492) you suggest a localized inversion that predated the start of the general convergence, you have to enforce your interpretation.

Lines 494-498: I suggest to delete this interpretation as you have already weakened it in the second sentence.

#### Comments on the Figures

1. Figure 2 shows various models of evolution of the Hellenides in the Cretaceous, which are not analyzed in the manuscript and in the end there isn't any suggestion about them. Therefore, it does not offer anything substantial to this work and could be removed.

2. In the geological map of figure 3 some things are not visible and difficult to distinguish, e.g. difficult to distinguish black dots from dark blue ones. Therefore, some symbols need to be magnified.

3. In the geological sections of Figure 8, there is a large number of faults. According to the manuscript and the map of figure 3, these are normal, thrust and strike-slip faults. In order for the reader to find out which is which, he must constantly resort to the map. Therefore, I suggest the relative slip of the fault-blocks should be plotted along the faults.

4. In figure 12 there is no legend explaining the symbols used to describe the different geological formations of the sketch. The sketch also gives a false impression that the

C6

basin has developed mainly east and northeast of the VOC. Perhaps the sketch should also include the western margin of the basin in order for the reader to have a complete picture. See also previous comment for 3D sketches.

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Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2020-106>, 2020.