Open Ph.D. position (starting Jan. 2020 or later)

The Project: Examples of buoyancy-driven flow abound in nature, industry and everyday life from atmospheric convection to the steam that rises from a hot kettle on the stovetop. Less obvious, but equally important, is buoyancy-driven flow within a porous medium whereby hot/cold fluid navigates through the interstitial spaces between solid grains. Indeed, buoyant convection within porous media is relevant to energy systems e.g. thermal energy storage, methods of enhanced oil recovery and the geological sequestration of either carbon dioxide (CO_2) or acid-gas (a mixture of CO_2 and hydrogen sulfide).

The present research, though fundamental in focus, is motivated most especially by this latter example. Accordingly, one must define the precise conditions under which the CO_2 or acid-gas injected into formation will remain permanently sequestered. Although there are a variety of mechanisms that allow the injectate to become immobilized (capillary trapping, etc.), CO_2 and acid-gas are more buoyant than, say, aquifer brine and tend therefore to rise from one geological layer to the next. The competition between immobilization and vertical migration determines whether the large outlays of funding necessary for sequestration projects are, in fact, justified.

The research project will use theory and laboratory experiment to advance our current understanding of buoyant convection in porous media. Consistent with a number of on-going research projects described at https://sites.ualberta.ca/~mrflynn/pm.html, particular emphasis will be placed on scenarios where there is a competition between injection, lateral spreading and draining.

The University: Located in metropolitan Edmonton (pop. 1,000,000), U. Alberta is home to 40,000 students. The Faculty of Engineering, which is spread over six buildings with modern laboratory facilities, is a particular strength of U. Alberta and emphasizes both fundamental and industrially-sponsored research.

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