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Research Article

Modelling and Simulation of Bacteroides Transport in Heterogeneous Silty Formation in Deltaic Environment

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Abstract

This paper monitor the migration of Bacteroides in silty depositions, the soil formation experiences low degree of porosity, this implies that the depositions of Bacteroides were affected by the formations through their heterogeneous depositions in porous medium, the study observed that in some location that exhibited inhibitors and micronutrients pressure on the behaviour of the contaminant, these were reflected from its level of migration in heterogeneous silty formation. The study has express the litho structures of the formation that were observed to play serious role in the transport system of Bacteroides in silty formation, the derived solution generated parameters that were subjected to model validation, and both parameters maintained favourable fits, the study is imperative because it has explain the variation of Bacteroides in silty deposition through the influences from inhibitors and micronutrients in silty formation.

Keywords: Modeling bacteroides; Transport heterogeneous silty; Environment

Introduction

The behaviour of the system is a way that the migration of the contaminant transport to silty deposition, the deposition of silty formation in deltaic environment are observed to experiences heterogeneity in the study location, the study expresses the reflection of the geological setting [1-7]. Subsurface formations typically exhibit heterogeneities over a wide range of length scales. Because only limited amounts of data are generally available, formation properties are often described using some type of geostatistical approach. Flow and transport results for such descriptions reflect the uncertainty associated with the geological model. Using the first approach, formation properties are represented in the flow equations as random variables. The resulting flow quantities are then also random variables, that is, described in terms of expected values and higher statistical moments [8-13]. However, this approach also has some limitations. Specifically, the set of equations that must be solved is, in general, considerably more complex than the underlying deterministic equations [14-20]. Further, it is often difficult to include additional physics (e.g., three-phase flow) or other complications, such as different geostatistical models in different regions of the formation, without extensive reformulation. A variety of such approaches exists, and there are advantages and disadvantages associated with the different methodologies (for recent reviews, see [21,22]. he approaches described in this paper also differs considerably from previous methods for upscaling. Most such methods either attempt to minimize, and then neglect, sub-grid effects [8] or require the a priori estimate of the global flow field from which up scaled (or pseudo) flux functions are computed [23-26].

Theoretical Background

$$\frac{dc}{dy} + A_{(y)}C_{(d)} = B_{(y)}C_d{}^n ; n \geq 2 \quad (1)$$

Where $A_{(y)}$ and $B_{(y)}$ are function of y

$$\frac{dc}{dy} + A_{(y)}C_{(d)} = B_{(y)}C_d{}^n \quad (2a)$$

Divided by (1) through by C_d^{-n} we have obtain

$$C_d{}^{-n}\frac{dc}{dy} + A_{(y)}C_d{}^{1-n} = B_{(y)} \quad (2b)$$

Let $\beta = C_d{}^{1-n}$

$$\frac{d\beta}{dy} = (1-n)C_d{}^{-n}\frac{dc}{dy}$$

This implies that;

$$C_d{}^{-n}\frac{dc}{dy} = \frac{1}{1-n}\frac{d\beta}{dy}$$

Multiplying Equation (2a) through by (1- n)

$$(1-n)C_d{}^{1-n}\frac{dc}{dy} + (1-n)A_{(y)}C_d{}^{1-n} = (1-n)B_{(y)} \quad (3)$$

If recall that, $\beta = C_d{}^{1-n}; \frac{d\beta}{dy} = (1-n)C_d{}^{-n}\frac{dc}{dy}$

Therefore equation (3) can be written as:

$$\frac{d\beta}{dy}+(1-n)A(y)\beta=(1-n)B(y) \quad (4)$$

If we say A=B/2

$$\frac{d\beta}{dy}+(1-n)\tfrac{B}{2}(y)\beta=(1-n)B(y) \quad (5)$$

$$\frac{2d\beta}{dy}+(1-n)B(y)\beta=2(1-n)B(y) \quad (6)$$

$$\frac{2d\beta}{dy}+\beta(1-n)B(y)=2(1-n)B(y) \quad (7)$$

$$\frac{2d\beta}{dy}=(1-n)B(y)[2-\beta] \quad (8)$$

$$\frac{2d\beta}{2-\beta}=(1-n)B(y)dy \quad (9)$$

$$\frac{2}{2-\beta}\frac{d\beta}{dy}=(1-n)B(y) \quad (10)$$

Let $\frac{2}{2-\beta}=\phi^2$

$$\varphi^2\frac{d\beta}{dy}=(1-n)B(y) \quad (11)$$

$$\frac{d\beta}{dy}=\left(\frac{(1-n)B(y)}{\varphi^2}\right) \quad (12)$$

$$d\beta=\frac{(1-n)B(y)dy}{\varphi^2} \quad (13)$$

$$\beta=\int\frac{(1-n)B(y)dy}{\varphi^2} \quad (14)$$

$$\left[\beta=\frac{1}{\varphi^2}\int(1-n)B(y)dy\right] \quad (15)$$

$$\beta=\frac{1}{\varphi^2}\int(1-n)B(y)dy \quad (16)$$

$$\beta=\frac{1}{\varphi^2}\int(1-n)B(y)dy=\frac{1}{\varphi^2}(1-n)B(y)Y+K_1 \quad (17)$$

$$\left[\beta=\frac{(1-n)}{\phi^2}B(y)Y\right] \quad (18)$$

Materials and Methods

Standard laboratory experiments were performed to monitor the rate of Bacteroides transport at different formation. The soil depositions of the strata were collected in sequences based on the structural deposition at different study areas. The samples collected at different locations generated variation of concentration at different depths through its pressure flow at the lower end of the column. The experimental result was applied and compared with theoretical values for model validation.

Results and Discussion

Table 1: Predictive and experimental values for Bacteroides concentration at different depths.

Depth [M]	Predictive Concentration [Mg/L]	Experimental Values for void Ratio [Mg/L]
3	2.53E-01	0.27327
6	3.51E-01	0.34008
9	3.54E-01	0.38943
12	3.57E-01	0.42132
15	3.49E-01	0.43575
18	3.48E-01	0.43272
21	3.47E-01	0.41223
24	3.42E-01	0.37428
27	3.31E-01	0.31887
30	3.28E-01	0.246

Table 2: Predictive and experimental values for Bacteroides concentration at different depths.

Depth [M]	Predictive Concentration [Mg/L]	Experimental Values for void Ratio [Mg/L
3	2.64E-03	0.00572
6	2.28E-03	0.00188
9	2.92E-03	-0.00052
12	1.06E-03	-0.00148
15	1.32E-03	-0.001
18	1.58E-03	0.00092
21	1.84E-03	0.00428
24	2.11E-03	0.00908
27	2.38E-02	0.01532
30	2.64E-02	0.023

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Table 3: Predictive and experimental values for Bacteroides concentration at different depths.

Depth [M]	Predictive Concentration [Mg/L]	Experimental Values for void Ratio [Mg/L]
3	5.10E-05	0.00005772
6	5.81E-05	0.00005688
9	5.72E-05	0.00005748
12	4.62E-05	0.00005952
15	5.53E-05	0.000063
18	5.44E-05	0.00006792
21	6.34E-05	0.00007428
24	7.24E-05	0.00008208
27	8.15E-05	0.00009132
30	9.10E-05	0.000102
33	9.97E-05	0.00006
36	1.10E-04	0.00006

Table 4: Predictive and experimental values for Bacteroides concentration at different depths.

Depth [M]	Predictive Concentration [Mg/L]	Experimental Values for void Ratio [Mg/L/]
3	5.33E-06	5.5586E-06
6	5.42E-06	6.0128E-06
9	5.53E-06	6.3302E-06
12	5.67E-06	6.4784E-06
15	5.69E-06	0.000006425
18	5.96E-06	6.1376E-06
21	4.22E-06	5.5838E-06
24	2.54E-06	4.7312E-06
27	2.85E-06	3.5474E-06
30	3.18E-07	0.000002

Table 5: Predictive and experimental values for Bacteroides concentration at different depths.

Depth [M]	Predictive Concentration [Mg/L]	Experimental Values for void Ratio [Mg/L]
3	1.26E-06	2.2511E-06
6	1.26E-06	2.9288E-06
9	1.24E-06	3.9197E-06
12	1.28E-06	5.1104E-06
15	2.33E-06	6.3875E-06
18	3.37E-06	7.6376E-06
21	3.42E-06	8.7473E-06
24	4.27E-06	9.6032E-06
27	4.31E-06	1.00919E-05
30	4.46E-06	0.0000101

Results and discussion are presented in Table 1-5 including graphical representation of heterogeneous depositions on Bacteroides concentration at different depths. The Figure 1-4 shows how the deposition of Bacteroides behave in silty formation, there was a gradual migration of Bacteroides from three metres to the optimum rate recorded at eighteen metres, but sudden decrease were experience from twenty one metres to the lowest concentration recorded at thirty metres, while the experimental values gradually observed migration within three and twelve metres and maintained linear condition under constant migration

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influenced by velocity of flow. Figure 2 observed fluctuation in gradual process and suddenly express rapid increase to the optimum values recorded at thirty metres, while the experimental values for model validation maintained the same vein, but with slight variation in concentration, thus with exponential state to the optimum values recorded at thirty metres. Figure 3 maintained fluctuation between three and fifteen metres, but suddenly experienced decrease in concentration to lowest level recorded at thirty-six metres, while the experimental values experienced vacillation and rapidly developed exponential state to the optimum values recorded at thirty-six metres. Figure 4 express rapid increase between ten and eighteen metres and suddenly observed decrease in concentration to the lowest rate recorded at thirty metres, while that of the experimental parameters obtained gradual increase between three and fifteen metres and experienced deterioration to the lowest rate recorded at thirty metres. Figure five observed fluctuation from three and twenty-one metres in exponential state and finally observed constant migration between twenty-four and thirty metres.

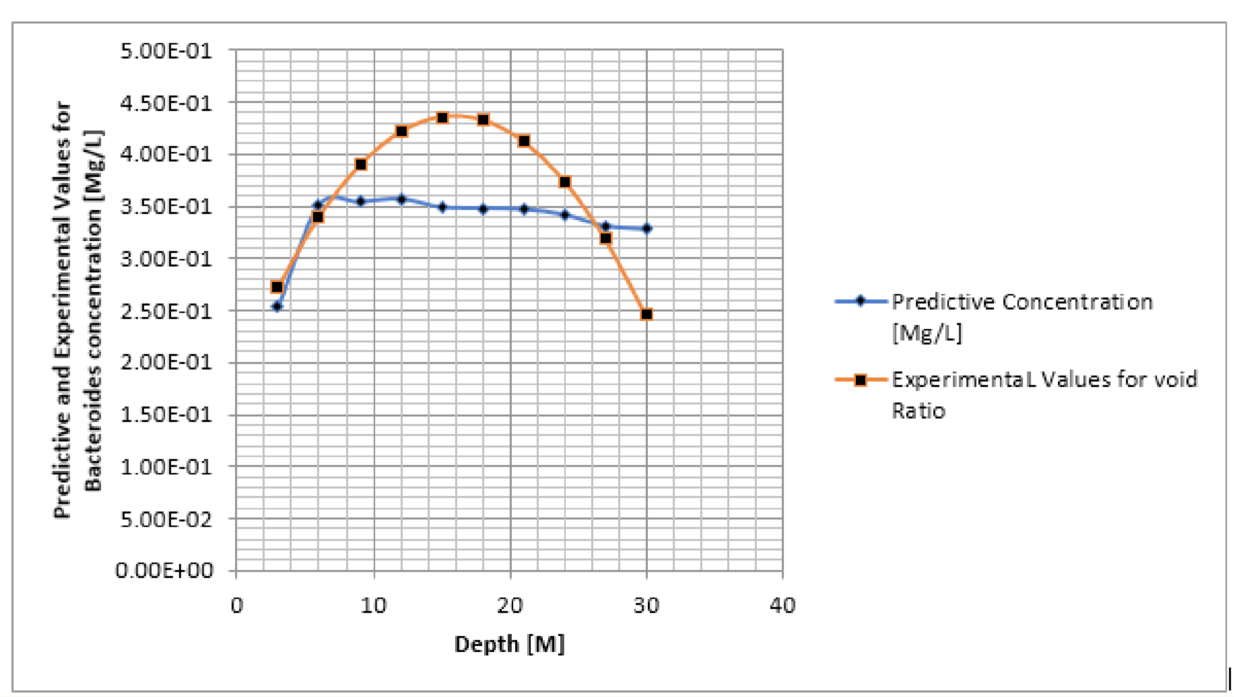

Figure 1: Predictive and experimental values for Bacteroides concentration at different depths.

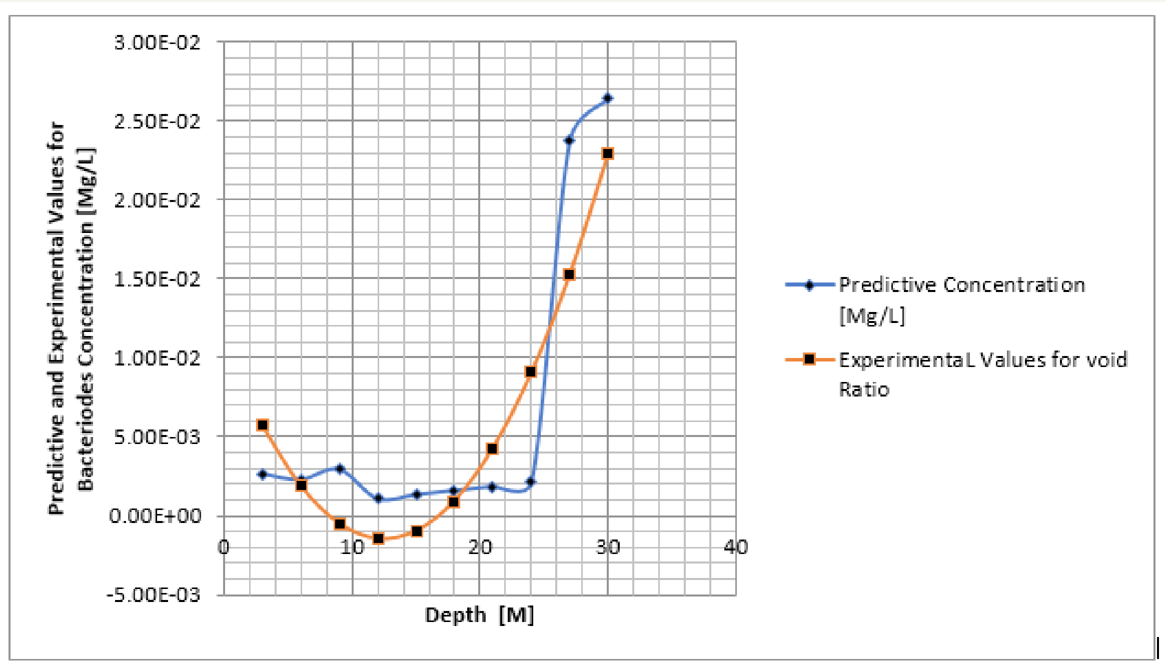

Figure 2: Predictive and experimental values for Bacteroides concentration at different depths.

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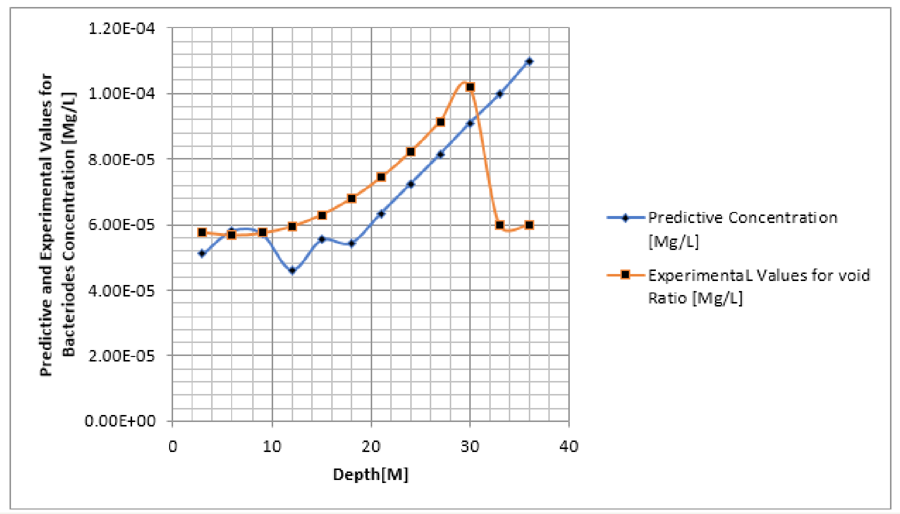

Figure 3: Predictive and experimental values for Bacteroides concentration at different depths.

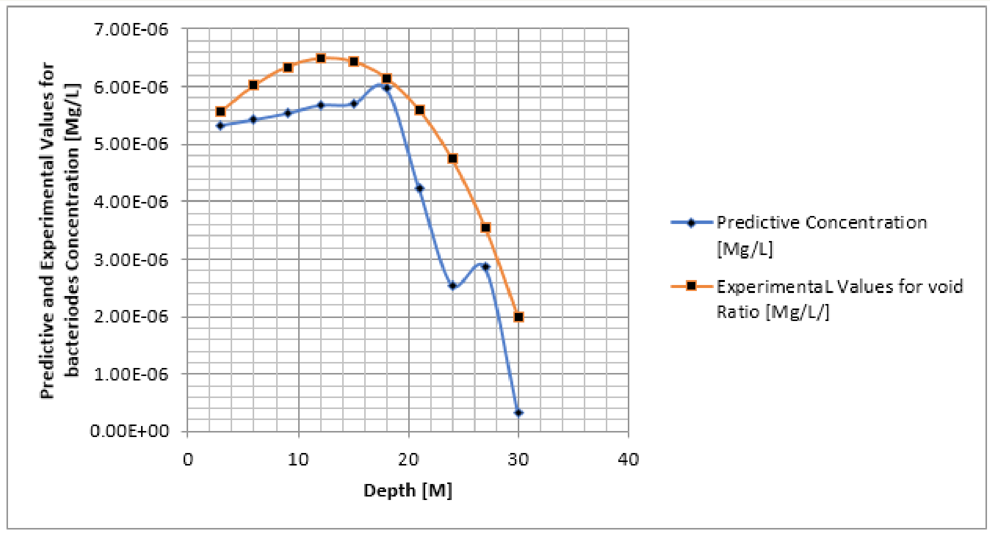

Figure 4: Predictive and experimental values for Bacteroides concentration at different depths.

Conclusion

The study from the graphical representation has shown that the system express fluctuation base on the heterogeneity deposition from silty strata in deltaic environment. The study explain the behaviour of Bacteroides concentration in heterogeneous silty deposition, such condition were observed to determine the migration rates in silty formation, lots of works has been done on other microbes, but the behaviour of their migration are not always the same, the behaviour of Bacteroides were capture from the predictive model simulation parameters, it has also express the heterogeneity in other substances that may have inhibit the migration rate of Bacteroides in silty depositions, porosities variation experiences heterogeneity and this affected the system in terms of its migration in silty depositions, although the rate of porosity experienced lower degree level, but it still reflect its influences on the migration rates in the study environment, the derived solution were able to monitor the behaviour of the contamination in silty depositions, experimental values were applied to validate the derived model, and both parameters developed favourable fits.

References

1. Eluozo SN (2013) Modeling and simulation of thermotolerant transport on heterogeneous fine sand influenced by porosity and permeability in coastal area of abonnema. Research Open Journal of Environmental Engineering and Management 1(1): 13-26.
2. Eluozo SN (2013) Mathematical model of biochemical depositions influencing enterococci in homogeneous silty and fine sand formation applying colloid filtration method in coastal area of Warri, delta state of Nigeria. World Journal of Science and Technology Research 1(8): 182-195.
3. Eluozo SN (2013) Predictive model to monitor the migration of virus in heterogeneous formation in ahoada east, rivers state of Nigeria. Open Journal of Waste Management and Environmental Protection 1(1): 1-14.
4. Eluozo SN (2013) Predictive model to evaluate physiochemical influence on thermotolerant transport in heterogeneous course and gravel formation pressured by dispersion using colloid filtration method in coastal area of Bayelsa state, Niger delta of Nigeria. Research Open Journal of Environmental Engineering and Management 1(1): 1-12.
5. Eluozo SN (2013) Void ratio and porosity validation of *E-coli* migration on homogeneous aquifer in upland area of rivers state, Nigeria. Open Journal of Waste Management and Environmental Protection (1)1: 21-35.

How to cite this article: Eluozo S, Afiibor B. Modelling and Simulation of Bacteroides Transport in Heterogeneous Silty Formation in Deltaic Environment. Adv Civil Eng Tech .2(4). ACET.000545.2018. DOI: 10.31031/ACET.2018.02.000545

6. Eluozo SN (2013) Mathematical modeling of unsaturated soil multi-flow assessment on hydrocarbon contamination in coastal area of okirika, rivers state of Nigeria. Research Open Journal of Environmental Engineering and Management 1(1): 27-37.

7. Eluozo SN (2013) Modeling of bacteriophage transport of fine and coarse sand on plug flow application in phreatic aquifers. Research Open Journal of Science and Technology 1(4): 12-22.

8. Durlofsky LJ (1997) Use of higher moments for the description of up-scaled, process independent relative permeability's. SPE J 2: 474 -484.

9. Gelhar L (1993) Stochastic subsurface hydrology. Prentice-Hall Englewood Cliffs NJ, p. 390.

10. Eluozo SN (2013) Evaluating the variables of static water level in rivers state: Niger delta region of Nigeria. Open Journal of Waste Management and Environmental Protection 1(1): 15-29.

11. Eluozo SN (2013) Model validation of void ratio influence on *E-coli* transport on homogeneous soil in upland area of rivers state, Nigeria. Research Open Journal of Science and Technology 1(4): 37-50.

12. Eluozo SN, Afiibor BB (2013) Mathematical model on porosity and permeability influence of plug flow application on thermotolerant transport in phreatic aquifers. Research Open Journal of Science and Technology 1(4): 23-36.

13. Eluozo SN (2013) Predictive model to monitor Enterobacteriaceae transport in unconfined bed influenced by aquitard recharge in coastal of amadi-ama, Niger delta of Nigeria. Research Open Journal of Environmental Sciences and Engineering 1(1): 1-13.

14. Neuman SP (1993) Eulerian-lagrangian theory of transport in space-time nonstationary velocity fields: Exact nonlocal formalism by conditional moments and weak approximation. Water Resources 29(3): 633-645.

15. Eluozo SN (2013) Model studies of heavy metals to monitor the rate of contaminated soil and water in port har court: rivers state of Nigeria. Research opens Journal of Environmental sciences and Engineering 1(1): 20-34.

16. Eluozo SN (2013) Modeling dispersions of virus influenced by homogeneous velocity and void ratio in homogeneous gravel formation in degema, rivers state of Nigeria. Research open Journal of Environmental Sciences and Engineering 1(1): 10-19.

17. Eluozo SN (2013) Mass rate of shigella transport influenced dispersion and permeability in lateritic and silty formation in buguma, rivers state of Nigeria. Global open Journal of Environmental Protection 1(1): 1-11.

18. Eluozo SN (2013) Modeling fluid in a vertical column influenced by phosphorous deposition in organic and lateritic soil in port harcourt metropolis. World Open Journal of Earth Science and Engineering 1(1): 1-9.

19. Eluozo SN (2013) Mathematical models to predict pathogen deposition influenced by degree of saturation in organic and lateritic soil in waste dump site of port harcourt metropolis. Global Open Journal of Environmental Protection 1(1): 20-29.

20. Eluozo SN (2013) Modeling volumetric water content in heterogeneous formation influenced by velocity and void ratio on *E-coli* migration in coastal area of bakana, rivers state of Nigeria. Research.

21. Christie MA (1996) Upscaling for reservoir simulation. J Pet Technology 48: 1004 -1010.

22. Wen XH, Hernandez JJG (1996) Upscaling hydraulic conductivities in heterogeneous media: An overview. Hydrol 183(1-2), ix-xxxii.

23. Dagan G (1984) Solute transport in heterogeneous porous formations. J Fluid Mech 145: 151-177.

24. Barker JW, Thibeau SA (1997) Critical review of the use of pseudo-relative permeability's for upscaling, SPE Reservoir Eng 12: 138 -143.

25. Efendiev Y, Durlofsky LJ, Lee SH (2000) Modeling of sub-grid effects in coarse-scale simulations of transport in heterogeneous porous media water resources research. Subsurface Hydrology 36(8): 2031-2041.

26. Dagan G (1987) Theory of solute transport by ground water. Annu Rev Fluid Mech 19: 183-215.

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