HLWYM HEmails

From: Hakan Basagaoglu
Sent: Monday, April 23, 2007 1:32 PM
To: Jack Guttmann; Chandrika Manepally; Jude Mcmurry; John Bradbury; Jin-Ping Gwo; James Rubenstone; Philip Justus; Randall Fedors; philippe.dubreuilh@swri.org
Subject: RE: Revised report with Summary

In the model, this increased the effectiveness of matrix diffusion and generally reproduced the observed fault test tracer transport rates, but it is not clear that this approach could be applied successfully to predictive modeling at another location. **(What is the alternative? Perform such tests throughout the mountain? What can DOE do in addition to what they have already done? How sensitive is this to risk?)**

Jack,

Here are some thoughts on what can (#1-2 below) or could have (#3-4 below) been done:

1) Scaling and portability:
Scale-dependence of matrix diffusion (that increases with the test scale) was reported by DOE (VZJ 2004, 3:312-315), and scale-dependence was quantified by a fractal dimension of 1.7 for Yucca Mountain in this article. In JCH2003 article, they used a matrix-diffusion coefficient ~45 times higher than the local matrix diffusion coefficient to account for potentially larger fracture-matrix interfacial area at large scales. **Question:** Did they use or will they use these findings to upscale their large plot and fault test results to a mountain scale (which is the ultimate goal) ? If so, how? and what is their confidence level with the upscaling and portability of their findings? If not, why?

2) Matrix diffusion coefficient via a multi-process model or a single process model:
The importance of the matrix diffusion process is quantified by the matrix diffusion coefficient in continuum-based models. DOE has recently reported that the multi process model (i.e., different diffusion coefficients associated with different matrix zone that involves degraded, intact and stagnant water zones) is more representative than a single zone model. However, they have used a single zone model in their matrix diffusion analyses so far. **Question:** Will "significance" of the matrix-diffusion process be affected if they replace their single-process matrix diffusion model with a multi-process matrix diffusion model?

3) Experimental analyses:
They used two inert tracers (PFBA and Br) whose D_m's are on the same order of magnitude (on the order of 10^{-10}, and their D_m's are different only by a factor of 3) (Salve et al., WRR, 2004, 40, WR002571, p.3)). According to fig.7.6.9 of the AMR (and also in Fig. 9 of their WRR04 article), they noted that PFBA (with the lower D_m) arrived earlier and displayed a higher concentration peak. This could be indication for matrix diffusion, but does not tell much about its significance, because:

The arrival times and the peak concentration values of these two tracers were very close. I believe if they had plotted error bars (measurement errors, experimentalist usually do), the error bars from these two experiments might have overlapped. I would be convinced by their results if they showed that their experimental observations were actually repeatable (but, they reported results from a single experiment), and/or if they ran the experiment with different inert tracers whose D_m's are at least an order of magnitude different (in this case the difference between arrival times and peak concentrations of two inert tracers would be much larger than potential measurement errors).

4) The link between the numerical model and the field experiment:
In JCH2006, the DOE noted that only 10% of the total volume of the liquid released from the infiltration plot seeps out of the fractured rock through the niche ceiling, and the rest is stored in the fractured rock or flows **away around the niche**.
In the numerical analyses, they assumed no-flow boundaries along the lateral (side) boundaries, which would promote vertical and more focused flow and would not allow water losses across the lateral boundaries. **Question**: How sensitive the significance of the matrix diffusion process to the uncertainties in the lateral boundaries? For example, if the free-drainage is allowed along the certain portions of the side boundaries, there would be some (water) losses across the lattreal boundaries; therefore, there would be relatively less water in fractures in the experimental flow domain, which would result in relatively smaller fracture-matrix interfacial area, and hence there would be less diffusion into matrix.

Hakan

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From: Hakan Basagaoglu

Created By: hbasagaoglu@cnwra.swri.edu

Recipients:
"Jack Guttmann" <Jack.Guttmann@nrc.gov>
Tracking Status: None
"Chandrika Manepally" <cmanepally@cnwra.swri.edu>
Tracking Status: None
"Jude Mcmurry" <jmcmurry@cnwra.swri.edu>
Tracking Status: None
"John Bradbury" <John.Bradbury@nrc.gov>
Tracking Status: None
"Jin-Ping Gwo" <Jin-Ping.Gwo@nrc.gov>
Tracking Status: None
"James Rubenstone" <James.Rubenstone@nrc.gov>
Tracking Status: None
"Philip Justus" <Philip.Justus@nrc.gov>
Tracking Status: None
"Randall Fedors" <Randall.Fedors@nrc.gov>
Tracking Status: None
"philippe.dubreuilh@swri.org" <philippe.dubreuilh@swri.org>
Tracking Status: None

Post Office: cnwra.swri.edu

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