Comment on se-2022-18
Hilmar von Eynatten (Referee)

Referee comment on "Reconstructing post-Jurassic overburden in central Europe: new insights from mudstone compaction and thermal history analyses of the Franconian Alb, SE Germany" by Simon Freitag et al., Solid Earth Discuss., https://doi.org/10.5194/se-2022-18-RC2, 2022

Simon Freitag and co-authors use petrographic and petrophysical properties and organic maturation data of Lower and Middle Jurassic mudstones from outcrops and drillcores of the Franconian Alb to estimate thicknesses of the post-Jurassic regional overburden. The paper is overall well written, methods and calibrations appear sound to me (though I’m not an expert in petrophysical properties), and the results constitute a significant and highly relevant contribution for the understanding of the Mesozoic evolution of the area. I recommend minor revisions only. The authors may consider separating chapter 3 into 'Results' (largely sections 3.1 to 3.4) and 'Discussion' (largely 3.5 and 3.6, could then be a new chapter 4).

When comparing the results to those by von Eynatten et al. (2021) in section 3.5, please consider that their modeling leading to 3-4 km burial refers to Early Triassic (Bundsandstein) strata (their figure 10). Including about 600-800 m of Middle Triassic (Muschelkalk) and Late Triassic (Keuper) strata significantly reduces the contrast between the two studies. Moreover, the study area is located towards the eastern/southern margin of the domal uplift proposed by von Eynatten et al. (2021) with likely less uplift/exhumation, as already emphasized in section 3.6. Given that the thermal anomalies mentioned are mainly local (as already stated by Freitag et al.) and an elevated heat flow of 80-85 mWm\(^{-2}\) still requires removal of 2.5-3 km of post-Early Triassic overburden (von Eynatten et al. 2021), I guess the contrast between the two studies remains within the uncertainties of the individual methods, implying that there is no need to call for increased heat flows or geothermal gradients.

Some parts appear over-referenced (and in this respect redundant in the Introduction and Methods parts, e.g. lines 125-126, 127-129, 133-134, 188-190). Please consider reducing to two or three major references as examples (e.g., ...) or being more specific regarding information and respective references.
Minor points:

Line 80-82: sentence should be reformulated.

Line 97: the Cretaceous strata are even more related to the parallel structure further south, not labelled in figure 1 but abbreviated as ‘DF’ in the inset (Bayrischer Pfahl?, not explained in caption). This should be clarified for readers not familiar with the regional geology.

Line 275: it remains unclear whether these are 41 individual samples or 41 measurements on ca. 10 samples (please note that in the heading for table 1 and in the text (line 157) the numbers summing up to 41 (in case of GSC) are declared as measurements per sample). The same holds for line 222: 72 samples (or measurements per sample?) for bulk density and porosity. This should be consistent and clear for the readers without checking the Appendix.

Line 280: these terms should be used in figure 4a as well (i.e. avoid clayshale, mudshale, siltshale, they are rather unusual).

Line 308: quartz, pyrite, ...

Line 325: ... (2018) suggests vertical effective stresses ... ... and roughly equates to 700-2000 m true vertical depth.

Line 433: just for consistency, lower limit is 800 m in Fig.9, caption to Fig. 9 and in the text (line 450).

Line 464: not fully clear how the 1.1 km are deduced.

Line 484: von Eynatten et al. ...

Line 631: though correct for German name rules, ‘von ...’ is usually listed under ‘v’ in the reference lists of international journals. The same holds for ‘Le Bayon et al.’, etc. I guess.