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Solid Earth Discussions

Interactive comment on "The effect of obliquity on temperature in subduction zones: insights from 3D numerical modeling" *by* Alexis Plunder et al.

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Answers to the interactive review of the paper: "The effect of obliquity on temperature in subduction zones: insights from 3D numerical modeling" by Alexis Plunder et al.

Dear Editor, dear reviewers,

First of all, we wish to thanks the reviewer for their time considering our work. Below you can find *answers* the questions asked by the referees.

Answers to first referee: M. Faccenda (Referee) manuele.faccenda@unipd.it

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Plunder and co-authors have addressed the role of subduction obliquity in modifying the slab thermal structure. They found that trench-parallel (toroidal) component of the subduction-induced mantle flow can generate from 50 to 200 along-strike temperature differences according to the subduction velocity, and, more importantly, the subduction obliquity. The manuscript represent a substantial contribution to scientific progress within the scope of Solid Earth, as it suggests that along=strike variations in the degree of metamorphism in exhumed rocks (assuming that the pressure represent depth and no important contribution derives from tectonic stresses) could be explained by subduction obliquity. The scientific approach and applied methods are valid, and the model limitations are fairly discussed. Results are concise and clearly explained. The only major comment I have is that, in order to make the paper more appealing to a wider geological and geophysical audience, may be the authors could have investi- gated how the results change as a function of the (i) slab dip (for example, 30-60-90 degrees), (ii) slab age (for example, 50-75-100 Myr) and (iii) upper plate age (5 Myr is a quite unusual age for the upper plate where oceanic plates subduct below overriding continents). In this way the results could be more applicable to different subduction set- tings, and successively could be further tested in another study by introducing further complications like dehydration and melting reactions, temperature- and composition- dependent viscosity, etc.

Concerning (i): we now provide a set of experiment for additional subduction dip angle (30°). As expected, the results show similar patterns to what is described for the experiments presented in the original manuscript (with 45°). The corresponding depth-temperature paths were added on Fig. 4. We excluded subduction dip angles of

60° and 90° for problems related to the setup and their respective boundary conditions: With a dip angle of 60° we have seen large effects on the side of the models and therefore excluded them. A dip angle of 90 ° is so rare that it is beyond the scope of our investigation.

(ii) We now provide the depth-temperature path for the reference model with different slab ages (Fig. 4). As expected, older lithosphere decreases the thermal regime of the subduction zone but does not change the lateral effect that is the prime target of our study. We want to warn the reviewer that the one-to-one applicability of our model to natural settings would be difficult considering the large assumptions we made. Rather, we perform a set of experiments to test whether the hypothesis that strong lateral changes in metamorphic grade along a subduction system may reflect changes in obliquity, is physically plausible. Our experiments suggest that it is.

(iii) We chose the young overriding plate age in order to be as close as possible to the geological observation of Turkey (ophiolite forming during subduction initiation). This is now better stated. It also allows us to reduce the size of the computational domain (and the size where v=0).

The geometries used in our paper are suit the testing of our hypothesis, but should be adjusted if designed for direct comparison to the field in future work.

Aside this, I recommend publication of the paper in the present form.

*The typos have been found, corrected. We also double-checked carefully the manuscript. (**we removed one line of the comments by ref. #1 due to latex incompatibility**)*

Manuele Faccenda

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