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Interactive comment on "Testing the effects of the numerical implementation of water migration on models of subduction dynamics" *by* M. E. T. Quinquis and S. J. H. Buiter

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We would like to thank Manuele Faccenda for his comments that helped the revision of our manuscript. We reply point by point below.

"This study investigates the effect of different water migration schemes on the subduction dynamics. Basically, model results indicate that the style of oceanic plate subduction and extent of mantle wedge hydration are quite similar, regardless of the implemented water migration schemes, and even when there is coupling between water absorbed and mantle viscosity. I have few comments that I would like to see addressed before publication

- page 1773, line 25: I think it is fair to add as a reference the work of Hacker et al., 2003, JGR, that has calculated phase diagrams for hydrated mafic and ultramafic rocks."

We agree and we have added this citation to the text.

"-page 1779, line 18: “(1) elemental and vertical”, may be you want to add “velocity”?"

We have changed the text to: (1) One element vertically up per time step (referred to as ‘elemental’)

"-page 1780, line 15: in Faccenda et al., 2008, Nature, there is no fluid flow. Fluid flow is computed in Faccenda et al., 2009, Nat. Geo., and Faccenda et al., 2012, G3, in a slightly different way than the third migration scheme of this study: where vf and vs are the fluid and solid velocities, const is a term function of the as- signed constant hydraulic properties of the medium (permeability and porosity) and fluid viscosity, PTOT is the total (lithostatic + dynamic) pressure. Hence, the fluid velocity depends on the solid flow, the constant term const and the effective total pressure gradients."

We have removed the citations to Faccenda et al. (2008) from the section that describes the second migration scheme. We have kept Faccenda et al. (2008, 2009, 2012) in other parts of the manuscript where the references are applicable.

"-page 1781, eq. 8: please insert a citation for this empirical equation."

We have added a reference to Turcotte and Schubert (2002). Furthermore we have added the reference (Wark et al., 2003) for the constant 270 used in the Darcy equation(eq 8).

"-Table 2: the viscosity of the dry mantle is similar to that of the cylindrical body, while the dry lithosphere viscosity is 3 orders of magnitude lower. Please correct."

We thank the reviewer for spotting this! The accidental switch has been corrected in Table 2.

SED
5, C1160–C1162, 2014

Interactive Comment

"-page 1789, last part: I think it would be good to check dynamic pressure differences in the two models, as slab-lifting should be induced by lower dynamic pressure (or tectonic under-pressure) above the slab"

We agree. Our models assume vertical migration of water and we are therefore implicitly arguing that the horizontal pressure gradient, dP/dx, is small. We now illustrate this with (new) figure 4 of the manuscript, that shows the contoured values of variations in the pressure field following the horizontal component (dP/dx) superimposed on the bound water content for the model using scheme I. The models run using the three water migration schemes all show very similar pressure fields in the mantle wedge. dP/dx is low, varying with 1 MPa over a distance of 20 km where the bound water content is high, which is negligible in comparison to the vertical variations in the pressure field. We therefore ignore the dynamic component of the pressure gradient, reproducing the water migration scheme of Cagnioncle et al. (2003).

"-section 4.3: among the other discussed processes not included in the modelling, I thing it is worth to mention that during fluid flow compaction/dilation of the solid matrix produces additional flow divergency and pressure components that might affect the water migration patterns."

We have added a discussion of this possible effect on the water migration paths. We have added the following text. 'During fluid flow, compaction and dilation of the solid matrix may occur related to pore pressure effects. This could locally change the pressure field and thus in return effect water migration paths, changing the hydration patterns in the solid matrix.'

Interactive comment on Solid Earth Discuss., 5, 1771, 2013.