

Deceleration process of laminar thermal plume of Earth's mantle

Shin Iwata[1]; Kei Kurita[2]; Ichiro Kumagai[3]

[1] ERI, Univ. of Tokyo; [2] ERI, Univ. of Tokyo; [3] IPGP

We have conducted laboratory experiments on mantle starting plumes to investigate whether these velocities reach steady state or not. In a recent laboratory experiment, Kaminski et al.[2003] showed existence of the steady velocity of the thermal starting plume in fluid whose viscosity weakly depends on temperature. But it is not obvious that this result is consistent with Earth's mantle plume, because properties of Earth's mantle (viscosity, thermal diffusion, entrainment of surrounding material, heat flux from the root of stem) are not well known.

Our experiments are carried out in a rectangular tank filled with syrup which has a strong temperature dependence of viscosity like Earth's mantle. A thermal starting plume is generated by operating a heater placed at the bottom of the tank. The plume is visualized by using TLCs (Thermochromic Liquid Crystals) method for temperature measurements. As a result, we confirmed the velocity of the thermal starting plume does not have steady state (deceleration process near the heater). We confirmed this deceleration was not caused by free surface effect at the top of the fluid and sidewall effect of the tank.

A thermal starting plume is cooled by thermal diffusion and mechanical entrainment of surrounding material as it ascends. We will discuss the velocity of the mantle plume head and tail, and the role of cooling effect, the temperature dependent viscosity and heat source effect on deceleration process.