RC2: 'Comment on egusphere-2023-3123', Anonymous Referee #2, 06 May 2024

Based on the isopach maps, subsidence curves, and reconstructions of flexural profiles, supported by Bouguer anomaly data and maps of dynamic topography and seismic tomography, the authors discussed the intricate interplay between deep earth dynamics and surface processes, and then proposed a two-stage evolution of the NW Zagros foreland basin from flexural subsidence to dynamic subsidence. Moreover, the authors suggested that the subsidence of the Zagros foreland basin was triggered by surface loading and slab subduction during the early Miocene, and the tear propagation of the NeoTethys horizontal slab during the late Miocene.

Overall, this manuscript exhibits a high level of organization and clarity in its presentation. I would suggest a middle revision before final acceptance.

General comments:

1. The authors proposed the notion of northward flow of the Afar plume, drawing from the spatial distribution analysis of the crystallization age of mantle magmatism (Ball et al., 2021; Fig. 7). However, it's important to note that the spatial distribution analysis provided may not be comprehensive. There are many Late Eocene mantle magmatic outcrops in Iran (e.g. Deevsalar et al., 2018, JGS), which are missing in Fig. 7c. Therefore the evidence supporting this northward flow remains uncertain.

If the authors maintain their stance on the northward flow of the Afar plume, it is essential that they provide additional evidence to support their claim. This could include a comparative analysis highlighting the similarities and differences between plume-derived magmatism and other types of mantle sources. For instance, it would be valuable to discuss how mantle-derived magmatism resulting from processes like slab break-off, slab tearing, and sub-parallel subduction of the NeoTethys ridge can be distinguished from plume-related magmatism.

Dear R2 (Anonymous),

Thank you for your supportive and constructive comments:

We proposed a northward flow of the Afar plume based on the distribution of mantle magmatism, upper mantle structure as imaged by teleseismic, and fast velocity polarization orientation analysis (SKS splitting) as documented in previous publications (Camp and Roobol, 1992; Ershov and Nikishin, 2004; Faccenna et al., 2013; Kaviani et al., 2018). We agree that further geochemical synthesis will enhance the manuscript, but it may deviate from the focus of our manuscript, which basin analysis.

Indeed the plotting of the 20 (?) samples from Deevsalar et al. (2018) is not included, but the plotted complication from Ball et al., 2021 represents 4443 samples of alkaline and sub-alkaline mafic and ultramafic rocks. Furthermore, the samples from Deevsalar et al. are located in the central part of the Zagros, away from the northwestern segment, which is the focus of this study.

2. The timing of continental collisions is a topic fraught with controversy. While the authors have chosen to adopt the Oligocene time frame in the text and Fig. 4, it would enhance the logical flow of the discussion to provide a comprehensive summary of the various proposed collision times. Furthermore, it would be beneficial for the authors to elucidate the criteria used to select the Oligocene time frame as the preferred collision time, thereby providing readers with insight into the rationale behind this decision.

In the Tectonostratigraphic context section, the new text below is introduced to provide that rationale for the preferred age of collision in the NW Zagros, and the relevant papers are cited.

Various ages for the Arabia-Eurasia collision have been suggested, spanning from the late Cretaceous to the Pliocene (Dewey et al., 1973, 1986; Berberian and King, 1981; Stoneley, 1981; Dercourt et al., 1986; Hempton 1987; Alavi 1994; Agard et al. 2005, 2011; Fakhari et al. 2008; Ballato et al. 2011; Khadivi et al. 2012; McQuarrie and van Hinsbergen 2013; Saura et al. 2015; Gholami Zadeh et al., 2017; Pirouz et al., 2017; Darin and Umhoefer, 2022; Sun et al., 2023). However, as continental collision is a prolonged process, the onset and culmination of the process need to be distinguished. Additionally, the collisional age must agree with well-constrained global paleotectonic models and geologic records. Continental collision is defined by the total subduction of oceanic crust between two continental crusts (Dewey and Horsfield, 1970). In the NW Zagros belt, considering the Arabia-Eurasia collisional age older than Oligocene is less likely due to (1) the necessity for unrealistically long post-collisional subduction of the Arabian continental crust beneath Eurasia (e.g., McQuarrie and Hinsbergen, 2013) and (2) the pervasive occurrence of oceanic crust subduction-related magmatism during Paleocene and Eocene (e.g., Chiu et al., 2013). Considering the Arabia-Eurasia collisional age younger than Oligocene, does not account for lines of evidence from provenance, geochronology, and thermochronology studies, and timing crustal deformation as well as regional tectonostratigraphic observations (Allen and Armstrong, 2008; Koshnaw et al., 2019, 2021; Cai et al., 2021; Song et al., 2023).

Detailed comments:

1. The conclusion section could benefit from some refinement. The authors may consider restructuring it with a series of concise paragraphs following a brief summary to enhance clarity and reader comprehension.

The conclusion section is extensively edited and organized into two paragraphs.

2. The font size in some figures appears to be too small, such as the well names in Fig. 5 and the age legend in Fig. 7c.

The font size in both figures has been updated.

3. The reference list requires updating.

The reference list has been updated.