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# Spontaneous Formation of Mantle Wind by Subduction and Its Impacts on Global Subduction Asymmetry

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Various subduction zone characteristics, including the slab dip, plate velocity, seismicity, and back-arc stress regime, show the global asymmetry with respect to the subduction direction. In particular, the east-directed subducting slabs show shallow dips and slow convergences, contrast to the steep dips and fast convergences of the west-directed subducting slabs. To explain the global asymmetry, the westward lithospheric motion or the eastward mantle wind with respect to the underlying mantle and the overlying plate, respectively, have been proposed. However, the causative force for the lithospheric motion, the tidal force between the Earth and Moon, is only acceptable when the asthenospheric viscosity is dramatically low such as $10^{15}$ ~ $10^{16}$ Pa·s, which could not globally exist in the mantle. The causative force for the mantle wind has left unknown even though the impact of the mantle wind has been verified. Past studies have shown that slabs sinking into the lower mantle can cause global mantle flow. That is, the slabs sinking at the eastern and western trenches around the Pacific ocean can cause the global mantle flow above the low-viscosity liquid outer core, expressed as the mantle wind. Therefore, to verify whether the subducting slabs around the Pacific ocean cause the mantle wind, we conducted a series of 2-D numerical models using an annulus-shape model domain, which simplifies the subduction history in the paleo- and present-Pacific ocean. Along with an allowance of dynamic subduction, both the realistic mantle viscosity and the major phase transition in the mantle were considered. Results show that the global-scale mantle wind is spontaneously formed by the imbalance in lateral mantle stresses owing to the subducting slabs around the Pacific ocean when the slippery core-mantle boundary operates as a lubricant layer, and the direction and magnitude of the mantle wind are periodically changed every tens of million years. When he eastward mantle wind occurs, it induces the relative westward drift of the plate, and as a result, the westward plate velocity becomes greater than the eastward plate velocity with respect to the hotspot reference frame. Simultaneously, the mantle wind pushes the west-directed subducting slab toward the ocean, forming steep slab dips but does the east-directed subducting slab toward the arc, forming shallow slab dips, consistent with the present subduction asymmetry in the Pacific ocean. After that, the negative buoyancy of the shallow slab steepens the slab itself, changing the direction of mantle wind westward; the opponent slab dips and plate velocities occur in the subduction zones. This study reveals that the present subducting asymmetry is a snapshot expression of the evolving global mantle flow, formed by the subducting slabs.