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# Trench migration and upper plate strain over a convecting mantle

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Trench motion and upper plate deformation ultimately respond to mantle flow. Herein I build upon the mantle flow model results of Conrad and Behn (2010) and compute the drag forces underneath all plates, and show that they control the dynamics of plates and plate boundaries. The small misfit angle between between the traction azimuths of mantle traction and absolute plate motion corroborates the idea that convective mantle drag is a prominent driver of plate tectonics. Less intuitive is the fact that the interplay between the drag forces from the upper and lower plates, that amounts to -5 to 8.5 TN/m (per unit trench length), dictates both trench migration rates and upper plate deformation. At odds with the classic view that assigns the prime role to the idiosyncrasies of subduction zones (slab age, interplate friction, water content etc), I find that the intrinsic properties of subduction zones in fact only modulate this behavior. More specifically, the mean value of the integrated trenchward mantle drag force from the lower and upper plates (from -2 to 6.5 TN/m) controls upper plate deformation. Conversely, it is the difference between the lower and upper plates mantle drag forces (from -3 to 10 TN/m) that controls trench migration rates. In addition, I find that a minimum trenchward force of $\sim$2.5 TN/m must be supplied by mantle drag before trenches can actually advance, and before upper plates undergo compression. This force results from the default tendency of slabs to rollback when solely excited by their own buoyancy, and is thus the effective tensional force that slab pull exerts on the plate interface.