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Subducted oceanic plates should be one of the significant factor deciding structures and the evolution of the Earth’s lower mantle. The typical large and strong heterogeneity is large low shear velocity provinces on the lowermost mantle indicated by seismic tomography models. Seismic analyses indicate that these structures have prominent features, such as steep edges, a correlation between margins and hot spot locations, and the stability over a long term. We investigate that influence of the lower mantle properties on the mechanical interactions between the subducted plate and the compositionally dense layer, using mantle convection model in which plate-like motion is realized without any forces imposed on the surface plate.
Our 2-D Cartesian numerical model has chemically distinct materials with the density contrast of +77.3 kg m^{-3} on the core mantle boundary (CMB) and the post-perovskite phase change with the Clapeyron slope of +8 MPa K^{-1} and the density contrast +1.4%. In this study, we focus on the following parameters that affect the slab subducting history and the evolution of the dense layer; depth dependence of the thermal expansivity, the depth profile of the background mantle viscosity and the yield strength of the slab. We also incorporate phase diagrams of hydrous minerals and hydration effects on the density and the viscosity.
In our result with the thermal expansivity decreasing with the depth, the dense material piles can remain on the CMB during the calculation. Moreover, the thermal expansivity depending on the depth makes the slab velocity slow down, even when the viscosity is small. This effect leads to the convection layered at the boundary between the regular mantle and dense segments, such that the slow convection is generated in the regular mantle layer and the active convection is in the dense layer. Steep difference in the temperature overlaps at the chemical boundary between dense materials and the surrounding mantle. Upwelling plumes are generated on the top of the dense layer. These plumes entrain only small amount of the dense material. On the other hand, the constant thermal expansivity destabilizes the dense layer. The dense segments deform strongly and rise off the CMB by the subducted slab plunging into the dense material piles. The subducted slab deformation near the 660 km depth discontinuity occurs except when the thermal expansivity is constant and the yield strength is 300 MPa. The amplitude and the wavelength of the slab buckling become larger with lower mantle viscosity. This deformation influences contact area between the dense structure and the slab, and spatial distribution of water in the lower mantle. We did not find significant effects of the slab buckling on the evolution of the lowermost mantle structures in the long term.

キーワード：subducted slab、LLSVPs、thermal expansivity
Keywords: subducted slab, LLSVPs, thermal expansivity

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