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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

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Authors Reply

Anonymous Referee #2

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.

The release rate of slab fluids used in our paper is given by Hyndman and Peacock (2003) in their Figure 5. In this figure they also indicate the dehydration reactions involved. The fluid expulsion rate is roughly constant from the forearc mantle corner landward for about 150 km. The Hyndman and Wang (1995) original article for this model is now also referenced.

Hacker et al., 2003 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.

There is some information on the incoming slab water given by S.M. Peacock, (1993) (and other articles) but this seems too much detail for our article. (Peacock, 1993, Large-scale hydration of the lithosphere above subducting slabs, Chem. Geol. 108, 49-59)

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.

We have used the amount of water content in serpentine estimated using seismic velocities. Carlson and Miller (2003) is in the reference list that discusses water content estimation from mantle serpentine using seismic velocities.

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 Hacker et al., 2003, it looks like the 600_C isotherm (where dehydration is basically complete)

The thermal model is that shown in Figure 3 of Hyndman and Peacock (2003). The computation is given by Hyndman and Wang (1995).

Hyndman and Peacock (2003) provide detailed discussion of different dehydration temperatures.

I think a more thorough discussion on how realistic the assumed mineralogical compositions are with respect to thermal models would really strengthen the paper.

This is a geophysical article and we leave this kind of discussion for the geochemists that have written extensively on the subject (we give some references). We use the summary given by Hyndman and Peacock (2003) (the geochemistry in that article is the work of Peacock).

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.

This is the first article with data of sufficient quality and resolution to allow quantitative map of the serpentinization distribution in the forearc mantle. There have been a number of references to the presence of serpentinite. The definition of a region of low Poisson's Ratio just seaward of the forearc mantle corner is new. The inference of deposited silica from slab dehydration has important implications for crustal compositions.

PS: All minor comments will be addressed in the revised manuscript.

Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/3/C615/2012/sed-3-C615-2012-supplement.pdf

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