A8-P007 Time: June 5 17:00-18:30

Three-Dimensional Large-Scale Dynamic Response of Distributed Local Hot Materials Near the CMB Within the Static Layered Mantle

Takao Eguchi[1], Kiyoshi Matsubara[2], Mizuho Ishida[3]

[1] NDA, [2] CCSE Fuji Res. Ins. Co., [3] NIED

We conducted numerical simulations for investigating the 3-D mantle flows. Here, we focused on the dynamic effect of global hotspot distribution against the large-scale mantle flow. As the initial conditions, local warm masses are inserted just above the CMD within the static layered mantle. We observed the mutually interacted passive flow pattern of both upwelling and downwelling due to the spatially distributed local initial warm spots. The result depicts a weak rising pattern in east Eurasia where no warm source was initially inserted. Although the calculation result of passively excited viscous flows is not easily utilized to interpret the realistic earth's mantle dynamics, the result might reveal some basic characteristics associated with the distribution of the global hotspots.

We conducted numerical simulations for investigating fundamental characteristics of three-dimensional mantle flows dynamics. In this study, we focused on the dynamic effect of global hotspot distribution against the large-scale mantle flow. As the initial conditions, local warm masses are inserted within the static layered mantle with the thermal boundary layers at the surface and just above the core-mantle boundary (CMB). The locations of the initially inserted warm thermal anomaly masses with 4,000K, at the depth from 2,500km to the 2,900km are below the currently active surface hotspots. The initial mantle temperature is monotonic increasing with depth from 300K, through ~ 2000 K at 670km, to 4,000K at the CMB, and is laterally homogenous except the portion of the thermal anomalies. The Rayleigh number, Ra, is approximately10**7. Here, we did not incorporate, for simplicity, any effect of horizontal motion of the surface lithospheres, downgoing slabs, mineral phase changes, and internal heating, etc. The simulation code used was developed with the finite difference method.

According to the basic calculation of a single localized warm source within the mantle thermal field being similar to that stated above, the direct response flow with the circular downwelling progresses at the angle distance of 25 - 30 deg. from the source. The circular downwelling at the distance of 25 - 30 deg. approach the CMB after a period of 30 - 40Ma. Moreover, at the larger angle distance than 50 deg., we found other axial symmetric upwelling and downwelling flows, by turns, with the temporal shortening of the horizontal cell sizes. We confirmed that the dynamic shortening process during the transient evolution history of the multi-lobed flows due to a single warm source continues until at least 60 Ma.

In the case of the multi warm sources, we observed numerically the mutually interacted passive flow pattern of both upwelling and downwelling due to the spatially distributed local initial spots of active rising just above the CMD. For example, the simulation result depicts a weak regional rising pattern in east Eurasia including the western Indonesia, although there is no warm source inserted initially beneath the eastern Eurasia in our calculation. As is obvious in the initial condition of the numerical model, the calculation result of viscous flows being passively excited with the initial local warm sources is not easily utilized to interpret the realistic earth's mantle dynamics. The result, however, might reveal some basic characteristics associated with the three-dimensional complicated dynamics of both the upwelling and downwelling within the mantle, especially with the distribution of the global hotspots.