

Interactive comment on “Using open sidewalls for modelling self-consistent lithosphere subduction dynamics” by M. Chertova et al.

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This is very interesting and useful paper concerning detailed investigation of the use of different boundary conditions for subduction modeling. The paper is well written and can be published in SE after addressing following two issues

1) The paper insists that open boundaries are the most natural type of BC to be used in subduction modeling. This is only partly correct since without proper implementation of intraplate stresses this type of BC will always promote trench retreat and results will be different for models with different aspect ratio. The latter is not surprising since models with open BC and no intraplate stresses imply unnatural plates, which are infinitely long but have finite bottom plate traction (which depends on the length of the plates actually present inside the models) and have no ridge push. Consequently, a model

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with shorter aspect ratio and reduced bottom plate traction has smaller resistance to retreat and higher trench retreat rate compared to the model with longer aspect ratio. Plates are finite in nature and it is thus natural to have them finite in models. From this perspective, one should compare models CROR with models OROR (i.e. with a model which has two open boundaries and two ridges) and not with models OO as in the paper. Additional testing of OROR type models would be really useful for this paper.

2) Discussion on the used BC in subduction modeling could be extended. CROR type models are used in a number of recent papers (Dutetz et al., 2011, 2012; Ueda et al., 2012). Also, models with open bottom boundary are used which allow for both trench advance and retreat by allowing mass exchange between the left and right part of the model (Gorczyk et al., 2007; Gerya and Meilick, 2011; Vogt et al., 2012). Also, one could mention recent high-resolution global scale 3D models, which allow for self-consistent (and lateral BC-free) modeling of plate tectonics with one-sided subduction (Stagler et al., 2010; Crameri et al., 2012).

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References

Crameri, F., Tackley, P.J., Meilick, I., Gerya, T., Kaus, B.J.P. (2012) A free plate surface and weak oceanic crust produce single-sided subduction on Earth. *Geophys. Res. Lett.*, doi:10.1029/2011GL050046.

Dutetz, T., Gerya, T.V., May, D.A., 2011. Numerical modelling of spontaneous slab breakoff and subsequent topographic response. *Tectonophysics*. 502, 244-256.

Dutetz, T., T. Gerya, B. J.P. Kaus, and T. B. Andersen 2012. Thermomechanical modeling of slab subduction. *J. Geophys. Res.*, doi:10.1029/2012JB009137

Gerya, T.V., Meilick, F.I., 2011. Geodynamic regimes of subduction under an active margin: effects of rheological weakening by fluids and melts. *J. Metamorphic Geol.* 29,

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7-31.

Gorczyk, W., Willner, A.P., Gerya, T.V., Connolly, J.A.D., Burg, J.-P., 2007. Physical controls of magmatic productivity at Pacific-type convergent margins: New insights from numerical modeling. *Phys. Earth Planet. Inter.* 163, 209-232.

Stadler, G., Gurnis, M., Burstedde, C., Wilcox, L.C., Alisic, L., Ghattas, O., 2010. The dynamics of plate tectonics and mantle flow: From local to global scales. *Science* 329, 1033-1038.

Ueda, K., T. Gerya, and J.-P. C. Burg 2012. Delamination in collisional orogens: thermo-mechanical modeling. *J. Geophys. Res.*, doi:10.1029/2012JB009144

Vogt, K., Gerya, T.V., Castro, A. (2012) Crustal growth at active continental margins: Numerical modeling. *Phys. Earth Planet. Interiors*, 192-193, 1-20.

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