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Subduction dynamics with complex rheologies.

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Subduction zone dynamics has been extensively studied with laboratory and numerical models in which typically a dense, high viscosity slab is considered that sinks into a less dense and less viscous mantle.
Recently, we developed a semi-analytical subduction model for such setup and we demonstrated that the semi-analytical model is capable of reproducing the geometry and the temporal evolution of slabs that subduct in a viscous mantle.

Yet, subducting plates on Earth do not have a constant viscosity and thickness. Instead, they have a temperature-dependent viscosity and its rheology might be ductile or plastic, depending on the magnitude of stresses. There have been a number of numerical modelling studies that included more complex slab rheologies, but it remains unclear how those models compare to the semi-analytical slab models.

Therefore, we performed systematic numerical simulations of temperature-dependent viscoelastoplastic slabs sinking in a viscous mantle. We use the numerical results to further-develop our semi-analytical slab model with the goal to reproduce the temporal evolution and geometry of slabs with a complex rheology. The results will be used to develop phase diagrams that illustrate under which conditions plate-tectonics is feasible on terrestrial planets.