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Instabilities in four-layer gravity-driven Hele-Shaw flow AHMED AL BRAHIM, SIGURDUR THORODDSEN, King Abdullah University of Science & Technology (KAUST) — We study the dynamical rearrangement of gravitationally unstable multi-layer fluid in the narrow vertical gap inside a Hele-Shaw cell. Four layers of immiscible fluids are superposed inside the cell, which is subsequently turned over. The rearrangements are filmed with high-resolution and high-speed video. We vary the fluid properties and relative thicknesses of the layers. The layers in order of increasing density are air, oil, water/glycerin mixture and perfluorohexane. The concentration of the glycerin/water mixture is used to vary its viscosity. We classify various different dynamics of stirring and breakthrough of adjacent layers. We note a prominent phenomenon, where an air-pocket breaks through the high-viscosity layer to erupt into the lower-viscosity perfluorohexane layer above it. We were able to establish that the eruption velocity and the interface before eruption are highly influenced by the viscosity of the glycerin/water mixture. We also find that the thickness of the layers and the locations of the eruption have minor impact on the eruption speed and the interface beyond a specific limit. We investigate the center-of-mass trajectories for each layer and notice counter-flows, where the center of a layer can temporarily move against buoyancy.

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