Tethyan Closure, Andean Orogeny, and Westward Drift of the Pacific Basin

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A recent global survey of subduction zone parameters highlights that the net westward 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. 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. Circum-Pacific upper plates are moving to some degree to the West, inducing compression and extension at the eastern and western Pacific trenches, respectively. We evaluate the magnitude of the forces on plates based on the kinematics of the upper plates 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 a typical mantle viscosity of $\sim 3\,10^{20} Pa\,s$. This Andean orogeny is the main driving force. Andean building was induced by the asymmetric spreading of the Atlantic following the closure of the Tethys and the aggregation of the gigantic Africa-Eurasia high viscosity lithospheric keel.

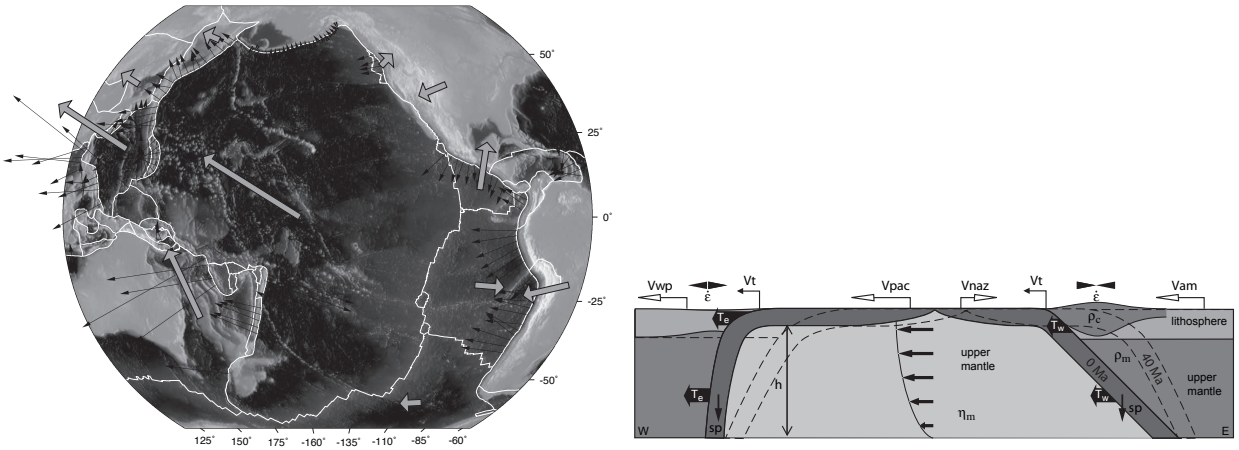

Figure 1: a) Kinematic of the Pacific domain. Black and gray arrows indicate trench and plate velocities in the hot spot reference frame, respectively; b) East-West Poiseuille flow across the Pacific domain.