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Solid Earth Discussions

Interactive comment on "Understanding controls on hydrothermal dolomitisation: insights from 3D Reactive Transport Modelling of geothermal convection" *by* Rungroj Benjakul et al.

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We welcome the positive feedback on our manuscript and are glad that someone with a strong rock-based background and such extensive experience of HTD at outcrop and in the subsurface found the manuscript easy to read and coherent with wide range field examples on which they have worked.

We agree that fluid mixing is key here and have referred to the Smith et al. (2008) abstract in both our Introduction and Discussion sections. However, it is our view that, hydrothermal dolomitisation in Trenton and Black River Groups would more likely occur from mixing of hydrothermal fluids with large volumes of seawater drawn down from

the sea floor (as proposed here), rather than by mixing associated with displacement of original pore fluids, where the volumes of seawater (and thus the mass of Mg2+ available) would likely be several orders of magnitude too small to explain the volumes of HTD described.

The observations made by the reviewer about the early faulting at shallow depth (<500 m) are indeed in line with the model we propose. It may be that hydrothermal alteration of the overlying low permeability shales / anhydrite has obscured evidence of tectonically-related high permeability features that connected the HTD bodies to the sea floor. We agree that these transtensional fault zones (note there is no vertical offset across our simple modelled fault) would have a very significant permeability contrast with the carbonate matrix. Our ongoing work incorporates additional complexity not just in the matrix but also within the fault damage zone, and support the observation of greater alteration at shallow depth. Many challenges remain in understanding HTD and we agree it will be useful to simulate specific case studies, although challenges of parameterisation, in particular of 3D variations in permeability in both space and time are considerable. We will certainly include your suggestion coupled with a fully systematic sensitivity analysis in the future work.

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