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September 11, 2000
Contract No. NRC–02–97–009
Account No. 20.01402.861

U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Two White Flint North
11545 Rockville Pike
Mail Stop T8A23
Washington, DC 20555

Subject: Programmatic Review of Abstracts

Dear Mrs. DeMarco:

The enclosed abstracts are being submitted for programmatic review. These abstracts will be submitted for presentation at the American Geophysical Union Fall Meeting to be held December 15–19, 2000, in San Francisco, California. The titles of these abstracts are:

> "Liquid Bridges and Intermittent Flow Regimes in Unsaturated Fractured Porous Media" by D. Or, T.A. Ghezzehei, and R. Fedors
>
> "The Case for a Neoclassical Approach to Subsurface Heterogeneity Modeling" by S. Painter

Please advise me of the results of your programmatic review. Your cooperation in this matter is appreciated.

Sincerely,

Budhi Sagar
Technical Director

/ph
Enclosures

cc:			
	J. Linehan	W. Reamer	W. Patrick
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Liquid Bridges and Intermittent Flow Regimes in Unsaturated Fractured Porous Media

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Unsaturated flow in fractured rocks is significantly influenced by interplay between gravitational and capillary forces and by abrupt changes in media pore space properties. Low flow regimes (e.g., film flow, intermittent rivulet and dripping flow) in fractures are being studied to address questions of seepage threshold into and diversion around open drifts. Macro-scale continuum models do not readily incorporate low flow regime processes, in particular bridging and intermittent rivulet flow. Even when a uniform flux is applied to a fracture, variations in fracture geometry could lead to fragmentation of the liquid into discrete elements, followed by formation of preferential flow pathways where large elements of liquid flow intermittently. We developed a model for interactions between a uniform flux and local variations in fracture aperture (asperity) leading to fragmentation of the liquid into discrete liquid elements (bridges) that discharge intermittently. Intermittency is shown to be a result of interplay between capillary, viscous, and gravitational forces much like dripping. Liquid bridge size and detachment interval are dependent primarily on local fracture aperture and the flux feeding the bridge. The presence of only a few irregularities in a vertical fracture surface suffices to result in complicated flux pattern at the fracture bottom. This chaotic-like behavior has been observed in previous studies involving gravity-driven unsaturated flow. (Work performed by CNWRA under contract NRC-02-97-009 does not necessarily reflect the views or positions of NRC.)

The case for a neoclassical approach to subsurface heterogeneity modeling

Scott Painter, Center for Nuclear Waste Regulatory Analyses, Southwest Research Institute, San Antonio TX

Stochastic (random-field) simulation techniques are increasingly used to capture the effects of aquifer heterogeneities in groundwater modeling studies. The classical approach to stochastic simulation utilizes a single variogram and a multivariate lognormal distribution to model the multipoint joint distribution of aquifer properties. Detailed analyses of hydraulic conductivity data have shown this classical assumption to be inappropriate for aquifers that are highly heterogeneous at the spatial scale of interest. In particular, subsurface heterogeneities are often organized spatially with connected regions of high or low permeabilities that form conduits or barriers to flow and transport. Several alternative approaches are utilized to capture these features and their effects on fluid flow, including non-parametric methods (indicator modeling or empirical transforms) and object-based lithofacies modeling. Although these approaches can provide realistic geologic models and distributions of aquifer properties, the data requirements, knowledge base and necessary modeling time may not always be manageable. A new modeling approach has been developed as a compromise between the conflicting requirements of ease-of-use and realistic representations. This neoclassical approach utilizes a single-variogram random field model, similar to the classical approach, but relaxes various overly restrictive assumptions embedded in the multiGaussian approach. A specific neoclassical approach based on subordination of a fractional Brownian motion (fBm) model is particularly successful at reproducing statistical features observed in various subsurface datasets. Subordination is the procedure of constructing a new stochastic process by randomizing the variance in an existing process. The subordinated fBm (sfBm) model provides a unifying framework for fractal heterogeneity modeling in that it includes previous fractal models as special cases. An accurate and convenient simulation method based on the sfBm model and the probability-field simulation algorithm has been developed. Comparisons with field data and tests of the new simulation algorithms will be described.

The author is grateful to the Southwest Research Institute's Advisory Committee for Research for supporting this work. This abstract documents work performed in part by the Center for Nuclear Waste Regulatory Analyses under contract No. NRC-02-97-009. The report is an independent product and does not reflect the regulatory position of the NRC.