



## **Westward drift of the Pacific plates, trenches, and upper mantle**

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An overall westward drift of the lithosphere has been recognized for some time. A recent global survey of subduction zone parameters highlights that this net rotation of the lithosphere is accompanied by a net westward drift of trenches. To explain the relationship between the drift of lithosphere and trenches, we focus on the Pacific basin, where most of the trenches and slabs are found. We show that the westward drift of both plates and trenches is associated with the dynamics of the circum Pacific plates, and the upper mantle below them. Because the Pacific upper mantle is almost entirely circumscribed by subducting slabs and leaks are sparse, its incompressible volume must be constant. Therefore, any trench or slab retreat must be accompanied by trench and slab advance at another location. Both Eastern (N. and S. America) and Western upper plates (Eurasia and Australia mostly) are moving to some degree to the West, inducing compression and extension at the Pacific trenches, respectively. We evaluate the magnitude of the forces on plates based on the kinematics of the upper mantle and show that these forces are large enough to explain the asymmetrical dynamics of the Pacific domain. These forces shear the upper mantle beneath the Pacific basin at rates that are comparable to the westward drift of the Pacific plates and trenches for typical mantle viscosities. This result implies that the overall westward drift of the lithosphere is not associated with Earth's rotation, but is simply an accidental consequence of the current distribution of plates on the surface of the Earth.