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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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This is a very good paper that should be published. I am going to lay out the hydrothermal dolomitization model that Graham Davies and I proposed in 2006 and compare it to this modeling study in hopes that the authors might incorporate some of these ideas. I really like the idea of mixing of seawater with hydrothermal fluids and I proposed a similar model back in 2008 in an abstract for a talk I gave at AAPG Eastern Section that won the best talk award at that meeting. So there is clearly support for this concept! I sent the abstract to Fiona.

In the model we proposed, hydrothermal dolomitization was thought to mainly occur

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Discussion paper

at relatively shallow burial depths of <500m. Most faults associated with hydrothermal dolomite reservoirs die out within or just above the dolomitized zone suggesting very early faulting at relatively shallow depths. There are commonly seals such as black shales or anhydrite immediately overlying carbonates that have undergone hydrothermal alteration. The Bowling Green Fault Zone in Ohio, one of the great HTD reservoirs in the world, was never buried more than 1km even at its maximum burial. The faults are almost always transtensional faults which would have extremely high permeability (probably multiple orders of magnitude greater than the matrix. We think, as this paper suggests, that the matrix permeability of the host controls the distance from the fault conduit that dolomitization might occur. Most alteration occurs when the faults are actively moving rather than in in a stationary fault. Fault movement might drive "seismic pumping" that would draw fluids up from depth, and perhaps down from the seawater source as well. Commonly, but not always, the most hydrothermal alteration is concentrated to the uppermost permeable unit below the seal, perhaps in zones only 10s of meters thick.

The shallow depth of alteration would fit very well with the mixing of seawater and hydrothermal fluids proposed in this paper. Perhaps the fault moves, there is an episode of high pressure, high temperature fluid flow up the fault and that fluid then mixes with whatever fluid is currently residing in the formation, probably seawater or slightly modified seawater. Burial depths of 50-500m would only help this model as it is that much closer to the seafloor. It would be nice to see some additional stratigraphy in the model that showed variations in permeability and alteration closer to the surface.

I have some animations that I will send to Fiona as well that illustrate some of these concepts.

All that said, this is great work and a great contribution and it should be published.

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