

Accepted Manuscript

Anomalous Behaviors During Infiltration Into Heterogeneous Porous Media

F.D.A. Aarão Reis, D. Bolster, V.R. Voller

PII: S0309-1708(17)30971-5
DOI: [10.1016/j.advwatres.2018.01.010](https://doi.org/10.1016/j.advwatres.2018.01.010)
Reference: ADWR 3066



To appear in: *Advances in Water Resources*

Received date: 17 October 2017
Revised date: 9 January 2018
Accepted date: 10 January 2018

Please cite this article as: F.D.A. Aarão Reis, D. Bolster, V.R. Voller, Anomalous Behaviors During Infiltration Into Heterogeneous Porous Media, *Advances in Water Resources* (2018), doi: [10.1016/j.advwatres.2018.01.010](https://doi.org/10.1016/j.advwatres.2018.01.010)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Anomalous Behaviors During Infiltration Into Heterogeneous Porous Media

F.D.A Aarão Reis^a, D. Bolster^b, V. R. Voller^{c,*}

^a*Instituto de Física, Universidade Federal Fluminense, Avenida Litorânea s/n, 24210-340 Niterói RJ, Brazil*

^b*Department of Civil & Environmental Engineering and Earth Sciences, University of Notre Dame, South Bend, USA*

^c*Department of Civil, Environmental, and Geo- Engineering, University of Minnesota, Minneapolis, USA*

Abstract

Flow and transport in heterogeneous porous media often exhibit anomalous behavior. A physical analog example is the uni-directional infiltration of a viscous liquid into a horizontal oriented Hele-Shaw cell containing through thickness flow obstacles; a system designed to mimic a gravel/sand medium with impervious inclusions. When there are no obstacles present or the obstacles form a multi-repeating pattern, the change of the length of infiltration F with time t tends to follow a Fickian like scaling, $F \sim t^{\frac{1}{2}}$. In the presence of obstacle fields laid out as Sierpinski carpet fractals, infiltration is anomalous, i.e., $F \sim t^n$, $n \neq 1/2$. Here, we study infiltration into such Hele-Shaw cells. First we investigate infiltration into a square cell containing one fractal carpet and make the observation that it is possible to generate both sub ($n < 1/2$) and super ($n > 1/2$) diffusive behaviors within identical heterogeneity configurations. We show that this can be explained in terms of a scaling analysis developed from results of random-walk simulations in fractal obstacles; a result indicating that the nature of the domain boundary controls the exponent n of the resulting anomalous transport. Further, we investigate infiltration into a rectangular cell containing several repeats of a given Sierpinski carpet. At very early times,

*Corresponding author
 Email address: voll1e001@umn.edu (V. R. Voller)

Download English Version:

<https://daneshyari.com/en/article/8883357>

Download Persian Version:

<https://daneshyari.com/article/8883357>

[Daneshyari.com](https://daneshyari.com)