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Solid Earth
Discussions

Interactive comment on "Insight into collision zone dynamics from topography: numerical modelling results and observations" *by* A. D. Bottrill et al.

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The authors would like to thank Susanne Buiter for her constructive comments that have improved the explanation of the numerical modelling techniques used in this study. We address specific comments below and have also made appropriate changes to the manuscript.

1 *I suggest that you extend the description of your modelling method so that the manuscript would offer a level of detail that would allow the models to be reproduced. More specifically, could you include:*

We will include all the points below in the revision of the manuscript. This should

hopefully allow others to reproduce our results.

2 *The flowlaws used for each materials, with references and a table of values (A, n, Q, V, grain size, wet/dry)*

The flow laws are the same for all material in the model and the same as described in (van Hunen Allen 2011). For clarity we will include them in the final manuscript rather than just refer to them.

3 *The values of the thermal parameters (capacity, conductivity, expansivity)*

Heat capacity $Cp = 1250$

Thermal diffusivity $k = 1 \times 10^{-6}$

thermal expansively $\alpha = 3.5 \times 10^{-5}$

Have now been added to the table of values

4 *The densities*

$\rho_c = 2700kgm^{-3}$

$\rho_m = 3300kgm^{-3}$

$\Delta\rho = 600kgm^{-3}$ (not as currently listed in table as $660kgm^{-3}$)

We will make sure this information is included in the manuscript

5 *The width + height and viscosity of the mantle weak zone. Is this zone coupled to the overriding plate, to the subducting plate, or free to deform?*

The weak zone is 13.2 km wide and extends down to 130 km (all the way through the lithospher) and has mantle viscosity of $1 \times 10^{20} Pa \cdot s$. The zone is coupled to the overriding plate and is maintains its original shape throughout the model run.

6 *A description of the yield behaviour and values used*

The yield behaviour is also described in (van Hunen Allen 2011) with the slight difference that we use a surface yield strength of $1 \times 10^7 Pa$. We will include the full description of this in the final manuscripts.

7 *The type of element (quadrilateral with linear velocity and constant pressure?)*

The elements are indeed quadrilateral with bi-linear velocity shape function and constant pressure.

8 *The subducting Neo-tethys plate is assumed to be old with an estimated age of 200 Ma (page 893). The model ocean plate is 60 Ma and ca 67 Ma at collision. Could this age discrepancy be important?*

We would argue that this difference in plate age between our general model and the Arabia Eurasia collision is unimportant. This is due to the suggestion that oceanic plates older than 70 Myrs behave mechanically like a plate of 70 Myrs (van Hunen et al. 2005; Ritzwoller et al. 2004). We will add this note to the manuscript.

9 *Topography in the models is calculated from normal stress at the free-slip surface.Could you add a brief discussion of how this would compare to topography obtained from models with a true free surface?*

To a first order the topography produced using our method and a true free surface would be the same. One advantage of a true free surface is the ability to simulate true elastic deformation which has to be added into our model by calculating the deflection due to the normal stresses. The disadvantage of using a free surface is that it is numerically expensive (Schmeling et al. 2008).Even without a full free surface model we would argue that our model successful captures the large scale trends for the overriding plate topography without the need for a full free surface model.

New references

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Interactive comment on Solid Earth Discuss., 4, 889, 2012.