Abstract Submitted
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Buoyant convection in porous media: multiple layers with inclined permeability jump[1] BHARATH KATTEMALALAWADI, University Of Alberta, CHUNENDRA K. SAHU, University of Cambridge, MORRIS R. FLYNN, University Of Alberta — We report upon an experimentally-validated theoretical investigation of buoyancy driven flow in a two-layered porous media. The upper- and lower-layers are characterized by different permeabilities and feature a sloping boundary (or permeability jump) in between. The flow of dense fluid originates as a plume in the upper-layer that then forms up- and down-dip gravity currents. We present coupled plume and gravity current equations, which are solved numerically along with a set of initial- and boundary-conditions. The governing equations assumes miscible Darcy flow with a sharp-interface between the gravity currents and surrounding ambient. Our scaling analysis reveals the importance of four non-dimensional parameters for describing the along- and cross-jump flows. The theoretical results predict the (i) (time-dependent) fraction of flow up- vs. downdip, (ii) (time-dependent) flow draining into the lower-layer from the underside of the gravity currents, and (iii) up- and downdip run-out lengths. Experimental images further reveal the formation of two distinct interfaces, namely a sharp- and dispersed-interface. Theoretical predictions accurately capture the time evolution of the sharp-interface as measured experimentally.

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