

EGU2020-6508

<https://doi.org/10.5194/egusphere-egu2020-6508>

EGU General Assembly 2020

© Author(s) 2020. This work is distributed under the Creative Commons Attribution 4.0 License.



Plate speeds modulated by sediment subduction: insights from numerical models

Whitney Behr¹, Adam Holt², Thorsten Becker³, and Claudio Faccenna⁴

¹Department of Earth Sciences, ETH Zürich, Geological Institute, Earth Sciences, Zurich, Switzerland (wbehr@ethz.ch)

²Department of Marine Geosciences, University of Miami, Florida, USA

³Jackson School of Geosciences, University of Texas at Austin, Texas, USA

⁴Department of Geological Sciences, Università Roma TRE, Italy

Tectonic plate velocities predominantly result from a balance between the potential energy change of the subducting slab and viscous dissipation in the mantle, bending lithosphere, and slab-upper plate interface. A range of observations suggest that slabs may be weak, implying a more prominent role for plate interface dissipation than previously thought. Behr & Becker (2018) suggested that the deep interface viscosity in subduction zones should be strongly affected by the relative proportions of sedimentary to mafic rocks that are subducted to depth, and that sediment subduction should thus facilitate faster subduction plate speeds. Here we use fully dynamic 2D subduction models built with the code ASPECT to quantitatively explore how subduction interface viscosity influences: a) subducting plate sinking velocities, b) trench migration rates, c) convergence velocities, d) upper plate strain regimes, e) dynamic topography, and f) interactions with the 660 km mantle transition zone. We implement two main types of models, including 1) uniform interface models where interface viscosity and slab strength are systematically varied, and 2) varying interface models where a low viscosity sediment strip of finite width is embedded within a higher viscosity interface. Uniform interface models indicate that low viscosity (sediment-lubricated) slabs have substantially faster sinking velocities prior to reaching the 660, especially for weak slabs, and also that they achieve faster 'steady state' velocities after 660 penetration. Even models where sediments are limited to a strip on the seafloor show accelerations in convergence rates of up to ~5 mm/y per my, with convergence initially accommodated by trench rollback and later by slab sinking. We discuss these results in the context of well-documented plate accelerations in Earth's history such as India-Asia convergence and convergence rate oscillations along the Andean margin.

References: Behr, W. M., & Becker, T. W. (2018). Sediment control on subduction plate speeds. *Earth and Planetary Science Letters*, 502, 166-173.

How to cite: Behr, W., Holt, A., Becker, T., and Faccenna, C.: Plate speeds modulated by sediment subduction: insights from numerical models, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-6508, <https://doi.org/10.5194/egusphere-egu2020-6508>, 2020

