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Interactive comment on “Polyphase evolution of Pelagonia (northern Greece) revealed by geological and fission-track data” by F. L. Schenker et al.

F. L. Schenker et al.

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Five major points of criticism have been raised from the referee:

1) No clear distinction between presentation and discussion

Our results are divided in two parts: (i) Location and description of the samples and (ii) FT results. In part (i) we describe the age of deposition (based on fossils or published work) and the metamorphic grade of the rocks (based on petrographic observation in thin-sections). These field results are used in (ii), where we combine them with statistical parameters to attest if the FT ages are detrital or reset cooling ages. Thus, we acknowledge that in the same section after presenting the FT data we also discuss

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their degree of resetting. Such a discussion is required to introduce the results of the binomial peak-fitting analysis of the detrital sample. Despite this apparent mixing, we argue that presentation and discussion are still distinct and that the examination of the resetting degree of the FT data is basic and necessary to any further discussion, which is conducted separately.

2) Confusion between tectonics and sedimentation

This criticism refers to section 1.1 of the manuscript (tectonic settings and geological overview). In this section of the manuscript we are discussing the Pelagonia Zone in the context of the tectonic of the Hellenides. We state that “Basins at the western (Mesohellenic trough) and eastern (Axios basin, Fig. 1) Pelagonian margins were filled with colluvial-proluvial sediments during the Eocene compressional and the Miocene extensional events”. These tectonic events are regional (see figure 2) and generally accepted. The sedimentation is well constrained. The Meso-hellenic basin hosted an almost continuous deposition from the Eocene to the Miocene (e.g. Ferrière et al 2004). The Axios basin has an Eocene-to-Pleistocene deposition history characterized by a Oligocene-Miocene unconformity (Roussos, 1994). Furthermore, there is no sedimentation without tectonics creating the space for sediments to stay. As such we do not clearly see where we make confusion between tectonics and sedimentation. Please specify the point of contention.

3) Relationship between age of burial and cooling are not clear in the text.

This criticism refers to subsection 2.3.1. (p. 3083, lines 10-13). We agree that our formulation may lead to misinterpretation. We will change the sentence from: - Nevertheless, the metamorphic growth of chlorite indicates peak temperatures above 250 °C (Spear, 1995) that have partially or totally reset the zircons at 92.2 (+10 –9) Ma. To: -Nevertheless, the metamorphic growth of chlorite indicates peak temperatures above 250 °C (Spear, 1995) that have either partially or totally reset sample 10-029, which subsequently cooled below 240 °C at 92.2 (+10 –9) Ma.

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4) In the discussion section some processes (e.g. thermal subsidence, slab dynamics) are introduced that are not supported by data (section 3.1, page 3086, lines 6-16).

It is partly true that relating large-scale processes to punctual data is a delicate generalization. We invoke thermal subsidence because it requires the fewest assumptions to explain the following observations: regional scale subsidence and cooling from ~ 100 to 68 Ma without evidence for extension but instead apparent tectonic quiescence. Invoking other processes would require more assumptions and actual, geological evidence for which there is no existing constraint. We used geometrical arguments (“slab dynamics”) to exclude invisible processes such as underplating below Pelagonia during the Miocene and we reconstruct the slab using the established position of the trench during roll-back of the Hellenic slab (section 3.2 pages 3087-3088).

5) There is some confusion between denudation and erosion.

The term “denudation” is often used only for “tectonic denudation” of the detachment footwall in extensional core complexes, as discussed in Ring et al. (1999). Nevertheless the original and accepted meaning of denudation refers to the sum of the long-term processes that cause the wearing away of the Earth’s surface. As such, denudation and erosion have also been used as synonyms (Ring et al., 1999). By specifying “erosional denudation”, we clearly define the process, to which we refer as dominant mechanism to explain our observations that are fast cooling and thrusting, as we do in section 4, page 3089, in the following sentence: “Abrupt and rapid cooling below 240 °C of the Pelagonian basement at about 68 Ma due to erosional denudation during thickening.” The referee suggests that high exhumation rates may imply “tectonic denudation” rather than “erosional denudation”. We argue that fast cooling and erosion rates are by no means typical for tectonic denudation and they can occur regardless of the tectonic regime (Ring et al., 1999): in fact the highest erosion rates on earth are found in regions under compression like, for instance, in Taiwan (Dadson et al 2013, Willett et al., 2003). 6) We are not taking into account the interpretation of Coutand et al., 2014 on south of our working area. We take into the account the work of Coutand

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et al. 2014 (see for instance in Figure 11). Their results show slow steady cooling (3-6 °C/Ma) from 60 Ma to present in western Pelagonia and fast cooling between 12 and 6 Ma in eastern Pelagonia along the same normal fault that we describe in our study. We observe fast cooling between 25 and 16 Ma. Since Coutand et al. 2014 worked ~80 km south of our study area, the difference in the timing of cooling along the same normal fault can be related to diachronous fault activity along strike (as shown in Figure 11). We are not in conflict with the results of Coutand et al. 2014. We agree with the reviewer that we may be clearer on the topic and as he suggested, we will add some clarification in the text.

Addressing other comments

In Figure 8a (Figure 1 of this comment) there was a graphical error in the error bars (95% confidential interval). Ages and error are calculated using the Zetage code by Brandon based on the method of Hurford and Green (Isotope Geoscience, 1983) and the formulation of Galbraith (Nuclear Tracks, 1990).

References: Ring, Brandon, Willett and Lister, 1999, Exhumation processes. In: Ring, Brandon, Lister and Willett (eds) Exhumation Processes: Normal faulting, Ductile flow and Erosion. Geological Society London, Special Publications, 154, 1-27. Dadson, Hovius, Chen, Dade, Hsieh, Willett, Hu, Horng, Chen, Stark, Lague and Lin, 2003, Links between erosion, runoff variability and seismicity in the Taiwan orogen. Letters to nature, 426, 648-651. Willett, Fisher, Fuller, En-Chao, Chia-Yu, 2003, Erosion rates and orogenic-wedge kinematics from fission-track thermochronometry, Geology, 31, (11), 945-948. Roussos, N., 1994. Stratigraphy and paleogeographic evolution of the Paleogene Molassic basins of the North Aegean area. Bulletin of the Geological Society of Greece, 30, 2.

Interactive comment on Solid Earth Discuss., 6, 3075, 2014.

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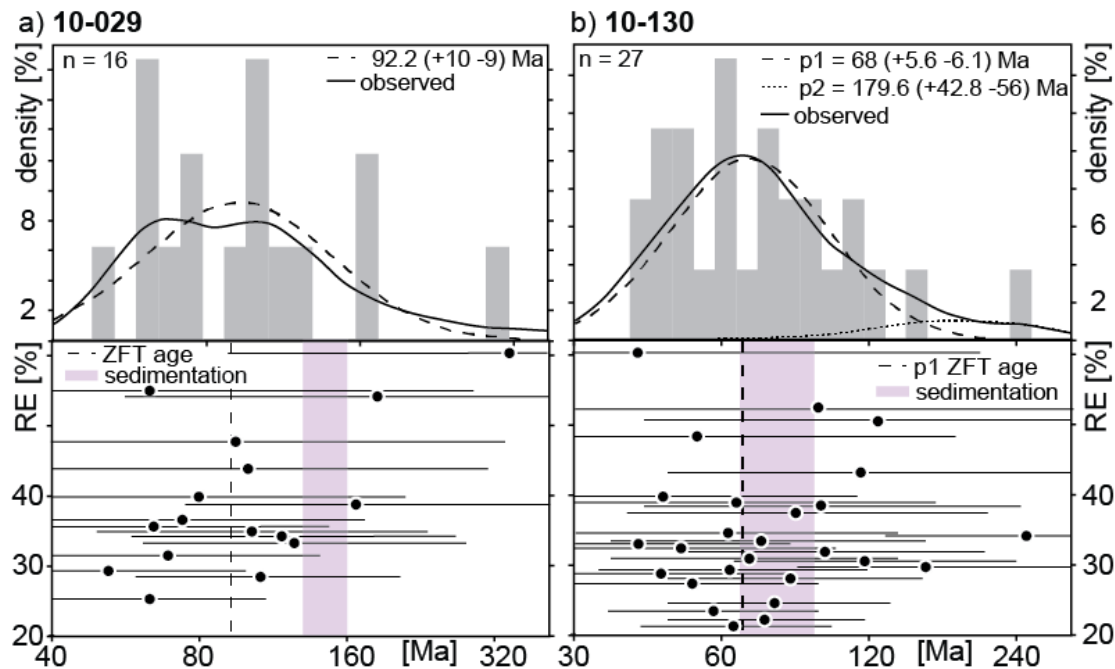


Fig. 1.

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