

# 1.723 – Computational Methods for Flow in Porous Media

## Homework #2

Due on February 19, 2015

**Problem 1 (4 points)** Consider the hydrodynamic dispersion tensor in 2D. Given the longitudinal dispersivity  $\alpha_L$ , the transverse dispersivity  $\alpha_T$  and the Darcy velocity  $\mathbf{u} = [u_x, u_y]^T$ , write the full  $2 \times 2$  matrix with the components of the hydrodynamic dispersion tensor.

**Problem 2 (6 points)** Figure 1 shows the evolution of the horizontal footprint of the plume of a conservative tracer, from a large-scale tracer test in Cape Cod [1]. Determine:

1. The magnitude and direction of the mean groundwater flow (the interstitial velocity  $\mathbf{v}$ ). From a reported value of porosity of 0.39, determine the Darcy velocity  $\mathbf{u}$ .
2. Knowing that the diffusive-dispersive length of a plume scales as  $l \sim \sqrt{2Dt}$ , estimate the longitudinal and transverse dispersivities,  $\alpha_L$  and  $\alpha_T$ .

## References

- [1] D. R. LeBlanc, S. P. Garabedian, K. M. Hess, L. W. Gelhar, R. D. Quadri, K. G. Stollenwerk, and W. W. Wood. Large-scale natural gradient tracer test in sand and gravel, Cape Cod, Massachusetts 1. Experimental design and observed tracer movement. *Water Resour. Res.*, 27(5):895–910, 1991.

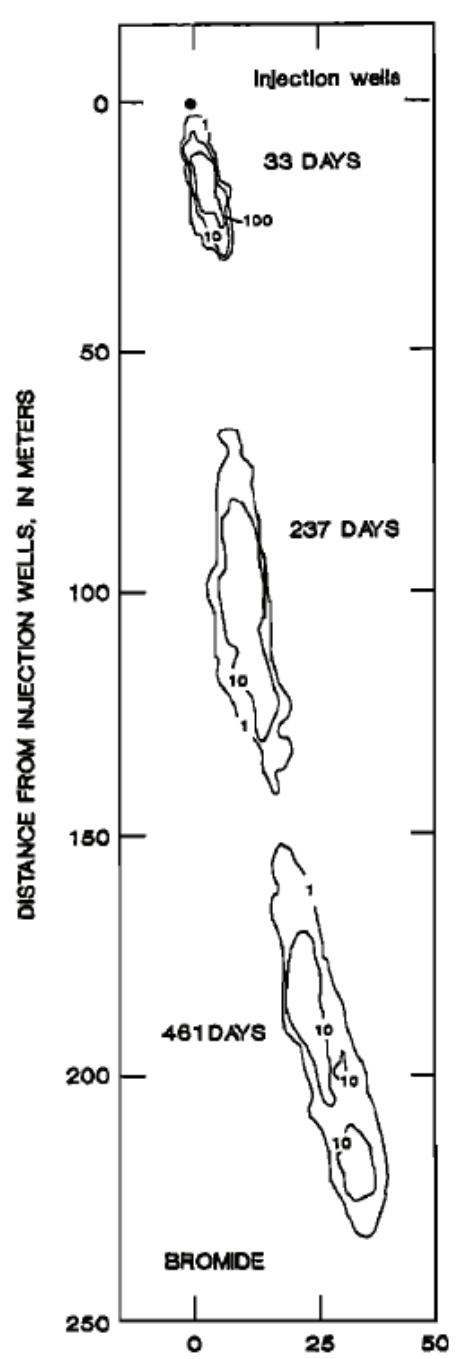


Figure 1: Areal distribution of maximum concentrations of a conservative tracer (bromide) at 33, 237, and 461 days after injection (from LeBlanc et al. [1]).