Dataset for numerical modeling to investigate plume-plateau subduction initiation

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1. Licence

2. Citation

When using the data please cite:

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The data are supplementary material to:

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3. Data description

This data publication is supplementary material to the paper " Subduction initiation by plume-plateau interaction: Insights from numerical models" by Baes, Sobolev, Gerya and Brune.

In this study, using 3-d numerical models, we explore the effect of relative distance of plume head and plateau edge, age of the lithosphere and strength of the lower crust on plume-induced subduction initiation. We use I3ELVIS code which solves the momentum, continuity and energy equations based on a staggered finite difference scheme combined with a marker-in-cell technique (Gerya, 2010; Gerya et al., 2015; Baes et al., 2016). Our numerical results show four different responses (shown in Figures 2-5 in the article of Baes et al., 2020) that are: (a) oceanic trench formation, (b) circular plateau-oceanic trench formation, (c) plateau trench formation and (d) no trench formation. The results of models in which plume head is far away from the plateau edge are compatible with the outcomes of models with uniform lithospheres.

The current data set contains the figures of five models representing five different deformation regimes (shown in Fig. 7 in the paper), which result from interaction of a plume with a homogenous lithosphere.

Note that in all figures the upper panels show the logarithm of viscosity within the lithosphere. The middle and lower panels illustrate compositional field of a 2d cross-section cutting through centre of model and surface topography, respectively. The colour bars of temperature field and surface topography are shown at the top of the figure and colour code of compositional field is at bottom of the figure.

4. References

Baes, M., Gerya, T.V. and Sobolev, S.V., (2016): 3-D thermo-mechanical modeling of plume-induced subduction initiation. Earth and Planetary Science Letters, 453, 193-203, https://doi.org/10.1016/j.epsl.2016.08.023

Baes M., Sobolev, S., Gerya, T. and Brune, S., (2020): Subduction initiation by plume-plateau interaction: Insights from numerical models G-cubed.

Gerya, T., (2010): Introduction to Numerical Geodynamic Modelling. Cambridge University Press, https://doi.org/10.1017/S0016756811000604

Gerya, T.V., Stern, R.J., Baes, M., Sobolev, S.V. and Whattam, S.A., (2015): Plume-induced subduction initiation triggered Plate Tectonics on Earth. Nature, 527, 221–225, https://doi.org/10.1038/nature15752

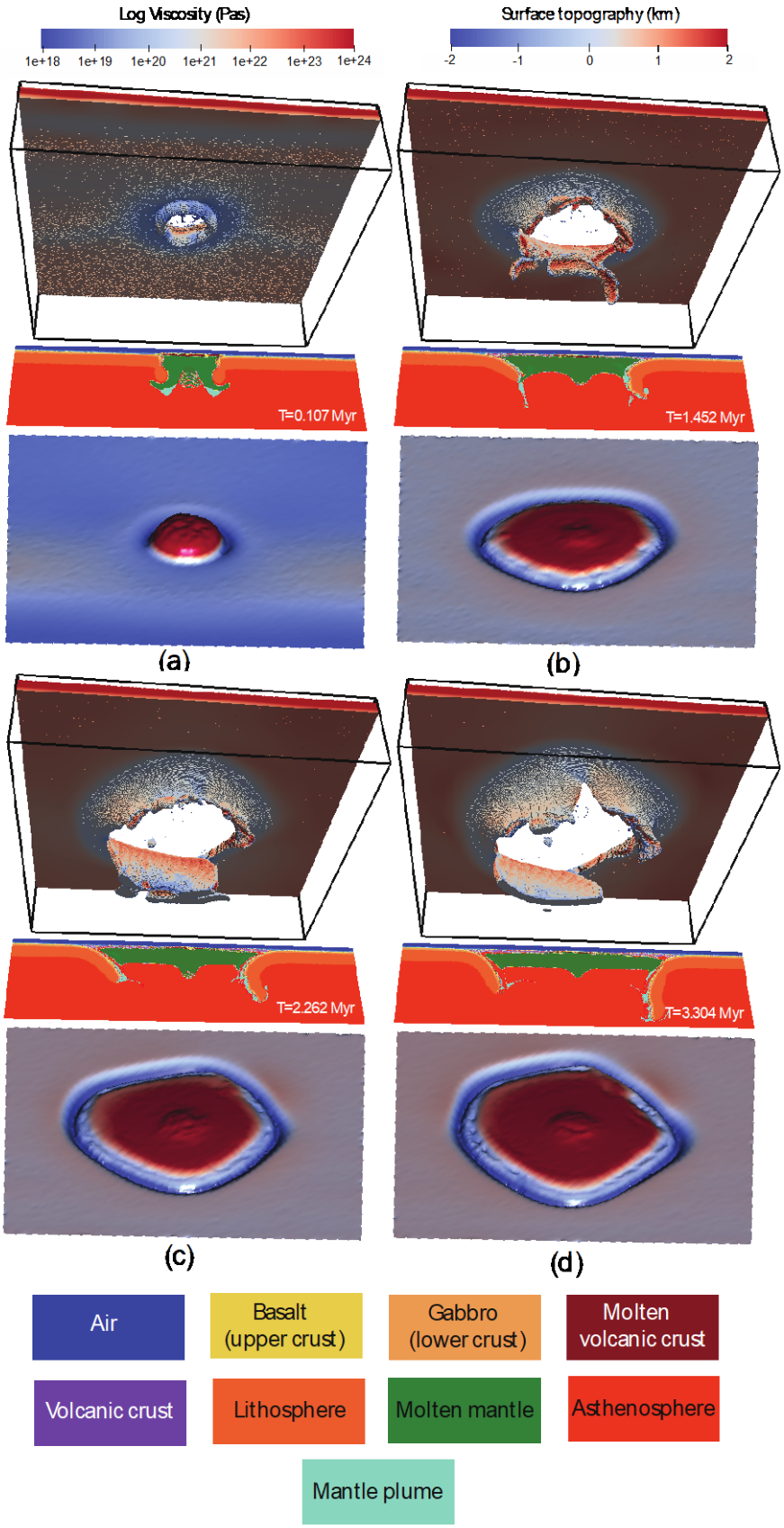

Figure S1 illustrates the results of a model which has a 20 Myr old oceanic lithosphere with a uniform oceanic crust of 8 km thick (model M67 in Table 2 of Baes et al., 2020). The temporal evolution of this model shows formation of a circular oceanic trench ("CO" in Fig. 7 in the article).

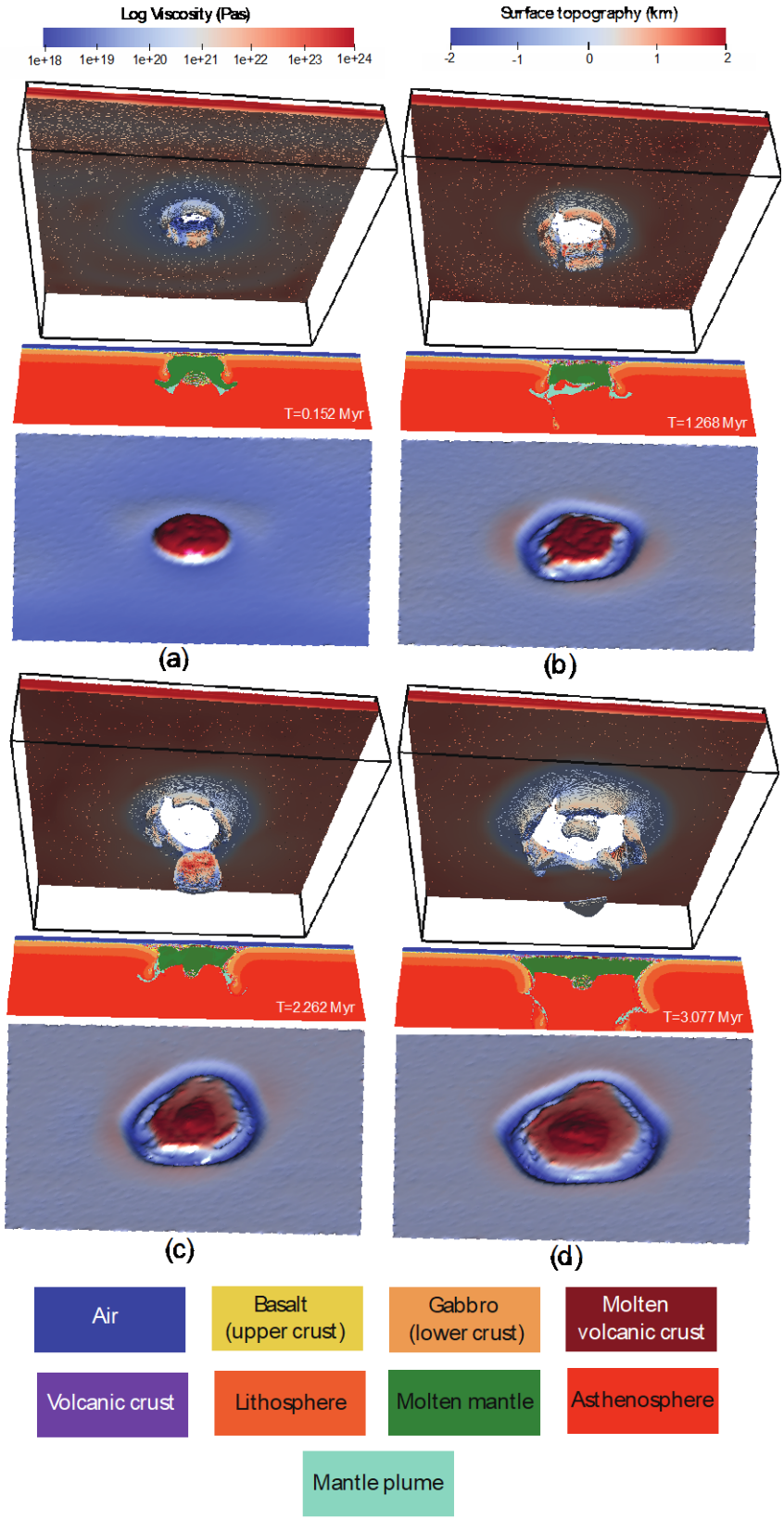

Figure S2 shows the model results of an experiment which has a 20 Myr old oceanic lithosphere with a uniform plateau of 20 km thick (model M68 in Table 2 of Baes et al (2020)). Results demonstrate development of a circular plateau ("CP" in Fig. 7 in the paper).

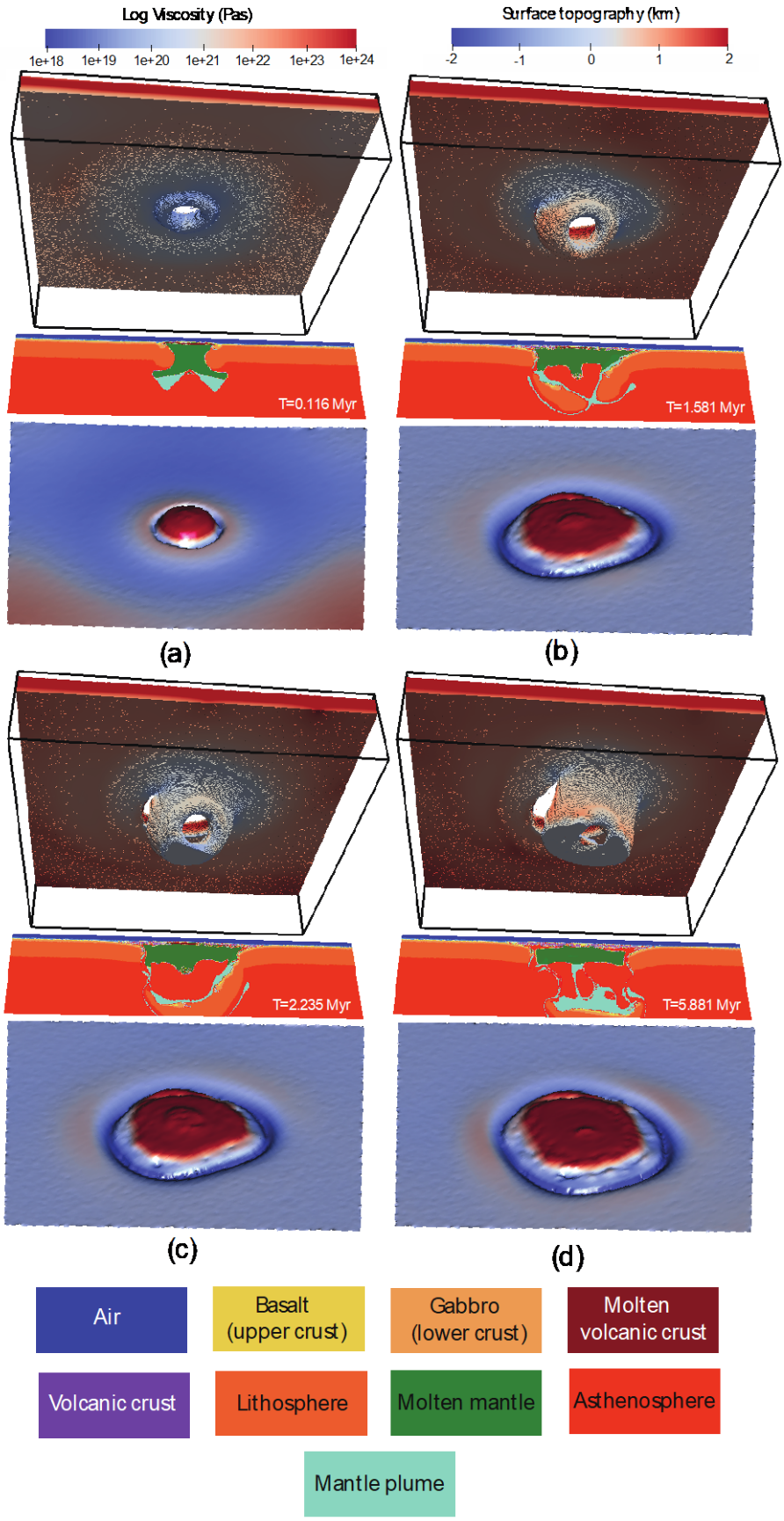

Figure S3 displays the results of a model with a 40 Myr old oceanic lithosphere and a uniform oceanic crust of 8 km (model M71 in Table 2 of Baes et al., 2020). The outcomes of this model indicate initiation of a one-sided subduction zone ("O" in Fig. 7 in the article).

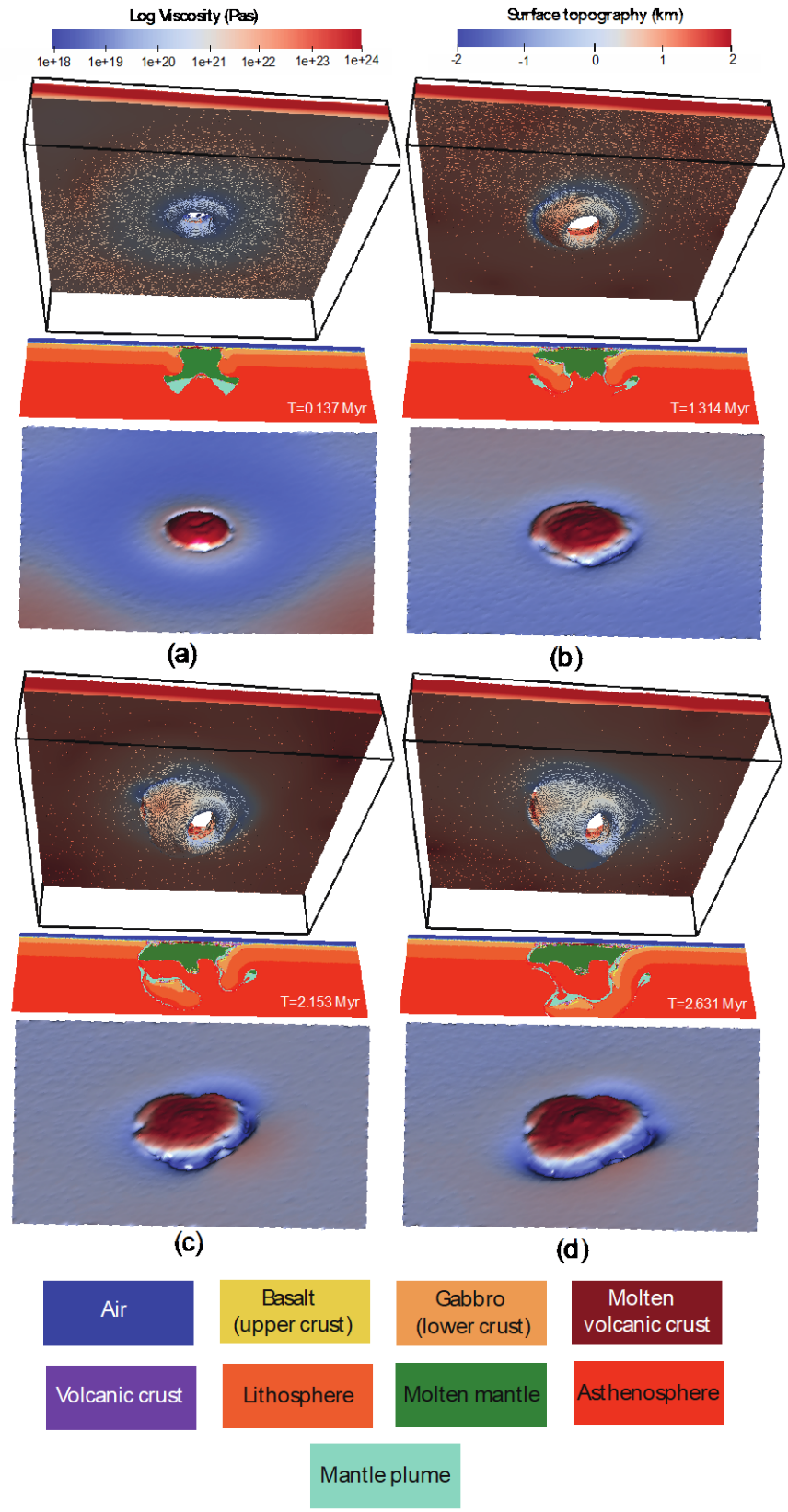

Figure S4 shows the results of a model which has a 40 Myr old oceanic lithosphere with a uniform plateau of 20 km (model M72 in Table 2 of Baes et al, 2020). The lithospheric response of this model is a one-sided plateau subduction initiation ("P" in Fig. 7 in the article).

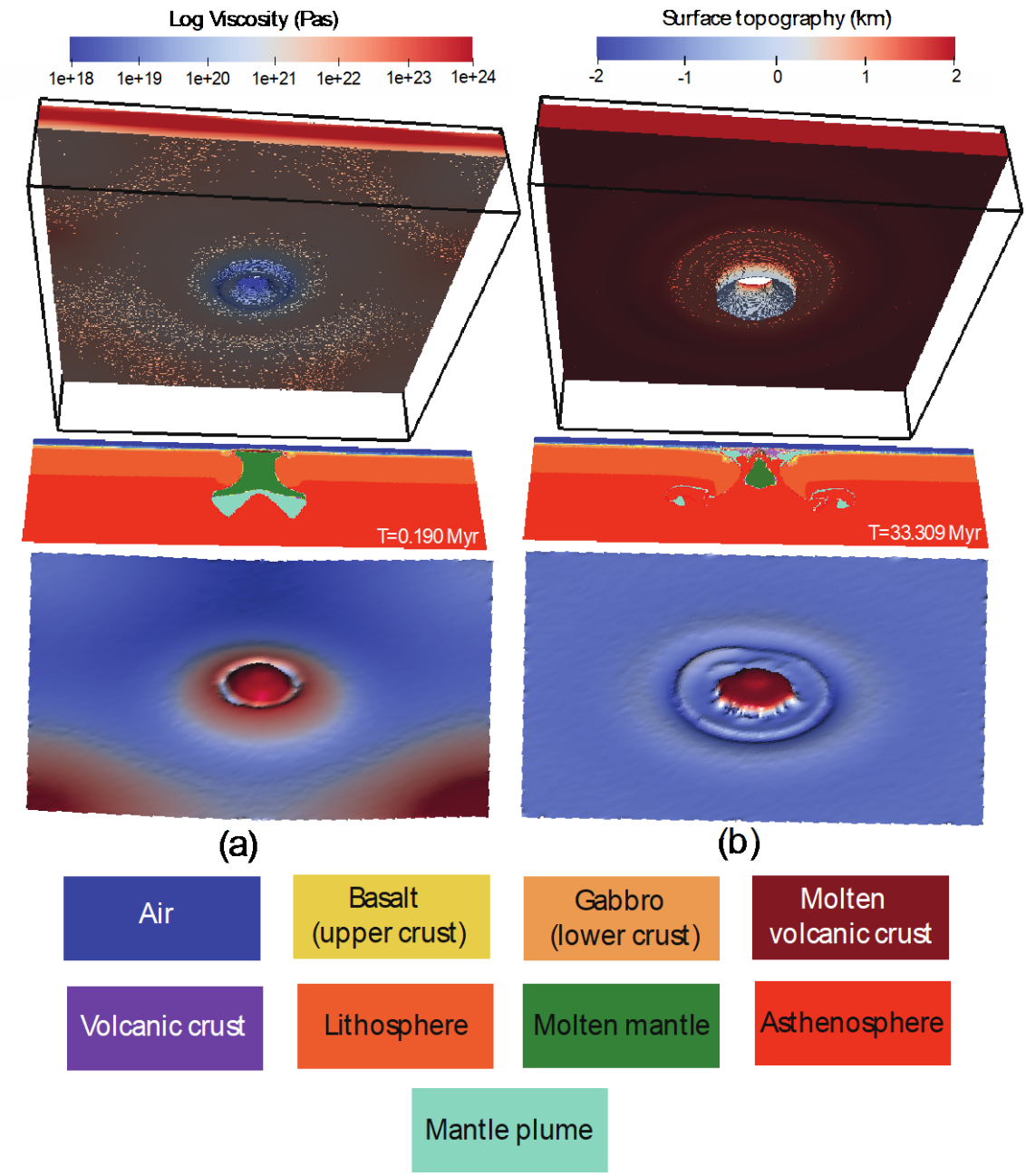

Figure S5 exhibits the results of an experiment which has a 70 Myr old oceanic lithosphere with a uniform oceanic crust of 8 km (model M75 in Table 2 of Baes et al., 2020). In this model plume-lithosphere interaction does not lead to development of a new subduction zone ("N" in Fig. 7 in the article).