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Thermal convection at high Rayleigh and Prandtl numbers SOPHIE ANDROVANDI, IPG-EDFG, 4 place Jussieu 75252 Paris, France, ANNE DAVAILLE, IPG-EDFG and Laboratoire FAST, Bat 502 campus universitaire , 91 405 Orsay — We conducted laboratory experiments to study the convective patterns developping in a fluid with strongly temperature-dependent viscosity. As the viscosity ratio γ increases, the thermal structure of the tank becomes asymmetric, the more viscous cold thermal boundary layer (TBL) at the top becoming thicker than the bottom hot TBL, and moving much more slowly ("sluggish lid regim"). For high Rayleigh numbers($> 10^6$) and intermediate viscosity ratios ($\gamma < 4000$), the temperature and velocity fields show that three different scales of convection develop: the largest convective scale is cellular, with cold downwelling sheets of viscous fluid encasing hotter, less viscous, parts of the tank. Within each of those cells develop several (typically 3 to 7) hot $3D$ upwelling plumes. Upon impinging under the cold TBL, each plume in turn generates locally a small ring of cold material which does not reach the bottom of the tank. A regim diagram of the multiscales convection existence and scaling laws describing the characteristics of the instabilities have been obtained.

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