Diapiric motion in a salad dressing system

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Motion of magmatic diapirs is basically described by the Stokes velocity for a sphere. In classical experimental studies on compositionally buoyant diapirs, their buoyancy is constant in time. However more realistic cases in the Earth's mantle, their buoyancy changes as they ascend/descend because differentiation, crystallization, diffusion processes occur in the diapirs. Here we have explored laboratory experiments on the motion of a fluid sphere in a salad dressing system (water-oil-salt system), which changes its buoyancy as it propagates. Our experiments are conducted in a water tank filled with water. We put a thin layer of oil over the water layer and sprinkled salt grains from the top. The salt grains falls in the oil layer and a sphere of oil is entrained in the water layer when the salt grains pass through the oil-water interface. The average density of the salt-water sphere is initially heavier than that of the water and it descends in the water layer. Its buoyancy changes with time because surrounding water dissolves the salt grains of the sphere. The sphere decelerates and eventually rises when the average density equals to the water density. The behavior of the oil-salt sphere is time-dependent and also strongly depends on density difference between the sphere and ambient fluid, rate of diffusion, solubility, size of the sphere, and density (solubility) structure of the water layer.