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A Division of Southwest Research Institute™
6220 Culebra Road • San Antonio, Texas, U.S.A. 78228-5166
(210) 522-5160 • Fax (210) 522-5155

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U.S. Nuclear Regulatory Commission
ATTN: Ms. Deborah A. DeMarco
Office of Nuclear Materials Safety and Safeguards
Program Management, Policy Development, and Staff
Office of the Director
Mail Stop 8D-37
Washington, DC 20555

Subject: Transmittal of Abstract for Spring AGU Meeting

Dear Ms. DeMarco:

The purpose of this letter is to provide you a copy of an abstract that will be submitted for presentation at the Spring 2000 AGU meeting in Boston, Massachusetts, by Dr. Scott Painter. The research described in the attached abstract, which is entitled "Power-law Velocity Fluctuations in Networks of Rock Fractures: Numerical Evidence and Consequences for Contaminant Transport", was funded by an internal research grant at Southwest Research Institute. Because this work was not funded by the NRC there is no need to respond to this letter. However, if you have any questions regarding the content of the abstract, please contact me at (210) 522-5252 or Dr. Painter at (210) 522-3348.

Sincerely,

Budhi Sagar, Ph.D.
Technical Director

/ph
Enclosures

cc:	J. Linehan	W. Reamer	W. Patrick
	B. Meehan	D. Brooks	CNWRA Directors
	J. Holonich	N. Coleman	CNWRA Element Mgrs
	J. Greeves		T. Nagy (SwRI Contracts)

Power-law Velocity Fluctuations in Networks of Rock Fractures: Numerical Evidence and Consequences for Contaminant Transport

Scott Painter[1] Vladimir Cvetkovic[2] and Jan-Olof Selroos[3]

Transport through interconnected networks of fractures in an otherwise low-permeability medium is an important issue in contaminant hydrology. In many situations of practical interest the fracture networks are not well connected and transport is not well described by the classical advection dispersion equation. We develop an alternative modeling approach for these situations using the stochastic Lagrangian methodology. Transport is conceptualized as occurring in a pathway consisting of many rock fractures connected in series. Transport occurs by advection with velocity that fluctuates from fracture to fracture in the pathway. Downstream movement is slowed by sorption and matrix diffusion, which act to retain particles in the host rock. Contaminant discharge at the outlet of the fracture pathway is controlled in a general way by two Lagrangian parameters, both of which are related to the integral of 1/v, where v is the local velocity. A set of three-dimensional discrete fracture network simulations were used to study the velocity fluctuations. These simulations, which were designed to mimic as closely as possible a well characterized site, show that 1/v is accurately approximated as having a power-law distribution over a range of 3 orders of magnitude. In this situation the Lagrangian parameters controlling the transport in the pathway converge to one-sided stable distributions, and the expected arrival time for contaminants becomes infinite. This has important consequences for some applications; in particular, it suggests that the expected value of arrival times may not be a reliable measure of repository geosphere containment under some conditions.

References:

1. S. Painter, V. Cvetkovic and J-O. Selroos, "Transport and Retention in Fractured Rock: Consequences of a Power-law Distribution for Fracture Lengths", Phys. Rev. E, 57(6), 6917–6922.

2. S. Painter and V. Cvetkovic, "Stochastic Analysis of Early Tracer Arrival in a Multiple-Fracture Pathway", in press.

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[1]CNWRA, Southwest Research Institute, San Antonio, TX

[2]Division of Water Resources Engineering, Stockholm, Sweden

[3]Swedish Nuclear Fuel and Waste Management Company, Stockholm, Sweden