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Evaluating the transport behavior of DNA-tagged silica particle tracers in laboratory soil columns

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DNA-tagged particle tracers have been the subject of several researches as a new tracer for hydrological applications. This tracer potentially permits the production of a large number of identically transported but distinguishable tracers. Such technique facilitates multi-point and multi-time tracer experiments in a specific location without confounding the signal of the different tracers. All of those potential benefits of DNA-tagged particles can effectively improve our understanding on contamination flow origin and its pathways in the subsurface environment.

In this study the effect of soil size on the transport of DNA-tagged silica particles is evaluated. We assumed that the presence of preferential flow pathways or dual porosity in a clayey soil can lead to negligible mass recovery rate of tracer in comparison to matrix flow in sandy soil. Thereto, a series of soil column laboratory tests under saturated conditions were conducted. The columns are custom-designed with a diameter of 25 cm and a height of 25 - 28 cm. The columns were in-situ excavated from a clayey Holocene soil from West of the Netherlands; and from a sandy Pleistocene soil from the East of the Netherlands. We not only determined mass recovery rates and advective-dispersive transport parameters of the colloidal DNA-tagged silica particle tracer, but also compared DNA tracer data with deuterium tracer data, applied to the same columns. Finally, we defined the role of preferential flow paths in the columns.