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Experiments on the fragmentation of a buoyant liquid volume in another liquid MAYLIS LANDEAU, Geological Fluid Dynamics, IPGP, France, RENAUD DEGUEN, IMFT, France, PETER OLSON, Johns Hopkins University, USA — Buoyancy-driven fragmentation of one liquid in another immiscible liquid was a common process during the formation of the terrestrial planets. Another example of this phenomenon is the sudden release of petroleum into the ocean during the Deepwater Horizon disaster. In this study, we present experiments on the instability and fragmentation of volumes of heavier liquid released into lighter immiscible liquids. We characterize the different fragmentation regimes in parameter space. We find that, at low and intermediate Weber numbers (measuring the importance of inertia versus surface tension forces), the fragmentation regime mainly results from a competition between the growth of Rayleigh-Taylor instabilities and the roll-up of a vortex ring. At high Weber numbers, a turbulent fragmentation regime is found, and the large-scale flow behaves as a turbulent vortex ring or a turbulent thermal. An integral model based on the entrainment assumption, and adapted to buoyant vortex rings with initial momentum, is consistent with our experimental data. This indicates that the concept of turbulent entrainment is valid for non-dispersed immiscible fluids at large Weber and Reynolds numbers.

Maylis Landeau
Institut de Physique du Globe de Paris

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