Assessing the influence of infiltration on the migration of light non-aqueous phase liquid in double-porosity soil media using a light transmission visualization method

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ABSTRACT

The influence of infiltration on the migration of a light non-aqueous phase liquid (LNAPL) in double-porosity soil using the light transmission visualization (LTV) technique is investigated. Two LNAPL volumes (low and high volumes) were exposed to two rainfall intensities (light and heavy infiltration). For comparison purposes, the experiments were also repeated by compacting the flow chamber with silica sand only to represent the single-porosity medium and to investigate the influence of double-porosity on LNAPL migration. High-resolution LTV images of the flow chamber during LNAPL injection and subsequent water infiltration events were collected. Results show that the LNAPL migration depth during injection and its migration velocity were both correlated to the LNAPL volume. Subsequent water infiltration events caused the LNAPL that was entrapped in the porous media to be pushed further downward in all the experiments. The LNAPL migration velocity was 1.1 and 1.6 cm/h for the low and high LNAPL spillage volumes for double-porosity experiments, respectively, a reduction rate of 64.7 and 70% compared to the LNAPL migration velocity during LNAPL injection, respectively. However, for single-porosity experiments, the LNAPL migration velocity was 0.7 and 1.2 cm/h for the low and high LNAPL volumes, respectively. Furthermore, it was observed that the capillary fringe level was depressed in the saturated zone due to the influence of both infiltration and LNAPL volume. This study demonstrates that the LTV technique is an accurate and cost-effective laboratory tool for the visualization of the time-dependent influence of infiltration on LNAPL migration in porous media.

Keywords: Laboratory experiments/measurements . Light transmission visualization . Double-porosity . Non-aqueous phase liquid . Porous media

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