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Contribution ID: **173** Type: **Oral Presentation**

Experimental investigation of buoyant convection in a heterogeneous porous media: Two-layers separated by an inclined permeability jump*

Monday, 31 May 2021 18:15 (15 minutes)

In this study, we employ a 'filling-box'model to experimentally investigate the flow of a dense, Boussinesq plume through a saturated porous medium characterized by a high permeability layer above and a low permeability layer below. The boundary, or permeability jump, separating the two layers is inclined to the horizontal. Upon striking the permeability jump, the discharged plume fluid propagates along the permeability jump as an unequal pair of up- and downdip '*primary*'gravity currents. As these gravity currents propagate, some fluid is lost by drainage through the permeable boundary. The associated (early time) spreading behavior has been theoretically investigated in our previous work (Bharath *et.al*, *J.FluidMech.*,**902**, 2020). It was shown that the primary gravity current reaches runout (static state), wherein inflow from the plume is precisely matched by outflow due to draining. This static state can be maintained only so long as the discharged plume fluid falling through the lower layer does not itself collide with an impermeable boundary. Once such a collision occurs, there will form a pair of '*secondary*'gravity currents, which, in turn, exert a significant dynamical influence over the entire depth of the heterogeneous porous medium. For instance, the secondary gravity currents will "tug"upon the primary gravity currents leading to a remobilization of this previously-arrested front. At later times, primary and secondary gravity current flows are impeded by vertical sidewall boundaries. In characterizing the resulting filling-box flow, we distinguish between two qualitatively different filling regimes, i.e., a sequential vs. simultaneous filling of upper- and lower-layers with contaminated fluid. Parameter combinations conducive to one or the other filling regime are also identified.
Through this work we attempt to address some of the key uncertainties in the field of underground hydrogen storage and carbon-dioxide/acid-gas sequestration. These uncertainties include (i) the degree of asymmetry in the flow structure of the gravity current pairs as they propagate along an inclined and permeable boundary, (ii) the influence of impermeable boundaries encapsulating the porous media, and, (iii) the nature and time required to fill the porous medium in the presence of heterogeneities.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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