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The Role of Viscosity Contrast on the Plume Structure and Dynamics in High Rayleigh Number Convection SREENIVAS KR, VIVEK N. PRAKASH, Engineering Mechanics Unit, JNCASR, Bangalore India, JAYWANT H. ARAKERI, Dept of Mechanical Engineering, IISc, Bangalore, India — We study the plume structure in high Rayleigh number convection in the limit of large Prandtl numbers. This regime is relevant in Mantle convection, where the plume dynamics is not well understood due to complex rheology and chemical composition. We use analogue laboratory experiments to mimic mantle convection. Our focus in this paper is to understand the role of viscosity ratio, U, between the plume fluid and the ambient fluid on the structure and dynamics of the plumes. The PLIF technique has been used to visualize the structures of plumes rising from a planar source of compositional buoyancy at different regimes of U (1/300 to 2500). In the near-wall planform when U is one, a well-known dendritic line plume structure is observed. As U increases (U $>$ 1; mantle hot spots), there is a morphological transition from line plumes to discrete spherical blobs, accompanied by an increase in the plume spacing and thickness. In vertical sections, as U increases (U $>$ 1), the plume head shape changes from a mushroom-like structure to a "spherical-blob." When the U is decreased below one, (U$<$1; subduction regime), the formation of cellular patterns is favoured with sheet plumes. Both velocity and mixing efficiency are maximum when U is one, and decreases for extreme values of U. We quantify the morphological changes, dynamics and mixing variations of the plumes from experiments at different regimes.

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