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Geodynamic models for decarbonation of subducting sediments

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As the largest cyclic matter system on the earth, the carbon migration in subduction zones is the key process to understand the Earth's carbon cycle. Sediments dominate the subducting flux of carbon by a factor of about two over oceanic crust and peridotite input fluxes, and drive the variability in subducting carbon ([1]). Low-CO_2-flux emitters by volcanism are found in subduction zones with no carbonate sediments (for example, Kuriles-Aleutians), whereas high-CO_2-flux volcanoes occur where carbonate-rich sediments subduct (for example, Central America). However, the physical mechanisms of decarbonation of subducting sediments and the carbon migration process have been enigmatic.

Here we employ numerical code I2VIS ([2]), which is based on a finite difference method using a marker-in-cell technique, to build 2D petrological-thermomechanical models. In our model setup, the oceanic plate, which is composed of hydrated and carbonated sediment, hydrated basalt, gabbro, and lithospheric mantle, is subducted beneath the overlying continental plate. Thermal age and sediment thickness of subducting slab, convergence rates, and so on are tested to obtain controlling parameters. We compute the decarbonation efficiency of all models for quantitative restoring the geodynamic evolution of sediment subduction and decarbonation.

[1] Plank & Manning (2019). Subducting carbon. *Nature* 574, 343–352.

[2] Gerya & Yuen (2003). Characteristics-based marker-in-cell method with conservative finite-differences schemes for modeling geological flows with strongly variable transport properties. *Physics of the Earth and Planetary Interiors* 140, 293–318.