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Numerical study of biocolloids transport in geochemically heterogeneous porous media

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Although the effect of formation heterogeneity on the transport of conservative and reactive contaminants as well as suspended particles in porous and fractured formations has been extensively investigated in the literature, the transport of colloids and biocolloids in geochemically heterogeneous formations, where biocolloid attachment onto the solid matrix is spatially variable, is still not fully understood. The purpose of this work was to investigate in depth the transport of biocolloid particles in a multi-dimensional, geochemically heterogeneous, water saturated formation. A novel three-dimensional mathematical model was developed, which assumes that the collision efficiency is a stochastic spatially variable parameter. The results showed that the existence of spatially variable biocolloid attachment strongly contributes to an early time substantial increase in biocolloid spreading, an effect that asymptotically dissipated when the migrating biocolloid plume had sampled all of the geochemical heterogeneity within the porous formation. Furthermore, biocolloid plume spreading and enhanced transport were shown to increase with increasing variability of the attachment coefficient. Our findings suggested that neglecting to account for aquifer chemical heterogeneity may lead to erroneous predictions of biocolloid transport in porous media.