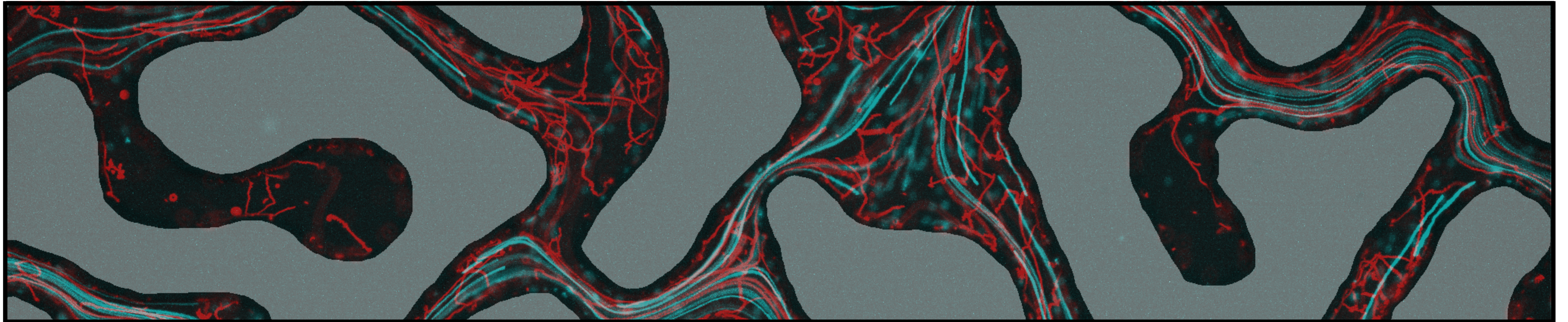
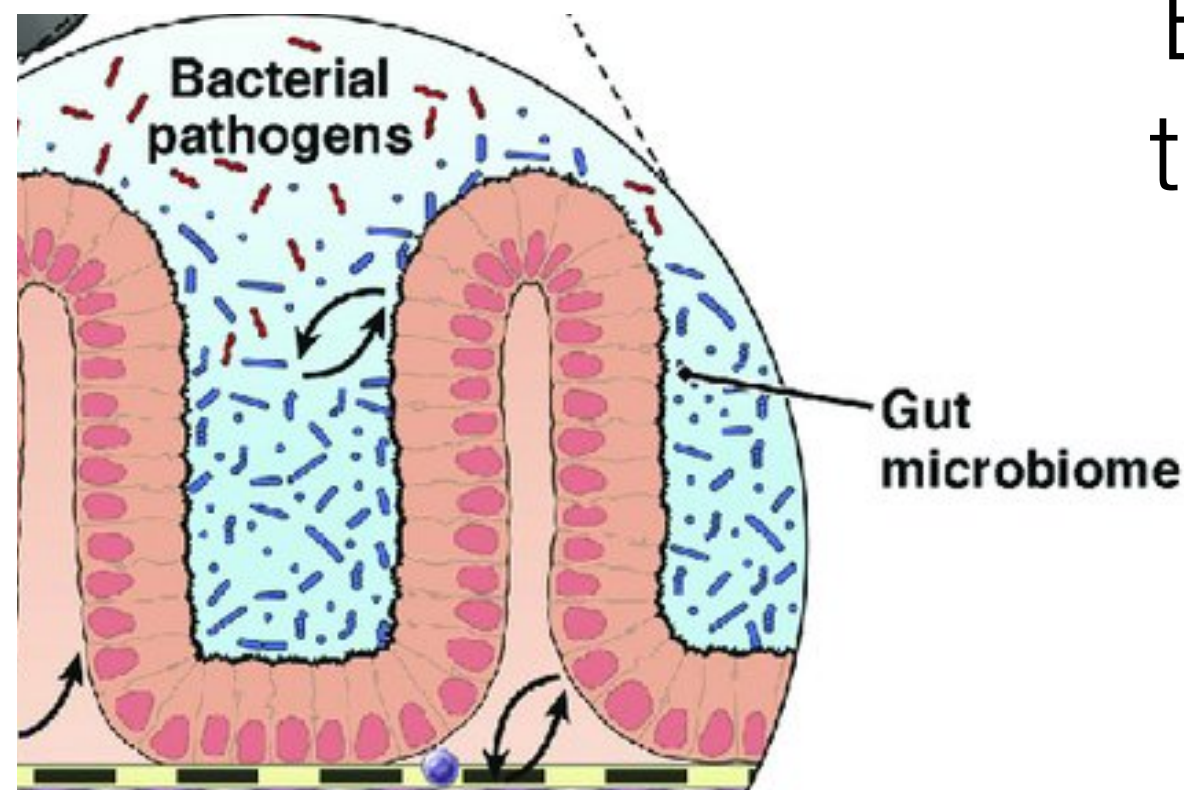


Bacterial dispersal in dead-end pores and role of chemotaxis

David Scheidweiler ¹, Ankur Deep Bordoloi ¹ and Pietro de Anna ¹

¹ Institute of Earth Sciences – Université de Lausanne

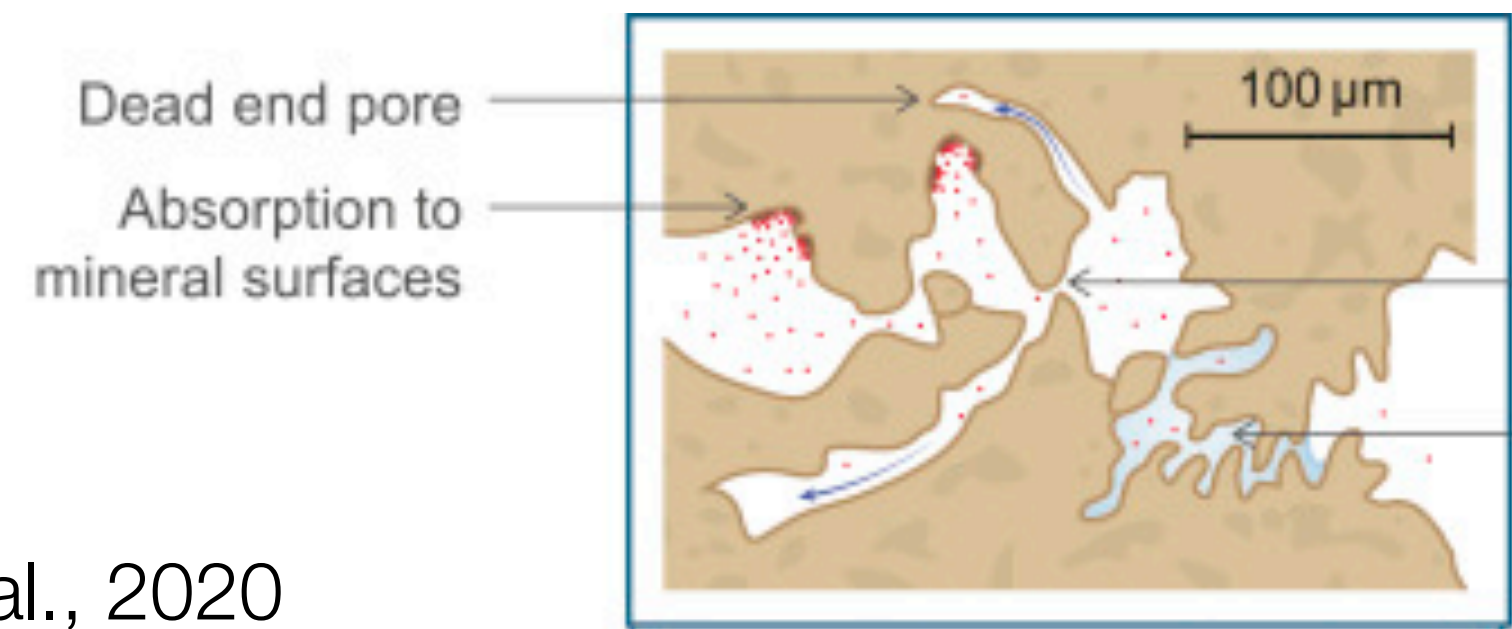




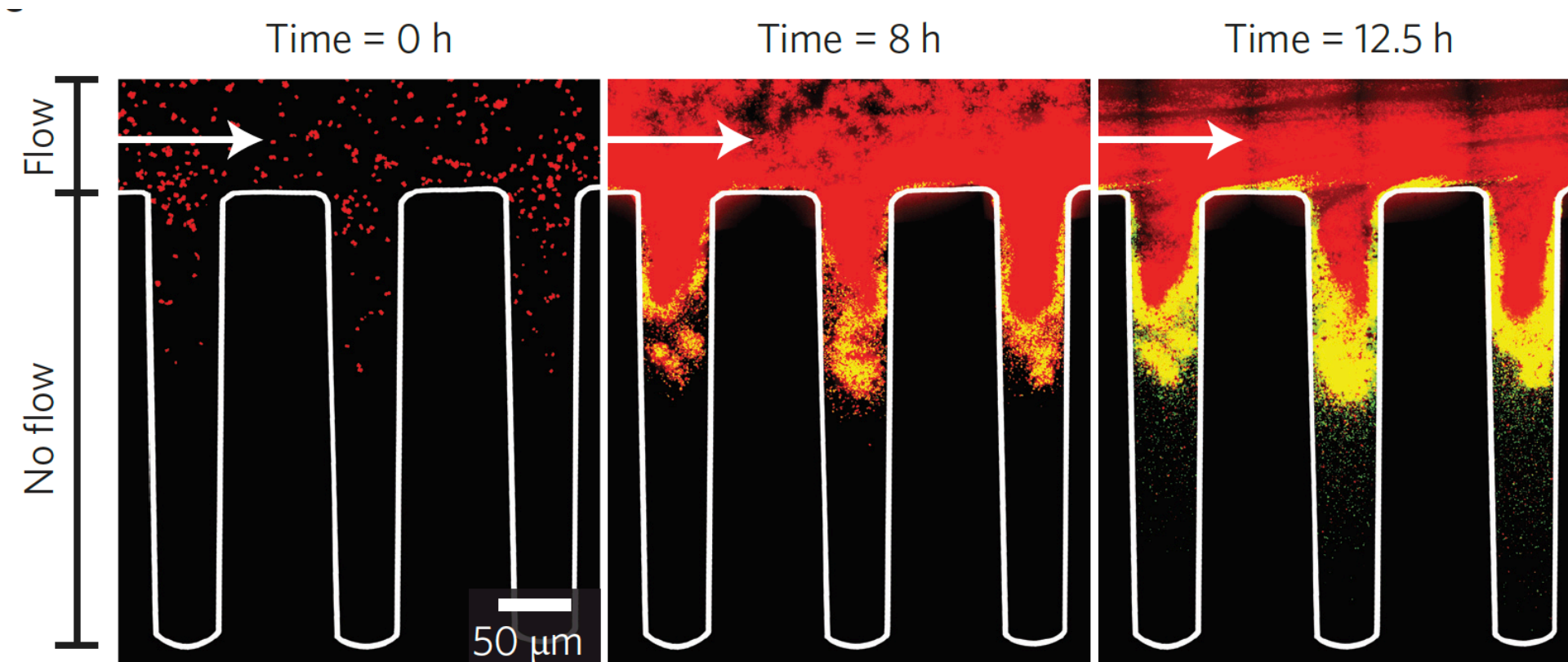
Bein et al., 2018

Biological tissues, sedimentary environments, or engineered systems may present topological features that promote the coexistence of advection dominate channels and dead-end pores, where flow is stagnant and diffusion dominated.

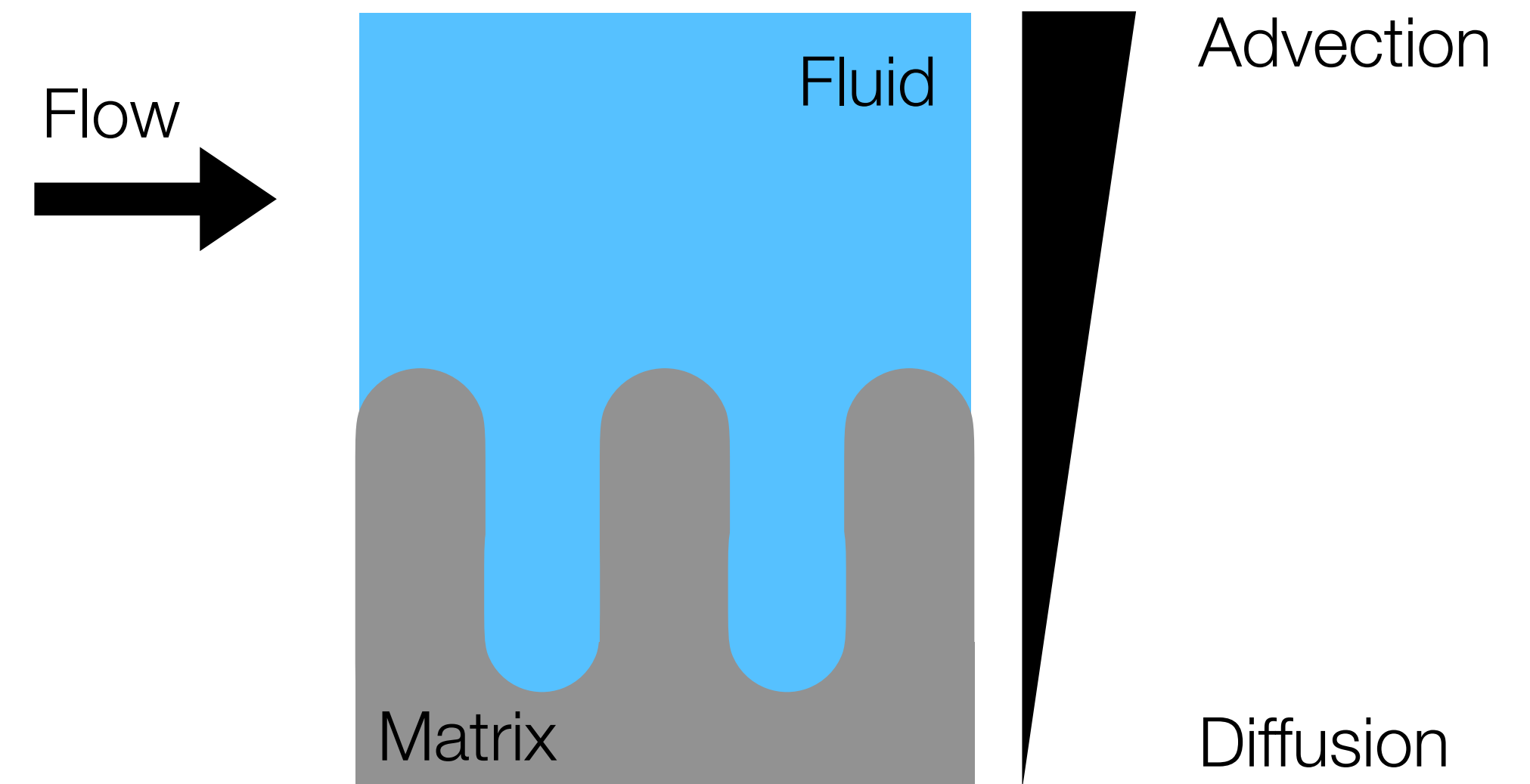
This complex physical environment may have repercussion on the hosted microorganisms by controlling the transport of individuals (i.e. dispersal), resources availability, as well as chemical signals produced by bacteria.



Erktan et al., 2020



Kim et al., 2016



The aim of this work is to study how fast channels and dead-end pores control bacterial dispersal, in absence and in presence of resources gradients.

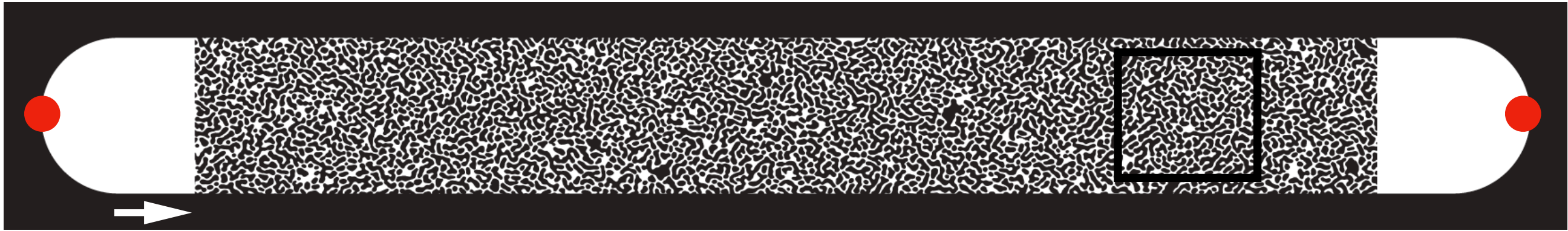


Fig 1. Diagram of the microfluidic channel. Flow rate has been chosen to have an average velocity comparable with the swimming speed of *E. Coli* cells ($20\text{ }\mu\text{m min}^{-1}$). One pore volume (pv) is 24 minutes. Arrow indicates flow direction.

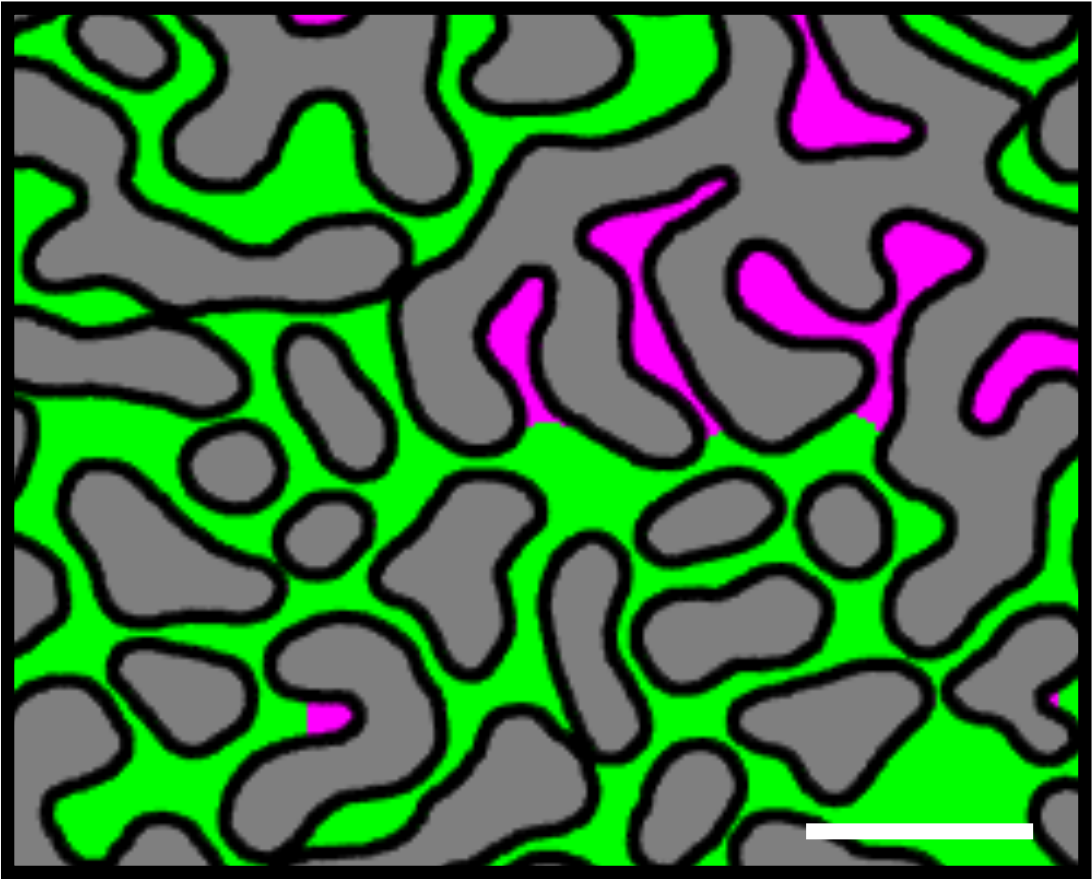
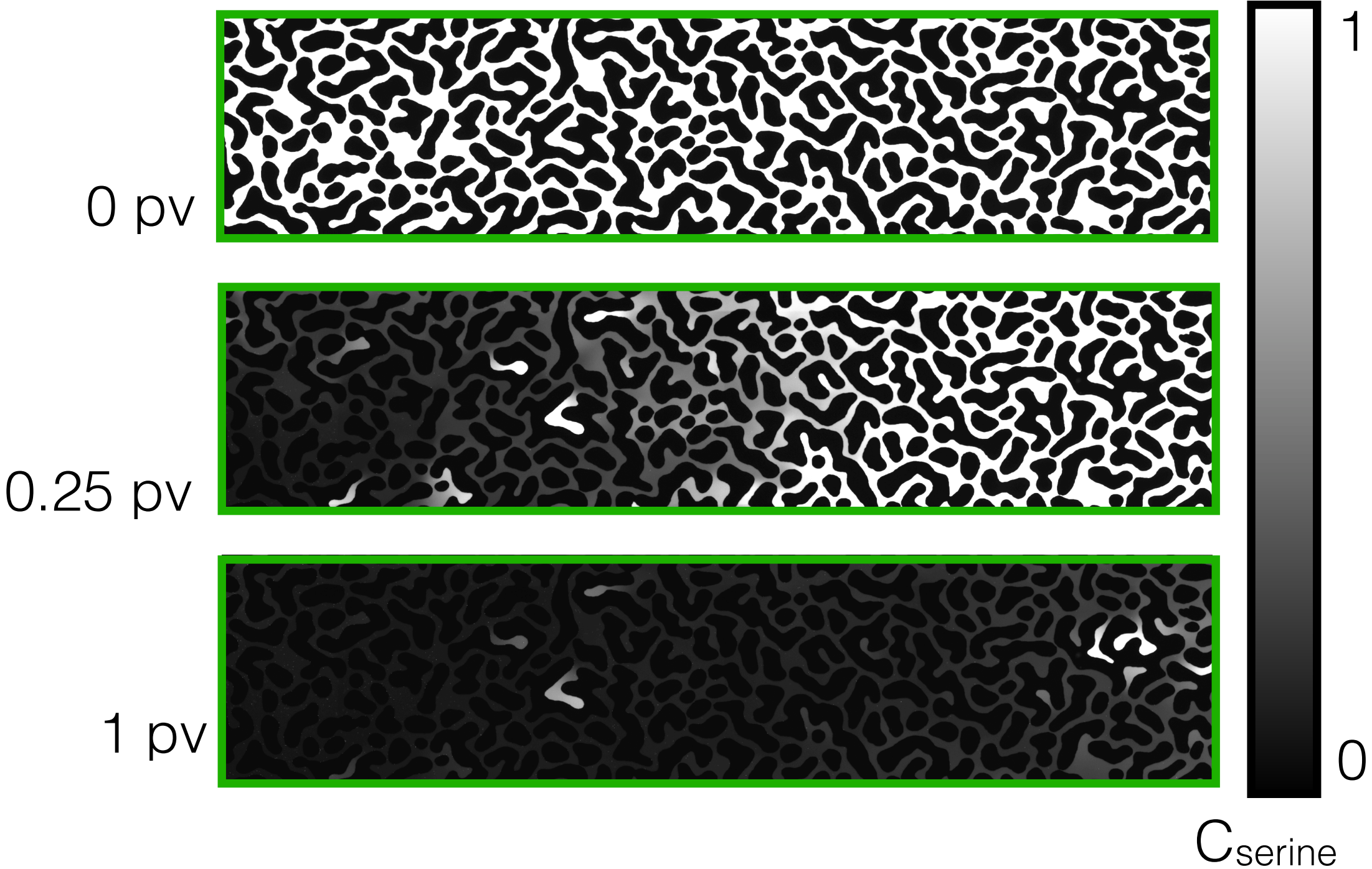


Fig 2. Geometrical pore characterisation: transmitting pores (green) and dead-end pores (magenta). Scale bar $100\text{ }\mu\text{m}$.

Fig 3. Concentration map of a chemoattractant (the amino acid L-serine) dissolved in a saline buffer, displaced by the buffer devoid of the chemoattractant.



Dispersal of motile and non-motile E. Coli in absence of resources gradients

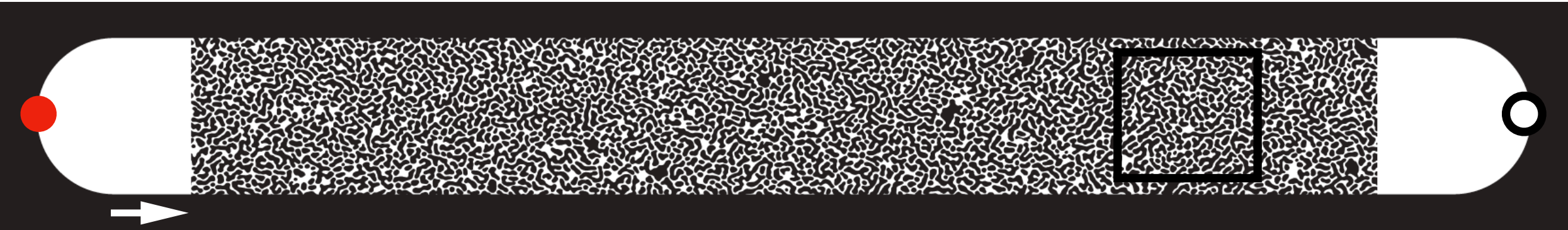


Fig 4. Porous media has been initially saturated with a motility buffer, later motile and non-motile E. coli, suspended in the same buffer, have been injected from the inlet (red circle).

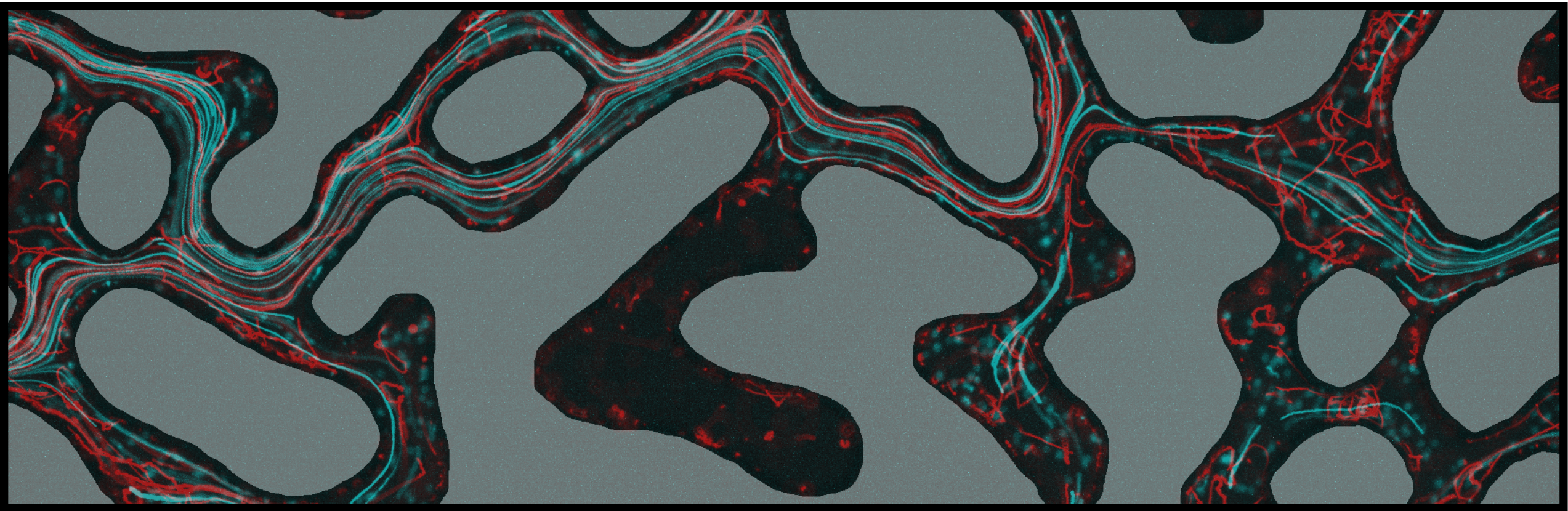
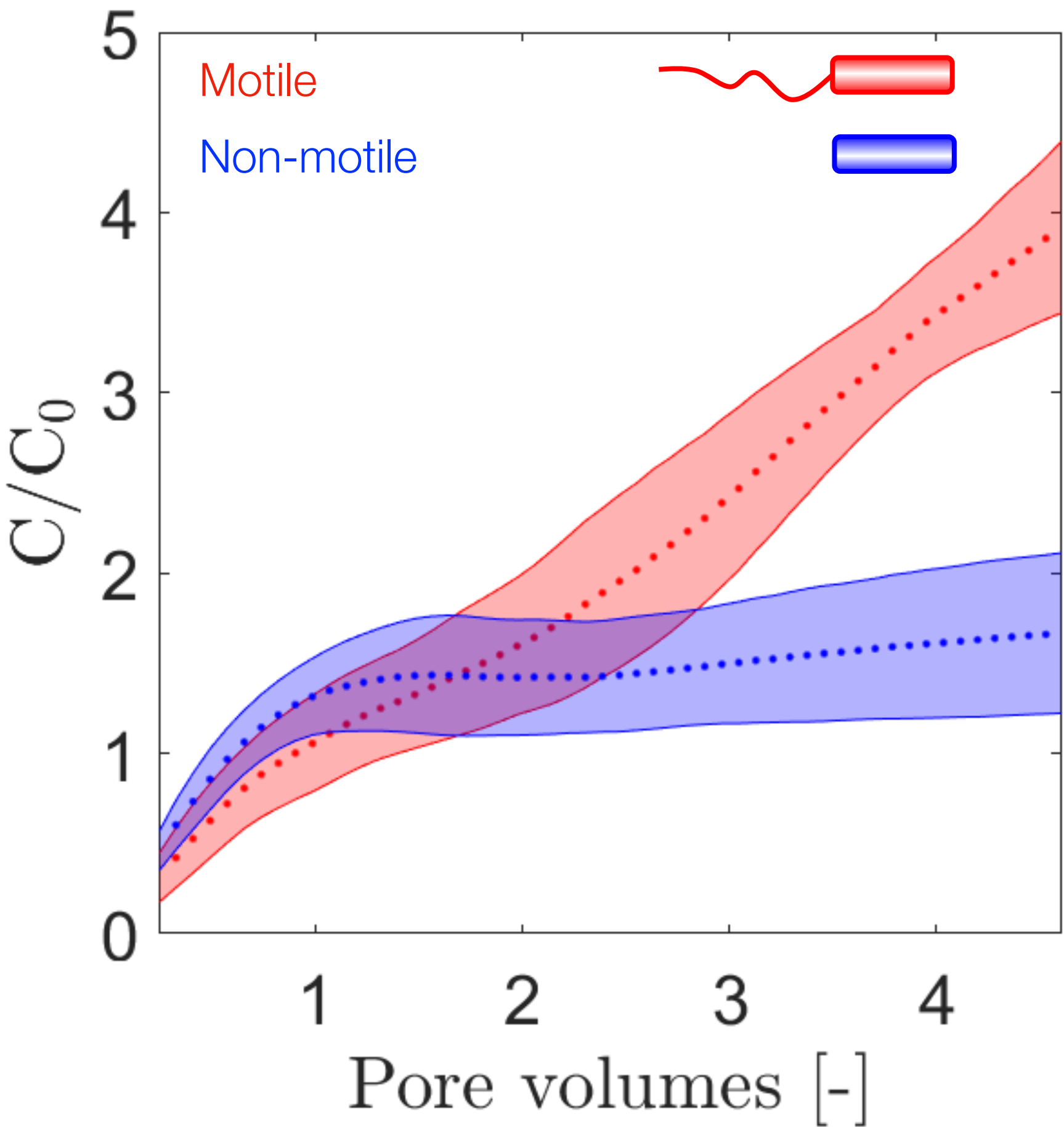


Fig 6. Trajectories of motile (red) and non-motile (blue) E. Coli cells through a portion of porous medium. It is evident how only motile cells invade the dead-end pores.

Fig 5. Motile (red) and non-motile (blue) E. Coli cells retained within the porous medium. C is the concentration of cells retained in the porous medium and C0 is the concentration of the injected suspension.



Dispersal of motile and non-motile E. Coli in presence of a chemoattractant

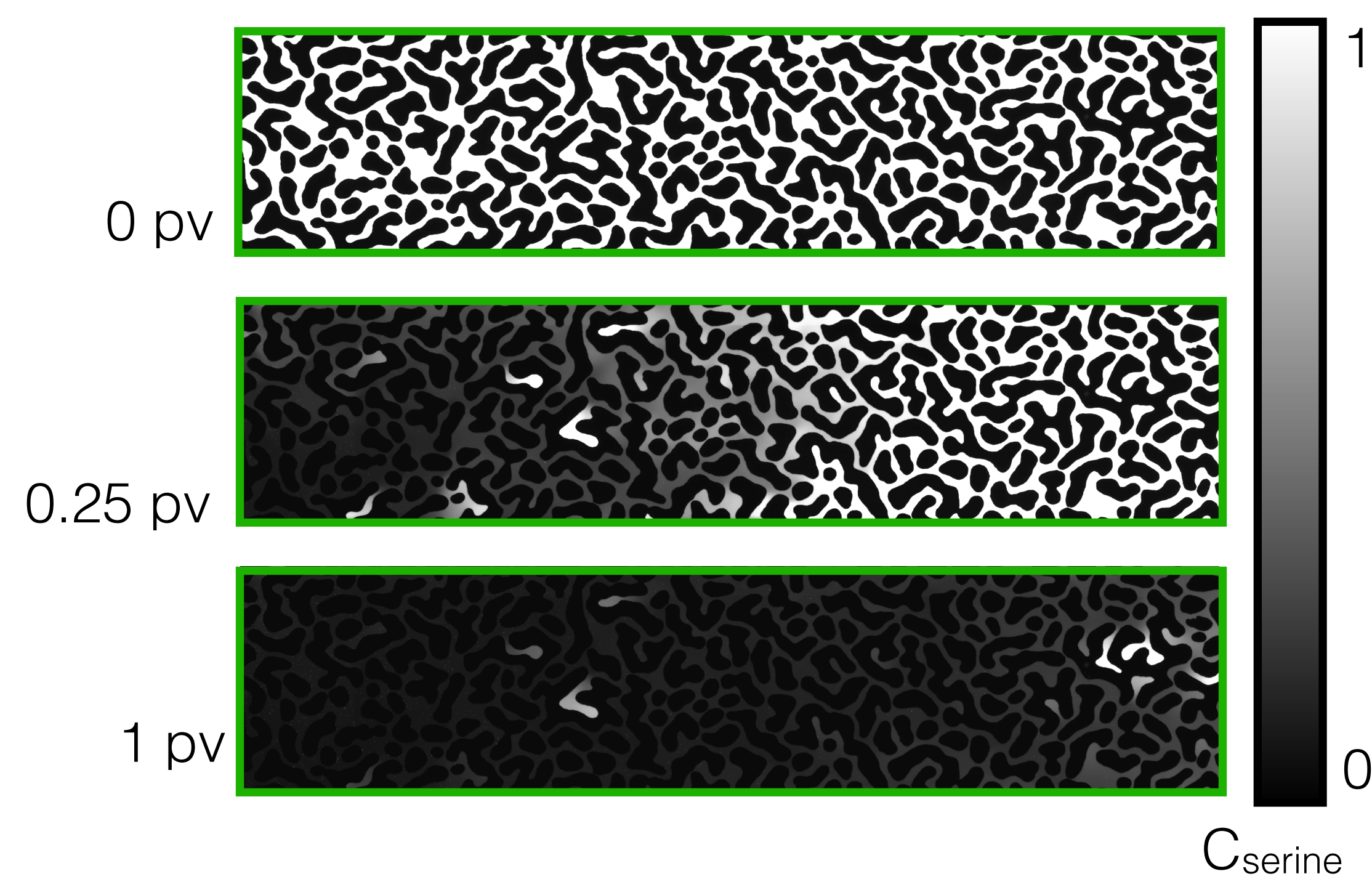
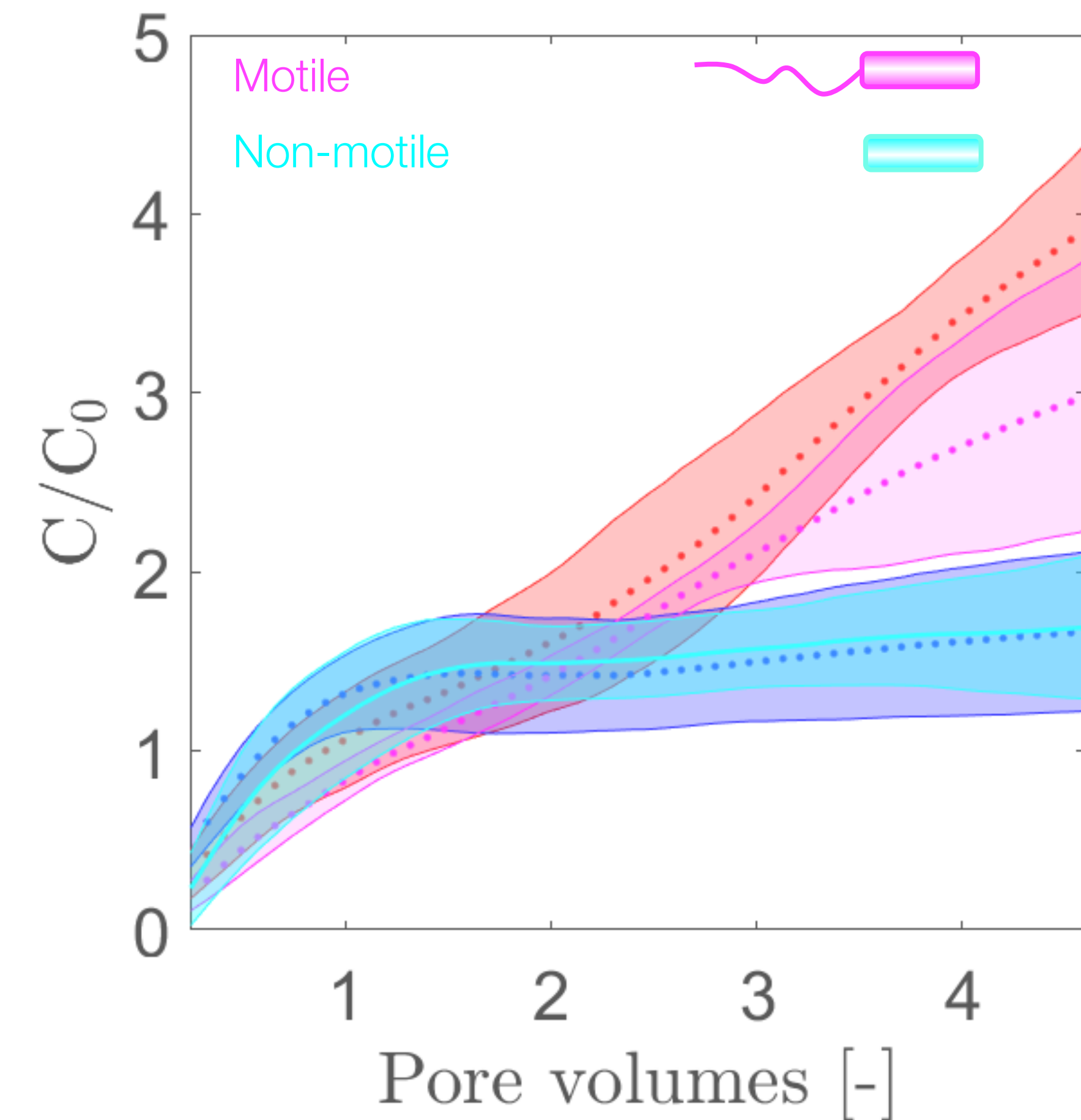


Fig 7. Concentration map of a chemoattractant (L-serine) dissolved in a saline buffer, displaced by the buffer devoid of the chemoattractant. The porous media has been saturated with a motility buffer containing L-serine, then motile and non-motile *E. coli*, suspended in the buffer without L-serine, have been injected from the inlet.

Fig 8. Motile (magenta) and non-motile (ciano) *E. coli* cells retained within the porous medium in presence of L-serine. Where C is the concentration of cells retained in the porous medium and C_0 is the concentration of the inlet suspension.



Dispersal of motile and non-motile *E. Coli* in presence of a chemoattractant

Fig 9. Bacterial distribution across the two pore features. The curves show the ratio between the concentration of bacteria in the dead-end pores (C_{dep}) and their concentration in the transmitting pores (C_{tc}). The presence of chemoattractant did not affect the distribution of non-motile cells. Differently, the chemoattractant presence increased sensibly the trapping of motile cells (magenta) in the DEP.

