Interaction of hot anomaly and subducting cold slab

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Recently, Honda et al. (2007) studied the origin of low velocity anomaly, which is in close connection with 410km seismic discontinuity near the Honshu subduction zone. They proposed a scenario in which a plume-like hot anomaly under the Pacific plate was carried laterally, dragged into the mantle by the plate motion and finally it stayed above the 410km seismic discontinuity for a long time due to the effect of exothermic phase change. Based on this scenario, they could explain the shape of hot anomaly imaged by seismic tomography. Furthermore, they tried to find out how long the hot anomaly can stay above the 410km discontinuity by changing the parameters such as the size and intensity of hot anomaly and they suggested a possible connection with the past super plume activities.

As usual, the model is constructed on many assumptions. Among them, they made two important assumptions in their modeling of subducting slab. First, they considered only the base of the plate and the slab and set their temperature to 1573K. This assumption may underestimate the heat sink effects of cold slab. Second, they assumed that the slab extends straightly into the lower mantle, that is, they neglected the deformation of slab. Especially, in Honshu subduction zone many tomographic studies showed an existence of stagnant slab in the transition zone. Thus, it is necessary to consider the effect of deformation of slab on the fate of hot anomaly.

In this study, by using a new slab model, we tried to evaluate the effects of two factors mentioned above (thermal effects of cold subducting slab, and the deformation of the slab near the 660km discontinuity including the conditions of slab stagnation) on the fate of hot 'sinking' anomaly. Preliminary results show considerable effects of slab stagnation suggesting longevity of survival of hot anomaly and possible breakage of slab by an intrusion of hot anomaly.

Lowman et al. (2001) has shown that if the effects of internal heating are taking into account, a hot anomaly appears near the sinking cold plume. Thus, we also considered the effect of internal heating as one of the candidates of the origin of hot anomaly by using a cylindrical mantle convection model. Preliminary results showed that the hot anomaly near sinking cold plume cannot be explained only by the internal heating.