The 479th Geodynamics Seminar

Numerical simulations on the formation and avalanche of stagnant slabs

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Abstract

We conducted numerical simulations of thermal convection of highly viscous fluid in a 2-D cylindrical geometry, in order to study what mechanisms control the dynamic behaviors of subducting slabs such as the formation of "stagnant slabs" in the mantle transition zone (MTZ) and their avalanche into the lower mantle. We carried out calculations with systematically varying the trench retreat velocity, the Clapeyron slope at around 660 km depth, and the viscosity jump between the upper and lower mantle. In addition, we take into account the temporal changes in the trench retreat velocity, and studied how they affect the dynamic behavior of already-formed stagnant slabs.

We found that, by appropriately choosing the trench retreat velocity and its temporal change, our model successfully reproduces various types of avalanches of stagnant slabs, which can be well compared with those of natural ones including those observed in Izu-Bonin, Tonga, Mariana and Java subduction zones. Our results imply that the formation and avalanche of stagnant slabs is strongly related with the temporal changes of the trench retreat velocity.

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