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The topological origin of anomalous transport: Persistence of β in the face of varying correlation length.

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Traditional concepts for flow in porous media assume that the heterogenous distribution of hydraulic conductivity is the source for the contaminant temporal and spatial heavy tail, a process known as anomalous or non-Fickian transport; this anomalous transport behavior can be captured by the β parameter in the continues time random walk (CTRW) framework. In previous studies we showed that there is a functional form relating the β parameter to the permeability variance¹ and fracture alignment in fracture fields². Moreover, we showed that this variance is strongly influencing the reaction pattern during transport³. This study shows that as the spatial correlation length, between these heterogenous distribution of hydraulic conductivities, increase, the anomaly of the flow reduces, yet the β value is unchanged suggesting that there is a topological component to the flow field, captured by the β ⁴. This finding is verified by an analysis on the flow field, showing that the changes in the conductivity values have little effect on the flow field morphology, which points to the topological component in the flow.

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