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Solid Earth Discussions

Interactive comment on "The fate of fluids released from subducting slab in northern Cascadia" *by* K. Ramachandran and R. D. Hyndman

Anonymous Referee #2

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The authors present the results of a seismic tomography study that they interpret in terms of a serpentinized forearc beneath the Cascadia subduction zone. They further argue that an observed low poisson ratio in the lower crust could be related to the addition of silica emplaced by rising slab fluids. This is an interesting study that gives further support to the idea that the forearc mantle at many subduction zones may be serpentinized. Before publication the authors should address a number of major and minor comments:

Major comments:

Water budget: The authors make a tentative water budget between the release rate

of slab fluids and the degree of forearc serpentinization. I do not find the budget convincing. First of all, they cite Hyndman and Peacock 2003 and Hacker et al., 2003 for the assumed release rate of slab fluids. In neither of those papers can I find the cited number for Cascadia. Yes, HP03 give a similar number for a "warm subduction" zone but apparently not for Cascadia. The authors should make it clear what this number is based on and for which depth range it is representative. Also some comments on how much water the incoming slab has prior to dehydration would help. Second, I find the calculation of the volumes of water stored in forearc serpentinites a bit confusing. There are many conversions between volume and mass; I think it would help if the authors clarify their approach a bit. Finally, a proper mass balance should be given how those two numbers relate to each other (fluid release rate and degree of serpentinization). So far I find the water budget a bit vague.

Thermal structure: The dehydration/hydration scenario the authors are proposing implies a certain thermal structure. Is this thermal structure realistic and consistent with all the different models out there? On which thermal model is the discussion really based? When I look at H03, it looks like the 600°C isotherm (where dehydration is basically complete) crosses the slab at ∼45km depth, while the imaged serp. forearc mantle extends ∼15km deeper. In the van Keken et al. 2003 model the 600°C isotherm has yet a different shape and would imply different hydration/dehydration patterns. I think a more thorough discussion on how realistic the assumed mineralogical compositions are with respect to thermal models would really strengthen the paper.

Previous studies: In my perception, Cascadia seems to be one of the best studied subduction zones in the world. Just for this review, I have found quite a few studies discussing the possibility of a serpentinized forearc mantle – including similar numbers for the degree of serpentinization and poisson ratios. Yet the authors make quite a poor job of discussing those previous works and do also not make it very clear how this new study is different from all those previous studies. Their results are interesting but it's not so clear to me in which way they are different from previous works.

Minor comments:

page 947 , line 5: maybe add something on tremors and how we can learn something about fluid ascent pathways? page 950, line 15: if the forearc mantle has temperatures of 400-600°C – would serpentine still form? yes, antigorite is stable but it is not so clear if it would still form. Plots: Fig. 2: please label x-axes, and make y-axes label legible Fig. 3: Labels are not readable Fig. 4: color scale is very confusing Fig .6: where does the fluid flux come from?

Interactive comment on Solid Earth Discuss., 3, 943, 2011.